Curtin Graduate School of Business

Business Intelligence for Sustainable Competitive Advantage: The Case of Telecommunications Companies in Malaysia

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signature:

Date:

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DEDICATION

To Dad, Awon, Adek and Im….. whom I know that forever will love me… Your pure hearts always motivate me to pursue our dream. I love you guys….. THIS is for US!

Abstract

The concept of Business Intelligence (BI) as an essential competitive tool has been widely emphasized in the strategic management literature. Yet the sustainability of the firms' competitive advantage provided by BI capability is not well explained. To fill this gap, this study attempts to develop a model for successful BI deployment and empirically examines the association between BI deployment and sustainable competitive advantage.

Taking the telecommunications industry in Malaysia as a case example, the research particularly focuses on the influencing perceptions held by telecommunications decision makers and executives on factors that impact successful BI deployment. The research further investigates the relationship between successful BI deployment and sustainable competitive advantage of the telecommunications organizations. Another important aim of this study is to determine the effect of moderating factors such as organization culture, business strategy and use of BI tools on BI deployment and the sustainability of firm's competitive advantage.

This research uses combination of theoretical foundation of resource-based theory and diffusion of innovation theory to examine BI success and its relationship with firm's sustainability. The research adopts the positivist paradigm and a two-phase sequential mixed method consisting of qualitative and quantitative approaches are employed. A tentative research model is developed first based on extensive literature review. Qualitative field study then is carried out to fine tune the initial research model. Findings from the qualitative method are also used to develop measures and instruments for the next phase of quantitative method. A survey is carried out with sample of business analysts and decision makers in telecommunications firms and is analyzed by Partial Least Square-based Structural Equation Modeling.

The findings revealed that some internal resources of the organizations such as BI governance and the perceptions of BI's characteristics influence the successful deployment of BI. Organizations that practice good BI governance with strong moral and financial support from upper management will have better chance in realizing their dreams of having successful BI initiatives in place. The scope of BI governance includes providing sufficient

support and commitment in BI funding and implementation, laying out proper BI infrastructure and staffing and establishing a corporate-wide policy and procedures regarding BI. The perceptions about the characteristics of BI such as its relative advantage, complexity, compatibility and observability are also significant in ensuring BI success. It thus implied that the executives' positive perceptions towards BI initiatives are deemed necessary. Moreover, the most important results of this study indicated that with BI successfully deployed, executives would use the knowledge provided for their necessary actions in sustaining the organizations' competitive advantage in terms of economics, social and environmental issues.

The BI model well explained how BI was deployed in Malaysian telecommunications companies. This study thus contributes significantly to the existing literature that will assist future BI researchers especially in achieving sustainable competitive advantage. In particular, the model will help practitioners to consider the resources that they are likely to consider when deploying BI. Finally, the applications of this study can be extended through further adaptation in other industries and various geographic contexts.

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INTRODUCTION

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*"What enables the wise sovereign and the good general to strike and conquer, and achieve things beyond the reach of ordinary men, is **foreknowledge**"*

---- Sun Tzu, the Art of War

Over 2,500 years ago!

1.1 OVERVIEW

The above quote highlights that acquiring and utilizing knowledge in sustaining competitive advantage is not a new phenomenon. Human civilizations have been preserving and passing knowledge from generation to generation for better understanding of the past and therefore, the future. In fact, knowledge has been utilized as early as 4,000 years ago when the earliest civilization evolved (Wiig, 1997; Ives & Learmonth, 1984).

In the 21st century, organizations are evolving into new forms based on knowledge and networks in response to a turbulent and equivocal environment characterized by indistinct organizational boundaries and fast-paced change (Seufert & Schiefer, 2005; Drucker, 1993; Kelly, 1998; Grove, 1999). In such environments, knowledge-based assets are realized to be the base of sustainable competitive advantage and the foundation of success in this century (Wiig 1997; Ross et al., 1996; Groom & David, 2001).

The most important source of wealth and basic economics resource in this contemporary society, so-called 'knowledge society' (Drucker, 1993), is knowledge. Since businesses today face competitors that perform well in areas such as planning, marketing, products and services, and customer service, effective utilization of knowledge may be the only weapon to win the competition (Davenport et al., 1998). Knowledge is believed to be the strategic source for the company to develop its sustainable competitive advantage (Grant, 1996; Bontis, 1999). However, the most knowledgeable firms are not always sustainable.

Knowledge only leads to superior performance if the companies can make the intelligence out of it (Hannula & Pirttimaki, 2003).

Brackett (2001) states that intelligence is the ability to learn, understand or to deal with new or trying new situations; the skilled use of reason; and the ability to apply knowledge to manipulate one's environment. In the context of business organizations, only those that can fully utilize knowledge available to them will stay ahead of the competitions. This research investigates how business intelligence (BI) can be successfully deployed to achieve sustainable competitive advantage for the organization. This strategic use of BI is defined as the extent to which organizations can understand their internal and external environment through systematic acquisition, collation, analysis, interpretation and exploitation of information in their business domains to support their organizational goals (Chung et al., 2002; Liebowitz, 2005). When BI is successfully deployed, it is more likely that BI–based knowledge is fully utilized and thus holds or even sustains the organization's competitive position.

The deployment of BI applications in today's firms is increasing and the demand for BI in market is stronger than ever before. This is evidence through the tremendous increasing market for BI software that has defied the current recession to show big revenue growth. A recent report by Gartner (2009) showed that BI software industry has grown by 21.7% from over US$7.2 billion in 2007 to US$8.8 billion in 2008. In addition, BI was also being in the list of top ten chief information officers priorities according to Gartner survey in 2004 (Gartner, 2005). The survey found out that companies plan to make BI a top priority in 2006, increasing the budget for the technology an average of 4.8 percent at a time when many other corporate activities' budgets are shrinking or staying the same. In another study on CIO survey (Gartner, 2007) showed that BI as their highest rating technology issue; as they focus on projects that enable users to positively affect financial and business performance. A survey of 225 Fortune 500 companies in 2001 reported an increasing use of computer-based systems in BI programs (Grooms, 2001).

This new trend has called firms' attention to the importance of BI and its role in creating and sustaining competitive advantage due to its knowledge creation capabilities (Golfarelli & Rizzi, 2007, Heinrichs & Lim, 2003; Chuang, 2004; Liebowitz, 2005; Golfarelli et al., 2004; Bernstein, 2001; Chung, 2002; Vedder et al., 1999; Davis, 2005; among many others). In this regard, BI resources and capabilities are seen as firms' competitive tools in making sound business decisions that can lead to sustained competitiveness.

1.2 PROBLEM STATEMENT AND RESEARCH QUESTIONS

Recognizing the need for an effective Business Intelligence (BI) deployment in an organization is just a first step. The real challenge is to make it an integral part of decision-making process and to help an organization in sustaining its competitive advantage. To date, little empirical research has been found in BI literature on factors affecting the successful deployment of BI and its relationship with sustainable competitive advantage.

Building BI is reported to be a complex, expensive and time-consuming tasks. Expert practitioners in this field have stated that these software applications are high-risk/high return projects and these applications are expensive to implement (Heinrichs & Lim, 2003). It may require seven-digit expenditure and take months to initially develop and years to become fully enterprise-wide systems (Watson & Haley, 1997). Further, despite the importance placed on these knowledge-based systems, only 32% of the firms surveyed were satisfied with information provided by the resulting applications (Heinrichs & Lim, 2003). There is no assurance that BI systems will be successful because many are reported to be over-budget, behind schedule, fail to live up to expectations or 'belly-up' completely (Watson, 1997). Various BI components are also reported to be used only through ad-hoc tactical requests, which means deployment is based on occasional needs and BI applications are also implemented separately by different departments in organizations (King, 2001; White, 2006). These lead to incomplete information being used to support the whole organizational business strategy and turn many organizations into data rich and information poor (MacGillivray, 2000).

There are a variety of reasons to explain the relatively low implementation success rate and the relatively low satisfaction ratings from these projects. The typical reasons identified from recent studies include technical complexity issues, lack of senior management focus, inflexibility of the software tools and difficulty in accessing benefits provided to the firm (Heinrichs & Lim, 2003). Furthermore, since no proper development methodologies, standards or guidelines have been established, BI today is not systematically deployed and does not normally meet the decision-makers' unique requirements. It is reported that only small percentage of knowledge workers in organizations utilizes BI tools as a regular part of their work, while a large portion of analytical works to support decision-making is still done somewhere else (Netezza Corporation, 2004).

Therefore, a proper guidance to assist firms in successfully deploying BI is of utmost importance. Keeping the idea in mind and by selecting Malaysian telecommunication industry, the topic for the research arises. Being an industry of rapidly evolving technology, telecommunication industry is now becoming increasingly competitive (Mesher, 2000; Lee, 2002; Mazlan, 2005; Li et al., 2007). The deregulation of telecommunication industry in Malaysia by the government has brought about the acute competition. The industry has entered a very competitive environment and in order to sustain its competitiveness, many firms are deploying BI that promise to meet the demands of today's market, as well as to prepare for the future.

The Malaysian telecommunications industry is particularly appropriate to be included in this study since all of its five industry players are currently the users of BI. With the main task of providing the best infrastructure and services to the nations, the telecommunications industry can be observed as a knowledge-based industry. Adopting BI and applying BI-based knowledge are considered to be valuable for telecommunications companies in creating and sustaining competitive advantage. Hence, it is possible to see how their executives perceive BI towards their companies' sustainability.

Based on the above discussions, the primary focus of the study translates to the following research questions:

1. What are the major issues related to successful deployments of BI in telecommunications industry in Malaysia?
2. What type of BI technologies and tools are needed in telecommunication strategic business decisions in helping telecommunication companies sustain their competitive advantage?
3. How can BI help telecommunications companies in Malaysia sustain their competitive advantage?
4. How do organization culture and business strategy impact the deployment of BI in sustaining firm's sustainable competitive advantage?

1.3 RESEARCH OBJECTIVES

This study will assess, in broad terms, the dominant factors and determinants that affects the successful deployment of BI in telecommunications companies in Malaysia. Based on the research questions, the main research objective of the study is to construct a conceptual BI model for sustainable competitive advantage in telecommunications industry in Malaysia. The following objectives will be studied via the model:

1. To identify the factors in ensuring successful BI deployment in telecommunications industry in Malaysia.
2. To assess the association between successful BI deployment and sustainable competitive advantage of telecommunications companies in Malaysia.
3. To examine the effect of organizational culture on the relationship between BI deployment and sustainable competitive advantage.
4. To examine the impact of utilizing effective BI tools on the relationship between BI deployment and competitive advantage.
5. To examine the effect of business strategy on the relationship between BI deployment and sustainable competitive advantage.

1.4 SIGNIFICANCE OF RESEARCH

The research has both theoretical and practical contributions. In an attempt to investigate the deployment of BI in Malaysian telecommunications industry, the research comes up with a proposed model for BI deployment in sustaining competitive advantage. Literature lacks in empirical research relating BI with sustainable competitive advantage. In addition, determinant factors for successful BI deployment including quality information, quality users, relative advantage, organization culture and others which are stated in current BI literature have not been empirically tested. Therefore, for researchers, the model will suggest the types of variables that need to be included in future empirical tests of the relationship between BI and sustainable competitive advantage. Consequently, the model extends understanding of what is becoming increasingly important issue in BI management, especially the relationship between BI and sustainable competitive advantage.

From the practical point of view, it is expected that a better understanding of determinant factors in successful BI deployment will be realized in the context of Malaysian telecommunications industry. Practitioners especially BI applications developers and BI users such as business analysts and decision makers can also make use of the model to refine their thinking about BI and their firm's other strategic resources. The model will suggest the types of BI investments that are most likely to be the sources of sustained competitive advantage.

1.5 SCOPE OF RESEARCH

This research is exploratory in nature. The main aim of the research is to explore factors that might influence the successful deployment of BI in Malaysia. Since BI is considered to be the higher level of information system that normally used by decision makers and to accomplish their decision-making tasks, executives or higher level of officers are selected to be interviewed. The samples from all five telecommunications companies in Malaysia are used in the sequential two-phase mix-method of qualitative and quantitative approaches. The research will only conclude the findings of the telecommunication industry in Malaysia. Telecommunications industry is selected due to its robustness in wireless competition nowadays. Their current level of BI usage and awareness among its executives are also taken into consideration while choosing the samples for the study.

1.6 DEFINITION OF TERMS

The following are the operational definitions of terms used throughout this study:

Business Intelligence - Business Intelligence combines data gathering, data storage, and knowledge management with analytical tools to present complex and competitive information to planners and decision makers (Negash & Gray, 2006).

Sustainable Competitive Advantage - Sustainable competitive advantage is achieved when a firm receives a return of investment that is greater than the industry norm and that persists for a period long enough to alter the nature of industrial competition or the relative strength of the organization, despite market entry and rivals' attempts at replication (Porter, 1985; Clemons, 1986).

Deployment - Adoption and successful utilization (Croteau, 2001; Brugue-Camara et al., 2004).

BI Governance - The patterns of authority for key BI activities in business firms including infrastructure, use, and project management (Sambamurthy & Zmud, 1999).

1.7 STRUCTURE OF THE THESIS

This thesis is organized into nine separate chapters. These chapters are closely related to each other and their relationships are illustrated in Figure 1.1.

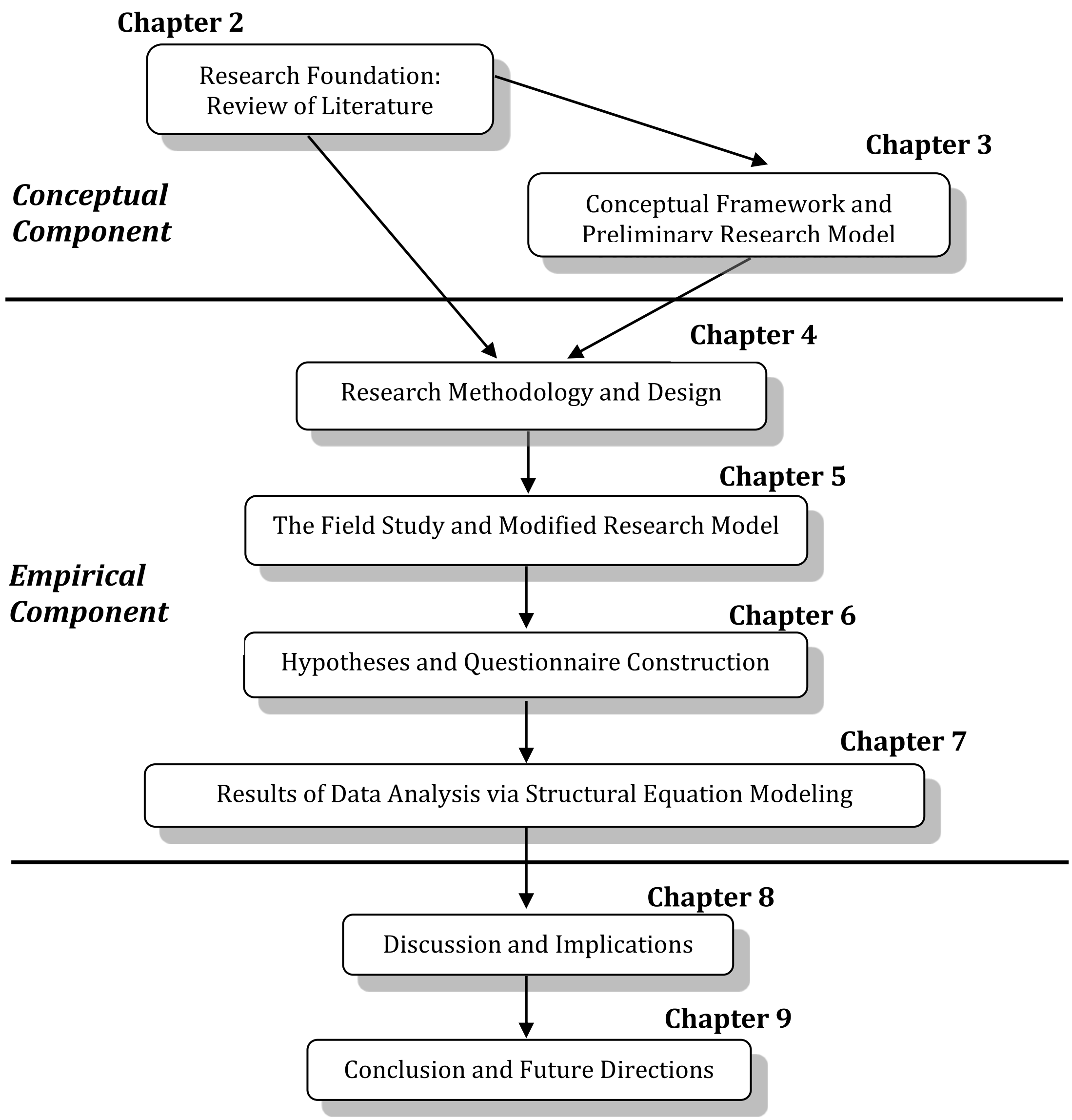

Figure 1.1 An Outline Showing the Relationship Between Chapters

The contents of every chapter are provided as follows:

Chapter 1 Introduction. This chapter is an introduction and overview of the study including research background providing an overview of the overall structure of the research, identifying problem statements and setting up the context of the research with respects to successful BI deployment. This is followed by statements of the research questions and research objectives, which set the scope of the study and finally, the statement of potential contributions of the study is provided.

Chapter 2 **Research Foundation: Review of Literature.** Previous researches relating to the research domain are provided covering the main areas including successful BI deployment and its relations with sustainable competitive advantage. Two reviews of the core theories relating to BI success; Innovations Perceptions Theory and Resource-based Theory are presented in details. This chapter also briefly illustrates Malaysian telecommunications industry in terms of its fierce competition among the providers. It also discusses BI utilizations in the industry.

Chapter 3 **Conceptual Framework and Preliminary Research Model.** This chapter presents the conceptual framework of this study based on the background theories and related studies described in the previous chapters. A preliminary research model is then proposed with its development and related references discussed in detail. Finally, the operational definitions of the terms used in the preliminary model are provided.

Chapter 4 **Research Methodology and Design**. This chapter discusses the research methodology and design incorporated in the study. It first introduces the research paradigm of the study. An interpretive (qualitative) approach and a positivist (qualitative) approach are discussed. A mixed-method approach incorporating qualitative approach into a quantitative framework is adopted. It then specifies the research model, which was developed by extending established innovations perceptions theory and models as well as firms resources from previous BI related studies. Partial Least Squares (PLS) analysis is chosen for statistical data analysis.

Chapter 5 **The Field Study and Modified Research Model.** This chapter details the results of the analysis of the qualitative data collected as part of field study. It presents a brief description of the demographic of the study sample and details the factors and variables identified during the interviews. The chapter also presents a finalized diagram of the BI research model by incorporating the field study results and the factors identified from the literature reviews.

Chapter 6 **Hypotheses and Questionnaire Construction**. The first section of the chapter described the development of the hypotheses from the final BI model. It then followed by a description of the instrument developed and the reference sources of the measurement items. The chapter concludes with a brief description of the pre-testing of the survey instrument that was undertaken.

Chapter 7 **Analysis of Quantitative Data via Structural Equation Modeling (SEM).** This chapter presents the analysis of the quantitative data, using SEM approach. The initial section discusses the results of the non-response bias assessment analysis that was undertaken in this study. It then followed by the main findings of the study in terms of the major research questions posed and the fifteen hypotheses proposed.

Chapter 8 **Discussion and Implication**. This chapter discusses the findings of PLS results by discussing the major research questions and the hypotheses proposed in this study. Theoretical and practical implications from these results are provided in this chapter.

Chapter 9 **Conclusion and Future Directions**. In conclusion, this final chapter provides an overview of the study and presents its theoretical and practical contributions. The chapter also discusses the limitation and weaknesses of this study and concludes with a brief discussion of the possible future research directions in the subject area of this study.

1.7 SUMMARY

Business intelligence is the buzzword in the IT world today. The research on BI has grown distinctly over the last decades. Viewing knowledge as essential internal resources, organizations are required to integrate and manage them well in order to create sustainable competitive advantage. While the business world has embraced the applications and use of BI widely, the same is not true for the telecommunication industry in Malaysia. There is a genuine lack of BI deployment in the setting of telecommunication business in general. With the main task of providing the best infrastructure and services to the nations, the telecommunications industry can be observed as a knowledge-based industry. Adopting BI and applying BI-based knowledge are considered to be valuable for telecommunications companies in creating and sustaining competitive advantage. Therefore, this study seeks to extend previous research by investigating the factors affecting the successful BI deployment in this industry for their sustainable competitive advantage. The results of the study will increase the understanding in BI deployment by telecommunications companies, particularly those embarking on using knowledge in sustaining their competitiveness. The findings of the review of the literature relating to BI will be discussed in the next chapter.

CHAPTER 2

RESEARCH FOUNDATION: REVIEW OF LITERATURE [1]

2.1 INTRODUCTION

The three classic resources necessary for an industrial enterprise frequently described by the economists are land, labor and financial (Sullivan, 2000). But in the last two decades, business environment has progressively moved into a so-called knowledge-based economy. This contemporary economy is not based on natural resources anymore; they are replaced by the intellectual ones. Knowledge has become an important asset in today's competitions comparable to the traditional tangible assets (Keen, 1991; Venkatraman, 1991; Steward, 2001). Insight generation is required from the firm's knowledge workers to understand this turbulent environment, as the only sustainable competitive advantage for firms has become the acquisition and use of knowledge (Heinrichs & Lim, 2003; Nonaka, 1991; Nonaka & Takeuchi, 1995; Peters & Brush, 1996). Companies now are moving towards technology-intensive in acquiring knowledge, where intangible resources such as human and information technology are more sought after. The emphasis currently is more on

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1) Parts of this chapter have been presented in the following conferences:

[a] Ahmad, A., Quaddus, M. and Shiratuddin, N. (2007), 'Application of Business Intelligence Tools in Telecommunication Industry', *in Proceedings of the 2007 International Conference on Information and Knowledge Engineering (IKE2007), part of World Congress of Computer Science, Computer Engineering and Applied Computing (WorldComp'07*), Las Vegas, Nevada, USA, 25-28 June 2007, pp 265-271.

[b] Ahmad, A., Quaddus, M. and Shiratuddin, N. (2007), 'Determinants of Successful Business Intelligence Deployment: Field Study of Telecommunication Industry', *in Proceeding of Society for Global Business and Economic Development, Kyoto, Japan*, 8-12 August 2007, pp 1746-1758.

knowledge by managing and leveraging the intangible resources with the hope to improve their immediate and long term business performance.

Companies believe that to survive in this turbulent and complex environment, they have to embark into the knowledge economy which enables them to quickly respond and adapt to changes in their business settings (Bhatt & Zaveri, 2002). These are essential in order to strengthen the firm's competitive position and ensure its future sustainability (Davenport, T. H., 1993; Drucker, 1988; Hammer & Champy, 1993; Keen, 1991; Peters & Waterman, 1982; Porter & Miller, 1985; Canibano et al., 2000; just to name a few). Hence, the term business intelligence which is considered knowledge-acquiring engine has become becoming hot topic (Menninger, 2003; Raymond, 2003; Vitt et al., 2002). BI as a concept and as an application has been widely emphasized especially in the strategic management field as well information systems field. In today's turbulent marketplace, a company which owns BI possesses distinct advantages over its market rival (Chou et al., 2005; Lee & Park, 2005).

However, the degree to which current business intelligence initiatives can support company's sustainable competitive advantage has yet to be investigated in depth. So far there is little empirical study on success factors on business intelligence deployments in particular. This scarcity of academic research has prompted calls for rigorous and empirical studies examining BI success and its relationship on sustainability of the organizations. In this research, the main focus is on the factors affecting the successful BI deployment that will lead to sustainable competitive advantage of the competing firms.

The purpose of this chapter is to review the literature that conceptualizes this research. Although recent literature on the strategic use of BI has been chiefly conceptual and anecdotal works, only a few empirical studies associating BI with competitive advantage exist. Since available theories on which to base the research model are limited, the major theoretical perspectives are drawn from strategic management and information systems fields. Three distinguish theories from the literature are used as a basis for this research. Information systems success (ISS) model by DeLone & McLean (1995) will be the basis for formulating successful BI deployment. The ISS model has been widely used by many IS researchers to measure the success of various types of IS. Another theory is the resource-based theory; RBT (Barney, 2001), is used as the underlying theory on internal firm's resources and capabilities for sustaining competitive advantage. The RBT was introduced to the IS field in the 1990s and frequently adopted in recent years (Gowen III & Tallon, 2002). The other theory is theory of innovation diffusion (Rogers, 1995), which takes into account of the perceptions about an innovation before adoption process takes place.

This chapter contains five main parts. Following section first provide background review of BI in general including its definitions, categories, and frameworks. The second part discusses BI deployment and its related antecedents that lead to its success. BI-based knowledge and the relationship with sustainable competitive advantage are presented next in the third part. The underlying theories of RBT and perception of innovation's characteristics as well as the information systems success model are discussed in the fourth part of the chapter. The last part of the chapter discusses the telecommunication industry in Malaysia and the rationale behind having it as the study population.

2.2 BUSINESS INTELLIGENCE

Business intelligence as a concept is not new. The first probable reference to BI is made by Sun Tzu, the great Chinese warrior and military genius during the warring state period more than 2,500 years ago in China (Chung, 1991). Sun Tzu's "The Art of War" claimed that in order to succeed in war, it is crucial to possess full knowledge of own strength as well as weaknesses. Lack of either one might result in defeat (see below). The conduct of business in a competitive environment is like waging a battle. In business, the firms are armies; competitors are enemies; and the outcome of competition may be fatal to one side or the other. As in war, the key to survival in 'enemy territory' is the information.

"If you know yourself and your enemy, in a hundred battles you will never fear the result
When you know yourself but the enemy, your chances of winning or losing is equal
If you know neither yourself nor your enemy, you are certain to be in danger in every battle"

-- Sun Tzu's the Art of War

Stefan Dedijer, who was hailed as 'the Father of BI' by OSS.net, the web site of the open source intelligence network, emphasized the long history of transplanting from war to business (Marren, 2004). According to him, intelligence in business probably had at least as long as a history as intelligence in war. Intelligence as concluded by Dedijer was an integral and necessary part of any self-maximizing system in conditions of competition. These included armies, businesses, nations, human beings, animals, ecosystems, and even the entire world. He was fond of quoting Heraclitus: "*War is the father of all things*". Wherever competition existed, intelligence must be involved. Frederick the Great (Rustmann, Jr., 1997) also expressed his opinion on the importance of intelligence when he said:

"It is pardonable to be defeated, but never surprised"

Hence, in order to keep up with today's competitive world, and in some cases, to 'survive', many companies are scanning their environment, keeping a close eye on their competition and attempting to understand their customers. Companies cannot afford to stand still, even if they are leaders in the industry. They are gathering and using information to make educated decisions (Shin, 2003; Liautaud & Hammond, 2001). One term for the gathering and analyzing business information is "business intelligence" (from now on will be referred to as BI).

The demand for BI is increasing as companies face the competitive challenges outlined above (Gilad & Gilad, 1988; Heinrichs & Lim, 2003). This is evidenced when BI applications are in demand even at a time when demand for most IT products is soft (Soejarto, 2003; Whiting, 2003). For the first time in 2004, BI made the list of top ten CIO priorities according to a Gartner survey (2005). Another survey of 225 Fortune 500 companies also reported an increasing use of BI programs (Gartner, 2007). In 2005, the BI market grew 11.5% to reach US$5.7 billion in worldwide license and maintenance revenue (Vesset & McDonough, 2006). Gartner group forecasting estimated that from 2002 to 2006, the percentage of BI deployments that provide instantaneous data currency grew from 11 percent to 29 percent. A report suggests that nearly 70% of the companies responding from all over the world are currently developing some type of BI applications (Hall, 2003). A more recent report by Gartner (2009) 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 (Cody et. al., 2002; Watson et al., 2002; Shin, 2003; Cooper et al., 2000; Moore & Wells, 2000; Sullivan, 1996; among many others). Thus, many companies now are deploying BI tools and techniques which are designed to seek out, interpret and explain the information at hand (Gilad, 2004; Rafii & Kampas, 2002).

BI is the art of wading through tons of data overload, sieving through data and presenting information both internally as well as externally (King, 1997). Internal information normally resides in the organizational databases while external information is from market intelligence on which management can act or build strategies. With the information at hand, companies are able to constantly scanning their environment to protect themselves from the unexpected or unforeseen attacks.

Even though interests on BI did not take off until recently, in the last several years large literature on BI have emerged. In recent years, BI has been a hot 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 (Bernstein et al., 2001). In particular, BI research spans both business expertise and expertise in the technologies. Such breadth and synergy are relatively rare on other research communities that impinge on BI.

Table 2-1: Previous BI Researches

Author(s)	Objective	Outcome
Ramamurthy et al., 2008	To examine the key factors of BI adoption	Research model proposed the direct impact of five organizational and two innovation factors on BI adoption
Hayen et al., 2007	To identify factors that affect BI success	Three main categories of success factors: organizational, project, and technical
Hwang & Xu, 2007	To identify success factors effect on BI implementation	General model
Hwang et al., 2004	To investigate factors influencing adoption of BI technology in the banking industry in Taiwan	Five factors
Mukherjee & D'Souza, 2003	To improve BI success implementation	Three phased for BI implementation: Pre-implementation, Implementation, and Pos-Implementation phases
Shin, 2003	To improve general understanding of BI issues from the perspective of IS success	System quality affects user satisfaction.
Wixom & Watson, 2001	To identify significant relationships between system	Data quality and system quality affects net benefits

	quality and data quality factors and perceived net benefits.	
Chen et al., 2000	To identify the underlying factors of end-user satisfactions with BI and develop an instrument to measure these factors	Information centers interaction with end-users during the development and improvement phases will increase satisfaction with the system
Haley, 1997	To identify key success factors in Data Warehouse implementation.	Nine factors
Watson & Haley, 1997;	To identify a number of success factors effect on BI implementation	Four factors
Chen et al., 2000	To avoid expected obstacles in enterprise-sized data warehouse projects and increase the likelihood of success	Accuracy, format & preciseness; user satisfaction
Wixom & Watson, 2001	To investigate the factors influencing adoption of BI technology in the banking industry in Taiwan	System quality; data quality; net benefits
Watson et al., 2001	To improve the chance of BI success implementation	Better information; improved business process
Hwang & Cappel, 2002	To improve general understanding of BI issues from the perspective of IS success	Five factors
Shin, 2003	To identify significant relationships between system quality and data quality factors and perceived net benefits	System quality; info quality; service quality; user satisfaction
Hannula & Pirttimaki, 2003	To identify the underlying factors of end-user satisfaction with BI and develop an instrument to measure these factors	Quality info
Mukherjee & D'Souza, 2003	To identify the key success factors in BI implementation	Two factors
Hwang & Xu, 2007	To identify a number of success factors effect on BI implementation	Quality info; easy-to-use
Haley, 1997	To avoid expected obstacles in enterprise-sized BI projects and increase the likelihood of success.	Information quality; system quality
Cody et al., 2002	To investigate the factors influencing adoption of BI	Three factors

	technology in the banking industry in Taiwan	
Dobbs et al., 2002	To improve the chance of success implementation for BI	User satisfaction; information quality
Watson et al., 2006	To improve general understanding of BI issues from the perspective of IS success.	Governance
Chung et al., 2005	To identify significant relationships between system quality and data quality factors and perceived net benefits	Quality and users
Vural et al., 2006	To identify the factors of end-user satisfaction with BI	Performance indicator

Today, there are heaps of literatures on BI research covering various topics from strategic issues to the technicalities of BI tools. Some exciting research areas of BI include (but are not limited to) – (1) intelligent agents for BI, (2) knowledge representation to describe goods and services, (3) buyer and seller decision making including pricing and bidding, (4) brokering and matchmaking, (5) reputation, recommendation and other third party services, (6) promotions, advertising and navigation of buyer attention, (7) intelligent presentation of information, (8) opportunities and timings of BI techniques, and (9) BI-relevant aspects of business processes especially in B2B. Examples of the BI researches covering topics in BI success that are relevant to this study are listed in Table 2-1; among many others.

2.2.1 Definition of Business Intelligence

The term business intelligence, the jargon and buzzword in the information and communication technology (ICT) industry, has been used in many studies. Current literature on BI has proved to be fairly sketchy and theoretical (Hannula & Pirttimaki, 2003) and the term is defined in many different fields with many different interpretations (Niu, Lu & Zhang, 2009). BI term has somewhat double meaning in the English language. In the fifties and sixties, the term was used to indicate the collecting of information about the business processes at competitors. These activities were almost company espionage, and sometimes illegal.

BI was first defined in 1958 by Hans Peter Luhn, who wrote, "***Business is a collection of activities carried on for whatever purpose, be it science, technology, commerce, industry, law, government, defense, etc. The communication facility serving the conduct of a business may be referred to as an intelligence system. The notion of intelligence is also defined here, in a more general sense, as "the ability to apprehend the interrelationship of presented facts in such a way to guide towards a desired goal***"

But it was not until 1989; BI became a popular umbrella term introduced by Howard Dresner (Power, 2002). He was the analyst of the Gartner group, an information technology research firm that applies BI in the ICT industry. He then first coined BI term in 1996 and introduced the term to describe a set of concepts and methods to improve business decision making, by extracting and analyzing data from databases for strategy formulation. But according to Negash and Gray (2003), BI as just a term replacing decision support systems (DSS), executive information systems (EIS), and management information systems (MIS).

BI has different definitions from different fields of experts and is viewed from several approaches (Adelman et al., 2003). However, there is no generally agreed conception of BI, but, rather each author has promoted his or her own idea of its connotations. To some CRM experts, BI is all about seamless integration of operational front-office applications with operational back-office applications. To some data warehouse experts, BI is just a new term for data warehousing; that is providing decision support applications on a new technology platform. To some data mining statisticians, BI represents the advanced data mining algorithms, such as neural induction techniques. Table 2-2 summarizes some definitions used by researchers based on their approaches.

Table 2-2 Some Definitions of BI

Author(s)	BI Definitions	Approach
Chang et al., 2006	Using of data purely for repetitive calculations, monitoring and controlling to obtaining knowledge in a form that is suitable for supporting and enabling business decisions from marketing, sales, relationship formation, and fraud detection through to major strategic decisions	Managerial
Tyson, 1990; Tyson & Swanson, 1993	BI comprises of a variety of information - customer intelligence, competitor intelligence, market intelligence, technological intelligence, product	Managerial

	intelligence and environmental intelligence for continuous monitoring of customers, competitions, suppliers and other fields	
Liebowitz, 2005; Golfarelli, 2004; Kahaner, 1996	A process of turning data into information and then into knowledge typically obtained about customer needs, customer decision-making process, the competition, conditions in industry, the general economics, technology as well as cultural trends, which uses specialized computer programs that allows an enterprise to easily aggregate, manipulate, and display data as actionable information that can be acted upon in making informed decisions	Managerial
Negash & Gray, 2005	BI systems combine data gathering, data storage, and knowledge management with analytical tools to present complex and competitive information to planners and decision makers	Technical
Cody et al., 2002	Technologies that improve the quantitative and qualitative value of knowledge available to decision makers	Technical
Cook &Cook, 2000	BI offers organizations quick and powerful tools to store, retrieve, model, and analyze large amounts of information about their operations, and in some cases, information from external sources. Using the analysis functions of BI, firms can look at many aspects of their business operations and identify factors that are affecting its performance	Technical
Azoff & Charlesworth, 2004; Lawton, 2006; Popovic et al., 2006	A system that presents business information in a timely manner and easily consumed way that provides the ability to reason and understand the meaning behind business information through discovery, analysis and ad-hoc querying	Managerial
Herschel & Jones, 2005	BI can be used to empower knowledge workers with information that allows them to make decisions based on a solid foundation of fact	Managerial
Hannula & Pirttimaki, 2003	Organized and systematic processes, which are used to acquire, analyze and disseminate information significant to their business activities. With the help of BI, companies learn to anticipate the actions of their customers and competitors as well as different phenomena and trends of their market areas and fields of activity. Companies then use the information and knowledge generated to support their operative and strategic decision-making	Managerial
Pirttimaki et al., 2006	Dualistic definition – (1) the relevant information and knowledge describing the business environment, the organization itself and its own situation in relations to its markets, customers, competitors and economic issues, and (2) the process that produces the intelligence described	Managerial

Keyes, 2006	A set of methodologies and technologies for gathering, storing, analyzing, and providing access to data to help users make better business decisions	Technical
Ghoshal, 1987	The ability to access and analyze information as needed and to utilize this information to make sound business decision	Managerial
Bernstein et al., 2001	The utilization of high-level software intelligence for business applications, specifically BI as a collection of cutting-edge technologies that help to make systems more intelligent includes (1) representation, communication, execution and retrieval of business policies, rules, and processes, (2) data mining and visualization, (3) machine learning and knowledge discovery, (4) information retrieval, (5) competitive intelligence/analysis, (6) dynamic pricing, (7) agents and the semantic web, (8) recommendation and reputation systems, (9) automated contracting, brokering and negotiation	Technical
Chung et al., 2002; Liebowitz, 2005; Davies, 2002; Chung et al., 2005	BI enables organizations to understand their internal and external environment through systematic acquisition, collation, analysis, interpretation and exploitation of information in the business domains	Managerial
Hoelscher (2002)	An amalgamation of reporting, data mining and online analytical processing applications	Technical
Boon, 1998	BI provides access to data that has been integrated and cleaned so that it combined to discover correlations, trends, and patterns that offer new insights, aid in decision making, and alter the competitive scene	Technical
Girad & Herring, 1996	A system that helps managers to make better decisions on time, which is designed to retrieve particular information asked by users in a company's extensive database and then display that information with a model or presentation. From this model, managers will have clear pictures of what is going on in the company. Thus, managers will deliver better decisions from it.	Technical
Chang et al., 2008	BI is an accurate, critical data, information and knowledge that support strategic and operational developments such as new initiatives, new revenue streams and risk assessment in uncertain and dynamic business environments. The source of data, information and knowledge are both internal organizationally collected as well as external supplied by partners, customers or third parties as a result of their own choice.	Managerial
Gill, 1999	Provide an integrated view of business, extend analytical capabilities to users, and leverage a corporation's data and expertise, to help organizations make faster, better, and more-informed decisions	Managerial

Cody et al., 2002	Applied the functionality, scalability, and reliability of modern database management system to build ever-larger data warehouses, and to utilize data mining techniques to extract business advantage from vast amount of available enterprise data	Technical
Cottrill, 1998; Fuld, 1995a; Kahaner, 1995a, 1995b; Vibert, 2004	Associated with competitive intelligence in North America, which emphasized the external environment and external information sources.	Managerial
Marren, 2004	The rational application of the principles of intelligence services to business and the collection, analysis, and application of strategic information to business decisions	Managerial
Vedder et al., 1999	Known as competitive intelligence, which comprises of process and product. A process which is the set of legal and ethical methods used to harness information in achieving success, while as a product BI is the information about competitors' activities from public and private sources comprising of present and future behavior of competitors, suppliers, customers, technologies, acquisitions, markets, products and services, and the general environment	Managerial
Bergerou, 2005	A process for increasing the competitive advantage of a company by intelligent use of available data in decision-making	Managerial
Burns, 2003	The use of information systems and transaction database to provide decision-making support and transform data into intelligence within a rational management framework. Companies use these techniques as a form of market intelligence that focuses on monitoring trends in the market to identify future problems and opportunities, and provides a company with the information necessary to maneuver in advance of the change in the market	Technical
Meyer, 2004	Central Intelligence Agency (CIA) of the US defines BI as 'radar for businesses'	Managerial
Negash & Gray, 2006	Combine data gathering, data storage, and knowledge management with analytical tools to present complex and competitive information to planners and decision makers	Technical

Almost all definitions share the same focus, even though definitions have been defined from two broad perspectives of managerial and technical (Casado, 2004; Petrini & Pozzebon, 2009; Niu, Lu & Zhang, 2009). The managerial approach sees BI as a process that gathers data from inside and outside of organizations and integrates them in order to generate information relevant to decision-making process. While the technical approach presents BI as a set of tools that support the process. Despite the differences in approach, they all include the idea of analysis of data and information. The main idea of BI is to aid in controlling the vast stocks and flow of business information around and within the organization by first identifying and then processing the information into condensed and useful managerial knowledge and intelligence. In this study, the following definition by Negash and Gray (2006) is adopted:

> *"**Business Intelligence combines data gathering, data storage, and knowledge management with analytical tools to present complex and competitive information to planners and decision makers**"*

Above BI definitions highlight the important elements of BI. The first crucial part of BI is the gathering, storing and managing data available internally and externally. The critical analysis of available data using BI tools emphasizes the intelligence of BI. The definition also emphasizes the complex and competitive information provided by BI, which the crucial for executives and decision makers in organizations.

2.2.2 Classification of Business Intelligence

Researchers have defined BI into several different categories according to its level of utilization. Most researchers and practitioners categorized BI applications into three types of (1) Strategic BI, (2) Tactical BI and (3) Operational BI (Loftis, 2007; White, 2006; Imhoff & Pettit, 2004; Sullivan, 1996). 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 2-3.

Most BI applications initially were developed for business analysts and experts whose daily jobs involve accessing and analyzing data (Imhoff & Pettit, 2004). These applications were tactical and were targeted at making short-term business decisions. Common data operations include detailed integrated data combined with historical analysis result (Loftis, 2007). Examples of this type of BI applications include customer relationship management (CRM), enabling analysis of customer behavior and market segmentation.

Table 2-3 Types of BI

Types of BI	Definition	Author(s)
Strategic	Developed to support long-term corporate goals and objectives and applications include aggregations, statistical analysis, multidimensional analysis, data mining and exploration.	Loftis, 2007
Tactical	Developed for business analysts and experts whose daily jobs involve accessing and analyzing data and were targeted at making short-term business decisions.	Imhoff & Pettit, 2004
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.	White, 2006

BI has recently been extended to support executives and senior line-of-business managers (Loftis, 2007). The strategic BI is used to support long-term corporate goals and objectives, which usually drive the short-term initiatives by tactical BI applications. Common data operations behind these applications include aggregations, statistical analysis, multidimensional analysis, data mining and exploration. The business purpose includes trend and pattern discovery, development of business and behavioral models and what-if analysis. A hotel franchise uses BI analytical applications to compile statistics on average occupancy and average room rate to determine revenue generated per room. It also gathers statistics on market share and data from customer surveys from each hotel to determine its competitive position in various markets. Such trends can be analyzed year by year, month by month and day by day, giving the corporation a picture of how each individual hotel is faring.

Operational BI is used to manage and optimize daily business operations and the concepts and techniques discussed for tactical and strategic BI apply equally to operational BI (White, 2006). This type of BI evolved to meet the need to respond to specific events that happen in the operational world. The target audience is the customer-facing staff.

Nadeem & Jaffri (2004) stated that BI applications can be deployed either strategically across functional departments or tactically within functional departments. They posit that 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 help companies with the knowledge and insights which will bring quick and quantifiable results.

Strategic use of BI is concerned with intelligence that is of assistance to management in developing their holistic plan and in testing the sufficiency of the visioning process (Sullivan, 1996). BI is used to develop the organization's vision, to define the organization's business purpose, and to define its mission statement. Strategic BI is developed in a number of ways, including environmental scanning, industry structure analysis, competitive analysis, scenario analysis, issues management, technology forecasting, and development of competitive personality types.

On the other hand, BI is defined into three main categories of (1) Risk Analysis, (2) Targeted Collection, and (3) Counter Intelligence (Rustmann Jr., 1997). The first is the general background information, which is normally multi-source and analytical-type that company needs to know. The second category is about specific information that company can use to increase its productivity or share market. The last category is about the company's information about their process, patent, copyright and products, which purpose is to protect the company's rights.

2.2.3 The Intelligence Process

Intelligence, from the Latin word *intelligenti*, means "the ability to learn or understand or to deal with new or trying situations . . . applies knowledge to manipulate one's environment" (*Merriam-Webster's Collegiate Dictionary,* 1993). Gardner (1999) defined intelligence as a 'bio psychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture'.

Intelligence is both process, a system for collecting and transforming information, and content, actionable knowledge that can be used to make business and marketing decisions. The intelligence process is a cycle that consists of (1) framing the question; (2) gathering the data/information; (3) organizing and analyzing the data, transforming them into actionable intelligence; and (4) disseminating the outcome to appropriate decision makers (Siegel, 2000). Feedback is obtained throughout the cycle and used to modify the process, as needed. As a cyclical process, it should be proactive and continuous, not reactive or episodic. It can be performed in-house by one or more employees, often in a self-contained intelligence unit, or by hired consultants with expertise in business intelligence operations. Data are collected from in-house sources such as sales records, salesperson reports, customer feedback and public external sources such as industry experts, trade shows, conferences, presentations, newspapers, trade journals, court documents, annual reports, suppliers, association newsletters, advertisements and brochures (Siegel, 2001).

Computers are an integral part of most intelligence systems (Siegel, 2001). However, human thought is essential in ensuring that data are transformed into actionable intelligence. Frequently used analysis techniques include ratio analysis; scenario building; trend analysis; strengths, weaknesses, opportunities, and threats (SWOT) analysis; forecasting; benchmarking; cost analysis; regression analysis; content analysis; and qualitative analysis (Gartner, 2007; Bernstein et al., 2001). Intelligence content, which is the actionable knowledge, is used in activities such as identifying internal strengths and weaknesses and external opportunities and threats, preparing business and marketing plans, locating emerging markets, preparing for technological change, and designing risk reduction strategies (Bernstein et al., 2005; Gilad & Gilad, 1988).

2.2.4 Business Intelligence Framework

BI framework is proposed (White, 2003) to show some perspective on how BI system works, as illustrated in Figure 2.1. BI systems consist of a complete process of creating reports and analysis for decision making from start to end. Traditional BI systems consist of back-end database, a front-end use interface, software that processes the information to produce the intelligence itself, and a reporting system (Lawton, 2006). Initially BI consists of extract, transform and load (ETL) tool or server as shown in Figure 2.1, which integrates data from disparate transaction data files and database, and transform it into the right form, and load it into a data warehouse. The main purpose of ETL function is to cleanse the data before it is being used by BI users.

The data warehouse (shown as DW in Figure 2.1) is the foundation of BI. William H. Inmon started developing the idea of a data warehouse in the late 1980s (Kelley, 2005). Data warehousing is a systematic approach to collecting relevant business data into a single repository, where it is organized and validated so that it can be analyzed and presented in a form that is useful for business decision-making. Data warehouse is especially designed to deal with large amounts of data. Large data warehouse currently hold tens of terabytes of data, whereas smaller, problem-specific data marts are typically in the 100 gigabytes range (Cody et al., 2002). It is claimed that a combination of BI and data warehouse technologies provide the flexibility to support a dynamically changing competitive environment (Rao, 2000).

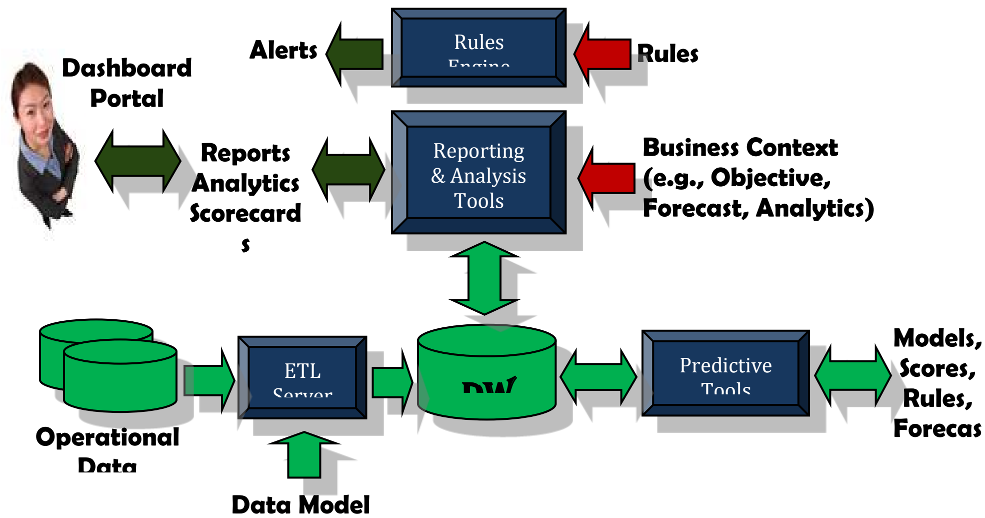

Figure 2-1 Business Intelligence Framework
(Adapted from DM Review, September 2003)

BI practitioners contend that 90% of their raw information can be found in the public domain (Burns, 2003). On the other hand, it is believed that 80% of what companies need to know about their competitors is right inside them (DeWitt, 1997). BI practitioners are advised to study business decisions to grasp data and locate the intelligence source (Fuld, 1985a).

Reporting and analysis tools are reported to give business users the ability to run canned, parameterized and ad-hoc reports (White, 2003). Queries and reporting tools are used to provide an answer to ad-hoc user questions, and reporting is used to create standard reports. Insufficiency of basic reporting has lead to the development of analysis solutions such as OLAP tools and engines, and multi-dimensional data stores (White, 2006). More recently, these BI analysis tools have evolved to provide web-based information delivery. Another recent trend in BI tools is to use the predictive tools component shown in Figure 2-1 that adds techniques such as data mining and forecasting to a BI framework.

The above BI definitions and categories highlight the important elements of BI in acquiring knowledge for decision-making process. The purpose of BI is to aid organizations in managing huge amount of business information that lies inside and outside their organizations. The task can be accomplished by first identifying and then processing the information into condensed and useful managerial knowledge and intelligence. As such, BI task is considered as basic task in management, which is analyzing complex business environment in order to make competitive decisions. As organizations have been for years collecting information about their surroundings, the real revolution in BI now is to materialize intelligence activities (Gilad & Gilad, 1986). Intelligence in BI is often defined as the discovery and explanation of hidden, inherent and decision-relevant contexts in large amounts of business and economics data (Hameed, 2004). BI in this case can act as the eye and ears of the corporation, only if the intelligence is used (Thomas Jr., 2001).

Although there have been BI studies done over the last several years, literature suggests that there is a scarcity of empirical studies on BI. The existing works and researches on BI consist primarily on general and conceptual principals of BI and case descriptions of such systems in a handful of leading organizations. Those studies also mainly focus on the issues of the process of implementing BI, approaches and guidelines to build BI, BI tools classification and framework, measurement of BI success, roles and objectives of BI in organizations, characteristics of BI users, and BI applications in various area. Literature on empirical study on BI and its relationship with company's sustainability could not be found at present. Some reviews on various dimensions related to BI success and the relationship with competitive advantage will be presented in the next sections.

2.3 BUSINESS INTELLIGENCE DEPLOYMENT

BI-related technologies and strategies have been deployed in various industries many years ago. The first known BI application was the use of International BI for monitoring foreign currency instabilities way back in 1967 (Hilty, 1967). Organizations often employ BI to assess the business environment in various ways such as marketing research (Frates & Sharp, 2005), competitor analysis (Bouthillier & Shearer, 2003), business process reengineering (Malhotra, 1998), enterprise resource planning (Chou et al., 2005) and customer relationship management (Kelly, 2000). A wide variety of companies including telecommunications providers, travel agencies, manufacturing and finance use BI for activities such as customer profiling, customer support, market research and segmentation, product profitability, statistical analysis, and inventory and distribution analysis. Some examples of industries that have deployed BI are shown in Table 2-4; just to name a few.

Table 2-4 Examples of BI Deployments in Industries

Industry	BI Applications	References
Logistics	Transport management and warehouse management	Rao & Swarup, 2005
Manufacturing	Order shipment and customer support	Bendoly, 2003; Wu et al., 2004
Retail	User profiling and inventory management	Cody et al., 2003
Financial	Claims analysis, risk analysis, credit card analysis and fraud detection	Nadeem & Jaffri, 2004
Transportation	Fleet management	Watson et al., 2006
Telecommunication	Call analysis, network usage assurance and fraud detection; customer churn analysis; customer segmentation; customer loyalty	Li et al., 2007; Lee & Park, 2005; Ahn et al., 2006; Gerpott & Massengil , 2004; Gerpott et al., 2001; Kim et al., 2004
Utilities	Power usage analysis	Anderson-Lehman et al., 1998
Insurance	Premium payment behavior, claim activity, agency performance, risk management, targeted marketing and potential policy lapses	Ferguson, 2002; Chidanand et al., 2002
Healthcare	Customer analysis; Clinical Data Repository (CDR) queries; diabetic screening and pharmaceutical R&D supply chain, electromyography (EMG); diabetic data warehouse	Spil et al., 2002; Alshawi et al. 2003; Einbinder et al. 2001; Chidanand et al., 2002; Balter et al., 2002; Breault et al., 2002
Marketing	Customer targeting and clustering, market segmentation	Kim & Street, 2004

Particularly, 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 heaviest users of BI (Watson et al., 2001). Over the past ten years, the appearance of BI applications requiring or benefiting from BI has accelerated (Berstein et al., 2001). For example, electronic markets for buying and selling goods and services over the web are a fast-growing, multi-billion dollar segment of the world economy. 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 (Buytendijk, 2001).

Having known the goodness of BI, the real challenge now is to measure its success. The number of individual users who access BI systems alone is not a good indicator of successful BI as it is commonly believed (Wu, 2006). Indicators of BI success can be grouped into three categories of (1) access, (2) usage and (3) evolution.

A six-step approach is recommended in order to successfully implement BI: (1) identify BI needs that are linked to business strategies and goals, (2) identify multiple data sources, (3) extract, transform and load data to create a subject-oriented database, (4) help the organization choose a reporting engine to view and analyze the database, (5) create standard reports and undertake ad hoc analysis and data mining to gain insights into the key drivers of corporate performance, and (6) plan an enterprise-wide deployment to ensure the right decision makers have the right information whenever and wherever they need it (Abukari, 2003).

There a number of BI process models in the literature (Pirttimaki & Hannula, 2003). All these models share the same common elements of (1) identifying what information needed, (2) how it should be gathered, (3) how it should be organized and stored, (4) who should have access to it, and (5) how the management has exploited the knowledge to gain competitive advantage.

BI is also reported to have reached a new level of maturity, both as a discipline and a technology market (Knightsbridge, 2005). Recent trends in BI including (1) taking data quality seriously, (2) infrastructure standardization and consolidation, (3) offshore sourcing for BI, (4) strategic approach to information, (5) regulatory compliance as a driver for BI, (6) elevating the enterprise data integration discussion, (7) educating the end user, (8) master data management, (9) powerful new entrants to new BI market, and (10) actionable BI.

2.3.1 Successful BI Deployment

As BI continues to grow in volume and importance, the need of having BI successfully deployed in organizations escalates (Watson, 1997; Heinrichs & Lim, 2003; King, 2001; White, 2006; among many others). 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 (Gangadharan & Swami, 2004) 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 (Ko & Abdullaev, 2007). Among the suggestions are:

- 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

There were common reasons for failure across many of the companies that implement BI --- weak sponsorship and management support, insufficient funding, inadequate user involvement, and organizational politics (Watson et al., 2004). With few exceptions, the reasons for failure were organizational rather than technical. As with most IT projects, organizational issues are usually more daunting and critical to success than technical ones. Factors such as support from the top management, size of the organizations, effect of champion, internal needs, and competitive pressure would affect the adoption of BI (Hwang et al., 2002).

2.3.2 User Satisfaction as a Measurement of BI Success

Different methods have been used in evaluating decision support systems such as BI (Barki & Huff, 1985). Among these methods are event logging, attitude surveys, cognitive testing, rating and weighting, system measurement, system analysis, cost/benefit analysis and value analysis (Sprague & Carlson, 1982). Is it possible, perhaps preferable to use more than one method in determining these systems in a particular organization setting.

Currently, end-user satisfaction emerged as an important factor in measuring the IS success and use (Ives & Olson, 1984; Doll & Torkzadeh, 1988; DeLone & McLean, 1992; Doll et al., 1994; Seddon 1997). Although many studies in end-user satisfaction do not explicitly separate information and system features when identifying the structure and dimensionality of the user-satisfaction construct, DeLone and McLean (1992) made an explicit distinction between information aspects and system features as determinants of satisfaction. Based on IS success literature, DeLone and McLean's highly cited model (1992) identified information quality and system quality as antecedents of user satisfaction and use.

Satisfaction is defined as a state of mind that represents the composite of a user's emotional and material responses to a particular activity, such as information seeking (Bruce, 1999). User will emotionally be satisfied when the outcome match their requirements, expectations, task orientation and goal determination (Waern, 1989; Applegate, 1993). Users will also be materially satisfied as a result of their experience associated with system usage (Santosa et al., 2005). Satisfied users may prolong their website usage, revisit it, and may recommend it to others (Zhang & Von Dran, 2000). User satisfaction has also been used in the study of measuring website success by (Zhang & Von Dran, 2000). Hence, user satisfaction is a highly desirable measure of systems usage and eventually systems success.

Previous literature has focused on user satisfaction as a commonly acknowledged measurement of IS success (Caldeira & Ward, 2003; Shin, 2000; Delone & McLean, 1992; Guimaraes & Gupta, 1988; among many others). Based on the general definition suggested by Ives et al. (1983) – user information satisfaction is 'the extent to which users believe the systems available to them meets their information requirements'. Chen et al. (2000) has identified the underlying factors of end-user satisfaction with data warehouse success and developed an instrument to measure these factors. The study demonstrated that most of the items in classical end-user satisfaction measure are still valid in BI environment.

In addition, user satisfaction also has been used as surrogate of system success (Amoako-Gyampah & White, 1993; Palanisamy & Sushil, 2001). A type of user satisfaction with information system is called material satisfaction (Bruce, 1998) that can be associated with IS performance of system's design including information presentation (Hoque & Lohse, 1999; Zhang, 2000), link colors and menu positions (Pearson & Van Schaik, 2003). User satisfaction was used as one of the website success factors (Zhang & Von Dran, 2000) and found out website success is influenced by download time, navigability, and its content (Palmer, 2002).

To date, user satisfaction is probably the most widely used measure of IS success (DeLone & McLean, 1992). A summary of the studies and a list of measures adopted in measuring user satisfaction from empirical studies done for the year 1981 to 1987 are available. These variable have been adopted by numerous IS research because (1) satisfaction has a high degree of face validity, (2) several reliable measurements have been developed for measuring satisfaction, and (3) most other measures of IS success are problematic.

There were no specific studies found on the deployment of BI that are related to the firm's internal resources factors that influence its success in telecommunications companies. In the context of this study, the potential antecedents of BI success are based on the above discussions and are discussed in detail in the following section.

2.4 ANTECEDENTS OF SUCCESSFUL BI DEPLOYMENTS

Two groups of potential antecedents of successful BI deployment based on specific BI literature and IS-enabled sustainable competitive advantage studies have been defined for the purpose of this study. The first group of antecedents is based on Resource-based Theory (Barney, 2001), which considers firm's internal unique resources in deploying BI. These resources include firm's assets, skills, knowledge and ability that will play important roles in BI deployment. The second group of antecedents is adapted from the Theory of Innovation Diffusion (Rogers, 1995), which takes into account of 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. In this study, the innovation is BI systems that are planned to be adopted by the firms.

2.4.1 Firm's Internal Resources

In this study, four antecedents under the firm's resources group are to be considered, namely quality information, quality systems, quality user, and BI governance. The combination of these tangible and intangible resources, which owned internally by organizations are posited to influence successful BI deployment. Successful BI would then help in acquiring knowledge needed for firm's sustainable competitive advantage (Fuld, 1991; Herring, 1992; Ranjan, 2008; Petrini & Pozzebon, 2009).

An exploratory study was conducted on data warehouse success factors from the perspective of IS success (Shin, 2003). The study concluded the effect of variables pertaining to system quality, information quality, and service quality on user satisfaction was significant. In general, the study also indicates that the IS success model introduced by Delone and McLean (2002) become a good framework in understanding the success of data warehousing.

Significant relationships between system quality and data quality factors and perceived benefits in a data warehouse study (Wixom & Watson, 2001) have been identified as shown in Figure 2-2. Management support and resources were found to help in addressing organizational issue that arise during implementation; resources. User participation, and highly-skilled team members increase likelihood that data warehousing projects will finish on-time, on-budget, and with the right functionality.

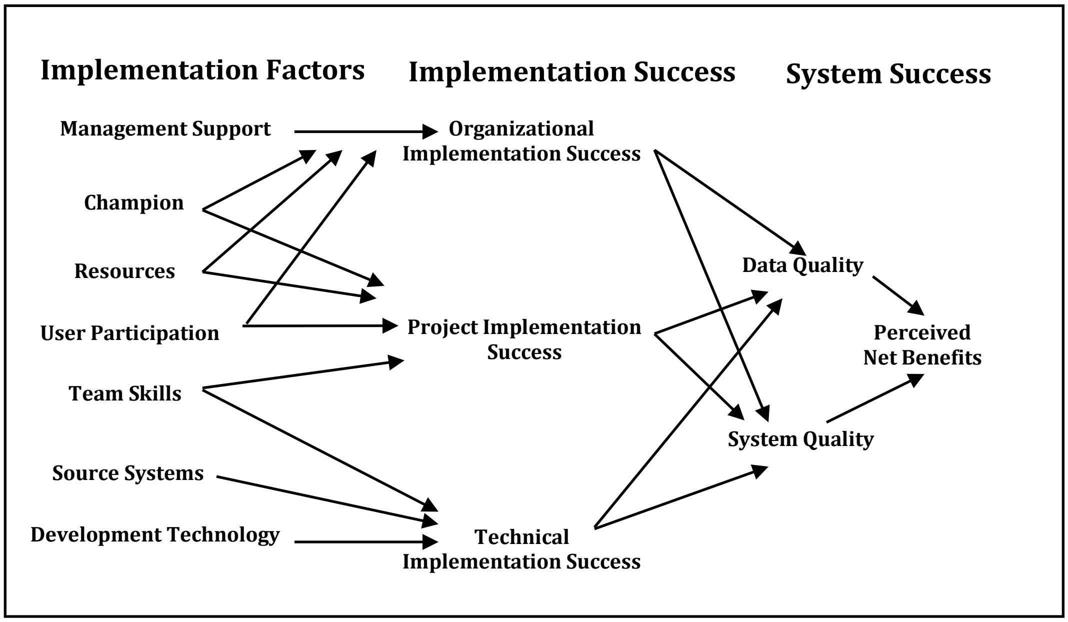

Figure 2-2 Data Warehousing Success Model
(Adapted from Wixom & Watson (2001)

The success of information systems (IS) has been investigated in numerous ways, such as by measuring the satisfaction of users, system quality, and the perceived usefulness of specific applications (Hayen et al., 2007). Researchers treated IS success as a multi-faceted constructs and selected several appropriate success measures. These provided possible relationships among the success dimensions when constructing a research model. That model established a framework for metrics that can be used to manage BI implementation project to help insure its success. The work was built upon a case study of the Financial Service Company (FSC) in the southeastern United States. FSC has approximately 7500 employees and operates in six southern and southeastern states. The results from the case study and interview identified significant relationship among the system quality, data quality, perceived net benefits. It was revealed that management support and adequate resources help address organizational issues that arise during data warehouse implementations; resources, user participation, and highly-skilled project team members increase the likelihood that data warehouse projects will finish on-time, on-budget, and with the right functionality. The implementation's success with organizational and project issues, in turn, influences the system quality of the data warehouse.

An exploratory study on data warehouse success factors was also conducted from the perspective of IS success (Shin, 2003). The study concluded the effect of variables pertaining to system quality, information quality, and service quality on user satisfaction was significant. In general, the study also indicated that the IS success model introduced by DeLone and McLean (2002) become a good framework in understanding the success of data warehouse.

Another exploratory study on data warehouse success implementation (Hwang & Xu, 2007) was conducted by examining success variables individually. The study revealed the factors that are important and the strength of their effects on different success variables. The research model was developed to collect eight data warehouse success variables and eleven implementation factors. The data warehouse institute e-mail list of over 15,000 data warehousing professionals was used as the source of the survey. The results considered five factors that are important to the perception of how easy a data warehouse is to use: clearly defined business needs/benefits user involvement/participation, source data quality, practical implementation schedule, and adequate funding. Overall, top management support is the only factor found to be insignificant.

Guidelines (Solomon, 2005) are provided to help managers avoid common pitfalls and obstacles in enterprise-level data warehouse projects based on reviewing previous related-studies and extensive field experience. The following are the guidelines that could be considered, by the organizations, to increase the chances for success

- Service level agreements and data refresh requirements.
- Source system identification
- Data quality planning
- Data model design
- ETL tools selection
- Relational database software and platform selection
- Data transport
- Reconciliation process
- Purge and archive planning
- End-user support

A study intended to explore the critical factors affecting the adoption of data warehouse technology in the banking industry in Taiwan was conducted (Hwang et al., 2004). The study focused on the following packaged-factors - organizational, environmental, and project. A questionnaire survey was designed and used to achieve the study's objective. A total of 50 questionnaires were mailed to CIOs in local banks. After an intensive review of prior relevant studies, a total of ten factors influencing the success of data warehouse project were developed - size of bank, champion, top management support, internal needs, degree of business competition, selection of vendors, skills of project team, organization resources, user participation, and assistance of information consultants. After collecting the results from the questionnaire, they found that top management support, size of the bank, effect of champion, internal needs, and degree of business competition would affect the adoption of data warehouse technology in banking industry in Taiwan.

A framework was presented which might help the data warehouse people to visualize how critical success factors can be included in each phase of data warehouse implementation process (Mukherjee & D'Souza, 2003). It was found out that the data warehouse implementation process follows the three phased pattern of evolution (Pre-implementation, Implementation and Pos-Implementation phases). After reviewing previous related-studies, a list of 13 critical implementation factors was developed; Data, Technology, Expertise, Executive sponsorship, Operating sponsorship, Having a business need, Clear link to business objectives, User involvement, User support, User expectation, organizational resistance, organizational politics, and Evolution and growth. Each factor and the contribution of each factor in every phase of data warehouse implementation process were discussed.

An exploratory study was conducted to assist in the understanding of data warehouse problems from the perspective of information systems success, using system quality, information quality and service quality as they impact user satisfaction (Shin, 2003). Empirical data were gathered at a large enterprise from three different information sources: a survey, unstructured group interviews with end-users, and informal interviews with an IT manager who was in charge of the data warehouse. It was found that user satisfaction with data warehouse was affected by system quality factors such as data quality, ability to locate data, and system throughput. In addition, the study indicated that users had a high level of satisfaction with data currency although in separate interviews, data currency was listed as a problem.

A case study presented some explanation to why some organizations realize more exceptional benefits than others after data warehouse installation (Watson et al., 2002). The report started by giving a basic background about a data warehouse, then went through the obtainable benefits gained from data warehouse installation in general by the adopters. Three case studies of data warehousing initiatives, a large manufacturing company, an internal revenue service and a financial services company, were discussed within the context of the suggested framework. The results from the case studies highlighted the benefits achieved by the three organizations. The researchers noticed that some of them considered more significant payoffs than the other adopters. The researchers built an argument about the main issues behind the success in the three cases. The argument led to the following critical success factors: business need, champion, top management support, user involvement, training matters, technical issues (adequate tools), accurate definition of the project's objectives, growth and upgradeability, organizational politics, and skilful team.

An empirical investigation of the factors influencing data warehouse success among the American organizations was held (Wixom & Watson, 2001). A cross-sectional survey was used in this study to build up a model of data warehousing success. A questionnaire was distributed among data warehouse managers and data suppliers from 111 organizations, to gain relevant data about implementation and success factors of data warehouse. They cited, in their studies, seven factors considered to be crucial in the adoption of data warehouse based on reviewing the prior related research materials (Management support, Champion, Resources, User participation, Team skills, Source Systems, and Development technology). The results revealed that the following factors have a big and positive influence on the successful adoption of data warehouse project; Management support, Resources, User participation, Team skills, Quality source systems, and Better development technology.

Another important survey conducted by KPMG management consulting and the Nolan Norton institute (Hurley & Harris, 1997) was carried out. This survey was distributed among the Pacific's senior information managers in mid and large sized companies. The survey aimed to achieve a coherent understanding regarding data warehousing initiatives. The findings from the survey revealed that data warehouse technology heavily increases financial and business returns in the adopters. They found also the following factors for successful data warehousing initiatives: project teal skills, technical infrastructure, project team, technical architecture, good vendor capability, business imperative, clear objectives, data quality, and IS alignment.

Above literature highlights the importance of the internal tangible and intangible resources within the organizations that could influence BI success. The quality-based resources such as quality BI information and quality BI system would be important factors in ensuring BI success. The human-related factors such as skilled BI users and effective governance of BI are also expected to have significant influence in this study. The following sections discussed these resources in detail.

2.4.1.1 Quality Information

Literature suggests that quality information is important in BI success (Jedras, 2003; Burns, 2005; Berndt, Hevner & Studnicki, 2003; Nelson et al., 2005; Rudra & Yeo, 2000; among many others) as sound business decisions are based on information derived from BI systems. Information quality is concerned with the relevance, timeliness, and accuracy of information generated by organizations' BI initiatives. BI researchers have been focusing on the quality of the BI output, which is the information quality that the system produces (Firth, 1997; Barry and Parasuraman, 1997; Miller, 1996; Mohidin, 2007). Over the last decade, quality information research activities have increased significantly to meet the needs of organizations attempting to measure and improve the quality of information (Lee et al., 2002). Quality information has been rated regularly as a top concern in BI projects (Brown, 1997; Firth & Wang, 1996; Orr, 1998; Schusell, 1997).

Table 2-5 Information Quality Dimensions (Wang & Strong, 1996)

Dimensions	Definitions
Accuracy	The degree to which information is correct, unambiguous, meaningful, believable, and consistent
Completeness	The degree to which all possible states relevant to the users
Currency	The degree to which information is up-to-date, or the degree to which information precisely reflects the current state of the world it represents
Format	The degree to which information is presented in a manner that is understandable and interpretable to the user and thus aids in the completion of task

Based on context-based view, quality information is described as the usefulness of the information in aiding decision-making (Wang & Strong, 1996). The context-based view expands the dimension of information quality beyond accuracy to include dimensions such as relevance, completeness, currency and format of the information that shape the perceptions of quality in the context of use. The four dimensions of information quality are further illustrated in Table 2-5.

Accuracy is most commonly defined as the correctness in the mapping of stored information to the appropriate state in the real world that the information represents (Fisher, & Kingma, 2001; Nelson et al., 2005). The notion of accuracy is further refined to include the idea that the information not only is correct, unambiguous, and objective, but also meaningful and believable. The key element of this refinement is the notion that there is an important perceptual component to accuracy. Information not only must be accurate but must also be perceived to be accurate (Wang & Strong, 1996).

Beyond accuracy, the quality of information also can be shaped by *completeness.* Completeness refers to the degree to which all possible states relevant to the user population are represented in the stored information (Nelson et al., 2005). It is important to recognize that the assessment of completeness only can be made relative to the contextual demands of the user and that the system may be complete as far as one user is concerned, but incomplete in the eyes of another. While completeness is a design objective, its assessment is based on the collective experience and perceptions of the system users.

In addition to completeness, *currency* has been identified as an important factor in contextual information quality (Canibano, Garcia-Ayuso & Sanchez, 2000). Currency refers to the degree to which information is up to date, or the degree to which the information precisely reflects the current state of the world that it represents. Users may have different demands for currency and, as a consequence, information that is viewed as current for one task may be viewed as too dated for another. User perceptions of currency relative to the task demands over time will be an important determinant of information quality (Nelson, et al., 2005).

The final dimension of information quality captured in Table 2-3 is *format*. Format is tied to the notion of representational quality (Lee, Strong, Kahn, & Wang, 2002). Format refers to the degree to which information is presented in a manner that is understandable and interpretable to the user, and thus aids in the completion of a task. Nelson et al. (2005) stated that the assessment of format will be shaped by the perceptions of the user completing different tasks with the system over time. Jarvenpaa (1989) investigated the effect of task demand and graphical format on decision time and evaluation strategy and found that presentation format influenced the decision time and information acquisition strategy.

According to Gartner's survey on BI projects (Burns, 2005), more than 50% of BI have little acceptance or fail completely because data quality has been ignored. They reported that many companies don't even see they have a data quality issue. Gartner later warns companies of 'dirty data', reporting that more than 25% of critical data in Fortune 1000 companies is flawed (Swartz, 2007). They predicted that over the next two years, more than 25% of critical data in the world's top firms will continue to be flawed – the information will be inaccurate, incomplete or duplicated. They stressed that poor quality customer data can cost business dearly in terms of higher customer turnover and excessive expanses from customer contact processes. They suggested companies to consider data quality issues including (1) existence, (2) validity, (3) consistency, (4) integrity, (5), accuracy, and (6) relevance.

In addition, information quality is stressed among the major roles in determining the successful BI deployment in the study of data warehouse success factors (Nelson et al., 2005). Successful adoption of Information System is largely based upon understanding the linkages between quality, satisfaction and usage However, satisfaction and usage has been widely emphasized in the literature, while information and system quality has received little attention. The fundamental of quality is explored by developing and testing a IS success model based on data warehouse environment. Their model strikes a balance between being comprehensive and parsimonious. The results suggested that BI project should emphasize (1) accuracy, (2) completeness and (3) format as the primary drivers of information quality.

Information quality aspect is often ignored in BI implementation and a methodology for embedding data quality into overall BI architecture is strongly suggested (Dijcks, 2004; Jarke et al., 1999). In addition, for BI to be effective is dependent on high quality information (Brackett, 2001) and understandably, this can only be derived from a high-quality data resource. Naturally, in any given industry there are going to be disparate sources of data that are relevant to effective BI. This in turn raises the issue of how such data might be cleaned up, linked together and accesses in a meaningful way.

It is suggested that the first part of any BI deployment should involve carrying out data audit (Walter, 2005). Organizations need to keep a close eye on the quality of data they are capturing. This is to ensure that the information displayed later is able to boost the end-users productivity and efficiency, and ultimately the company.

Information currency is stressed as important factor in BI success as management is using BI solutions mostly for key performance indicator (Ratner, 2006). BI should enable managers at all levels to get on-demand and real-time information from multiple sources. This requires BI to adapt according to the way people think and work. BI is also expected to adapt to the different and unique business circumstances, which changes constantly over time.

Data quality is recognized as a major inhibitor of BI projects (Friedman, 2006). It can cause user distrust and abandonment of the system. Poor data quality also can destroy the credibility and utilization of BI systems (Marion, 2008) as "*bad data truly does bad decisions*" (Friedman, 2006). It is suggested a potential solution of implementing tools and techniques which puts control and measurements on the quality data going into and out of a data warehouse. It's critical that companies deploy sound data governance in conjunction with BI activities.

A surprising and frustrating finding in BI case study (Linder & King, 1991) was that in spite of the 'showcase' system and professional support, the information and intelligence from the BI system did not regularly reach the senior managers and strategic makers in the company. One executive commented: *Data in a database is useless to me*, while another executive commented that he used information and intelligence from the system just to justify decisions, not to formulate strategy.

Organizations tend to assume that the data from the source application is in pristine condition – but in a real world, transactional systems have been known to contain some data quality "quirks" (Robertson, 2004). Since most BI tools deliver information in summarized form, the enterprise cannot be sure if the quirks are generating benign or toxic effects in the information delivered. However, if the BI tools work as advertised, the business users will be able to acquire the flawed information needed.

Above all, the importance of quality information in BI success is essential as information provided will be turned into actionable knowledge needed for decision-making in organizations. Without an accurate, timely, complete and presentable format, information produced is of little value.

2.4.1.2 Quality BI Users

Another important factor to determine successful BI deployment is the availability of skilled users (Avery & Watson, 2004; Watson et al., 2006; Hwang et al., 2004) in competing firm. Realizing the importance of good, solid BI systems is just a first step. The second crucial step is employing experts to collect the intelligence that lies behind BI (Rustmann Jr., 1997). BI can only deliver value if the users are capable of utilizing information gained and turn them into sound business decisions (Avery and Watson, 2004). The users must have in-depth knowledge of business processes and operations in order to act on the results of the analysis (White, 2005). Many users simply don't have time, inclination or required skills to use BI systems. Therefore, quality users with different set of skill such as technical, business and analytical are needed in order to perform necessary tasks.

Based on a study by Avery and Watson (2004), it was suggested that BI users be well trained and supported technically in order to receive full value of the investment. Trainings would include basic technical skills such data warehouse concepts, the use of data-access tools and applications, the data in the warehouse and how to access them and the applications related to business intelligence.

Choosing and implementing the right BI tools and technologies is only part of the formula for BI success (Strange & Hostman, 2003). BI projects integrate requirements, data and priorities of the IS organization and its multiple business units. These tasks require people with unique skills in order to deliver the right outcome and this skilled users has been identified as one of the important factors of BI (McGillivray & Faulkner, 2003). The study findings revealed that eighty percent of the respondents agreed that it is very important for technical persons to have some grasp of the business. Unfortunately most enterprises have difficulty finding people with the right skills (Strange & Hostman, 2003). Most organizations lack the skills and organizational commitment for managing, implementing and supporting significant cross-functional BI projects.

Researchers have categorized BI users according to their business functions. Avery and Watson (2004) defined 4 types of BI users: (1) power users, (2) business users, (3) technical users, and (4) executives. According to them, these users have different needs and tasks that are categorized into strategic, tactical and operational. On the other hand, Imhoff and Pettit (2004) classified BI users as (1) Farmers, (2) Tourists, (3) Explorers, (4) Miners, and (4) Operators. They suggested companies to recognize the different types of analyses and group them with similar characteristics to gain value in understanding, anticipating, and satisfying their needs.

2.4.1.3 QualityBI System

Quality system is recognized as an important factor in successful BI deployment (Seddon, 1997) although issues relating to it received fewer attention than information quality in the IS literature (Nelson et al., 2005). Past researchers defined system quality as about whether there are errors in the system, the consistency of the user interface, ease of use, quality of documentation, and quality and maintenance of the program code (Davis, 1989; Seddon, 1997; Delone & McLean, 1992). They believed that higher-quality systems should be perceived as easier to use and, ultimately, have higher levels of usefulness and use.

Park (2006) agrees with Seddon (1997) that quality system is one of the factors in IS success model. He investigated the effects of BI on decision performance and found out the evidence that support the basic concepts of the model that postulates positive impacts of system quality and information quality on decision performance through system use. Srinivasan (1985) and Doll and Torkzadeh (1988) concluded that system quality is based on the technical details of IS interface, reflecting system reliability to measure ease of use. In addition, Hamilton and Chervany (1981) suggested additional dimensions such as completeness, currency, accuracy, ease of use, reliability, response time, system flexibility, and turnaround time as a measurement of system quality.

Although some researchers equate system quality with dimensions that are closely related to service quality and ease of use, but Nelson et al. (2005) believed the constructs used are not the same. They defined five dimensions to be associated with system quality – (1)

accessibility, (2) reliability, (3) response time, (4) flexibility, and (4) integration, which reflect the information processing system required to produce the output. Table 2-6 details definitions of dimension of system quality, which represent user perceptions of interaction with system over time.

Table 2-6 System Quality Dimensions (Nelson et al., 2005)

Dimensions	Definitions
Accessibility	The degree to which a system and the information it contains can be accessed with relatively low effort
Reliability	The degree to which a system is dependable overtime
Response time	The degree to which a system offers quick or timely responses to requests for information or action
Flexibility	The degree to which a system can adapt to a variety of user needs and to changing conditions
Integration	The degree to which a system facilitates the combination of information from various sources to support business decisions

The first dimension, accessibility, represents the degree to which a system and the information it contains can be accessed with relatively low effort (Nelson et al., 2005). Access to information can be viewed as a necessary condition for system quality. It is a system property to the extent that the system itself is either accessible to a user or not accessible, regardless of the task that the user is trying to accomplish.

Reliability refers to the dependability of a system over time (Nelson et al., 2005). It can be defined objectively as the technical availability of the system and can be concretely measured by metrics such as uptime, downtime, or mean time between failures. Despite the fact that reliability can be measured objectively, it also is true that individuals may have perceptions of reliability that are independent of measured reliability. Consider a user who only works with a system once a week for a short period of time. A moment of downtime during that time may have a significant detrimental effect on reliability. Thus, user perceptions of reliability are the key to determining system quality.

Response time refers to the degree to which a system offers quick (or timely) responses to requests for information or action (Nelson et al., 2005). Different kinds of systems (e.g., transaction processing, decision support) often are designed or optimized to provide certain response times, and users may perceive the response time of a system based on the kind of task that they are performing. For example, users may be very tolerant of long response times for an Internet application, but they would be much less tolerant of a similar response time in a desktop application.

Flexibility relates to the degree to which a system can adapt to a variety of user needs and to changing conditions. The definition of flexibility suggests the need to adapt to changing conditions and different user needs, making it a task property of system quality. To the extent that a system will be used over time and must provide information as input to a wide variety of decision tasks, flexibility can be expected to be a key determinant of quality. The relative importance of flexibility in determining quality may depend on the degree to which task demands change over time. In a data warehouse context, for example, we might expect that flexibility is less important in the context of predefined reports (which provide information for static tasks) and more important for querying and analysis, which are less structured and more likely to change over time.

Finally, integration refers to the degree to which a system facilitates the combination of information from various sources to support business decisions (Nelson et al., 2005). The need for integration will vary across tasks and contexts, and thus, integration represents a task-related property. Tasks that are more interdependent will require systems that facilitate integration to a greater degree than systems that support largely independent tasks.

2.4.1.4 BI Governance

Another important factor to determine successful BI deployment is the role of effective BI governance (Matney & Larson, 2004; Watson et al., 2004; Watson et al., 2006; Sambamurthy & Zmud, 1999; among the others) in competing firm. BI governance is defined as 'defining and implementing an infrastructure that will support firm's goal' (Matney & Larson, 2004). The infrastructure includes the hardware, software, staffing and strategy needed to glean intelligence from data.

Effective governance (Geiger, 2006) in any BI initiatives entails controlling, directing or strongly influencing actions and includes establishing and enforcing related policies. Unfortunately, people often think of governance as a constraint. A solid governance structure actually promotes resourceful thinking within an organization. The most benefit out of effective governance is the alignment of the BI initiatives with the business priorities, collaboration of business leaders to arrive at the enterprise view and promotion of the BI accomplishments throughout the organization. It is suggested that five components of (1) executive oversight and support, (2) program direction, (3) prioritization, (4) total cost of ownership, and (5) service level agreements be included in BI governance (Geiger, 2006).

Top management support and open support by the upper level executives in terms of financial or spiritual support are vital. There is evidence to suggest that management support is positively related to the adoption and use of new technologies in organizations (Kimberly & Evanisko, 1981). In IS literature, significant positive associations have been made between top management support and implementation success (Kim, 1988). Top management support (Sanders & Courtney, 1985) has been identified as an important factor of DSS success in the finance industry. Additionally, a study in hospitals yielded the same findings that top management support is essential for IS success (Kim, 1988). The findings also discovered that the higher the level of executive, the higher the IS performance.

There is a general agreement among the researchers of the idea of having alignment between business and IT in BI governance. It is believed that successful BI deployment are initiated and driven by business rather than IT (Moss, 2005). BI steering committee should be formed in order to sponsor and govern designing, development and deployment of BI project (Sherman, 2001). It needs both the Chief Information Officer (CIO) and a business executive, such as Chief Financial Officer (CFO), Chief Operations Officer (COO), or a senior Vice President of marketing/sales to commit budget, time, and resources.

Users training and support play an important role in BI success (Fuerst & Cheney, 1982; Igbaria et al., 1989; Nelson & Cheney, 1987; Sanders & Courtney, 1985; Quaddus & Intrapairot, 2001; among many others). User training is directly related to user satisfaction (Guimares et al., 1992) and lack of training programs is a major reason for user dissatisfaction with their systems (Fuerst & Cheney, 1982). It is believed that the success of BI project lies primarily on the quality of end-user training and support (Gangadharan & Swami, 2004). Training phase requires an interactive approach, with extensive user training and adjustments to meet the user needs. This phase included the development of predefined reports and analyses for the business users, and laying the groundwork for more advanced analytic in the future. Dominant policies for successful BI were also urged: *increasing the levels of training*, and *decreasing training delays* (Quaddus & Intrapairot, 2001). Trainings should include easy-to-use brochures, providing intranet-based training, and dedicated help-desk that would maximize the training support.

BI solution must develop training requirements and a support plan (Gallagher, 2004) in order to be deemed successful. Training plans should include all level of users that differs in their tasks and responsibility about data and information needs in organizations (Avery & Watson, 2004). The plan should be based on the functional requirements of each type of users. Support documentation and training manuals must be created for distribution when training is conducted. For large rollouts involving thousands of users, a Help Desk or Support Site is a critical requirement (Gallagher, 2004).

Involvement of the top management is another important aspect of BI governance in ensuring BI success (Hwang et al., (2004). For example, in the study of decision support systems success factors in Egypt, Elbeltagi et al. (2005) found out that top management involvement were among the most influential factor in encouraging its usage. The big mistake make by CFO, the chief marketing officer or other sponsor of BI systems is their lack of involvement (Marion, 2008). It is important that top management participation and involvement be active, not merely symbolic (Ang & Teo, 1997). Simply giving the go-ahead for the BI implementation in the organization is not sufficient. Some suggested ways that top management can demonstrate its support are by providing the necessary resources and leadership, setting goals and policies for BI, and showing interest by participating in BI design and development (King, 1996). It takes frequent injections of business process and strategy savvy to guide the IT team and prevent scope or data creep. BI projects typically go way over budget when a directionless IT staff isn't given enough parameters about how much data is enough. Howard Dresner, a former Gartner analyst, said as a result, BI burns tons of cash, takes far too long and creates inordinate complexity. Warehouse need not be big; they just need to be useful.

Big companies are urged to develop a BI Competency Center (BICC) as a measure of good BI governance (Marion, 2008). A core group of experts within the company could become internal consultants to business units. The competency center approach is to help avoiding a huge number of mistakes and wasted money for BI deployments. Organizations are suggested to embark into BICC, which role is to champion the BI technologies and define standards.

2.4.2 Perceived Characteristics of the Innovation

Some of the most important contributions to the field of innovation have been the work of researchers like Rogers (1995), Rogers and Shoemaker (1971) and Rothman (1974) on innovation characteristics. Diffusion theory, particularly by Rogers' (1995) work has provided an important set of theoretical constructs in influencing adoption and diffusion (Chiasson & Lovato, 2001). These constructs are called 'perceived characteristics of an innovation', and include relative advantage, compatibility, complexity, trialability, and observability. Rogers' model includes some useful generalizations about the characteristics of innovations.

In the context of end-user computing (Schubart & Einbinder, 2000), the relative advantage of an innovation is often expressed in terms of increased profitability, time savings, or labour savings within an organization. Likewise, an innovation is less uncertain and more compatible if the adopter has previous experience with a similar technology. The more complex using an innovation appears to be, the less likely it is that an individual will adopt it. 'Ease of use', that is less complexity, seems to be a significant factor for lay-users in the decision to use a computer resource. The more the results of an innovation can be measured or demonstrated (observability), the more likely the innovation is to be adopted. Trialability helps increase knowledge about the innovation and relates to the adopter's ability to return to the pre-adoption state with minimal risk.

A recent study on data warehouse adoption indicated that two of the innovation characteristics are the key determinants - relative advantage and low complexity by (Ramamurthy et al., 2008). Key determinants of data warehouse adoption, a technology that falls into the category of an infrastructure type innovation are examined. A research model that posited the direct impact of five organizational and two innovation factors on adoption of data warehouse was proposed. The proposed model was empirically validated using data from a large-scale field survey of nearly 200 firms in both manufacturing and service sectors located in two major states in the continental United States. An analysis of the data indicated support for the proposed effects of five of the seven variables considered as being important in distinguishing adopters from non-adopters. Those five variables are:

organizational commitment, absorptive capacity, organizational size, relative advantage, and complexity. In addition, they suggested that a data warehouse success would confer "flexibility" and "responsiveness" for both current and future research.

Another study (Pankratz et al., 2002) also indicated the way targeted adopters perceive the attributes of an innovation is critical and that these perceptions account for 49-87% of the variance in whether or not they adopt. The following sections will discuss the five attributes of innovation which are used in the study.

2.4.2.1 BI's Relative Advantage

One variable that has consistently emerged as a facilitator of adoption is relative advantage, which is the degree to which an innovation is perceived as better than the one it replaces (Rogers, 1995; Berndt et al., 2003; Ramamurthy, 2008). Firms have to perceive advantages of BI before adopting them due to high-risk nature of its initiatives (Watson et al., 2002). BI can only be deployed successfully if users can perceived its full potential and these potentials are categorized into tangible and intangible benefits (Watson et al., 2004).

Literature suggests that many benefits can be derived from BI initiatives (Thomas, 2001). The importance of BI rests on many aspects and results in many organizational benefits (Agosta, 1999; Watson et al., 2004). BI provides a single version of the truth and better data analysis. BI can also shrink the information delivery time between an event's occurrence and business decision making. The data warehouse empowers users as it supports end user analytical activities (Zeng et al., 2003).

BI can offer several benefits to organizations (Watson, et al., 1999; Wixom & Watson, 2001) 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 (Goodhue & Quillard, 1988; Goodhue et al., 1992; Jain et al., 1998; Schubart & Einbinder, 2000). In a study on data warehouse benefits, it was found out that the most tangible benefits are time saving and more and better information (Watson et al., 2002). The latter includes better decisions, improved business process and support for the accomplishment of strategic business objectives.

An empirical finding of the study for 50 Finnish companies (Negash & Gray, 2003) supported the idea of most BI benefits are soft. It was found that most companies do not consider cost or time savings as primary benefit when investing in BI systems (Hannula & Pirttimaki, 2003). The hope is that a good BI system will lead to a 'big-bang' return at some time in the future.

However, BI benefits are difficult to define and measure solely because it includes intangible impacts. The benefits are always not clear as the measurement of BI is difficult to carry out although the importance of BI is clearly mentioned (Solomon, 1996). It is reported that only a few organizations have any metrics in place to measure the value of BI (Marin & Paulter, 2004).

2.4.2.2 BI's Compatibility

Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of potential adopters (Rogers, 1995, p. 250). The innovation also is judged based on its perceived consistency with "existing values, past experiences, and needs" (Rogers, 2003, p. 15) 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 (Lundblad, 2003).

A number of studies have found compatibility to be positively associated with adoption (Grover & Goslar, 1993). 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 (Schubart & Einbinder, 2000).

2.4.2.3 BI's Complexity

Complexity, which is determined by the degree to which an innovation is perceived to be difficult to understand and use, has been noted to be another important determinant of innovation adoption (Rogers, 1985). Individuals and communities also assess the ease of use and understanding required to adopt an innovation. "New ideas that are simpler to understand are adopted more rapidly than innovations that require the adopter to develop new skills and understandings" (Rogers, 2003, p. 16).

Previous studies have found complexity to be an important variable for various types of innovations (Cooper & Zmud, 1990; Damanpour, 1996; Ettlie, 1986; Tornatzky & Klein, 1982). BI tools must be easy to use, but at the same time must provide significant power and flexibility (Garza, 2007). 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.

It is reported that BI has shortcomings that made it unattractive to many companies. Business users find BI applications both difficult and time consuming to use (White, 2005). Since BI was considered complex, expensive, and time consuming, companies generally used it only on large-scale projects at the departmental level (Ortiz Jr., 2002).

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 (Marion, 2008). 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.

Information produced by BI tools is also reported not tied directly to business processes. The information is not immediately actionable and often requires further analysis by experience users. BI also often took a long time to yield analyses, making the data unsuitable for real-time usage or short-term projects (Lawton, 2006). BI products and their interfaces are also complex than most applications and they 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 about 5 percent of a company's employees.

This situation, however, is rapidly changing. BI is becoming simpler and user-friendly and users are also turning to BI for deeper analysis (Srivastava & Cooley, 2003). Web-based analysis tools and packaged analytics applications are now combined with information portal to provide self-service intelligence solutions (Frates & Sharp, 2005; Reiterer et al., 2000). These provide users with business information they need to do their job, regardless of their skill level.

2.4.2.4 BI's Triability

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). Triability is the degree to which an innovation may be experimented with on a limited basis (Rogers, 1995, p. 251). This may include trying out parts of BI systems or having opportunity to watch others using new systems. Triability is positively related to the likelihood of adoption.

2.4.2.5 BI's Observability

Observability is referred to the degree to which the results of an innovation are visible to others (Rogers, 1995, p. 251). 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 (Lundblad, 2003).

2.5 OTHER FACTORS RELATED TO BI SUCCESS

Apart from above mentioned antecedents, there are many other factors relating to BI success. The softer side of BI such as organizational culture, effective use of BI tools and business strategies are among the important antecedents of BI success mentioned in the literature. In achieving and sustaining competitive advantage, there may be some unique demands that need to be fulfilled by the competing firms. Some authors suggest a combination of three unique prerequisites of (1) skilled and capable people, (2) an organizational culture focused on learning, and (3) the use of leading-edge IT tools for effective knowledge management by the organizations (Heinrichs & Lim, 2003).

2.5.1 Organizational Culture

Organization culture refers to a system of shared meaning or common perception held by members that distinguishes the organization from the others (Frates & Sharp, 2005; Schein, 1985). As organizational culture is a based theme, it can be viewed as values as well as practices (Wibowo, 2008). The importance of organizational culture and technology is well recognized and researched (Ashburner, 1990; Goldstein & Zack, 1989; Sankar, 1988; Kanungo, 1998; Grote & Baitch, 1991; among many others). A number of researches suggest that organization culture is an important determinant of information systems success including BI (Moss, 2005; Buhler, 2003; Weir, 2004; Rao & Swarup, 2005; Chung, 2002; McGillivray & Faulkner, 2003).

It is posited that the success of information system implementation is a combination of managing organizational culture and fitting the characteristics of information supply and distribution mechanism to information requirements (Kanungo, 1998). A study of the reciprocal effects on organizational culture and a network office management system concluded that technology did not affect the change; rather technology was integrated into pre-existing culture patterns (Grote & Baitch, 1991). Furthermore, large percentage of BI applications fails not because of technology but organizational culture and infrastructure dysfunctions (Moss, 2005). Firms that instill the right organizational culture are foreseen to be successful in deploying BI initiatives.

Another important issue made by Barney (1992) was organizational culture is related to firm's superior performance. A firm's culture is one of several attributes that differentiate firms one from another (Alchian, 1950; Alchian & Demsetz, 1972). It is in these sustainable differences between firms that explanations of sustained superior financial performance must be sought (Chamberlin, 1933). It is often not easy to describe what it is about some firms that make them more successful than others. Precisely because an organization's culture is hard to describe; because the common sense of managers is taken for granted; and because even if the culture can be described, it is difficult to change; a firm's culture can hold promise for sustained superior financial performance for some firms.

Creating a culture of 'learning organization' has become an important strategic objective for many firms that hinges on the acquisition of information (Buhler, 2003). Many believe that the real challenge facing companies today is not availability of information but dealing with the quantity of information that is available (King, 1997; Himmelsbach, 2005). One manager commented: "*There's enough data. If you name the data, we've got it".* A study by Lyman and Varian (2000) found that the world produces between 635,000 and 2.12 million terabytes of unique information per year, most of which has been stored in computer hard drives or servers. This large amount of information poses a problem called information overload, where users find it difficult to sift through huge irrelevant information (Bowman et al., 1994).

Knowledge sharing culture is also reported to be critical aspect in ensuring the success of BI deployments (Weir, 2004). For BI to work, the entire organization must participate in intelligence gathering and sharing. Researchers pointed out that employees have resistance towards sharing knowledge in cultures where most people have gotten ahead by keeping knowledge to themselves (Reisenberg, 1999; Brown, 2001; King, 1997; Himmelsbach, 2005). Unfortunately, there was no organizational structure in place to facilitate the sharing of information (Himmelsbach, 2005). To change this, there is a need for top management to develop new cultural and reward systems; to recognize and reward new learning behaviors in front of the entire organization as well as to endorse, participate, and lead in knowledge sharing. Top leaders must lead the effort, becoming the change agents within the organization who leads knowledge sharing, fostering a culture of continuous learning and improvement to enable successful BI.

The stress on culture and its associated attributes such as knowledge-sharing and continuous learning suggests that culture is indeed important in ensuring knowledge acquired through BI deployment which will be used in achieving and sustaining organizations' strategic positions.

2.5.2 Utilization of BI Tools

The literature also suggests that effective utilization of BI tools is an important determinant of BI success (Moss, 2005; Buhler 2003; Weir, 2004; Rao & Swarup, 2005; Chung, 2002). BI developers are warned to be careful in choosing the number of BI tools (Dresner, 2006; Erikson, 2005). Too many tools lead to confusion and soaring training costs, while too few tools frustrate the users. It is recommended the developer to think strategically about the toolset (Dresner, 2006). It is stressed that one of the challenges for BI tools is to make the complex analytics easy-to-use for the end users, in order to achieve maximum business potential (Verdoes, 2007).

BI tool is defined as being composed of two classes (Carvalho & Ferreira, 2001; Chung et al., 2002; IDC, 2006) – (1) end-user query, reporting, and analysis, and (2) advanced analytics. The first class includes ad hoc query and multidimensional analysis tools as well as dashboards and production reporting tools, while the second class includes data mining and statistical software. BI tools also include dashboards, data mart, data mining, data warehouse, extract, transform, and load (ETL), online analysis processing (OLAP), portal, and scorecards (Kelly, 2005).

On the other hand, BI tool is also defined based on the internal and external data (Carvalho & Ferreira, 2001). The first class of tool is used to manipulate massive operational data and to extract essential business information. Examples include Decision Support Systems (DSS), Executive Information Systems (EIS), On-line Analytical Processing (OLAP), data warehouse and data mining systems. They are built from database management systems (DBMS) and are used for query and reporting, statistical analysis and to reveal trends and patterns that would otherwise be buried in their huge operational databases (Miller, 2005). BI tools now have additional functions of forecasting capability that uses mathematical formulas to manipulate historical data (Sullivan, 2005) and prediction capability (Breault et al., 2002). The second class of tools, sometimes called competitive intelligence tools, aims at systematically collecting and analyzing information from the competitive environment to assist organizational decision-making.

A comparison of twelve BI tools is made (Fuld et al., 2002) based on a five-stage intelligence cycle: (1) planning and direction, (2) published information collection, (3) source collection from human, (4) analysis, and (5) report and inform. It is concluded that BI tools should use more intelligent agents to dynamically retrieve information. Existing analysis capabilities of BI tools are still weak and these tools generally provide good reporting capabilities in textual, table or chart formats. It is revealed that BI tools have weaknesses in content collection as well as analysis and poor interface to display large amount of information (Chung et al., 2003). In general, many BI tools simply provide different views of the collected information, but not thorough analysis of information. Advanced tools such as text-mining and rule-based techniques to process information are needed. Although advanced predictive technologies is not in favor yet, but it will be soon (Robertson et al., 2007). This rapidly growing area has benefited from substantial technological improvements in recent years and covers a spectrum from robust data mining and predictive modeling to advanced data forecasting, segmentation, and optimization (Milam, 1999).

The most common business intelligence tool currently used by organizations is data mining (Heinrichs & Lim, 2003). Mining the data warehouses provides new insights into value adding business processes, customer buying patterns, fraudulent activity and product profitability (Bernstein et al., 2005). Data mining can be defined as analyzing the data in large databases to identify trends, similarities, and patterns to support managerial decision making (Zorn et al., 1999). Data mining incorporates a variety of tools and processes that can work independently or together to analyze and discover relationships in collections of data (Landry et al., 2004). Data mining then lets users search large volumes of data for patterns that can be generalized in order to improve future decisions. The road to success is not paved with gold and a one-size BI or data mining tool does not fit all firms (Heinrichs & Lim, 2003). Firms intend to achieve success must be cognizant of the caveats and must provide their knowledge workers with appropriate BI tools, business models, and training required to achieve strategic insights that ultimately translate to competitive advantage.

2.5.3 Business Strategy

The IT strategic planning literature identifies alignment of business or organizational strategy and IT strategy as a key factor in the success or failure of any IT project, BI included. This means that the chances of success in implementing BI are directly related to the way in which the implementation is articulated in terms of business strategy and of the characteristics of each industry (Reich & Benbasat, 2000). The information definition phase should be linked to corporate strategic planning since BI systems are supposed to link operational and strategic dimensions of an organization through the flow of information (Eisenhardt & Sull, 2001).

Many studies recognize the need for business strategy to be integrated with technology in the overall BI deployment framework (Choteau & Bergeron, 1999; Clemons, 1986). Business strategy as defined traditionally by Schendel and Hofer (1979) as dealing with questions of "How should a firm compete in a given business" (Dowling & McGee, 1994). This rather pithy definition contains all the necessary ingredients to develop dimensions of strategy which emphasize action in an environment (Butler & Carney, 1986).

Moreover, the relationship between information management systems and business strategy is well established. Business strategy and information strategy therefore need to be integrated. No business strategy can be complete without the inclusion of an information strategy. Since organizational strategy may work for better or worse, IS must be conceptualized and planned strategically (Earl, 1989, p. 62). IS is no longer just supporting the business strategy but also helping to determine it (Davenport, 2000, p. 20).

A study on Korean mobile telephony market (Choi et al., 2001) concluded that business strategy is composed of two types – (1) cost advantage, which seeks to attain to a lower price, and (2) differentiation advantage, which seeks to offer more valuable products. This is in-line with Porter's (1990) suggestions of three generic strategies of cost leadership, differentiation, and focus. The influence strategic framework espoused by Porter (1990) is argued, that the generic strategies do not describe all the ways companies compete in the current environment (Hax & Wilde, 1999). A new business model is proposed comprising of the triangle strategic options of 'best products', 'customer solutions', and 'system lock-in'.

Business strategy is also regarded as the outcome of decisions made to guide an organization with respect to the environment, structure and processes that influence its organizational performance (Croteau & Bergeron, 2001). There are several typologies (Ansoff & Steward, 1969; Freeman, 1974; Porter, 1980; Miles and Snow, 1978) to identify business strategy and the most popular one is by Miles and Snow (1978). This type of typology reflects a complex view of organizational and environmental processes, as well as the attributes of product, market, technology, organizational structure and management characteristics (Smith et al., 1989).

Miles and Snow's typology consists of four types of business strategy - (1) prospector, (2) analyzer, (3) defender, and (4) reactor. The first three types are expected to enhance organizational performance, while the reactor strategy is expected to impede organizational performance. An empirical study was conducted to identify various profiles of technological deployment specific to various types of business strategy that best support organizational performance (Croteau & Bergeron, 2001). Using Miles and Snow's typology to characterize business strategy, an outward technological profile contributes directly to organizational performance for the ‘analyzer’ strategic activities, while an inward profile of technological deployment contributes indirectly to organizational performance for the prospector strategic activities.

In addition to that, numerous other studies have been conducted on the relationship between business strategy and organizational performance (Miller, 1987; Venkatraman, 1989; Zahra & Covin, 1993; Parnell, 2002) and many employed Miles and Snow’s Typology (Snow & Hrebiniak, 1980; Hambrick, 1983; Conant et al., 1989; Namiki, 1989; Smith et al., 1989; Tavakolian, 1989; Thomas et al., 1991; Abernethy & Guthrie, 1994; Karimi et al., 1996) in their research. The most common observation is that the prospector, analyzer and defender strategies usually contribute to organizational performance, while the reactor strategy contributes negatively to it (Conant et al., 1989; Namiki, 1989; Snow & Hrebiniak, 1980).

Of several strategic typologies, the Miles and Snow (1978) typology is the most enduring and the most scrutinized (Hambrick, 2003; Segev, 1987). It has been under numerous tests with respect to the extent of centralization of IS services within organization. Their appeal, validity, correlation, and consistency have proved to be strong and consistent support in the information intensive industry such as hospitals, colleges, banking and life insurance (Gupta et al., 1997; Sabherwal & Chan, 2001).

However, the factors mentioned above are not empirically tested in the BI literature. These call for further empirical study to assess the factors affecting the successful deployment of BI, especially in telecommunications industry. It is argued that knowledge generated from successful BI deployment can be used to sustain competitive advantage of a firm (Golkar, 2004; Buhler, 2003; Garvin, 1993; Davis, 2001; Petrini & Pozzebon, 2009). Unfortunately, in the area of BI deployment and sustained competitive advantage, most of the research available focused on the technological and operational aspects (Chou et al., 2005; Chung et al., 2005), and there is very little research to consider the factors in the managerial and strategic levels.

Therefore, the study on antecedents of successful BI deployment that will lead to sustainable competitive advantage is utmost importance. The following section will review some of the related literature on BI and its relation with organization's sustainable competitive advantage. This will fill the empirical research gap in the literature.

2.6 BI-BASED KNOWLEDGE AND SUSTAINABLE COMPETITIVE ADVANTAGE

A number of theories are available in the literatures that deal with sustaining competitive advantage. These theories are dominated by two perspectives, both of which are grounded in economic theory (Porter, 1980, 1985). The first model is market-based model focusing on cost and differentiation, where the advantage is mainly driven by external factors such as opportunities, threats, and industry competition. Porter points out that sustainable competitive advantage is based on strategic positioning of firms within the industry and mobility barriers within an industry are the first major factor that sustains competitive advantage. Table 2.7 shows some key definitions of sustainable competitive advantage by several authors (Huang, 2008).

The second model is Resource-based Theory (RBT), which is used as an underlying theory for the study. RBT centers on the firm's resources and is driven by factors that are internal to the firm. Resources include assets, capabilities, organizational processes, firm attributes, information, and knowledge and can be classified in terms of physical, human or organizational capital (Barney, 2001). Being the most prominent theory used in strategic management, RBT links firm's competitive advantage with resources and capabilities that are firm-specific, and difficult to imitate or substitute (Chuang, 2004). Heterogeneity among firms' human and organizational resources is at the heart of the RBT of competitive advantage. The firms with resources that are different from and superior to those of competitors are at advantage. According to Barney (1991) resources must be rare, valuable as well as imperfectly mobile.

This research uses RBT (Barney, 1991) as the conceptual foundation. The decision to use RBT is grounded on the reason that there is a research gap in RBT and BI. Furthermore, many studies that link knowledge and sustainable competitive advantage have adapted RBT including Information Technology capability (Mata e t al., 1995; Santhanam & Hartono, 2003; Dehning & Stratopoulos, 2001; Griffith & Finlay, 2002; Ravichandran & Lertwongsatien, 2005; among many others), Enterprise Resource Planning (Pereira, 1999), Total Quality Management capability (Reed et al., 1999; Sullivan, 1996), and knowledge management capability (Chuang, 2004; Johannessen, 2003).

Table 2-7 Some Definitions of Sustained Competitive Advantage (Adapted from Huang, 2008)

Definition	Authors
Resources are the determinants of organizational performance (i.e., sustained competitive advantage). These resources must be rare, valuable, difficult to imitate and non-substitutable by other rare resources	Bates & Flynn, 1995
Sustained competitive advantage derives from the possession and utilization of unique, non-imitable, non-transferable, organizational specific resources	Bowen & Wiersema, 1999
Based on Barney (1991), to confer sustained competitive advantage, value, rarity, imitability, and substitutability of resources must be limited in their practical usefulness	Brush & Artz, 1999
To be a source of sustained competitive advantage, resources must be valuable, rare, and imperfectly imitable	Combs & Ketchen, 1999
Based on Barney (1991), to the extent that an organization's physical assets, infrastructure, and workforce satisfy valuable, rare, non-substitutable, and inimitable characteristics, they qualify as resources for sustained competitive advantage	Litz, 1996
Such resources as simultaneously valuable, rare, imperfectly imitable, and non-substitutable. Those organizations own these resources can earn sustained competitive advantage	Michalisin, Smith & Kline, 1997
To generate sustained competitive advantage, resources must be presently scarce, difficult to imitate, non-substitutable, and not readily obtainable	Powell, 1992
Sustained competitive advantage attributes to an organization's control over bundles of unique material, human, organizational and locational resources and skills that enable unique value-creating strategies. These resources are scarce, specialized, appropriate, valuable, rare, difficult to imitate or substitute	Rindova & Fombrun, 1999

Over the past decade, there has been a fundamental shift in the way organizations do business. The use of data as an organizational asset is one primary example (Kelley, 2005). It is no secret organizations depend on knowledge for their survival (Buhler, 2003). This is evidenced through companies now are boasting chief information officers (CIO), chief learning officers (CLO), chief knowledge officers (CKO) and more (Synnott, 1987). These new executive level positions reflect the increasing importance of knowledge in every organization.

A knowledge-based theory view of a firm posits that the main role of a firm is to create and apply the knowledge which will lead to sustainable competitive advantage (Grant, 1996). Knowledge in this case is defined broader in scope than information, weaving the fact with ideas and understanding with action. Knowledge which is formalized and codified is called 'explicit knowledge' and is often equated with the information processing view. This knowledge is captured in tangible records, documentation, rules, databases etc.

Recent advances in ICT such as BI offer fast, inexpensive ways to capture, apply, and disseminate explicit knowledge. As a foundation for building smart enterprise, BI has become the key to competing in the customer economy (Golkar, 2004). BI also can be a source of an organization's competitive advantage (Buhler, 2003; Garvin, 1993) by carefully acquiring, diffusing and utilizing information; organizations can build a learning organization and make necessary adaptations to remain strategically competitive.

BI has grown in importance, as organizations increasingly perceive the value of their intellectual capital and the potential profits of unlocking this capital (Simmers, 2004). This intellectual capital comes in the form of processes, solutions, expertise, heuristics of individuals and group within the organization. These have value in solving problems, identifying opportunities and threats, and improving organizational effectiveness harvested from the data provided by BI. The organization's ability to generate collective knowledge is a function of how it combines its infrastructure, culture, and processes with its explicit knowledge base.

The concept of BI in gaining competitive advantage has received a substantial support (Davis, 2001). It is noted that Japanese is the BI masters and insisted on BI as an innovation and a legitimate business function (Nonaka & Takeuchi, 1995). It is a common believe now that BI is especially valuable in gaining information about competitive environment especially in competitors, new technology, public policy and market forces and useful for predicting the future environment in which a company will operate (Thomas Jr., 2001). BI is also advocated as an effective tool for coping with and understanding competition (The Montague Institute Review, 2001). There some suggestion in embedding BI for the entire strategic planning process (Weiss, 1999).

Given the manifold deployments and clear potential of BI, it would be natural to assume that organizations would be clamoring to adopt and implement BI systems. It is argued that BI is among the prime technologies and tools that support for knowledge creation in organizations. Therefore, with that background and extending the traditional notion of organizational resource-based capability to firm's BI function, a firm's BI capability is defined as its ability to mobilize and deploy BI-based resources in combination with other resources and capabilities in order to sustain firm's competitive position.

It is posited that the key strategy for creating competitive advantage lies in understanding the data that will shape the networked marketplace (Gangadharan & Swami, 2004). Suggestions on finding ways of bringing together and making sense of the vast amounts of data flowing within and across the extended enterprise is becoming a key business success factor. It is viewed that BI will allow the path to business insight by following the process of integration of data from disparate internal and external data sources, applying analysis tools and techniques to understand the information within the data, making decisions, and taking actions based on this gained insight.

2.6.1 Sustainable Competitive Advantage and Corporate Social Responsibility

The concepts of sustainability and social responsibility are becoming the new phenomenon in today's environmental-friendly era. These concepts are important aspects of business strategy and an increasing number of firms are trying to determine and monitor the social and environmental impacts of their operations (Zadek, 2005).

The corporate social responsibility (CSR) field started way back in 1953 by one of the work of Bowen. CSR is defined as a comprehensive set of policies, practices and programs that are integrated into business operations, supply chains, and decision-making processes throughout a company, with the aim of inculcating responsibility for current and past actions as well as future impacts (Petrini & Pozzebon, 2009). The predominant interpretation of sustainable development was introduced by the Brundtland Commission's report in 1987 (BSR, 2008) - meeting the needs of the present without compromising the ability of future generations to meet their own needs. A strategy for corporate sustainability must meet the needs of the firm's stakeholders without compromising its ability to meet the needs of future stakeholders as well (Hockerts, 2001).

CSR is summarized into three selected groups of work that characterize important moments in the conceptual evolution of CSR and sustainability concepts from a management point of view (Elkington, 1998). A proposed the triple bottom-line concept, allowing organizations to interpret sustainability through the integration of the three primary dimensions of economic, environmental and social. The first point that can be made relates to the way in which environmental and social sustainability can contribute to economic sustainability itself. It allows companies to follow stakeholder strategies towards environmental or social sustainability goals. Secondly, a 'green case' examines how economic and social sustainability contributes to environmental quality. Finally, the ''social case" examines how economic and environmental sustainability can contribute to increasing social justice and equity (Dyllick & Hockerts, 2002).

A recent study explored how management of sustainability in organizations can be supported by BI systems (Petrini & Pozzebon, 2009). It is posited that BI has an important role to play in helping organizations implement and monitor sustainable practices. Particular attention to one phase of any BI project, the information planning phase, i.e., the systematic way of defining relevant information in order to integrate it in reporting activities. The study proposed a conceptual model that seeks to support the process of integration of socio-environmental indicators into organizational strategy for sustainability.

Researchers have viewed CSR, sustainability and BI separately and these themes have curiously been considered in conjunction. The purposive of BI tools and methods can improve the definition, gathering, analysis and dissemination of socio-eco-environmental information among employees, clients, suppliers, partners and community (Petrini & Pozzebon, 2009). The issue of how BI-based information be used in sustaining organizations in terms of the prominent aspects of economics, social and environment is considered in this study.

The following section discusses the background theories/materials used in the current research, which centered on the above themes.

2.7 REVIEW OF UNDERLYING THEORIES

Because BI is widely deployed in organizations and its lack of discipline related to either strategy or competition, some organization management theories that have substantially influenced IS research were borrowed. That is, considering firm's resources and innovation's perception, review of two major organizational perspectives: Resource-Based theory (RBT) and Diffusion of Innovation (DOI) theory are presented as the basis for research framework. The following sections elaborate the two underlying theoretical foundations on which this research is based. Although not exhaustive, it provides useful insights into the successful deployment of BI for sustainable competitive advantage and the perception of innovation, in this case BI systems.

2.7.1 Resource-Based Theory (RBT)

The field of strategic management focuses on understanding sources of sustained competitive advantages of the organizations (Barney, 2001; Priem & Butler, 2001; Pereira, 1999; Mata et al., 1995). A variety of factors have been shown to have an important effect on the ability of organizations to acquire sustained competitive advantage, including the relative capability development of a firm (Johannessen & Olsen, 2003) and a firm's ability to differentiate its products (Johannessen & Olsen, 2003; Teece et al., 1997).

Resource-based theory (Wernerfelt, 1984; Barney, 1991; Grant, 1991; Peteraf, 1993; Mata et al., 1995; Bharadwaj, 2000; among many others), also sometimes referred to as the 'resource based view of the firm' (Barney, 2001; Rungtusanatham et al., 2003), describes, explains, and predicts how firms can achieve a sustainable competitive advantage through acquisition of and control over resources. Such resources and capabilities are linked to competitive advantage when they are a source of abnormal profits (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993). These resources can include both tangible (e.g. equipment) and intangible (e.g. information or process knowledge) assets. Indeed, RBT places a great deal of attention on intangible assets that may be more firm specific such as knowledge and learning and have the potential to be more significant profit generators than purchasable resources.

Knowledge-related resources have been described for its possible role in creating sustained competitive advantages for organizations (Grant, 1996; Johannessen & Olsen, 2003; Lado & Wilson, 1994; Chuang, 2004; Barratt & Oke, 2007; Bharadwaj, 2000; just to name a few). Recent researches in the knowledge-related area have been linked to RBT and its extension of knowledge-based view (Hislop et al., 2000). It is suggested that this area has become the focal point for debates on mechanisms to facilitate firms acquiring greater competitive advantage (Clarke & Turner, 2004). In these debates, a firm's competitive advantage is considered to result from its unique knowledge and how it manages the knowledge (Huang, 2008; Levitin & Redman, 1998; Mata et al., 1995; Joglar & Chaparro, 2007). Thus, in examining the role of knowledge acquired through successful BI deployment in Malaysian telecommunication industry, this study predominantly adopts the perspectives that BI-based knowledge is viewed as the resources for organizations to sustain their competitive advantage.

RBT (Penrose, 1959) that considers organizations' internal factors as the primary sources of corporate profitability has contributed to strategic management fields since the 1960s (Barney, 1991; Hwang, 2008). In contrast to industrial organization theory that focuses on how organizations use their abilities to identify external threats and opportunities (Porter, 1985, 1996, 1998), RBT emphasizes how competitive advantage is achieved and how that advantage can be sustained over time (Peteraf, 1993; Wernerfelt, 1984; Carmeli, 2001).

RBT widely acknowledges that firm's unique resources and capabilities are important for achieving sustained competitive advantage. The theory gives emphasis on available resources including assets, skills, abilities and knowledge that are internal and developed within the firm – not those acquired externally (Barney, 2001). It is suggested that resources are inputs in to firm's production process and a firm's resources are classified by Michalisin et al. (1997) as either tangible or intangible resources (Barney, 1991). The tangible resources typically refer to the property-based resources, whereas the intangible resources refer to the knowledge-based resources, the ways in which firms combine and transform these tangible resources.

Building on the RBT, a knowledge-based perspective of the organizations has emerged in the management literature in 1990s (Huang, 2008; Nonaka & Takeuchi, 1995; Spender, 1996; Santhanam & Hartono, 2003). The knowledge-based perspective suggests the services rendered by tangible resources depend on how they are combined and applied, which is a function of the firm's know-how, which is the knowledge.

In a recent study that used RBT (Ravichandran & Lertwongsatien, 2005) posits that intangible IS resources and capabilities are critical determinants of IS successful deployment that have direct effect on firm's performance (Kim et al., 2006). Specific knowledge acquired through appropriate deployments of knowledge-based systems are considered to be the resources to generate long-term sustainable competitive advantages. Caldeira & Ward (2003) views RBT as treating enterprises as potential creators of value-added capabilities. These involve viewing the assets and resources of the firm from a knowledge-based perspective (Winter, 1988; Prahalad & Hamel, 1990).

Several authors have discussed five characteristics of a resource that would offer firms a sustainable competitive advantage (Barney, 1991; Peteraf, 1993; Rungtusanatham et al., 2003; Barratt & Oke, 2007). These characteristics are (1) resources should be valuable in that they improve the efficiency or effectiveness of a firm, (2) the resources must be rare in that by exercising control over it, the firm can exploit it to the disadvantage of its competitors, (3) the resource must be imperfectly imitable to prevent competitors from being able to easily develop the resource in-house, (4) the resource must be imperfectly mobile to discourage the ex-post competition for the resource that would offset the advantages of maintaining control of the resource, (5) the resource must not be easily substitutable; otherwise, competitors would be able to identify different, but strategically equivalent resources to be used for the same purpose. If organizational knowledge, one important element of a firm's strategic resources, fulfills these characteristics, the company is able to obtain a sustainable competitive advantage (Barney, 1991). A VRIO analysis framework is developed based on the series of four questions as presented in Table 2-8.

Table 2-8 Framework of VRIO Analysis

VRIO Analysis	Main Questions
The Question of Value	Do firm's resources and capabilities enable the firm to respond to environment threats or opportunities?
The questions of Rareness?	How many competing firms already posses particular valuable resources and capabilities?
The questions of Inimitability	Do firms without a resource or capability face a cost disadvantage in obtaining it compared to firms that already possess it?
The questions of Organization?	Is a firm organized to exploit the full competitive potential of its resources and capabilities?

The role of knowledge in organization can be investigated via answering the four questions above. Firstly, knowledge and its effective management can result in improved products, processes, or services, and thus enable organizations to remain competitive and viable. Secondly, organizational knowledge is the sum of employees' know-how, know-what and know-why (Bollinger & Smith 2001). Such knowledge is composed of the knowledge and experiences of current and previous employees, as well as the specific organization. The policies and methods used in different organizations would also be unique. Thirdly, the individual in the organizations contribute knowledge based on their personal interpretations of information. Group interpretations of knowledge depend on the synergy of the total members of the group. Besides, organizational knowledge and its approaches to leverage the knowledge are built of the inimitable past history of the organization's own experiences and accumulated expertise (Bollinger & Smith, 2001). Accordingly, it is uncommon that two groups or organization will think or function in identical ways. Lastly, knowledge is carried through organization systems, routines, policies, documents and employees (Grant, 1996; Spender, 1996). Hoards information or knowledge is of little value. Organizations should actively acquire, integrate and use both individual and organizational knowledge to create and sustain competitive advantage (Alavi & Leidner, 1999). Therefore, the specific knowledge and the appropriate management of it are considered to be the resources of an organization to generate long-term sustainable competitive advantages.

Current knowledge management studies have been linked to the RBT and its extension, knowledge-based view (Clarke & Turner, 2004). It is suggested that knowledge management has become the focal point for debates on mechanisms to facilitate firms acquiring greater competitive edge in the emerging global information economy (Clarke & Turner, 2004). In these debates, a firm's competitive advantage is considered to result from its unique knowledge and how it manages the knowledge (Carlsson, 2001; Clarke & Turner, 2004). Thus, in examining the role of BI in telecommunications industry in Malaysia, this study predominantly adopts the perspectives that knowledge and BI-related resources are viewed as the resources for the organizations to increase their competency in the extremely competitive environments.

RBT focuses mostly on the firm's resources, their implications for performance, as well as their relationship with environment threats and opportunities (Wernerfelt 1984). Barney suggests that resources are input in to a firm's production processes and a firm's resources are classified by Michalisin, Smith and Kline (1997) as either tangible or intangible. The tangible resources typically refer to the property-based resources, whereas the intangible resources refer to the knowledge-based resources, the ways in which firms combine and transform these tangible resources (Michalisin, Smith & Kline, 1997). Building on the RBT, a knowledge-based perspective of the organizations has emerged in the management literature in 1990s (Cole, 1998; Nonaka & Takeuchi, 1995; Spender, 1996). The knowledge-based perspective suggests that the services rendered by tangible resources depend on how they are combined and applied, which is a function of the firm's know-how, in this case knowledge.

2.7.2 Diffusion of Innovation (DOI) Theory

This study adopts Diffusion of Innovation (DOI) theory (Rogers, 1995) as a theoretical basis firstly because it is a well established theory and is widely used in information technology diffusion-related research (Prescott & Conger, 1995; Mustonen-Ollila & Lyytinen, 2003; Wainwright & Waring, 2003). 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 (Grant, 1996; Chen, 2007).

An innovation is viewed as an idea, practice, or object that perceived as new by an individual or other unit of adoption (Rogers, 1995). It is argued that innovation adoption is a process of uncertainty reduction and information gatherings. Information about the existence of innovation and its characteristics is gathered and the potential users engage in information-seeking behaviors to learn about the expected consequences of employing the innovation. The assessment and evaluation about this innovation determines users' behavior towards it. This information process leads to the formation of perceptions about the innovation. In line with perceptions, a decision to adopt or reject the innovation is made. This theory posits that perceived newness of an idea determines the individual's reaction to the innovations. 'Newness' of an innovation can be expressed in terms of knowledge, persuasion, or a decision to adopt or reject the innovation (Roger, 1995; Huang, 2008). Rogers (1995) suggests that individual's rate of adoption will be primarily affected by five perceived attributes or characteristics of innovation: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability and Table 2-9 details out the description of these five characteristics.

Relative advantage is described as the benefits of an innovation or existing ways of doing things, and use compatibility to measure how compatible an innovation is with existing culture, structure, infrastructure and previously adopted ideas (Taylor & Todd, 1995). Complexity is used to explain how difficult an innovation is to understand, learn, and use and triability is referred by them as how easy of an innovation is to try out or test (Taylor & Todd, 1995). Observability characteristic reflects how easy the outcomes of an innovation can be observed. Rogers (1995) posits the choices to adopt or reject an innovation can be made by a selected group or individual with some sort of authority in the organizations.

Table 2-9 The Perceived Characteristics of Innovation

Characteristics	Descriptions	Reference
Relative advantage	The degree to which an innovation is perceived as better than it supersedes	Kwon et al., 1987; Lee & Kozar, 2008; Chin et al., 1995; Prescott & Conger, 1995; Premkumar & Potter, 1995; Rogers, 1995
Compatibility	The degree to which an innovation is perceived as being consistent with existing values, past experiences, and needs of potential adopters	Kwon et al., 1987; Lee & Kozar, 2008; Chin et al., 1995; Prescott & Conger, 1995; Rogers, 1995
Complexity	The degree to which an innovation is perceived as difficult to understand and use	Kwon et al., 1987; Lee & Kozar, 2008; Chin et al., 1995; Rogers, 1995
Triability	The degree to which an innovation mat be experimented with on a limited basis	Lee & Kozar, 2008; Rogers, 1995
Observability	The degree to which the results of an innovation are visible to others	Lee & Kozar, 2008; Rogers, 1995

Researchers claim that relative advantage characteristic is similar to perceived usefulness in the technology acceptance model (TAM) and complexity is comparable to the perceived ease of use (Moore & Benbasat, 1991). Other characteristics of innovations have been identified including compatibility, result demonstrability, visibility, image and triability and empirically demonstrated to have effect on the behavior of adoption. The result of an empirical study indicates that the innovation characteristics, relative advantage, ease of use, compatibility, triability, visibility, result demonstrability and image, have impact on initial and future use (Agarwal & Prasad, 1997).

Numerous researchers in various areas (Quaddus, 1995; Rao et al., 1998; Xu, 2003; Huang, 2008) have used innovation's perceptions theory and the literature within this field which spans several applications. Examples are the innovations of new IT technology (Carter et al., 2001; Huff & Munro, 1985), intelligent telephone (Manross & Rise, 1986), telecommunications technologies (Grover & Goslar, 1993), electronic data interchange

(McGowan & Madey, 1998), internet (Rao et al., 1998; Wolcott et al., 2001), electric commerce (Kendall et al., 2001), knowledge management (Xu & Quaddus, 2005), among many others.

However, there is a genuine lack of literature on the deployment/adoption of BI, particularly in the telecommunication industry. In this study, BI is seen as an innovation for the executives in Malaysian telecommunication 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 gives 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.

It must also be noted that most of the above mentioned studies were carried out in developed countries in which capital markets were functioning more efficiently than those of developing countries. This attempted a study that will explore the factors that would affect the successful BI deployment and the utilizations among executives in the developing countries namely Malaysia.

2.8 THE MALAYSIAN TELECOMMUNICATIONS INDUSTRY

The telecommunications industry in Malaysia has entered a very competitive environment for the past few decades. Since the Malaysian government has established a vision to become a developed nation by year 2020, the deregulation of telecommunications services has been focused as one of the top priorities. One of the most significant moves made by the government in order to achieve this vision was to end monopoly over telecommunications services since 1992 (Mazlan, 2005). The expansion and development of telecommunication services are important for the growth of the industrial and services sectors. To modernize and to increase telecommunications service growth rate, a competitive element was introduced by the government in stages. The first step involved the incorporation of Telekom Malaysia in 1987 as a government-owned company. Later, new companies were licensed to provide certain services such as mobile cellular telephones, pagers, trunked radio, two-way radio systems and other value-added services (The National Telecommunication Policy of Malaysia (NTP), 1994).

It is believed that the growth in Malaysia's telecommunications sector will be powered by greater consumer interest in high-speed broadband Internet (Mohamad, 2004). The government has played its part in this development through its National Broadband Plan. Malaysia's regulator will also play an integral role in supporting this growth through its award of a number of Wimax licenses in 2007. Consumer interest, government support and regulator encouragement all pulling together has led to the industry's rapid growth. An annual average of 130% growth over the next five years is forecasted in the number of broadband subscribers in Malaysia with over 7 million customers by the end of 2011 (Chong et al., 2007).

Meanwhile, fixed-line penetration should fall to below 15% by the end of the decade, resulting in a 7% decline in the number of fixed lines in service over the next five years. The operator's fixed-line and data revenues contributed just 41% of the operator's total consolidated revenue in September 2006, a sharp fall from 51% just 12 months earlier. At the same time, Telekom Malaysia was able to boast a 74% y-o-y growth in broadband subscribers to 732,000. Interestingly, the operator's domestic mobile revenues were static, whilst revenues from its foreign operations now represent a quarter of the company's total revenue, up from just 10.5% in September 2005. In particular, Telekom Malaysia has found success in Indonesia and Bangladesh.

2.8.1 Competition within Telecommunications Industry in Malaysia

Rapid development of the internet and information technology has pushed telecommunications organizations into the era of a new competitive business environment. The increasing globalization of businesses, leaner organizations, products and services convergence and vast development of technologies (Davenport and Prusak, 1998) implied that a more efficient and effective operation of the telecommunication organization's knowledge assets has become more important than ever before. Hence, Malaysian telecommunications organizations need to play a proactive role in leading and transforming the Malaysian economy into a knowledge-based economy (Chong et al., 2006). As such, telecommunications organizations are beginning to understand and appreciate knowledge as the most valued asset in the emerging competitive environment (Syed-Ikhsan & Rowland, 2004).

Specifically, the telecommunications industry in Malaysia is experiencing rapid growth in the recent years, particularly with the introduction of the latest services and equipment. Malaysia's telecommunications industry is expected to reach US$ 6.7 billion (RM 22.85 billion) in year 2010, a growth of 4.4 per cent over 2009 (International Data Corporations, 2010). Some of the key factors leading to its growth include expected growth from the wireless markets, especially in wireless voice and wireless data, accelerated migration towards mobile services, strong emerging trend of mobile broadband services and higher penetration of smart-phone devices.

The integration between the telecommunications and computer industries also resulted in the rapid growth of sophisticated technology, which ushers in a new information technology-based century. The use of broadband service, for example, was 0.85 per cent in 2004 but its usage was predicted to increase to 10 per cent by 2008 (Lim, 2004). The mobile market has been more spectacular, reaching 20 million subscribers in 2006 from merely 3 million subscribers in 1999 and this figure is growing continuously at an annual rate of about 25 per cent. The number of Internet subscribers in Malaysia is expected to reach the 10 million mark in the next five years. The Malaysian government has developed policies to channel the telecommunications industry to foster the creation of an information rich and intelligent nation via supreme telecommunication facilities and networks. The telecommunication industry is thus considered to be prominent due to its contribution as a tool of technological support for the national development in line with the development of k-economy in Malaysia (Yusuf, 1998).

Development of the public telecommunications network is not only confined to the urban areas. Efforts to expand public telecommunications network to the rural areas are actively carried out. The total number of rural telephones in 1990 was 190,000 and this is expected to increase to 351,000 in 1995, an 11.5% growth. The rural telephone line penetration rate is expected to increase from 1.8 telephones for every 100 persons in 1990 to 3.1 telephones for every 100 persons in 1995. The Malaysian government will continue to emphasize efforts to upgrade rural telecommunications facilities. The main aim of the National Telecommunications Policy (NTP) with regard to the rural sector is to provide telecommunications facilities to every household by 2020. Besides the main provider, which now is required to supply telecommunications services to the rural areas, all telecommunications providers are expected to contribute towards this end.

Malaysia remains a competitive telecommunications market, with Telekom Malaysia coming under more pressure from alternative providers in the fixed-line and broadband markets. The domestic mobile market remains competitive, and this will only intensify with the introduction of mobile number portability (MNP), providing more good news for the consumer. Being one of the forefront country in the South East Asia region for the high-tech consumption, Malaysia took a giant leap with unprecedented trade volume surpassing RM 1.069 trillion (US$ 1 = RM 3.5, US$ 305 billion) for 2006. Mobile entertainment, 3G, Next Generation Networks (NGN), Instant Messaging (IM), Voice-over IP (VOIP), Wimax, and Wireless Local Loop (WLL), IP VPN services, interactive TV and radio are some of the best prospects for Malaysia. All this bodes well for the exporters in the telecommunications and broadcasting industries as Malaysian is a net exporter of technology.

The competition for customers among telecommunications services providers in Malaysia is very stiff. In this highly competitive marketing environment, the existing customers as well as potential customers are heavily exposed to various advertising messages from the competing firms through all sorts of media communication. The existing customers of a service provider are encouraged to switch their service to the competing firm by offering certain incentives. Among the incentives offered to the switchers are switching benefits, price reduction, flexible service, and attractive package. Certainly, there are service providers which would feel threatened that their customer base could be affected by the persuasive offer. These firms, in turn, would design their own loyalty programs in order to retain their customer base at bay, and at the same time would launch their own switching incentives to attract customers of other service providers into their service. In the end, customers are being exposed to various offers and counter offers from these competing service providers.

Many of the players in Malaysia's telecommunications sector were seriously affected by the economic crisis of the late 1990s. Despite this, there has been strong growth in the sector over the last decade. Fixed-line services jumped from around 2 million in 1990 to about 4.7 million (penetration of 20 percent) in 2002, but there has been virtually no growth since. The mobile market has been more spectacular, jumping from 3 million subscribers in 1999 to reach around 28 million by end-2008.

2.8.2 Telecommunications Players

Presently, there are five telecommunications services operators to serve the 26 million populations (Department of Statistics, Malaysia, 2009). From being a monopoly of the government, telecommunications services are now being provided by a number of government-linked privatized firms, private firms and a foreign firm with Malaysian partners. These firms are competing for market shares of 4.60 million fixed telephone services, 11.43 million services and 2.89 million dial-up internet customers (Malaysian Communication & Multimedia Commission, 2008). The Communications and Multimedia Act 1998 set up the new regulatory agency, which is the Malaysian Communication and Multimedia Commission (MCMC) and provided the broad frameworks as to how the sector would be promoted, regulated and developed.

To achieve the aspiration and realize the vision of making Malaysia a developed nation, and to survive in this highly competitive and challenging business environment, telecommunications companies have to be competitive, dynamic and robust. With the advancement made in the telecommunications technology and with the formation of various forms of business coalitions between local companies and other world-class companies, the challenge of the business survival among these companies are inevitable. Thus, the competing companies have to optimize the utilization of their resources, especially knowledge-related resources.

Dr Mahathir Mohamad, the former Prime Minister of Malaysia in his keynotes speaker address during Global Knowledge II conference in 2000, stressed that through k-economy, where knowledge content and knowledge contribution will see a quantum leap in every area, the Malaysian economy and Malaysian's society will not be quite the same again (Mohamad, 2000).

"Vision 2020 emphasizes that in the information age which we have entered – our society must be information rich. There was a time when land was the most fundamental basis for prosperity and wealth, then came the second wave, the age of industrialization. Now, increasingly knowledge will not only be the basis of power but also prosperity……"

----- Dr Mahathir Mohamad (2000),

Malaysia's developed nation, as outlined in Vision 2020 by Dr. Mahathir Mohamad, is to become a fully developed nation with a 'value-based society'. The National IT Agenda (NITA) interprets this, as the roles of information and knowledge are important to leapfrog the developmental stage from industrial economy to the k-economy. Companies need to leverage on knowledge economy, where intellectual capital becomes a primary factor of growth. Thus, in order to achieve the nation's vision and for their competitiveness, telecommunications companies have to develop and put together the use of their resource-based assets.

In this 'new economy' or 'knowledge economy' one principally driven by information and knowledge, the true value of these companies can only be achieved by developing their internal resources. This is the critical aspect of their present and future value – no longer confined to the managing of networks, systems and physical assets. Indeed, the companies could leverage the knowledge and capabilities they possess and decide how and where to apply them.

In the case of Malaysia, the country realizes that it cannot afford to ignore k-economy in order to achieve sustainable economic growth and to remain globally competitive. Malaysia thus started to lay the foundation for the k-economy in the mid-1990s with the launching of the Multimedia Super Corridor, which offers an excellent and conducive information and communications technology (ICT) environment to spearhead the development of a k-economy nation (Chong et al., 2006). Continuous efforts have been undertaken to enhance several key areas to support the transformation towards the k-economy, including human resource development, science and technology, research and development, infrastructure, incentives and financing. The move towards k-economy is in fact part of Malaysia's wider plan to become a fully developed and knowledge-rich nation by the year 2020.

The telecommunications industry in Malaysia has grown steadily since the past decade. At present, it is probably one of the most active markets in the region of Southeast Asia. The fixed telephone penetration rate in Malaysia increased rapidly, and in 1997 there were about 4,236,347 residential and business subscribers in a country with a population of about 21 million. This makes the overall penetration rate about 20 telephone lines per 100 people. The infrastructure with a capacity of 7,306,000 access lines is offering various types of services such as voice, data leased circuits, message and text services (e.g., telegram, facsimile, etc.), Internet, and so on.

2.9 TELECOMMUNICATIONS INDUSTRY AND SUSTAINABLE COMPETITIVE ADVANTAGE

The Malaysian government's main approach is to encourage a healthy and orderly competition within the telecommunication industry. The industry has been opened to competition where basic infrastructure and telecommunications services are operated by private enterprises. The main objective of the telecommunications sector is to encourage competition in the telecommunications sector in order to achieve efficiency and to provide excellent and quality service. This is in addition to the provision of services that will satisfy all users and people, in line with the National Privatization Policy (NPP).

Encouraging competitiveness in the telecommunications sector will be carried out in stages. It will start with value-added services followed by the provision of infrastructure and other services. Competition in this sector will take into account the existence of similar facilities that are not profitable and problems resulting from different technologies. However, competition will not only be encouraged between systems (technology) but also among providers using the same system. This element of competitiveness is encouraged at the domestic and international levels by taking into account the nation's commitment in international agreements such as GATT and others.

Domestically competition in the telecommunications sector is implemented by taking into account the development of a new system/infrastructure that emerges from time to time in keeping with the rise in demand. Even though on the Whole the NTP encourages competition, it does not necessarily mean creating separate systems. Even though competition is encouraged, the Government is empowered to determine the number of competitors that are economically viable for certain telecommunications system and services. The NTP will provide a healthy environment and equal opportunities to all competitors.

2.9.1 Telecommunications Industry and Corporate Social Responsibility

The telecommunication companies now are taking social responsibility seriously and are committed to achieving the highest standards on social, environmental and ethical issues. British Telecommunications Company was named the company of the year in the second annual Business in the Community awards for excellence in corporate community investment (Alan, 1999). The awards are concerned with quality of its program, which recognizes excellence in companies that make social responsibility an integral part of their businesses. The company devotes a minimum of 0.5 percent of UK pre-tax profits to the community and aims to be as business-like in its social activities as its commercial ones because they feel 'the communities of which they are part deserve nothing less'.

Telekom Austria also has been active in the sustainable investment field since 1993 and its analyses and assessments have gained an outstanding reputation amongst experts (M2, 2002). The company was one of 38 of the world's major telecommunications companies examined within the framework of a corporate responsibility rating recently conducted by Oekom Research. The rating covers social, cultural and environment activities, encompassing corporate policy in social and ethical issues, staff relations, relations with external stakeholders as well as environmental management.

Vodafone is a company which recognizes that youth will determine the future shape of the communications industry (M2, 2003). The company is reported to be giving youth the Youth Education Scheme (YES) scholarship fund to further their educations. To them youth have the drive, energy and ideas the industry needs, but they can't live up to this potential without the necessary education and experience. The YES scholarship funds are a good investment in the future of the industry.

2.9.2 Telecommunications Industry and Business Intelligence

Telecommunications companies worldwide are exploring BI solutions to survive and maintain their competitiveness in this era of k-economy (Marr, 2003). It has been documented that a lack of understanding of managing knowledge, including a narrow focus on it and its relations to performance outcomes (Marr, 2003) has resulted in many organizations making less investment or do not invest at all in its initiatives (Chong et al., 2006).

However, sales of BI software were expected to almost double to US$ 21.2 million (RM 70.81 million) in Malaysia within the next four years (International Data Corporation, 2008). The Malaysian BI software market worth US$ 10.8 million in 2007 was estimated to grow to US$ 12.3 million in 2008. The growth is mainly driven by regulatory and corporate governance requirements as well as increased competition landscape. This is due to the maturing IT infrastructure, steady levels of applications development and the increasing availability of affordable BI offerings.

A Malaysian multi-national company was reported having deployed BI solutions to better understand its 6.9 million subscribers (Kumar, 2009). This is to support analytical BI for customer analysis, where the new BI platform enables extensive analysis of data pertaining to customer call detail records and customer communications management. This will support their company's initiatives to provide more complete and effective services to its customers. Having the best and quick answers to any business question, any time, is a priceless economic advantage to companies that know how to create and leverage analytical intelligence. The company is taking a significant step forward in consolidating its data infrastructure to better compete on analytics and get quick, precise answers to complex business questions.

The key solutions for which telecommunications companies are looking involve marketing, such as customer retention, target marketing, and campaign management, customer-relationship management, and network business intelligence, to streamline network assets. Moving forward, additional systems are needed with capabilities to deliver best-of-breed BI and business management. These capabilities enable companies to accomplish the following:

- Understand the needs of their business (BI)
- Manage actions based on those needs (business management)
- Effectively run day-to-day operations (business operations)

These capabilities will enable companies to realize the opportunity of a business landscape characterized by customer relationships, customized product delivery, and opportunity-driven profit. One of the key enabling technologies to this evolution is the data warehouse. BI applications such as OLAP and data mining tools would benefit the cellular phone industry. Examples of BI application specific to telecommunication industry include traffic analysis; fraud detection and customer loyalty (churn) analysis, which require analyzing large volumes of call details (Chen et al., 2000). These applications are detailed in Table 2-10.

Table 2-10 Telecommunications BI Applications (Adapted from Pareek, 2007)

Application	Usage	Example
Fraud Management	Fraud detection tool that helps management stop crime and operate efficiently. Drilling down into customer and employee contact records, it delivers insight that can reveal possible fraudulent activity, as well as identifies operational problems that can be fixed	• Fraud analysis • Corrective action and notification • Product affinity/ • Bundling • Pricing models • Discounting • Call volumes • Call times • Response times • Complaint logs • Employee productivity Capacity forecasting
Financial Analysis	This vital BI tool enables telecommunications carriers to take the financial pulse of their business whenever needed. Examination of financial performance metrics from across the enterprise arms financial managers with intelligence to make the most profitable business decisions possible. Financial insight ultimately improves gross margins and bottom line performance	• Revenue reporting • P&L reporting • Cost analysis • Margin analysis • Tariffs • Taxes

Marketing Analysis	This analytical tool makes effective category management of telecommunications services possible by providing analytics across a wide range of marketing, planning, pricing, operations, and network variables, helping management determine what promotions and service plans are most effective for specific customer profiles	• Up-sell analysis • Loyalty programs • Customer segmentation • Demographic analysis • Cross-sell analysis • Service history • Channel efficiency • Next to buy • Promo lift • Price points • Market share
Network Optimization	Growing and maintaining profit margins requires optimum network efficiency. Powerful analytics tool that allows carriers to compare a wide range of metrics cross network operations, and create real-time reports that identify problems for immediate attention. Alerts can also be created for instant notification of emergency situations requiring rapid response	• Traffic analysis • Network planning • Quality of service • Network utilization • Switch operations • Call routing • Capacity • Switch utilization • Volume management • Failure notification • Capacity analysis
Sales Analysis and Billing	A vital tool to gain effective insight from the terabytes of data associated with selling and billing for residential, business, bundled, and unbundled services. Leverage data analysis into competitive advantage by revealing more profitable sales opportunities and the path to more efficient back-office operations	• Product sales and trends • Customer trends • Sales force performance • Commission reporting • Product affinity • Account balances • Utilization • Fraud • Telemarketing • EBPP/intelligent billing • Quota attainment
Customer Care and Analytical CRM	Fierce competition for customers across the telecommunications landscape demands advanced customer care efforts. This BI application enables Telco to segment customers by demographic, service plans, billing, and other criteria, delivering insight where it is needed, enabling managers to develop effective strategies that win and retain profitable customers while weeding out unprofitable ones	• Customer scorecards • Churn analysis • Customer profitability • Customer plan migration • Service level agreement • Trouble ticket • Service complaints • Customer inquiry • Dispatch request • Service call monitoring • Preferences and permissions

According to Pareek (2007) a telecommunications company can use various BI tools for strategic as well as operational decision making. Various analyses can be carried out to suit its unique requirements and position within the industry. Among the applications that play important roles in telecommunications companies' success are strategic decision support, scoring and segmentation, campaign assignment and management, traffic analysis, customer relationship analysis, corporate performance monitoring, and, last but not least, financial analysis. Other than these central application areas, other areas key to telecommunications companies' strategy are risk analysis, fraud detection (or revenue assurance), and platform convergence.

Some of the typical strategic decision support capabilities in the telecommunications industry include the following (Pareek, 2007):

- Develop simple reporting capabilities that allow one to measure and trend key performance metrics including
    - Install and disconnect rates
    - Call-centre average sales per hour
    - Call-centre average talk time
    - Campaign performance
    - Customer segment lifetime value
    - Peak network volumes
    - Uncollected receivables
    - Customer satisfaction
- Develop complex reporting capabilities that allow one to uncover problems and discover new opportunities typical areas for analysis include the following:
    - Market assessment
    - Channel planning
    - Competition assessment
    - Strategy and pricing
    - Customer penetration and profitability
    - Customer segmentation
    - Program definition
    - Recognition of patterns relative to customer behaviour and needs

- Develop statistical models that predict customer needs and behaviours; for example, one can build models that predict a customer's likelihood to do the following:
    - Buy a new product
    - Generate high profitability
    - Respond to contacts through specific channels (e.g., direct mail, telemarketing, e-mail, etc.)
    - Not pay their bill

BI tools can be applied to a variety of processes forming the telecom service provider's business. These business processes can be customer retention, cost cutting, or traffic management. For customer retention, strategic decision support BI tools would be used to track key performance metrics relative to customer install and disconnect activity and would assist telecommunications companies.

- This would provide early warning of increasing disconnect activity.
- If disconnect activity began to grow beyond acceptable limits, it would analyse why customers were disconnecting and extrapolate the impact on profitability.
- If the profitability impacts were not acceptable, it would formulate strategies for retention

An important application of BI is customer profiling, which aims at extracting typical or abnormal patterns of behavior (Chen et al., 2000). For instance, in telecommunications application, a customer's calling behavior is represented by the composition and periodic appearance of the callers. Calling behavior profiling has become increasingly important in a variety of telecommunications applications, such as fraud detection, service planning, and traffic analysis.

Churn management is another popular application of BI used within telecommunications companies. Based on marketing research (Hung et al., 2006), the average churn of a wireless operator is about 2% per month. That is, a carrier lost about a quarter of its customer base each year and it was reported than Asian telecommunications providers face a more challenging customer churn than those on other parts of the world. Thus, BI through its data mining tools is used to describe the procedure of securing the most important customers for a company (Hung et al., 2006). Proper customer management presumes an ability to forecast the customer decision to move from one service provider to another. Churn management is used under customer relationship management (CRM) framework consists of two major analytical modeling efforts: (1) predicting those who are about to churn and (2) assessing the most effective way that an operator can react in terms of retention.

Telecommunications firms have enormous data built from customer and calls-related business transactions and these data are systematically stored in a data warehouse. Applications of BI are employed to utilize these voluminous data for the telecommunication-specific purpose such churn management, customer profiling and other analytics. The knowledge which resulted from these BI applications is utilized by the decision makers for the benefits of the organizations, which is to achieve and sustain competitive advantage.

2.10 SUMMARY

BI has rapidly become an integral part of business function for many organizations as they realize the competitiveness hinges on effective utilizations of intellectual resources (Grover & Davenport, 2001). Through reviewing the BI and related literature, it is indicated that knowledge-based resources are essential for providing sustainable competitive advantages since they are inherently difficult to imitate (Alvi & Leidner, 2001). Moreover, the knowledge and associated approaches to utilize the intelligence from that knowledge depend on the unique resources such as skilled people and quality data found within organizations.

To create long-term sustainable competitive advantages, organizations should embark into the process of finding their own resources that would enable them to acquire such necessary knowledge. Thus, this found to be a gap in the literature on the area of antecedents of BI success, which is considered knowledge-generating mechanism of the organizations and utilization of BI-based knowledge for organization's sustainability. IS success model is used as the basis for measuring BI success in telecommunication companies in Malaysia. The study incorporates firm's resources and innovation's perceptions as the BI success antecedents. Once BI is successfully deployed in an organization, it is anticipated that knowledge acquired through effective utilizations of BI will help sustaining its competitiveness.

The review provides the basis for developing a preliminary model that will guide the investigation of the factors affecting BI deployment and success. Since the study involves generating knowledge, there is a necessity to identify factors based on internal firm's resources and how BI-based knowledge will be utilized for sustainable competitive advantages of telecommunications companies. The rapid development of Malaysian telecommunications industry, as well as the demand for knowledge-based assets over the past few years is discussed. Overall, Malaysia has shown to have a significant number of telecommunications companies competing in a national as well as global marketplace. These companies are seen to have a relatively high use of BI-related technologies. The following chapter will discuss the overall conceptual framework and the tentative research model undertaken in this study.

CHAPTER 3

CONCEPTUAL FRAMEWORK AND PRELIMINARY RESEARCH MODEL

3.1 INTRODUCTION

Based on the foundation of the theories and the discussion on the fierce competition among players in telecommunications industry in Malaysia in Chapter 2, this chapter presents the research concepts used in this study. The chapter then proposes the preliminary research model. The first section describes the conceptual framework of the research, and then followed by a presentation of the tentative research model and its associated factors. Definitions of the terms used in the research are also provided in the last section.

3.2 CONCEPTUAL FRAMEWORK

The study suggests a primary research model based on the three underlying theories as well as the review on the applications of those theories in the IS fields that have been discussed in the previous chapters. Various factors identified in studies on IS-related fields were also taken into considerations. The model development is done by combining the Resource-based Theory (RBT) by Barney (1991) with the Information System Success (ISS) model by DeLone and McLean (1995) and the Diffusion of Innovation (DOI) Theory by Rogers (1995). This combination of theories was adopted in this study by following a specific research process (see Section 5.3.1 of Chapter 5) in order to develop a specific research model of Successful BI Deployment for Sustainable Competitive Advantage.

Basically this research suggests that some firm's internal resources coupled with the right perceptions on innovations, in this case is BI, will influence the success of BI deployment in an organization. The first part of the research is to identify factors that would affect BI success. The factors are divided into two different groups of (1) firm's internal resources and (2) innovation perception.

The first group is based on the firm's internal resources, which gives emphasis on the unique resources that owned internally by the competing firm. Using RBT as the underlying theory, the model posits that these factors could influence BI success, which in turn would be the basis for sustaining competitive advantage. The model is further enhanced by taking into account the quality factors suggested in the ISS model as dimensions of BI success.

The second group of antecedents is the innovation perception factors, which are based on the understanding from Diffusion of Innovation theory that user's perceptions are crucial in any process of innovation's adoption. In this research it is suggested that BI success depends to a large extent on the perceptions of users on BI system that is being deployed in their organizations.

Past researcher has acknowledged that knowledge-related resources play important roles in creating sustainable competitive advantages for organizations (Grant, 1996; Johannessen & Olsen, 2003; Lado & Wilson, 1994; Chuang, 2004; Barratt & Oke, 2007; Bharadwaj, 2000; just to name a few). The firm's internal resources used in this research are the resources that affect the successful BI deployment. Since BI systems in this case are the knowledge-creation mechanisms, the resources that affect the systems can be considered as knowledge-related resources. Hence, these resources are the players in creating sustainable competitive advantage.

The resource-based theory is further used as a basis to ascertain that successful BI deployment would bring sustainable competitive advantage to the organizations. It is believed that once BI is successfully deployed, the organization would be able to acquire knowledge needed to achieve and later sustain their competitiveness. Many researchers (Hislop et al. 2000; Clarke & Turner 2004; just to name a few) stated that knowledge have been linked to RBT and suggested that it has become the mechanisms to facilitate firms acquiring greater competitive advantage. Firm's competitive advantage is considered to result from its unique knowledge and how it manages the knowledge (Huang, 2008; Levitin & Redman, 1998; Mata et al., 1995; Joglar & Chaparro, 2007).

Thus, in examining the role of knowledge acquired through successful BI deployment in Malaysian telecommunication industry, this study predominantly adopts the perspectives that BI-based knowledge is viewed as the resources for organizations to sustain their competitive advantage. This whole concept can be viewed as follows.

"Firm Internal → "Successful BI → "Sustainable Competitive
Resources" Deployment" Advantage"

This simple model is generic in nature and is likely to be replicable, with some adjustments, in various BI deployments. This research model serves as the conceptual framework for the development of proposed research model, which is discussed in the next section.

3.3 THE PRELIMINARY RESEARCH MODEL

This section explores the theoretical rational behind the proposed research model on Successful BI Deployment for Sustainable Competitive Advantage. The model as depicted in Figure 3-1 was developed from an understanding of the generic model that has been defined in the conceptual framework described in the Section 3-1. As discussed in Chapter 2, the factors and variables used in the model draw extensively from the combination of the Resource-based Theory (Barney, 1991), the Innovation's Perceptions Theory (Roger, 1995) and the Information System Success (Delone & McLean, 1992) and previous studies relating to IS success. The preliminary research model seeks to extend these theoretical models to develop a model that explains the internal firm's factors and perceptive factors that influence the successful BI deployment in telecommunications companies in Malaysia, which would thus result in sustainable competitive advantage of these organizations.

The model of Figure 3-1 also shows that the variable Successful BI Deployment impacts on the dependant variable Use of BI-based Knowledge for Sustainable Competitive Advantage. This relationship is moderated by the Organization Culture, Business Strategy and Use of BI Tools variables. The model also shows two groups of four independent variables of Firm Internal Resources and Innovation Perception, impacting on the variable Successful BI Deployment. The first group has four independent variables of Quality Information, Quality Users, Quality System and BI Governance and the second group has five independent variables of Relative Advantage, Compatibility, Complexity, Triability, and Observability. These nine variables are posited to be the determinant factors in successful BI deployment in telecommunications industry in Malaysia as discussed in Chapter 2.

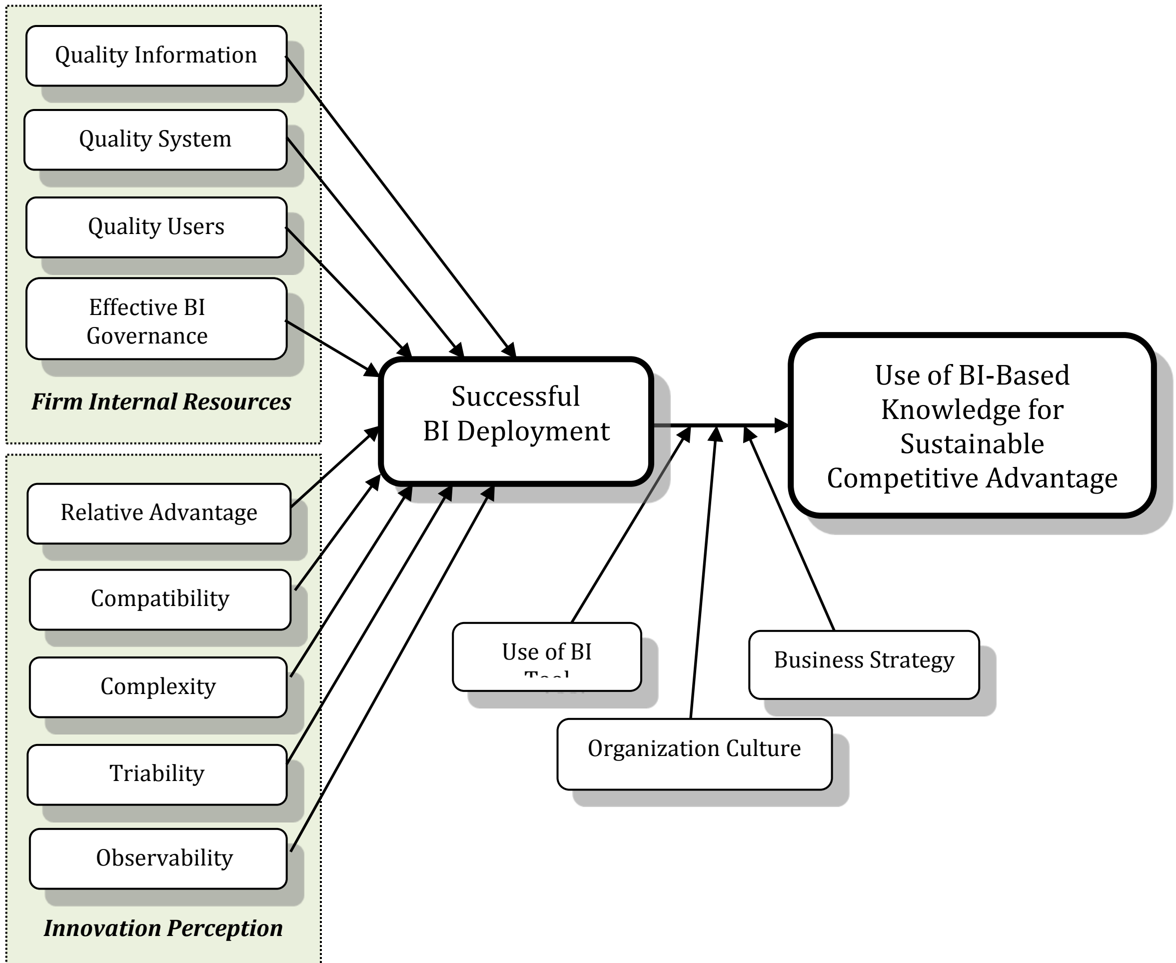

Figure 3-1 Preliminary Research Model of Successful BI Deployment for Sustainable Competitive Advantage

This study proposes that BI-related resources and capabilities such as skilled BI users, quality BI information, quality BI systems and BI governance will allow organizations to sustain competitive advantage. This is based on the argument that the combination of these tangible and intangible resources will produce valuable, rare, inimitable and non-substitutable assets to the competing organizations. RBT asserts that these factors will allow firms to sustain competitive advantage that competitors find hard to duplicate.

In addition to RBT, the study also adapts the quality factors proposed in ISS model as importance dimensions in successful BI deployment in organizations. The model posits that quality information is the product of quality BI systems. The combination of these two important assets will produce the essential knowledge required for organization sustainability. These two quality factors were also considered as firm's internal resources that are believed to bring uniqueness in terms of technical aspects of the systems as well relevant knowledge acquired through BI systems.

Another quality factor that is proposed in this study is human factor. It is an important determinant since the existence of quality BI users is vital in collecting the intelligence that lies in BI. The true value of BI will only be realized if the users are capable of utilizing information gained and turn them into sound business decisions (Avery and Watson, 2004). This study anticipated that BI users should have high quality skills of technical, analytical as well as business. The inclusion of this factor is a recognition that lack of quality users in BI implementations may lead to failure.

This study also considered effective governance as a key to BI success. In a similar manner to the suggestions by researchers such as Matney and Larson (2004) and Watson et al. (2004), this study considers the BI governance activities that range from strategic to operational. The main criteria of good BI governance that are used in this study include management support and involvement comprising of multiple stakeholders (e.g., senior management, business unit managers, users, IT, and consultants). Effective BI governance would require support in terms of sufficient funding, technical infrastructure, staffing and training. The study also takes into account governance activities that entails controlling, directing or strongly influencing actions and includes establishing and enforcing related policies.

The model also uses the Theory of Innovation Diffusion (Rogers, 1995) to include user's perception in strengthening the success of BI deployment. User's perceptions are considered one of the most important factors that influence the deployment of any innovations, which in this case is the BI system (Chiasson & Lovato, 2001). Based on the relative importance of these factors, this study suggests the success of BI deployment will be primarily affected by five perceived attributes or characteristics of innovation: relative advantage, compatibility, complexity, trialability, and observability.

This study posits that BI can only be deployed successfully if users can perceive its full potential and these potential can be seen as relative advantage. The perception of BI's compatibility is also considered in the model since a number of studies have found compatibility to be positively associated with adoption (Grover & Goslar, 1993). In this study, compatibility with an individual's work style and skills is considered important in determining BI success.

This study also considers the negative factors of innovation such as complexity of BI systems. Previous studies have stated that the complexity of BI tools is the hurdle in BI success deployment. The users stress on the tools that are easy to use, but at the same time must provide significant power and flexibility. Based on the relative importance of complexity, this study includes the perception on BI's complexity as one of the important success criteria of BI.

The literature identified perceptions on triability and observability as relevant factors in adoption. The triability perception is concerned with trying out parts of BI systems or having opportunity to watch others using new systems. The observability is the ability to see outcome of BI systems. A more readily observable innovation is adopted faster (Lundblad, 2003). Therefore, the model explicitly accounted for the influence of these two factors on BI success.

Business strategy is mentioned in the literature to have an influence in organizational performance. The alignment of business strategy and BI is also being stressed to be the vital element in BI-related initiatives. Based on the relative importance of business strategy and its alignment with BI in the literature, four types of business strategy namely prospector, analyzer, defender and reactors were included in the model. These different of types of business strategy, which adopted Miles and Snow's (1978) typology were used to measure the relationship between BI success and use of BI-based knowledge in sustainable competitive advantage.

The review of the literature on BI concluded that the role BI tools and their influence on BI success have been largely overlooked. BI developers are warned to be careful in choosing the type of BI tools as too many tools lead to confusion and soaring training costs, while too few tools frustrate the users. Therefore, this model will study the use of BI tools and the relationship of these tools on BI success and use of BI-based knowledge for sustainable competitive advantage. The model considers three different categories of BI tools based on the level of utilizations namely strategic, tactical and operational.

Another important factor mentioned in the literature on BI success is organizational culture (Moss, 2005; Buhler, 2003; Weir, 2004). According to Moss, large percentage of BI applications fails not because of technology but organizational culture and firms that instill the right organizational culture are foreseen to be successful in deploying BI initiatives. In the context of this research, the right organizational culture is those that are related to the acquisition of information and knowledge. The model stress on organizational culture and its associated attributes that are related to knowledge such as knowledge-sharing and continuous learning to be important factors in ensuring knowledge acquired through BI deployment will used in achieving and sustaining organizations' strategic positions. For BI to work, the entire organization must participate in intelligence gathering and sharing.

3.4 SUMMARY

Since successful BI for sustainable competitive advantage is a new phenomenon in the telecommunication industry in Malaysia, the proven resource-based and innovation theory can be used as a foundation of the BI deployment among Malaysian telecommunication companies. Besides, the well-developed DeLone and McLean's Information System Success model provide the basis in proposing the perceptive factors such as quality information, quality users, quality systems and BI governance as the factors affecting the successful BI applications. The measurements for several constructs have been provided in the previous studies. Nevertheless, they need to be adapted to be used in the context of telecommunication industry. The factors identified from BI literature were also required to be further explored to recognize the appropriateness in this context. Therefore, this study utilized an exploratory field study, which was qualitative in nature, to fine-tune the research model before administering industry surveys. In the following chapter, the research methodology and design for answering the research questions and achieving the research objectives are discussed.

CHAPTER 4

RESEARCH METHODOLOGY AND DESIGN

4.1 INTRODUCTION

A sequential mix-method (Cresswell, 2003) approach comprising of qualitative and quantitative methods is employed as a research method in this study. This chapter is dedicated to present the research methodology and design used in this study.

The discussion on the research paradigm and method approach employed is first presented. Then, the detailed descriptions of the two-phase study methods used namely qualitative field study and industry survey are provided. For every phase, the sample selection, data collection and analyses techniques are presented. Finally, other issues relating to research methodology involved in this study are also discussed.

4.2 RESEARCH PARADIGM

The overall research paradigm for this study is logical positivism (Crotty, 1998). The choice of being a positivist is determined by the principle that a belief could be gained from the research data and this could be independently verified. The choice of paradigm is also influenced by the fact that there are a number of theories in the literature that could explain the successful deployment in relation to BI that could lead to sustainable competitive advantage. The phenomenon is investigated using hypotheses that were developed from scientific theories and explored through empirical testing. The research method used in this study is reliant on quantitative measures. Therefore, the methods employed in this research were designed to be detached and independent of the researcher.

Understanding of the research paradigm to be adopted in this study is very crucial at this stage. Paradigm is viewed as a set of basic belief that deals with ultimatums or first principals (Guba & Lincoln, 1994), while research paradigm refers to the process of scientific practice based on people's philosophies and assumptions about the world (Hussey & Hussey, 1997).

Basically, there are two major research paradigms (Crotty, 1998):

i. **Interpretivist**- sees reality dependant on the mind and thus the researcher has to plunge into the actor's mind by feeling, hearing and observing how the actor interprets what is according to the context of a particular act (Schwandt, 1994). The Interpretivist approach aims to develop a natural science through social interpretation (Neuman, 1994).

ii. **Positivist** – assumes that reality is apprehendable and therefore a scientific concept or research idea can be objectively measured and observed (Hessler, 1992). The positivist approach believes that "no scientific concept, no research idea, is so abstract that it cannot be measured or observed"

Table 4-1 Interpretivist versus Positivist Paradigm

Assumption	Interpretivist	Positivist
Ontological: nature or reality	reality is subjective and multiple	reality is objective and singular
Epistemological: relationship of the research to the issue being researched	researcher interacts with and affects the issue being researched	researcher is independent from what is being researched
Axiological: roles of values	scientific study is value laden and biased	scientific study is value free and unbiased
Rhetorical: language of research	informal, use of qualitative words that evolve decisions	formal, use of quantitative words that are based on set definitions
Methodological: process of research	believing in idealism, use different methods to obtain different perceptions of the phenomena	believing in realism, focus on objective and hypotheses formulation

(Adapted from Creswell, 2003)

Creswell (2003) further illustrated the differences between the paradigms based on several assumptions as described in Table 4-1 to give further understandings of choice of available paradigms. There have been many researches attempting to bridge the two paradigms due to the complexity of the modern world today (Goles & Hirschheim, 1999). The bridging approach is referred to as mixed methods and is defined as the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study (Johnson & Onwuegbuzie, 2004). Methodological works on the mixed methods research paradigm can be seen in several recent books (Brewer & Hunter, 1989; Creswell, 2003; Greene et al., 1989; Johnson & Christensen, 2004; Newman & Benz, 1998; Tashakkorri & Teddlie, 1998, 2003). Johnson and Onwuegbuzie (2004) presented mixed methods as the third research paradigm in educational research and clarify some of the issues regarding mixed methods such as topology, strength and weaknesses of the methods as well as research process model.

The goal of mixed methods is not to replace either of these approaches but rather to draw from the strengths and minimize the weaknesses of both in single research studies and across studies. As quoted by Merriam (1998), rarely, however are all methods of data collection used equally. One or two methods of data collection predominate – the other(s) play a supporting role in gaining an in-depth understanding of the case. Researchers can take advantage of cross-fertilization between paradigms by transposing contributions from studies in one paradigm into the theoretical frameworks of another. Research results are richer and more reliable if different methods are combined because of the multidimensionality of the world today (Mingles, 2001). Therefore, combination of both Interpretivist and positivist research methodologies are called for (Gable, 1994; Tashakkorri & Teddlie, 2003).

The rationale behind employing positivist standpoint for this study is as follows. The main reason is that relevant prior studies on information systems were mostly undertaken positivist paradigm. BI as a matter of fact is an information system in nature and therefore is most likely to follow the same approach. Furthermore, the constructs and factors in this research are all measurable. Past researchers have identified that research done in this positivist spirit will normally begin with a general causal relationship and a preliminary research model as shown in Chapter 3 (Figure 3.1). Therefore, this study engages in survey research and employs the quantitative approach to measure and test relevant hypotheses (Newman, 1994). However, the positivist study is supported by an embedded Interpretivist paradigm, a qualitative field study, which serves to strengthen the richness and reliability of the positivist study by first refining the research model before the quantitative data collection via survey.

4.3 RESEARCH METHOD

As mentioned earlier, the methods used in this study contained elements of both qualitative and quantitative methods. The use of both methods in the same study is commonly referred to as mixed methods as mentioned by Tashakkorri and Teddlie (2003). They defined mixed method or sometimes refer to as "bridging study" as a method that employs both qualitative and quantitative approaches in either serial or parallel manner. Employing mixed methods in a serial (sequential) manner, this study uses all the data collection and analyses techniques imposed by both methods.

Since there has been limited previous research of the BI deployment, the research process is divided into a number of phases. The whole process in this study is diagrammatically presented in Figure 4.1, showing all the phases involved.

4.3.1 The Research Process

The research process has been conducted in two sequential phases that involved eleven steps as diagrammatically illustrated in Figure 5.2. Phase 1 starts with rigorous literature reviews on relevant topics on BI and its related issues such as BI deployment in various fields, BI success factors and its relationships with company's sustainable competitive advantage. At this point the preliminary BI model was developed and followed by a qualitative field study that finalized the preliminary model into the final research model. It was then followed by Phase 2, which is the comprehensive quantitative industry-wide study which attempted to empirically verify the BI model. The following section briefly describes each step involved in the research process.

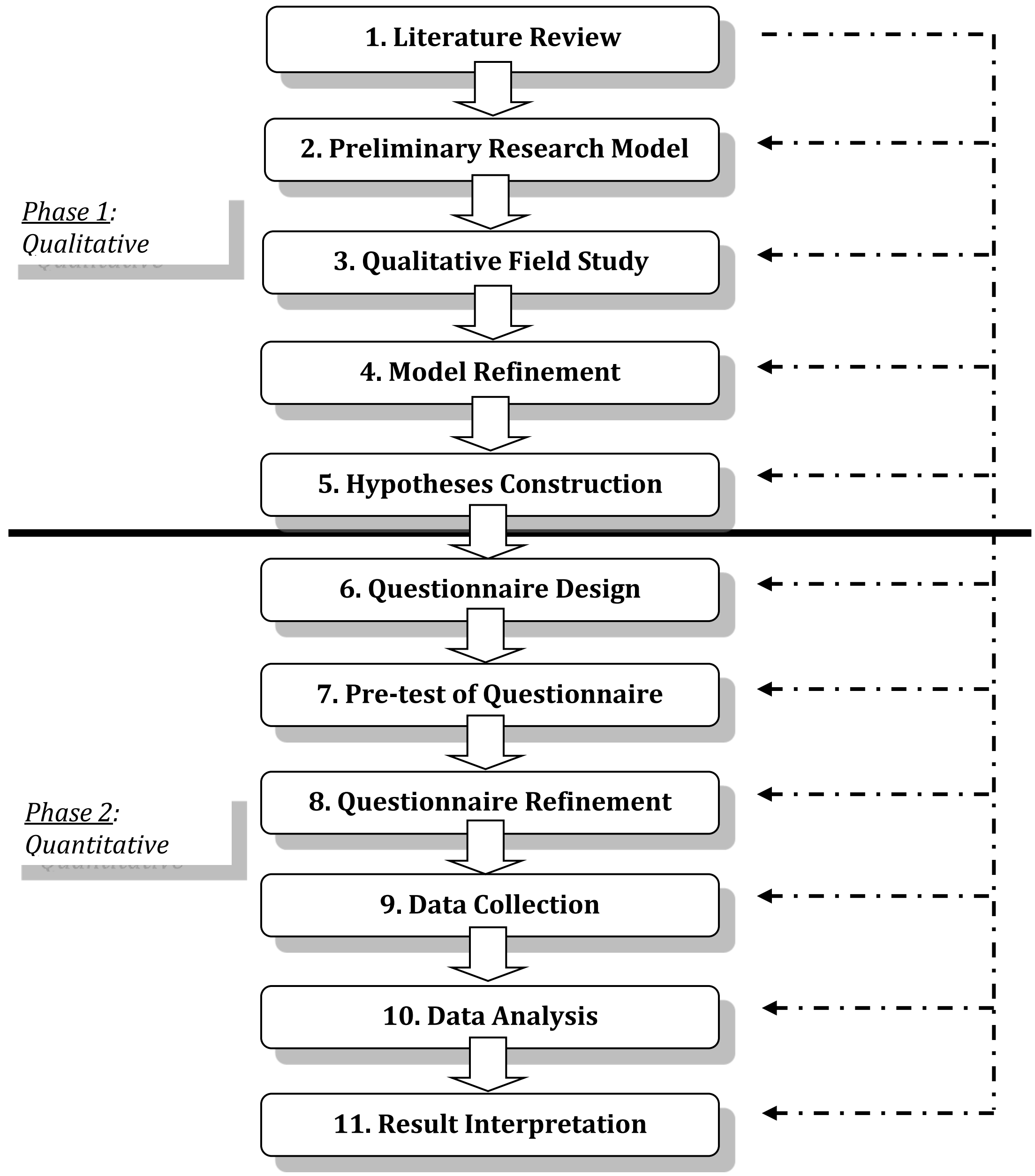

Figure 4-2 the 2-Phase Sequential Mixed Methods Research Approach

Step-1: Literature Review

Current literatures of significance relating to BI and sustainability are found in journals, books, seminar proceedings, working papers and other sources. These literatures are searched for the purpose of (1) noting the general impression of BI, (2) possible relationship to be investigated, and (3) relevant content categories (Hilty, 1967). The efforts were devoted to identifying concepts pertinent to the current BI problem and an exhaustive series of questions relating to the various BI functions and their relation with sustainability are prepared and used as a checklist for the next phase. The step also proposed research questions and research objectives.

Step-2: Preliminary Research Model Construction

A preliminary research model of BI for Sustainable Competitive Advantage as in Figure 3-1 was first constructed based on extensive literature review to get the first glimpse of the research model. The model was later refined with the support of more literature review and field study.

Step-3: Qualitative Field Study

Field study through interviews was then conducted with 10 executives and decision makers of all the five telecommunications firms in Malaysia. The objectives of the interview were to (1) search out and identify concepts and procedures that might not be reported or recognized in the literature review, (2) evaluate the worthiness of the concepts identified in literature review. The interview scripts were transcribed by the researcher and the content were analyzed in two stages. Stage one dealt with single interview transcripts, while stage two dealt with cross interview transcripts to integrate all the individual factors, variables and their relationships to produce the combined model of successful BI deployment. Section 5.5.3 describes this step in detail.

Step-4: Model Refinement

The preliminary model is refined based on the exhaustive related literature review as well as findings from field study. Necessary addition of items or constructs as well as elimination of the duplicate constructs and items were done at this stage. A research model was then finalized.

Step-5: Hypotheses Construction

Hypotheses are constructed at this stage based on the final research model and also past theories and applications from the literatures. The resource-based theory (RBT) and innovation perception's theory are used to guide the hypotheses construction.

Step-6: Questionnaire Design

A tentative questionnaire was designed based on 21 hypotheses that had been constructed in the prior step. Measurements in the questionnaire rely heavily on the available instruments designed in the past literature. Additional new measurements were based on the findings from the qualitative field study. The combination measurement totaled to 82 items and 16 constructs and was subjected to a pre-test for the validity and reliability before conducting to the industry-wide survey.

Step-7: Pre-test of the Questionnaire

The tentative questionnaire was pre-tested before it was widely disseminated. Pre-test was conducted with five telecommunications executives in one of the telecommunications firms' headquarters in Malaysia. The purpose of the pre-test is to consult the expertise in the relevant field in order to enhance content validity.

Step-8: Questionnaire Refinement

Necessary changes are then made accordingly to refine the tentative instruments based on the pre-test result prior to the actual surveys. The final questionnaire was then ready to be disseminated to the respondents of the survey.

Step-9: Data Collection

The main data collection process was gathered by distributing questionnaires to all executives in all five telecommunications firms. The five telecommunications firms involved in this study were selected based on the competitive nature of their business: one large government-owned firm, one multinational firm and three large privately-owned firms. The target samples were executives of the firms who are involved in acquiring, analyzing and utilizing BI-based information for decision-making activities. A sample of 310 responses is gathered, which is more than enough for Partial Least Square (PLS)-based data analysis. Section 5.6.4 describes this step in detail.

Step-10: Data Analysis

Data gathered through the survey were analyzed by PLS-based Structural Equation Modeling (Chin, 2003; Barclay, Higgins & Thompson, 1995). The analyses produced descriptive statistics, test construct validity and reliability as well as hypotheses.

Step-11: Result Interpretation

The final step of the research was the interpretation of the results. Based on the results acquired through the data analysis process from both qualitative and quantitative as well as from literature review, findings were interpreted and the whole theses writing process took place.

4.4 QUALITATIVE FIELD STUDY METHOD

This phase of the study endeavored to explore the phenomenon of successful BI deployment with telecommunications executives in Malaysia, to validate and enhance the factors and variables identified as part of comprehensive literature review. Since this phase was concerned with understanding BI success, the qualitative method is considered the most appropriate. The researchers argue that the goal of understanding a phenomenon from the point of view of the participants and its particular social and institutional context was difficult to achieve when textual data were quantified (Kaplan & Maxwell, 1994). Therefore, it was believed that a 'pseudo case study' that involved a qualitative study of a small number of participants would meet the objectives of this phase of the study.

As such, a field study approach (Patton, 1999; Zikmund, 2000) has been adopted as the research method for the qualitative phase. Qualitative methods permit the evaluator to study selected issues in depth and detail. Approaching fieldwork without being constrained by predetermined knowledge, contributes to the depth, openness, and detail of qualitative inquiry (Patton, 1990). The field study acquires the researcher to be involved in investigating the factors influencing the success of BI deployment and its relationships with the use of BI-based knowledge in sustaining competitive advantage of the participating organizations.

4.4.1 Sample Selection

This study took a convenience sampling procedure as it is the most commonly used in business research (Zikmund, 2000). Furthermore, this category of sample relied on available subjects who were close at hand or easily accessible (Berg, 2004). Ten executives from all telecommunications companies in Malaysia who were willing to participate were selected. Main selection criterion was that the selected participants have to be involved in decision-making activities and they have to have some level of utilizations in BI initiatives in their companies. The participants were contacted personally by the researcher to get their approval to participate in the interviews. All the respondents took part in the survey voluntarily. The five telecommunications companies in Malaysia were (Malaysian Communications and Multimedia Commission, 2007): (1) Telekom Malaysia Berhad (TM Bhd) - a large government-linked company, (2) MAXIS Mobile Berhad (MAXIS), (3) Celcom Berhad, (4) Time Telecommunications, large locally-owned private companies, and (5) DIGI Communication Bhd – multinational company.

4.4.2 Data Collection

Data collection and analysis method in qualitative studies are different from quantitative techniques (Lincoln & Guba 1985). Interview, has been accepted as one of the major techniques of data collection for qualitative study (Maykut & Moorehouse, 1994). Many researches in various fields such as psychology (Magolda, 1992) and education (Bogdan & Biklen, 1982; Kuh & Andreas, 1991) have employed interviews as a method of qualitative data collection. Researchers have identified three categories of interview (Babbie 2001; Merriam 2001; Nieswiadomy, 2002):

i. Standardized (formal or structured)
ii. Unstandardized (informal or nondirective)
iii. Semi-standardized (guided-semi-structured or focused)

For this study, semi-structured interview was chosen as a method of collecting relevant qualitative data to explore and refine the model of successful BI deployment in the Malaysian telecommunications industry. Here, the list of themes, issues to be addressed and questions to be asked were identified and pre-defined by the researcher. The use of semi-structured interviews ensured that information was captured from the respondents' perspectives rather than being imposed by the researcher (Burns 1995).

The guiding semi-structured questions were developed from comprehensive literature review. A pre-test interview was conducted with a company. Minor adjustments, namely the interviewer would ask the questions by referring them to some specific BI systems they were using, were made. The semi-structured interview questions have focused on the following areas of information needed in the field study:

i. General perceptions and understanding of BI
ii. The main factors that influence the successful BI deployment
iii. Usage of BI-based knowledge in decision-making activities
iv. Required BI tools for generating knowledge in telecommunications industry in Malaysia
v. The role of organization culture in utilizing BI-based knowledge
vi. The role of business strategy in BI success especially in creating the right knowledge for company's sustainability
vii. Utilization of BI-based knowledge in sustaining competitive advantage of the organization

The participants were contacted personally by the researcher before the actual interviews took place. A cover letter specifying several important perspectives of the research were handed beforehand. Thus, the interviewees knew the researcher and the research objectives before the interviews, which put them at ease and made them expressed their opinion freely. The participants were also aware of the interviews being recorded by a micro-audio recorder, of course with their permissions. All interviews were transcribed the next day.

4.4.3 Analyses of Qualitative Data

This research used content analysis approach in interpreting the interviews scripts. The main reason of choosing this method was the field study was more exploratory in nature at this stage, rather than confirmatory (Berg 2001). The other reason is that content analysis is useful in analyzing interview data and is cost effective.

With over 100 pages of interview scripts from a total of 10 interviews, considerable time was spent in the data analysis process. The data were broken down to the very fine details in order to generate the variables and factors from the interview scripts. The content analyses were carried out in two stages which involved several sequential step-by-step processes (Miles & Huberman 1994; Berg 2004; Xu 2005). The following describes the stages involved with the subsequent processes:

Stage 1 – dealt with single scripts and the procedures are as follows:

- Review all transcripts
- Produce categories of key words
- Identify relationships among factors
- Match factors with variables from the literature
- Develop raw tables of factors, variables and links of each interview

Stage 2 – dealt with cross scripts and the aim is to integrate all the factors, variables and links and the procedures are as follows:

- Recheck all the transcripts
- Identify similarities and differences
- Unify all variables and links using the "union" concept
- Develop final tables of factors, variables and links
- Develop the combined model of BI for Sustainable Competitive Advantage

The final output from this phase was a comprehensive BI model based on the combination of ten individual models extracted from the interview scripts. The combined model was used as a basis for the construction of hypotheses. The information sought from extensive literature reviews plus findings from interviews made up the hypotheses. The refined BI model and hypotheses defined were used in the next phase of the main quantitative research.

4.5 QUANTITATIVE STUDY METHOD

The second phase of the research aims at finding the important factors and variables affecting successful BI deployment, which was reflected in the BI model developed prior to this phase. A number of hypotheses were derived from the model, which were subjected to an empirical testing that focused on verifying or falsifying these hypotheses (Anderson 1983). Since the methods used in this phase were designed to be detached and independent of the specific situation under study, a quantitative method is considered most appropriate. Furthermore, the sample size was large and spread over a wide geographical location.

Therefore, the survey method was considered most appropriate for this study and a questionnaire-based survey was adopted.

4.5.1 Developing the Questionnaire

The construction of the questionnaire took considerable amount of time. A 6-point Likert scale questionnaire was intended to measure the factors and variables of the final BI model defined in earlier stage. Extensive literature reviews on measurements used and consultation with supervisor and expert in the telecommunications industry were done to ensure that the instrument served the indented purpose of the study.

These types of scales have been subject to academic debate in several studies. Joreskog (2005) claimed that the Likert scale is an ordinal variable in essence of it's having origins or units of measurement, its distribution being discrete, and it's not having values between numbers. Hence, to use SEM with ordinal variables requires other techniques than those traditionally employed with continuous variables – Maximum Likelihood (ML). In practice, however, it is reported that during the past 15 years, the application of SEM has mostly relied on the Likert scale, in which ML are used to estimate the parameters (Byrne, 2006).

Researcher has been debating over the optimal number of scale points to use. Many authors concluded that the optimal number of scale categories is content specific and a function of the conditions of measurement (Mattel & Jacoby, 1971; Garland, 1991). Hair, Jr. et al. (2007) stated there are two choices of between odd and even number in selecting scale categories. Garland (1991) examined the effect on survey results of having no neutral or mid-point on a Liker scale. The mid-point typically represents a neutral position when an odd number of categories used in a scale. This type of scale is used when, based on the experience or judgment of the researcher, it is believed that some portion of the sample is likely to feel neutral about the issue being examined. Mattel and Jacoby (1972) advised on minimizing usage of the mid-point category was to either not include it at all or use scales with many points. This study decided to use 6-point scale based on the above rational. Furthermore, the choice of 6-point Likert scale was also based on the study by Fong (1976) that anticipated participants of Asian ethnic tend to choose the middle score or non-partisan for their responses as this phenomenon is regarded as giving the research result as nonattractive (Fong, 2007). Since the study was done in Malaysia, which is part of Asian culture, the choice of the 6-point scale was rational.

4.5.2 Pre-test the Questionnaire

Prior to administering the actual survey, the quantitative survey process conducted a pre-test to identify any problem with the survey instrument. A pre-test process took a convenient sample of five telecommunications executives who were base in one of telecommunications company's head quarters. The five executives selected were a different sample from those selected for the field study. The process allowed time for each participant to complete the survey and requested them to record the time taken. A follow-up interview was conducted with each participant to identify any weaknesses in the instrument. The questionnaire was then finalized by making several changes after obtaining the participants opinion regarding the meaning and clarity of the questions.

4.5.3 Sample Selection

The industry survey was conducted among all five telecommunications providers in Malaysia. The list of companies was provided by Malaysian Communications and Multimedia Commission (MCMC, 2007). Malaysian industry regards telecommunication companies as companies that provide telecommunications services such as cellular and mobile communications, internet and fixed telephone as well as other network services. These companies are: (1) Telekom Malaysia Berhad (TM Bhd) - large government-linked company, (2) MAXIS Mobile Berhad (MAXIS), (3) Celcom Berhad, (4) Time Telecommunications, large locally-owned private companies and (5) DIGI Telecommunications Berhad, multinational company.

After taking into considerations of all the information from different sources, the preferences of the survey subjects were the executives or higher level officers who were involved in decision-making activities and have certain level of BI utilization in their organizations. The preferred sample subjects were based on the following list of executives in the companies:

i.	Vice President or above	v.	Department Manager
ii.	Assistant Vice President	vi.	Section Manager
iii.	Senior Director	vii.	Section Head
iv.	Director	viii.	Executive Officer

Based on the information from the companies' web sites, each company employed not more than 2,000 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, experienced researcher should consider a sample size of between 200 and 1,000 (Alreck & Settle, 1985). Therefore, taking the highest number of the suggested sample size, the initial sample size was fixed at 1,000. This was in view of time and cost considerations the researcher had at that point of time. The low response rate among executives was also taken into consideration when selecting the number of sample size.

4.5.4 Quantitative Data Collection

The participating companies were approached personally by the researcher to seek their approval. Upon companies' approval, contact persons were identified for later correspondence. The survey instrument together with covering letter explaining the purpose and instruction of the survey were sent to the identified contact persons. The main task of the contact persons was to distribute the questionnaire to the target sample across branches and departments. They were also expected to collect the questionnaire from the respondents upon their completion. The questionnaires were expected to be distributed evenly to the various departments of the companies. The main reason behind this was that executives from different field of work were expected to give different responses especially on the usage of BI tools in completing their daily tasks and their involvement in utilizing BI-based knowledge for their companies' competitiveness.

The first round of packages of the survey was sent out in middle of April 2008. The respondents were given ample time of one month to complete the survey. After the 1-month period, a total of 156 completed responses were received. In an attempt to boost the response rate, follow-up phone calls were made to the contact persons. The package containing reminder's letter, copies of questionnaire and small souvenirs were sent to the relevant key persons to further improve the response rate. This process resulted in a further 127 executives responding with completed surveys within one month after the reminder. At this point which was around middle of June 2008, the survey has yielded 283 responses. This figure gave a response rate of approximately 28%. The decision was reached for the researcher to pay visits to the contact persons of the companies in an attempt to further improve the response rate. Another package consisting of reminder letters, a copy of questionnaire and a souvenir were once again given to the contact persons and it was agreed to give them another two weeks for the responses. This desperate move was made based on the earlier understanding that a minimum response of 300 was needed in order to yield a good result from PLS data analysis procedure. Finally, after about 4 months of perseverance, the total returned questionnaires was 325, which gave a relatively high response rate of 32.5 percent.

4.5.5 Response Rate and Data Examination

Overall, there were 325 participants responded to the questionnaires in this quantitative study. This was translated to an effective response rate of 32.5 percent, which is considered high in a business research. The rationale behind the high response rate could be due to the fact that the contact persons responsible for the distribution and the collection of the questionnaires are high-rank executives who were quite influential in the companies.

The data were immediately input into the computer spreadsheet system once the data collection period was over. The raw data showed some missing values, meaning that the respondents either refused or overlooked the answer. Either way, data were examined closely for the analysis stage. Responses deemed to be invalid or incomplete were discarded from the analyses. There were 15 questionnaires that had to be discarded due to invalid responses, and this comprised of five respondents who did not fill in their demographics information and ten of them had too many missing answers (more than 10 missing values in each questionnaire). Overall, the survey yielded 310 effective and accepted responses, including 18 missing data which were imputed using Estimated Means method (Green et al., 2001; Little & Rubin, 1987; Rao & Toutenburg, 1995). This figure was translated to an effective response rate of approximately 31 percent.

4.5.6 Quantitative Data Analysis

Data analysis for this quantitative phase of the research was done via the Structural Equation Modeling (SEM) approach. SEM techniques such as LISREL and Partial Least Squares (PLS) are second-generation data analysis techniques that can be used to test the factors affecting successful BI deployment and its relationship with sustainable competitive advantage (Bagozzi & Fornell 1982; Gefen et al 2000). PLS is a form of causal modeling that, like LISREL, works by 'simultaneously assessing the reliability and validity of the measures of the theoretical constructs and estimating the relationships among these constructs or variables (Barclay, Higgins & Thompson 1995; Abdi, 2007). The PLS approach provides a general model which maps paths to many dependent variables and analyze paths simultaneously rather than one at a time (Fornell & Bookstein, 1982; Gefen, Straub & Boudreau, 2000).

The ability of PLS to model latent constructs under non-normality conditions and small sample sizes makes it popular among the researchers in recent years (Compeau & Higgins, 1995; Chin, 1998). PLS is more appropriate when the measurement items are not well established and are used within a new measurement context (Barclay, Higgins & Thompson, 1995). It is suitable when the primary objective of the research is the explanation of the model variance for one or more constructs and when the research focus is on theory development.

Since the existing literature is very limited in providing a comprehensive research model for successful BI deployment, the proposed BI model in this research is not based on strong theory. The model can be regarded as an estimate model that combines relevant theories and previous empirical research findings. Therefore, the focus of this research is more on prediction of applications and theory building, rather than testing the fit of strong theory-based model.

With the arguments stated above, PLS is considered the most appropriate data analysis tool for the quantitative study. This study attempted to use PLS to establish the relationship between the different model constructs, thus testing the hypotheses.

As such, the data collected in this study was analyzed using the PLS technique utilizing the PLS-Graph version 3.0 computer software that was developed by Chin (2003) (www.plsgraph.com). In this regard, PLS path-estimates are standardized regression coefficients, and the loadings of items on the constructs can be construed as factor loadings (Barclay, Higgins & Thompson 1995). PLS also produces R-squared values for all endogenous constructs, which can be interpreted in the same manner as R-squared values produced by the regression analyses (Igbaria, Guimaraes & Davis 1995).

4.5.7 Partial Least Squares (PLS) Procedures

The BI model was tested and evaluated in the following manner as identified by Barclay, Higgins and Thompson (1995) using PLS technique. Typically, there are two sequential stages of PLS procedure:

i. **Stage 1 - Assessment of the Measurement Model**

   This stage is concerned with the relationships between the observed variables and the constructs (Igbaria, Guimaraes & Davis, 1995). 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 (Igbaria, Guimaraes & Davis, 1995). 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.

Next sections will discuss the details about the procedures undertaken in these 2 stages of PLS data analysis.

4.5.7.1 Assessment of Measurement Model

The assessment of measurement model stage concerns with the constructs validity or the extent to which the manifest indicators reflect their underlying constructs (Hanlon, 2001;

Santosa Wei & Chan, 2005). The procedures follows the PLS framework on individual item reliability, internal consistency and discriminant validity to assess the adequacy of the measurement model (Hulland, 1999; Barclay, Higgins & Thompson, 1995; Quaddus, 2004; Santosa, Wei & Chan, 2005). Table 4-2 shows the 2-step procedures undertaken in stage 1 of measurement model assessment in this study and the following sections will discuss the details of the steps.

Table 4-2 a Two-Step Assessment Procedure of Measurement Model

MEASUREMENT	ASSESSMENT PROCEDURE
1. Convergent Validity	
a) Item reliability	*Item loading ≥ 0.7*
b) Internal Consistency	
i. Composite Reliability	*Calculated value ≥ 0.7*
ii. Average Variance Extracted(AVE)	*Calculated value ≥ 0.5*
2. Discriminant Validity	
a) Construct level	*√AVE of construct > correlation between the construct and other constructs*
b) Item level	*Item loadings of construct > all other cross-item loadings of the construct*

The first step of the assessment of measurement model is to test the convergent validity of the model. This is accomplished by performing the following two steps:

a) Item Reliability

The first assessment property of BI model which has 16 constructs and 82 items was the individual item reliability test. Item reliability assessment refers to an analysis of estimating the amount of variance in each individual item's measure that is due to the construct (Barclay, Higgins & Thompson, 1995).

PLS assessment procedure is conducted by conducting simple correlations of the measures with their respective construct. The calculated correlation leads to an item loading which gave an indication of the item's strength. Researchers have different opinion on the assessment of item loading's strength but the rule-of-thumb is that the higher the item loading, the better it would represent its constructs. Hair et al (1998) provide guidelines for using item reliability to assess the relative significance of constructs and suggested three types of significance level for item loadings; (1) item loadings greater than 0.3 are considered significant (2) item loading greater than 0.4 are considered more significant (3) loadings in excess of 0.5 are considered very significant. In addition, Igbaria, Guimaraes and Davis (1995) suggested 0.4 was an acceptable reliability limit.

However, the most frequently cited rule-of-thumb in the literature was given by Carmines and Zeller (1981), which suggests retaining only those items with loadings greater than or equal to 0.70. The rational of having higher item loading values is because items with lower loadings have a random error component that exceeds the explanatory component. By dropping the lower loading items would improve the item reliability and therefore would likely to lead to improving estimates of the true relationships between the constructs (Nunnaly, 1978).

Thus, this study has taken a stance of having item reliability rules of 0.50, the value proposed by Hair et al. (1995). The more conservative of Hair et al.'s assessment's guidelines (1998) was chosen, to provide for more robust and reliable findings. This approach was considered more practical, given that the BI related study was exploratory and very few literatures explained the factors affecting the BI success that lead to sustainability of the organizations. Therefore, 5 item with loadings less than 0.55 were removed from the model. The new modified model with lesser loadings was then ready for further assessment of other measurement properties.

However, it is common to find a number of loadings below the acceptable threshold found in the literature. Items with extremely low loadings should be carefully analyzed and reviewed especially in the case of strong theoretical rationale for including such items in the research model (Nunnaly, 1978). Low loadings are attributed to several reasons such as incorrect wording in the questionnaire, using improper items to measure constructs or problems related to transferring questions from one context to another (Hulland, 1999).

b) Internal Consistency

While item reliability refers to as a measure of items against its constructs, internal consistency is referred to as the measure of reliability of the constructs (Fornell & Larcker, 1981). Many quantitative researchers had been using Cronbach's alpha as a measurement for internal consistency. Fornell and Larcker (1981) suggest two types of measurements for assessing internal consistency: (1) Composite Reliability (CR); (2) Average Variance Extracted (AVE).

The first measure developed by Fornell and Larcker (1981) uses composite reliability as the measure of internal consistency. The value of composite reliability can be calculated using the following formula (Chin 1998; Barclay, Higgins & Thompson, 1995):

$$\rho c = \frac{(\sum \lambda i)^2}{(\Sigma \lambda i)^2 + \Sigma i \ Var(\varepsilon i)}$$

where λi = the simple correlation between the item and its constructs (item loading) and Var (εi) = $1 - \lambda i^2$, the variance.

Composite reliability is argued to be more superior than Cronbach's alpha. The claim is based on the argument that new measurement uses the item loadings obtained within the causal model (Barclay, Higgins & Thompson, 1995; Fornell & Larcker, 1981). Since the measurement is not influenced by the number of items in the scale, thus the new measure is considered to be more general than Cronbach's alpha.

However, irrespective of which measure is used, the values are interpreted in the same manner in the research reports. As with Cronbach's alpha, the benchmark of 0.7 was the minimum value for the calculated composite reliability suggested by Nunnaly and Berstein (1994) can be adopted to assess the internal consistency measure of the constructs (Barclay, Higgins & Thompson, 1995).

The second measure suggested by Fornell and Larcker (1981) to assess internal consistency is concerned with assessing the Average Variance Extracted (AVE) for each construct. AVE indicates the amount of variance shared between a construct and its measures. Chin suggests that the value of AVE can be obtained using the formula below:

$$AVE = \frac{\sum \lambda i^2}{\Sigma \lambda\ i^2 + \Sigma\ \mathrm{Var}\ (\varepsilon\ i)}$$

where; λi = simple correlation between item and its constructs (item loading)

$\mathrm{Var}\ (\varepsilon i) = 1 - \lambda\ i^2$ (the variance)

It is suggested that a construct should achieve a value greater than or equal to 0.5 in order to achieve adequate reliability (Barclay, Higgins & Thompson, 1995; Fornell & Larcker, 1981; Nunnaly, 1978).

Discriminant Validity

A third assessment property of measurement model is discriminant validity, which refers to the degree to which constructs differ with each other in the same model (Hulland, 1999; Barclay, Higgins & Thompson, 1995). It means that an item could potentially share more variance with other constructs than the construct it intends to measure.

Typically, PLS technique assesses discriminant validity by examining the correlation at both constructs and items level. In order to meet the criteria for discriminant validity at construct level, the variance shared between measures of two different constructs should be lower than the AVE for the items measuring each construct (Fornell & Larcker, 1981; Barclay, Higgins & Thompson, 1995; Santosa, Wei & Chan, 2005; Chin, 1998).

The cross-loading analysis in PLS measures the correlation of an item with respect to all of the constructs in the model, including the construct it intends to measure (Chin, 1998). An item should not load higher on other constructs than on the constructs it intends to measure; otherwise it should be excluded from the model. However, PLS Graph 3.0 software used in this study does not produce this statistics. Thus, the researcher has to manually calculate the output produced by the software using other statistical software package namely SPSS version 17 for Windows.

4.5.7.2 Assessment of Structural Model

The structural model comprises the hypothesized relationships between latent constructs in the research model (Santosa, Wei & Chan, 2005). The assessment process involves evaluating the explanatory power of the independent variables and examines the size and the significance of the path coefficients (Barclay, Higgins & Thompson, 1995; Santosa, Wei & Chan, 2005).

In this study, BI model comprises of nine independent latent variables, two dependent variables and three moderating variables. The nine independent variables are: Quality Information, Quality Users, Quality System, BI Governance, Relative Advantage, Complexity, Compatibility, Observability and Triability and the two independent variables are: Successful BI Deployment and Use of BI-based Knowledge for Sustainable Competitive Advantage. The model also has 3 moderating variables of Organizational Culture, BI Tools and Business Strategy. Moderating variable of BI Tools is sub-categorized into three categories of Operational Tool, Tactical Tool and Strategic Tool and Business Strategy is also sub-categorized into four categories of Prospector, Analyzer, Defender and Reactor.

Table 4-3 A Five-Step Assessment Procedure of Structural Model

Step	Procedure
1	*Collect standard path loadings*
2	*Test significance of path loadings*
3	*Produce R^2 values*
4	*Define direct and indirect effects*
5	*Revise the model where feasible*

The structural relationships were tested using the SEM approach, which is illustrated by 5-step procedure in Table 4-3. The predictive power of the proposed research model can be accessed by obtaining the R^2 values (Barclay, Higgins & Thompson, 1995; Santosa, Wei & Chan, 2005). Interpreting the values of R^2 in PLS model is the same as that in explain the R^2 values produced by multiple regression analyses (Barclay, Higgins & Thompson, 1995). Therefore, R^2 values will determine the explanatory power of a component of the model by indicating the amount of variance in the construct which is explained by its corresponding independent constructs.

Bootstrapping method was used in testing the structural paths in BI model. This was accomplished by estimating the value and significance of every BI model's path coefficients. Bootstrapping, or the alternative, Jackknifing, are commonly used procedures used in PLS analyses (Chin 1998). Bootstrapping is a non-parametric test of significance that produces t-statistics to evaluate the significance of the structural paths. The R^2 values of the endogenous variables, produced by the bootstrap method, allow for assessment of the BI model's explanatory power. The interpretations of these values are the same as the R^2 values in regression analysis (Fornell & Larcker, 1981). ,

Choosing bootstrap method over jackknifing was on the basis of computational time and efficiency factors. The bootstrap is considered has greater computational time but it was not an important issue in this study as the PLS calculations were done using a PLS-Graph software. Bootstrap also is being argued to be more efficient that jackknife method, as jackknife is considered to be an approximation to the bootstrap. Therefore, the choice of bootstrapping method for this study was appropriate.

4.6 SUMMARY

This chapter discussed the choice between two distinct research paradigms, namely the interpretivist and positivist (Crotty, 1998). The positivist paradigm was considered appropriate for BI study based its predecessors of generic information systems, which mostly undertaken positivist paradigm in prior researches.

The research method and the research process used in the study were discussed. Employing mixed method approach, the research was carried out in several sequential phases including field study and industry survey. The first phase of the study was the extensive review of the literature which resulted in the development of the initial BI model. The model was then validated through the field study which involved all of four telecommunication companies in Malaysia. The model was later enhanced and a more comprehensive research model was developed. The findings of this phase also were used to construct an industry survey instrument. The instrument, which was the questionnaire together with the hypotheses were later empirically tested using quantitative methods.

The following chapters will detail out the findings of the field study and the development of final research model.

CHAPTER 5

THE FIELD STUDY AND MODIFIED RESEARCH MODEL[2]

5.1 INTRODUCTION

A qualitative field study was undertaken in this phase of the research, where all five organizations from telecommunication industry in Malaysia were studied. The focus of this phase was to corroborate and enhance the factors and variables defined in the preliminary research model. It was based on the premise of the extensive literature done on the successful deployment of BI and its relationship with organizations sustainable competitive advantage.

Primary objectives of the field study were two-fold:

i. To identify various factors and variables of successful BI deployment and their relationship with organization's sustainable competitive intelligence; and
ii. To improve a research model of BI for Sustainable Competitive Advantage

The field study involved all present telecommunication service operators in the Malaysian telecommunications industry. Currently, there are five operators serving 25.58 million Malaysian populations (Department of Statistics, Malaysia, 2005; Malaysian

[2] Parts of this chapter have been presented in the following conferences:

[a] Ahmad, A., Quaddus, M. and Shiratuddin, N. (2007), 'Application of Business Intelligence Tools in Telecommunication Industry', *in Proceedings of the 2007 International Conference on Information and Knowledge Engineering (IKE2007), part of World Congress of Computer Science, Computer Engineering and Applied Computing (WorldComp'07*), Las Vegas, Nevada, USA, 25-28 June 2007, pp 265-271.

[b] Ahmad, A., Quaddus, M. and Shiratuddin, N. (2007), 'Determinants of Successful Business Intelligence Deployment: Field Study of Telecommunication Industry', *in Proceeding of Society for Global Business and Economic Development, Kyoto, Japan*, 8-12 August 2007, pp 1746-1758.

Communications and Multimedia Commission, 2004). Semi-structured interview technique was applied to collect relevant data, involving 10 decision-makers in those organizations. The interview data involving researcher's notes and micro-audio tape were transcribed verbatim into electronic transcripts. Content analysis was then performed on the transcripts to extract the factors and variables. These findings were used to confirm and enhance the initial model of BI for sustainable competitive advantage and the modified model was later developed.

The following section will first describe the operation of the field study using semi-structured interview technique. The data analysis via content analysis method using a combination of inductive and deductive approaches is presented next. Results of the study are then presented and interpreted in detail in the form of factors and variables of BI deployment and its relationship with company's sustainable competitive advantage. The finalized modified BI model is finally described in detail.

5.2 THE OPERATION OF THE FIELD STUDY

5.2.1 Qualitative Research Paradigm

The field study method employed qualitative as the research paradigm (Zikmund, 2003). A semi-structured interview approach was adopted in this phase of the study in order for the researcher to better understand the perceptions of the participants on business intelligence at both individual as well as organizational levels. The review of the literature has provided the framework for initial development of the interview questions. The literature also helped in refining the interview questions to better suit the actual environment. Interview is mentioned in the literature as a very common method in getting qualitative data and evidence shows that the method is indeed an effective tool to collect data for thousands of years (Whiteley et al., 1998). Like any other research method, field study also involves selecting samples from the study population of either random or non-random type (Zikmund, 2000). The sampling method chose for this study was a convenience non-random type.

The main objective of this phase was to develop a model of BI for sustainable competitive advantage. At the end of the phase, a modified model that was developed was used for further quantitative studies in the form of pilot and industry survey. This type of research; a qualitative followed by quantitative approach is sometimes called a mix-method and some has also referred it as a linked study. This mix-method type of research is used widely now and supported in the literature, for example Gable (1994), Tashakkorri and Teddlie (1998) and Creswell (2003), among many others. The details of the field study process are presented in the subsequent sections.

5.2.2 Interview Sample Demographics

All of the five telecommunications services operators in Malaysia were involved in the field study. One of the operators is a government-owned organization, another three are large private organizations and the last one is a multinational organization. A convenience sampling for the participants of 10 decision makers/executives was selected from these companies and some were through researcher's personal contacts. It is noted that convenience sampling is frequently undertaken in business research (Zikmund, 2004). The main selection criterion was that the selected participants have to be involved in decision-making and had some level of utilizations in BI initiatives.

Table 5-1 provides a brief overview of the participants in the field study. The participants were selected on the basis of their potential to contribute to the development of the insights and understandings of the research subject and because of the positions they hold. They were first contacted by telephone and the objectives of the study were explained. All participants who took part in the study were on voluntary basis. It should be noted that all of them had some level of decision-making as part of their responsibilities as they were holding important positions in their companies such as chief financial officer and senior vice president. All of them had at least basic tertiary education and one of them had doctor of philosophy degree.

The levels of BI awareness and utilizations among them were fairly high. Majority of the participants (Six of them) were involved in the development and implementation of BI applications in their companies. These involvements make them aware of the importance of acquiring knowledge in decision-making process and they were to certain extent contributing to the organizations' policy-making process. Thus, the respondents were in better positions in giving their perceptions on how BI could be deployed successfully and could lead to sustainability of their organizations. Meanwhile, others that were regarded as medium utilization simply because they were just mainly the users of BI systems in their organizations. One participant was regarded as low in BI utilization as he was new to BI system.

Table 5-1 Demographics of the Participants in Field Study

Company	Participant	Participant's Position	Participant's Education	Level of BI Utilization
Company A (Government-owned)	P1	General Manager (Planning & Monitoring)	Masters Degree	High
	P-2	General Manager (Network Operations)	PhD	Medium
	P-3	Assistant General Manager (Group Marketing)	Bachelor Degree	Low
Company B (Large Privately-Owned)	P-4	Chief Financial Officer	Bachelor Degree	High
	P-5	Manager (Network Operations)	Masters Degree	High
Company C (Large Privately-Owned)	P-6	Senior Vice President	Bachelor Degree	Medium
	P-7	General Manager (IT Operations)	Masters Degree	Medium
Company D (Large Privately-Owned)	P-8	Principal Engineer (Circuit Provisioning Center)	Bachelor Degree	High
	P-9	Assistant Principal Engineer (Transmission Engineering)	Bachelor Degree	High
Company E (Multi-national)	P-10	Manager (Transmission Engineering)	Bachelor Degree	High

5.2.3 Data Collection

This study used the method of semi-structured interview to collect relevant data in order to explore the basic model of BI deployment for sustainable competitive advantage. The semi-structured interview questions have focused on the following areas of information needed in the field study:

i. General perceptions and understanding of BI
ii. The main factors that influence the successful BI deployment
iii. Usage of BI-based knowledge in decision-making activities
iv. Required tools for generating knowledge
v. The role of organization culture in utilizing BI-based knowledge
vi. The role of business strategy in BI success especially in aligning between knowledge and business
vii. Utilization of BI-based knowledge in sustaining competitive advantage of the organization

The interviews were scheduled as per convenience of the interviewees to ensure less disruptions and interruptions in their working schedule. Prior to an interview session, a participant was contacted by telephone to provide an idea of the interview process and some brief understandings of BI. The duration of a one-to-one interview session took about one to two hours to complete. From the four organizations, a total of 10 interviews were conducted. It was observed that the interviewees were at ease during the sessions and they willingly answered all the questions posed to them. Fruitful discussions were observed during the sessions where the interviewer managed to tap some of the information that was not pre-defined in the questions. This may be due to the fact that most of the participants were aware of the subject matter and they were quite involved in BI initiatives.

The interview data were noted with the interviewees' permission and their voices were recorded using a micro-audio recorder. To ensure trustworthiness of the data, the write-up of the full set notes is done soon after the event (Saunders et al., 1997). These were performed immediately to ensure accurate data from participants' body languages and physical and emotional cues. Next, the verbatim transcriptions of all the recorded interviews were completed for data analysis (Merriam, 1997).

5.3 DATA ANALYSIS VIA CONTENT ANALYSIS APPROACH

There were more than 100 pages of verbatim transcripts from micro-audio and notes to be analyzed despite only 10 participants involved the interviews. Content analysis was carried out in two phases. Figure 5-1 shows the content analysis procedure adapted in this study. Phase one involved analysis of an individual script, while phase two dealt with integrating these individual scripts (Xu, 2004).

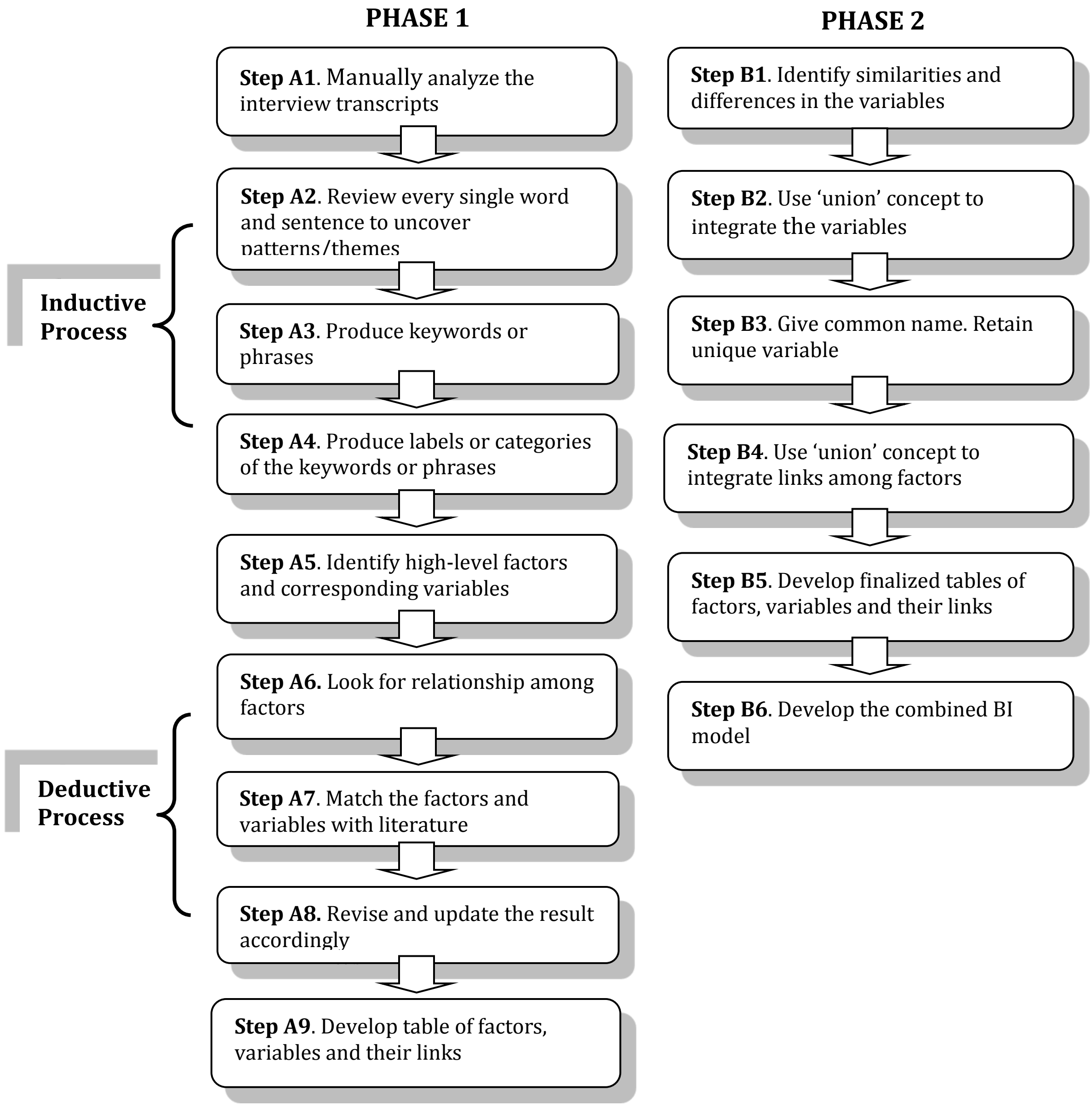

Figure 5-1 Content Analysis Process

Analysis was conducted manually because of the nature of a simple language used by Malaysian participants. The researcher had to carefully interpret the meaning of every word and sentence uttered by participants. A combination of inductive and deductive approaches was then performed to categorize the factors and variables (Berg, 2001).

As shown in Figure 5-1, every step was given a unique name such as Step A1 to Step A9 for Phase 1 and Step B1 to Step B6 for steps in Phase 2. Every step was completed in sequential order, which means that the output of the previous steps would be the input to the next steps. Phase 2 commenced only after the successful completion of Phase 1.

As mentioned before, the entire interview transcripts were first carefully analyzed manually (Step A1). An inductive process was first performed on the transcripts, where every single word and sentence was reviewed to uncover key patterns or themes (Step A2). Keywords or phrases were produced at this stage in order to be used later (Step A3). The key words or phrases were given labels or categories (Step A4). High-level factors and corresponding variables were identified. The relationship between factors from each script was identified next (Step A5). A deductive process was performed here where the identified factors were matched with the ones found in the literature previously (Step A6). These factors were revised and updated accordingly without scarifying any factors and variables obtained from the interviews (Step A7). Tables of factors, variables and their links were finally developed for each interview (Step A9).

Phase 2 commenced immediately after the completion of the first phase. The main aim of the second phase of the content analysis was to develop a finalized BI model based on the factors, variables and links that have been identified in the previous phase. The best way to do it was to integrate all the information gathered so far into one single entity. As shown in Step B1, the similarities and differences of variables under each factor were identified. A mathematical 'union' concept was used at Step B2 in integrating the similar variables. The new combined variable was given a new name and unique variables were retained (Step B3). The same 'union' concept was used to integrate the links among the factors (Step B4). Then, Step B5 developed the final tables of factors, variables and their links. Finally, the new combined BI model was developed, which is shown in Figure 5-12.

5.4 RESULTS AND INTERPRETATIONS

5.4.1 Factors and Variables

The analysis of the interview data, collected as part of the field study, identified a number of factors and variables. From the content analysis mentioned in the previous section, a total of thirteen factors and seventy-one variables of successful BI deployment and its relationship with sustainable competitive advantage were identified. Different participants from different telecommunications companies have mentioned either similar or different variables during the interview sessions.

Table 5-2 provides a complete list of factors and variables with subsequent frequencies. These frequencies show the number of times the variables were mentioned by corresponding participants. The interview data were coded and categorized by cross-referencing to the factors and variables of the preliminary research model (as presented in Figure 3-1 in Chapter 3).

Table 5-2 Factors and Variables of Successful BI Deployment for Sustainable Competitive Advantage

Factor/Variable	Participant									
	1	2	3	4	5	6	7	8	9	10
Quality Information										
Accuracy	√	√	√	√	√	√	√	√	√	√
Accessibility	√	√		√	√		√	√		
Completeness/Adequacy	√	√	√	√			√	√		
Currency	√	√		√	√			√		
Presentable/Format	√	√	√	√	√	√	√	√	√	√
Available internally	√	√	√	√	√	√	√	√	√	√
Available externally	√	√		√	√	√				
Trustworthy/Integrity			√		√					
Relevance	√				√	√	√	√		
Security								√		

Quality Users										
Possess technical skills	√		√			√	√	√	√	
Possess business skills	√			√			√	√	√	
Possess analytical skills	√	√	√			√	√	√	√	
Competence		√	√		√	√	√			
Understand requirements	√			√		√		√		
Determine to use and act on data		√		√		√			√	√
Able to utilize data and turn into knowledge	√	√		√		√			√	√
Willing to optimize BI capabilities	√	√		√	√				√	√
Accountable/Integrity							√		√	
Quality Systems										
Functionality	√	√	√	√		√				
Reliability		√		√						√
Flexibility/Adaptability			√	√						
Integrated to other systems	√	√	√	√	√	√	√	√	√	√
Accessibility	√			√			√	√		
Response time	√	√		√					√	√
BI Governance										
Manage and sponsor BI implementation	√							√		
Monitor and Support BI initiatives	√			√				√		
Enforce top- down directive			√	√	√					
Policy of BI and business alignment	√									
Provide good training and retraining program			√		√			√	√	

Successful BI Deployment										
System Dependent/Reliable	√	√	√	√	√	√	√	√	√	√
Satisfied users/Use		√	√							
Rely on BI	√	√	√	√	√	√	√	√	√	√
Utilize BI-based knowledge in decision-making	√	√	√	√	√	√	√	√	√	√
Help users be effective and efficient	√	√				√			√	
Organizational Culture										
Leadership by example		√								√
Learning organization				√						√
Knowledge-sharing	√			√					√	
Competitor-orientation	√	√		√						√
Customer-orientation	√	√		√						√
Continuous improvement										√
Utilization of BI Tools										
Identify trends and patterns to detect problem and bottlenecks	√	√	√	√	√	√	√	√	√	√
Support CRM for targeted marketing	√	√	√	√	√	√				√
Model customer behaviour	√	√	√	√	√	√		√		
Find revenue leakages by uncover billable services	√	√	√	√						√
Perform in-depth traffic and usage pattern analysis	√	√	√	√	√	√	√	√	√	√
Monitor performance	√	√	√	√	√	√	√	√	√	√
Setting up key performance indicator (KPI)	√	√	√	√	√	√	√	√	√	√
Customer service/Help desk	√		√	√						

Detect fraud and fault	√		√						√	
Business Strategy										
‘First-in’ in to introduce new telecommunications products				√		√			√	
Respond to opportunities quickly	√	√	√	√	√	√		√	√	
Contribute to industry innovation									√	
Adopt quickly to new products	√	√	√	√	√	√		√	√	
Examine new products carefully	√	√	√	√				√	√	
Monitor competitor’s action	√	√	√	√	√	√		√		
Locate safe product and services		√	√							
Try to maintain current products		√	√							
Use Of BI-Based Knowledge For Sustainable Competitive Advantage										
Create long-term strategy formulation for highest profit	√			√		√		√	√	√
Achieve long-term financial success	√	√		√	√	√		√	√	√
Improve customer service for customer loyalty	√	√	√	√	√	√	√	√		
Deliver quality and excellent services to customers	√	√	√	√	√	√	√		√	
Develop honest relationship with suppliers	√			√						
Plan for fair and safe environment for employees								√		
Plan for support and			√							

communication with local community										
Perceived BI's Relative Advantage										
Accomplish tasks quickly	√	√		√				√		
Improve quality of work				√						
Easy to perform job	√	√		√				√		
Increase productivity and performance	√	√		√						
Enhance effectiveness of decision-making tasks	√	√		√				√	√	
Greater control		√						√		
Perceived BI's Compatibility										
Relevance to current working culture					√					
Adaptable to current working style										√
No effect on current working style										√
Perceived BI's Complexity										
Time consuming	√		√					√		
Complicated	√	√	√	√				√		
Too much work involved	√	√	√	√				√		
Too long to learn	√	√	√							
Perceived BI's Observability										
Can see rewards of using BI			√		√			√		
Can see immediate benefits			√		√			√	√	
Encourage group work										√

The content analysis process attempted to maintain consistency between the interview data and the variables identified in the preliminary BI model. However, some of the variables identified in this study had slight difference in their meaning from those found in the literature. These differences could be due to the fact that the data captured were meant to represent the responses of the participants in the context of BI systems as compared to the variables used for information system in general.

It can be observed from Table 5-2 that responses from field study participants recognized all of the fourteen factors identified in the preliminary BI model except the factor of *Perceived BI's Triability*. The reason this factor was not mentioned by any of the participants could be due to the fact that the participants have been using BI systems for a number of years. They could not anticipated good reason of trying the systems before using them and triability would no longer be an issue. As anticipated, the two groups of antecedents of firm internal resources and perception of innovations characteristics (with the exception of BI's triability) were confirmed by the participants.

Interestingly, out of eighty-one variables identified only ten variables were confirmed by all participants. The variables are: *Accurate, Presentable, Available Internally, Integrated to other Systems, System Dependent, Rely on BI, Utilize BI-based Knowledge in Decision Making, Identify Trends and Patterns to Detect Problem and Bottlenecks, Perform In-Depth Traffic and Usage Analysis, Monitor Performance* and *Setting-Up Key Performance Indicator (KPI).* Eight variables were declared by majority of more than seven participants.

In general, the responses reflected the executives' level of BI usage experience and sophistication. For instance, in terms of the number of variables provided by the participants, Participant #1, the Planning and Monitoring General Manager of the oldest government-owned telecommunications company, whom had enormous working experience in telecommunications field and had high utilization of BI, indicated the most factors. Participant #4, the Chief Financial Officer (CFO) of the large privately-owned company scored second place. The rationale could be that their enormous experience in telecommunications field and high level of BI utilization make them more aware of the importance of BI and its related issues.

On the other hand, Participant #6 the Senior Vice President and Participant #7 the IT personnel from the youngest telecommunications company did not have the same level of BI utilization as some of other interview participants, and therefore identified the least number of variables. Their basic view towards BI deployment and its relationship to company's sustainable competitive advantage can be attributed to the fact that they are inexperience BI users. Therefore they are less concerned with strategic issues concerning BI successful deployment.

The responses from the interview participants confirmed the influences of the first group of antecedents of BI relating to the internal firm's resources found in the literature. These antecedents which were based on the Resource-based Theory (RBT) were *Quality Information*, *Quality Users*, *Quality System* and *BI Governance*. Our study brings out that most participants agreed with the first three firm's internal resources of *Quality Information*, *Quality Users and Quality System* to be the factors that affect the successful BI deployment and thus would contribute to their organizations' sustainable competitive advantage. This finding can be attributed to the fact that all of the participants were actively involved in their organizations' BI initiatives and they were aware and understood the issues involved in implementing and supporting BI initiatives. However, there was limited support for the influence of *BI Governance* from the field study participants, even though this construct was identified in the literature as an important factor in information system implementation success such as BI.

Another group of antecedents of BI relating to the perceptions of innovation characteristics received moderate support by the interview participants of Malaysian telecommunications executives. The variables of the perceptions of innovation characteristics suggested by Rogers (1995) such as *Perceived BI's Relative Advantage*, *Perceived BI's Compatibility, Perceived BI's Complexity* and *Perceived BI's Observability* were mentioned by the participants to be the important factors in BI success. However, there was no support for *Perceived BI's Triability* from interview participants, even though this factor was shown to be significant in studies relating to information systems adoption.

The variables relating to *BI's Relative Advantage* such as *accomplish tasks quickly, easy to perform job* and *enhance effectiveness of decision-making tasks* were all considered to be similar to the relative advantage construct identified by Rogers (1995). Factor of *Perceived BI's Compatibility* and *Perceived BI's Observability* received little support from the participants. Only one participant considered *can see rewards of using BI, adaptable to current working style* and *no effect on current working style* as important in BI success. This could be due to the fact that all the participants were high-ranking executives in these organizations and the issues of rewards and compatibility were not the issues for them. Their main concerned for BI success was to provide appropriate knowledge needed in performing their decision-making tasks.

Successful BI Deployment construct received overwhelming support from the field study participants. All participants agreed that successful deployment of BI systems in organizations means that BI users have to be dependent and relied on BI systems to perform their decision-making tasks and BI-based knowledge is utilized in sustaining their organizations' sustainable competitive advantages.

Factor of *Utilization of BI Tools* received majority support from the participants. All participants considered the variables of *identify trends and patterns to detect problem and bottlenecks, perform in-depth traffic and usage patterns analysis, setting-up key performance indicator (KPI)* and *monitor performance* to be important applications of BI tools. These four variables were considered to be similar in nature to the variable of strategic use of BI tools identified in the literature on BI for sustainable competitive advantage (Moss, 2005; Buhler, 2003; Weir, 2004; Rao & Swarup, 2005; Chung, 2002; Dresner, 2006; Erikson 2005)

Factor relating to *Business Strategy* was also reasonably well supported by the interview participants. Most of them agreed of aligning business strategy with BI to ensure knowledge acquired through successfully deployed BI would be used for their organizations' sustainable competitive advantage. Their main concern centered on the ability of their organizations to *respond to opportunities quickly*, *to adapt quickly to new products, to carefully examine new products* and *to monitor competitor's action*. These three types of business strategy which were supported by the participants were similar in nature to the prospector, analyzer and defender types of business strategy found in Miles and Snow's typology (1978). These three types of business strategies coupled with utilization of BI-based knowledge are expected to enhance telecommunications organizational performance.

However, there was limited support from the interview participants for the *Organizational Culture* construct. Only two participants mentioned *leadership by example* and *learning organizations* as important elements of organization culture, while three participants were concerned with *knowledge sharing* and *customer-orientation* culture in ensuring successful BI deployment in their organizations. Four participants supported the idea of having the element of *competitor-orientation* as part of organization culture to ensure BI success.

As previously discussed, the focus of the field study was on validating and enhancing the factors and variables identified in the initial research model. Next section will discuss about relationship between the factors found in the field study.

5.4.2 Perceived Relationships between Factors

Perceptions of relationships among factors were some of the important information sought during the interview process (Xu, 20003; Huang, 2007). The information about the relationships was also extracted from the interview scripts and analyzed via content analysis process as depicted in Figure 5-1. The analysis of these relationships is presented in Table 5-3.

Table 5-3 Causal Linkage among the Factors

Links Between Factors	1	2	3	4	5	6	7	8	9	10
QI → BD	√	√	√	√	√	√	√	√	√	√
QU → BD	√	√	√	√	√	√	√	√	√	√
QS → BD	√	√	√	√	√	√	√	√	√	√
BG → BD	√	√		√	√			√	√	
RA → BD	√	√		√				√	√	
CX → BD	√	√	√	√				√		
CP → BD					√					√
OB → BD			√		√			√	√	√
BD → SCA	√	√	√	√	√	√	√	√	√	√
BS → BD → SCA	√	√	√	√	√	√		√	√	
BT → BD → SCA	√	√	√	√	√	√	√	√	√	√
OC → BD → SCA	√	√		√					√	√

* Abbreviation for the factors:

QI - Quality Information
CP - Perceived BI's Compatibility
QU - Quality Users
OB - Perceived BI's Observability
QS - Quality System
OC - Organazitional Culture
BG - BI Governance
BS - Business Strategy
RA - Perceived BI's Relative Advantage
BT - Utilization of BI Tool
CX- Perceived BI's Complexity
BD - Successful BI Deployment
SCA - Use Of BI-Based Knowledge For Sustainable Competitive Advantage

As illustrated in Table 5-3, the relationships or causal linkages between the factors are found in column one and their corresponding frequencies found in the respective columns. For example, the notation of (QU → BD) found in column one and row three represents the pairs of factors and their respective relationship. This notation represents the relationship between *Quality Users* and *Successful BI Deployment* and this relationship has been identified by all participants in the field study. This particular relationship between these two factors was identified through content analysis by Participant #1 based on his statement of '*I don't regard them as quality users; I would rather called them capable users. Capable users are people that utilize the information that are available to them and turn them into knowledge that can be use to benefit the organization. With that their organization's performance will be boosted. Yes, definitely I would say capable users are utmost important in BI since they are the one who use the systems'* (see sample of interview scripts of Participant #1 in Appendix C).

Another example of a relationship is between factors *BI Governance* and *Successful BI Deployment* (depicted as BG → BD) found in column one and row seven, where the link was supported by Participant #1, #2, #4, #5, #8 and #9. The statement made by Participant #1 as "*Yes, good governance is making sure that rules and regulations regarding BI are in place…. all the do's and don'ts are clearly spell-out, surely it will help BI success…."* identified this link.

Table 5-3 was used as a basis to draw links between factors in a causal BI model. The development of individual BI model is discussed in the next section.

5.4.3 The Construction of BI for Sustainable Competitive Advantage Model

There are ten different causal BI models developed based on information of factors and variables found in Table 5-2 and information on relationship among factors found in Table 5-3. Individual models vary depending on the number of factors and variables mentioned by each field study participant. Some models are more comprehensive than the rest.

The difference in perceptions may be due to the number of reasons such as level of BI utilizations in the organizations among the field study participants as some participants had high BI utilizations when compared to the rest. The perceptions may also vary due to the level of experience in BI as well as level of educations among participants. The more experienced participants or the better educated participants were anticipated to provide more views on issues relating to BI. The organization's growth status may also lead to the differences in participants' perceptions as some Malaysian telecommunications companies were steady growing while some are not. These reasons could affect their perceptions on BI and its related issues in sustaining organizations competitiveness.

Figure 5-2 shows the first BI model as perceived by Participant #1 that has eleven factors and forty-eight variables. Factors that fall under firm's internal resources are *Quality Information, Quality Users, Quality Systems* and *BI Governance*, while perceptions of innovation characteristic's category has two factors: *BI's Relative Advantage* and *BI's Complexity*. The bulleted items are the variables for the above factors. For example Quality Information factor has eight variables underneath it which are *Accuracy, Accessibility, Completeness, Currency, Presentable, Available Internal Information, Available External Information* and *Relevance.* The arrows pointing into the variables depict the relationships between variables.

Based on Figure 5-2, firm's internal resources of *Quality Information, Quality Users, Quality Systems* and *BI Governance* and innovation perceptions category of *BI's Relative Advantage* and *BI's Complexity* are claimed to be the determinants of *Successful BI Deployment*. It is interesting to note from Figure 5-2 that the thick arrow from *Successful BI Deployment* points towards the *Use of BI-based Knowledge for Sustainable Competitive Advantage*. This is to suggest that successfully deployed BI can help the organizations sustain their competitiveness by utilizing knowledge acquired through BI deployment. This phenomenon can be further enriched by having good *Organizational Culture* of *knowledge sharing* and *competitor-oriented* among the users as depicted in arrows pointing to the arrows that connecting two factors.

The model also suggests that the variables *Organizational Culture, Business Strategy* and *Use of BI Tools* would moderate the relationship between *Successful BI Deployment* and *Use of BI-based Knowledge for Sustainable Competitive Advantage*. The stress on organizational culture and its associated attributes such as *knowledge-sharing* and *competitor-oriented* suggests that culture is important in ensuring knowledge acquired through BI deployment will be used in achieving and sustaining organizations' strategic positions. Business strategies such as *Quick to respond to opportunity, Quick to adapt to new products, Careful to examine new product* and *Monitor competitor's action* are suggested to enforce utilization of BI-based knowledge in sustaining competitive advantage. Applications of BI tools such as *Identify trends and patterns, Support CRM, Model customer behaviour, Find revenue leakages, Perform traffic and usage analysis, Monitor performance, Set-up KPI, Customer service/Help* *desk* and *Detect fraud and fault* are really useful when properly utilized for acquiring the right knowledge for decision-making.

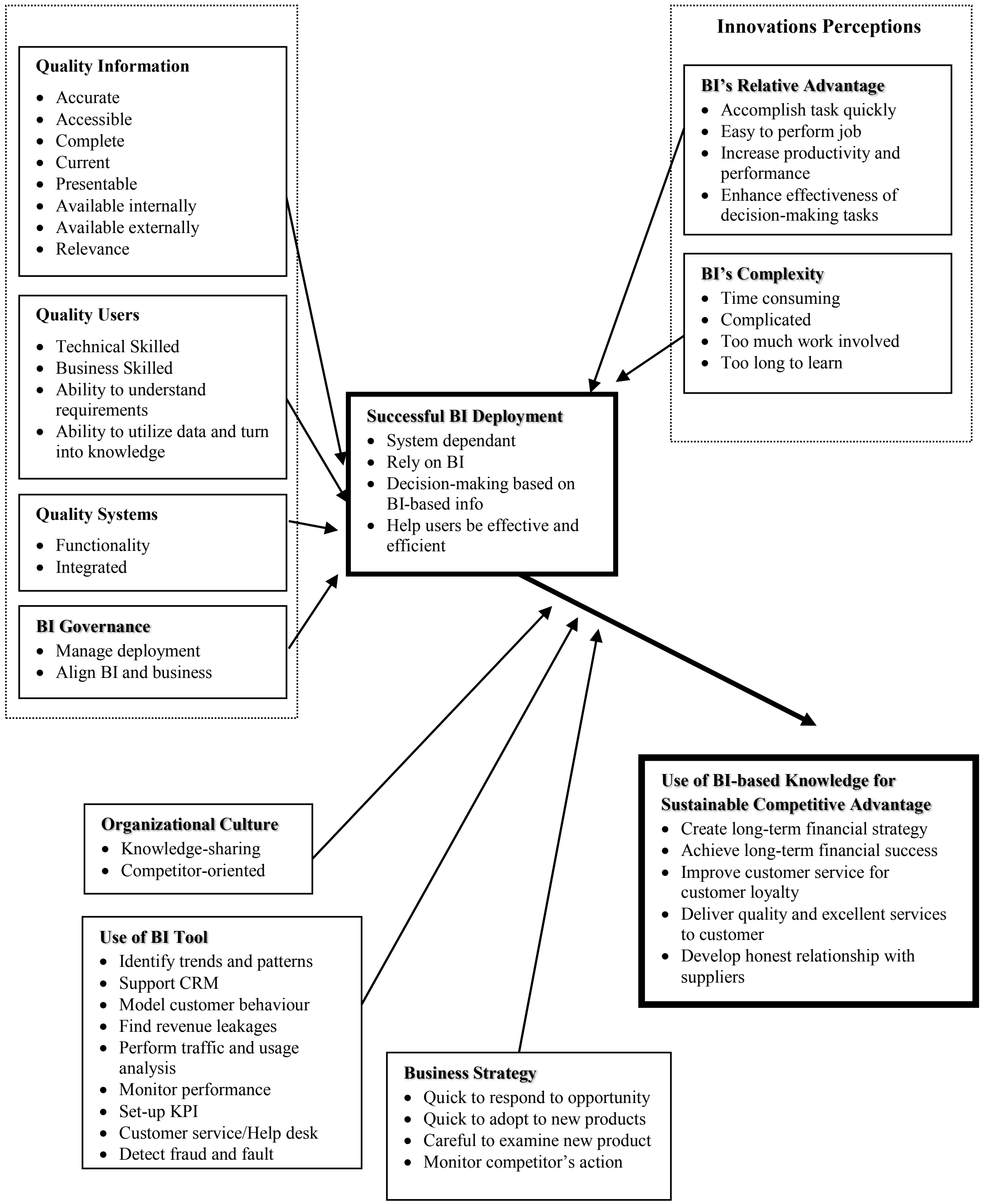

Figure 5-2 BI for Sustainable Competitive Advantage of Participant #1

The rest of the individual BI models are shown in Appendix D (Figure 5-3 to 5-11). From these ten individual models, a finalized model of BI for sustainable competitive advantage was developed using the 'union' concept as discussed in the following section.

5.5 THE FINAL COMBINED BI MODEL

The focus of the field study was to explore factors and variables that could influence the successful BI deployment that would lead to company's sustainable competitive advantage. The finding of the field study generally confirmed the preliminary model of BI for sustainable competitive advantage developed previously. This was achieved through practical support from interviews to fine-tune the factors and variables identified before-hand. From the ten individual models discussed in the previous section, a combined model of BI for sustainable competitive advantage is developed using the 'union' concept. Union concept was adopted by combining all the factors and variables identified from all the 10 models. This model is then combined with preliminary research model to develop the final research model.

The final research model, presented in Figure 5-12, represents a comprehensive set of factors that affect the successful BI deployment in telecommunication companies in Malaysia. Upon successful BI deployment, the knowledge acquired would thus be utilized for these companies sustainable competitive advantage. The model is similar to the preliminary research model with firm's internal resources and perception's of BI's characteristics, considered to better explain the successful BI deployment that would lead to sustainable competitive advantage of organizations.

Looking at Figures 5-2 to 5-11, it is observed that the preliminary model defined based on resource-based theory in the conceptual framework as **"Firm Internal Resources" → "Successful BI Deployment" → "Sustainable Competitive Advantage"** applies quite effectively for this study. However, it must be highlighted that factors and variables are different and very specific to BI deployment. This final BI for Sustainable Competitive Advantage model is unique in the sense that it has been developed based on the combination of data obtained from the substantial review of related literature and findings from ten interviews in five different telecommunications

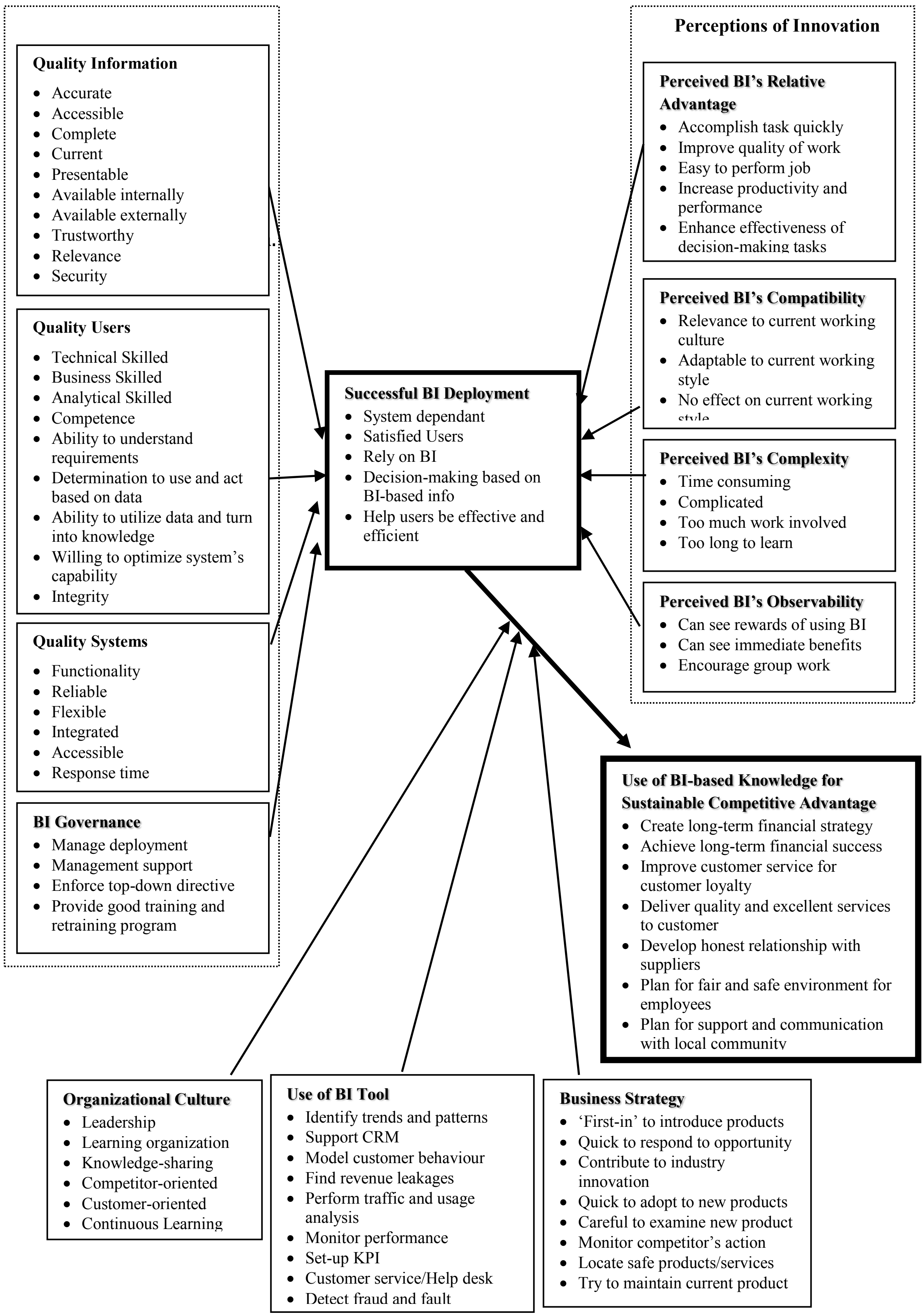

Figure 5-12 Finalized Model of BI for Sustainable Competitive Advantage

The final BI model shown in Figure 5-12 has 13 factors and 81 variables which are slightly different in terms of number of variables from the preliminary model. It is observed that the basic determinants, which are obtained from the literature, apply quite effectively in the successful BI deployment with exception of one determinant. These determinants are *Quality Information, Quality Users, Quality Systems* and *BI Governance*, which fall under the firm internal resources and *Perceived BI's Relative Advantage, Perceived BI's Compatibility, Perceived BI's Complexity,* and *Perceived BI's Observability,* which fall under the perceptions of innovation characteristics. *Organization Culture, Business Strategy* and *Use of BI Tools* are considered moderators between *Successful BI Deployment* and *Utilization of BI-Based Knowledge for Sustainable Competitive Advantage.* It should be noted that linkages between factors in the model also represent the hypotheses used in the study.

The final model was used as a research model for the next phase of the study, which is the quantitative method. A causal modeling approach of structural equation modeling (SEM) was undertaken to validate the final BI model (Barclay, Higgins & Thompson, 1995). The construction of the hypotheses will be discussed in the next chapter. The following sub-sections first details out the constructs used in the final research model.

5.5.1 Factors of Firm Internal Resources

The resource-based theory (RBT) postulates that firm unique resources and capability are important in achieving and sustaining competitive advantage (Barney, 1991; Peteraf, 1993; Ravichandran & Lertwongsatien, 2005). Knowledge-related resources have been described for its possible role in creating sustained competitive advantage (Grant, 1996; Golkar, 2004; Garvin, 1993; Buhler, 2003; Simmers; Davis, 2001; Thomas Jr., 2001; Weiss, 1999). Based on RBT, this model contests the knowledge-related resources within the organizations be identified to have influences on BI success and knowledge acquired through successful BI deployment are believed can be used as a strategic asset for company's sustainable competitive advantage.

This study considers quality information, quality users, quality systems and BI governance as the firm's internal unique resources and capabilities to be important in ensuring successful BI deployment that would lead to utilization of BI-based knowledge in sustaining competitive advantage of the competing firms.

5.5.1.1 Quality Information

Majority of the participants in the field study confirmed the characteristics of quality information such as accuracy, completeness, accessibility, currency, relevance, presentable format, and availability. These characteristics of information were mentioned to be crucial in carrying out the managerial and decision-making tasks in their organizations. All the field study participants confirmed the a*ccuracy, presentable format* and *availability* variables. The rest of the variables received strong support from them.

Several interview participants expressed their concerned on the danger of having inaccurate information as pointed out by Participant #3, the group marketing's general manager as '*Our marketing strategy is very crucial. For example, in choosing a product to suit customers' preference or the environment takes some quality data. We do forecasting for that purpose and the data has to be accurate. Forecasting without accurate data would lead to disaster…..'* Another important comment on the importance of having accurate information was by Participant #9, an assistant principal engineer from a multinational telecommunication company. He stressed that among his important tasks was the monitoring of the nationwide network operations and the tasks required integrated and highly reliable information. Participant #8 added that the accuracy of information on telecommunications equipments is very crucial to them because they make decisions based on them. He added that '*in order to verify the integrity of the data, we have to audit the system and try to minimize the inaccuracy level….."*

There was also a strong support amongst participants for *accessibility* and *availability of internal* and *external data* for information to be considered as quality information. Participant #3 was quoted saying "*BI from my perspective is the compilation of overall important information on our business. We need to access ourselves, the market and the most important thing is our competitors….. I believe internal information as well as external is equally important…."* Participant #4 believed that the availability of external information is more important than internal information that resides within the company. He was quoted as saying '*for me the most crucial information in BI is about what are our competitors are doing now in the market?*'

All participants except Participant #7 and Participant #10 agreed to the importance of currency as a determinant of information quality. They mentioned that their companies had BI systems to monitor the performance of both staffs and the telecommunications network. Since their technical staffs were scattered throughout the country handling the operations of the network, the availability and accessibility of *current* information was crucial in performing their monitoring tasks.

All of the interview participants expressed their concerned on having information in the right form or more presentable format. Some of them commented on the current format didn't meet their expectations such as too complicated and thus delayed their decision-making tasks. Participant #9, an assistant principal engineer, whose work was to monitor the performance of his nation-wide telecommunications network for his company, commented on the format as '*I wish the system can produce a better report, may be in a diagrammatic form so that I can understand better…..I mean a particular diagram that shows the exact network circuit in a particular area'*. On the other hand, Participant #8, the principal engineer from another telecommunications company, was pleased with the graphical representation of information provided by BI systems. His comment was '*….previously when we used spreadsheet to table out the report, it was hard to see the connectivity between the ports. But now since deploy BI systems that integrate all the database in our organization, this connectivity is clearly shown using network diagram as shown in this report….'*

Therefore, based on the discussions above it can be inferred that quality information that has dimension of accuracy, completeness, currency, accessibility, relevance, and presentable format which are found within telecommunication companies will have effects on the success of BI deployment.

5.5.1.2 Quality Users

The majority of the field study participants supported the idea of having quality users as the determinant factor for BI success. Since BI is regarded as a high-end sophisticated system, quality or capable users (as mentioned by Participant #1) were required to optimize the systems capabilities. He mentioned that '*the main BI users in my organizations are the top management teams such as Chief Executive Officer, Chief Technical Officer, Chief Financial Officer and some other higher-level executives….'.* In addition, Participant #7 a senior manager from company C, whom had been utilizing BI systems for a number of years, strongly supported skilled BI users to be the determinant of BI success. As he was saying "*First is the technology that drives all the systems that we're using now. Without technology, we have no business. Second are the skilled resources, where we have to recruit competent workers to operate the systems."* Participant #8, a principal engineer, who used BI systems in telecommunications network management, supported this idea by saying '*For me it's the human factor. Let's say if you invest millions of ringgit in BI systems, but if the users are not competent to run them, it only comes to a waste……..'*

Five field study participants confirmed that business knowledge is a required skill by BI users in Malaysian telecommunication companies in order to perform their tasks. Participant #4 pointed out that BI users should have knowledge in business especially marketing aspects as the main focus of BI usage currently are towards forecasting and predicting organizations' future.

Eight out of ten participants from the field study confirmed the technical knowledge to be important skill required by users in performing their tasks associated with BI systems. Participant #2 supported the importance of this variable by saying' *I think users with good technical skills are important because as we can see we're dealing with massive database and to produce reports from that kind of environment is not an easy job…..'*

Six field study participants confirmed that analytical skill was deemed necessary for BI users in ensuring that BI systems would be deployed successfully in their organizations. As Participant #7 said "*We do need a person who is competent in doing the analysis of the problem. Once they have the data, their main job is to diagnose, analyze, highlight and give* *instructions…*" Participant #4 stressed that BI users in their organizations lack of analytical skills and they felt that there was a need to polish these skills among BI users. He emphasized that '*BI systems can only delivers value if the users are capable of analyzing information gained and turn them into sound business decisions*'..

Ability to understand company's requirement, determination to use and act based on data and willingness to optimize BI capabilities were also mentioned by the field study participants to be the attributes associated with quality BI users. Participant #8 pointed out users that have the ability to understand the needs of the companies they are working with were an added advantage in BI success. He was referring to his own experience as a data analyst back in the year 1997, '*I did my own programming when I need certain information from database. Since I understand the company's requirement and processes, then it's easy for me to dig out information from database….'* Participant #9 added that BI users need to have the determination to use the data produced by BI systems and act accordingly. According to him, "*all of telecommunications companies now have good BI systems in place; the action we take based on the information from the system makes all the difference… you can have the best BI system in the world, but if you cannot act wisely on the available data… it would come to a waste eventually.*"

Another important issue raised by two of the field study participants was accountability of BI users in ensuring the right data is produced by BI systems. According to Participant #9, in the context of telecommunications companies in Malaysia, the on-site system engineers through-out the country were given full responsibility for inputting the raw data about their network operations into the database. Should there be any fault in terms of inaccuracy of data produced by the systems rely solely on their shoulders. Therefore, BI users should be accountable on the data quality issues in their organizations.

Based on the above discussion, it can be inferred that having quality BI user is an important determinant in deploying successful BI systems and in turns will lead to utilizing BI-based knowledge for sustaining competitive advantage among telecommunications companies in Malaysia.

5.5.1.3 Quality System

Conformance with the literature (Seddon, 1997; Park, 2006; Srinivasan, 1985; Nelson et al., 2005), all of the variables identified to be associated with quality systems were confirmed by the majority of the field study participants. *Integration* was supported by all participants, while *functionality, reliability, flexibility, accessibility* and *response time* variables of quality system received substantial support. When asked about the main factor that would contribute to BI success, Participant #2, a PhD holder of government-owned company responded by saying '*Of course is the BI system itself. The reliability of the system is very much needed since we are going to act on the data that is produced by the system. Since we are going to do data mining, then the data produced has to be in depth to get good result…..*

It is said that BI system is only useful when the information available inside the system is accessible to its intended users. Nelson et al. (2005) stated that *accessibility* represents the degree to which a system and the information it contains can be accessed with relatively low effort. Access to information can be viewed as a necessary condition for system quality. Participant #4, #7 and #8 confirmed the accessibility variable as important in defining quality BI system. They indicated that to be able to have easy access to BI systems with acceptable down-time will encourage them to utilize information acquired through BI systems and these will boost their routine managerial performance. Participant #8 suggested that the must-have feature in BI systems was the online real-time capability to ensure that the systems can be accessed anywhere and anytime. He stressed that most of BI users in his organization were decision-makers and their job required them to frequently travel and it was deemed important to be able to access needed information resides in BI systems whenever is required.

Interview Participants #2, #4 and #10 believed that reliability of BI system plays major role in BI success deployment in their organizations. Field study participant #2 praised having effective user interface on his current BI system that was used to monitor his company's nation-wide network operations. He was quoted as saying '*the BI system can produce a report in a diagrammatic form so that people can understand better…. the diagram shows exactly the network circuit in a particular region you're monitoring….it really is a great help!'*

The participants of the field study (Participant #3, #5, #9 and #10) shared the same view and acknowledged that response time is an important factor in ensuring BI system is successfully deployed in their organizations. Most of these high-level telecommunications executives expressed that the response time in the context of BI systems was a big issue in their organizations. Participant #3 commented that some high-level executives in his organization were unwillingly using BI systems as the current systems were slow in responding to their requests especially for high-level strategic information. The response time did not improve despite having a couple of systems upgraded these past few years. They anticipated that slow response time was due to the fact that BI systems were complicated in nature and the systems involved integration, aggregation and a multidimensional analysis of data originating from various information resources. They suggest that BI vendors take the issue of response time seriously when implementing BI initiatives. They felt that if the response time could be improved, they definitely would be willingly obliged to use the systems.

Only two participants (Participant #3 and #4) felt that flexibility system is important in BI success. Participant #3 indicated that BI systems should be flexible enough to cater for any changes in business environment that may occur since the systems will be used over long period of time and also provide information to different level of decision makers. He suggested that BI system's upgrading or enhancements that might happen should have minimal effects on the whole BI operations.

All participants agreed that integration plays very important role in deploying BI systems in their organizations. When asked the most important factor in BI success, the immediate response by Participant #8 was '…*of course the maintenance of data warehouse, which integrates and consolidates various operational databases…. the task is very hard as it involved maintaining enormous consolidated information to be used for strategic purposes…'.*

Therefore, this study attempted to prove that quality BI systems that are functional, accessible, reliable, acceptable response time, flexible, and integrated is the determinant of BI success that would lead to using BI-based knowledge for sustainability of organizations.

5.5.1.4 Business Intelligence Governance

Participants from the field study indicated that having good BI governance includes management of the people and infrastructure relating to BI, and enforcements of policies and rules regarding BI in organizations. Participant #2 said "*I believe that having governance is important in any organization that wants to impose any new systems and good governance must include infrastructure, people and enforcements….."* Participant #8 urged organizations to create conducive environment for BI systems to be effectively employed in organizations.

Participants #4 and #8 reinforced the argument that the top-level management to be *involved in the BI implementation* as there was evidence to suggest that management involvement is positively related to the use of new technologies in organizations (Kimberly & Evanisko, 1981; Hwang et al., 2004). Participant #8 believed that long continuous support by top management plays an important role in BI success and the top management has to be employed on permanent basis. He objected to the idea of having temporary top persons to be involved in BI implementation as their commitment to the project was on ad-hoc basis.

On the other hand, three of the participants (Participants #3, #4 and #5) had different view in BI success. They believed in *enforcing a top-down directive* in BI initiatives as a way to ensure the system is fully utilized.

Participant #1 and #8 strongly believed that the right funding is an important part of BI governance since BI is considered high-end and high-cost systems. Participant #4 expressed that funding was very crucial when companies decided on deploying BI systems. He said '*I guess the most important factor in BI success is the cost… for example; the BI system for provisioning that we have now costs more than 1 million ringgit. That cost is exclusive of hidden costs that might incur such as incurring cost and maintenance cost…'*

When asked about training for BI users, participants #3, #5, #6, #7 and #8 indicated that companies have to invest on continuous training and retraining programs in ensuring BI users are sufficiently competent in using the systems. Participant #5 stated that effective BI training involves three aspects of required BI skills namely technical, business and analytical. The training programs are suggested to be conducted in several phases based on user's competency levels.

Therefore, based on the above discussions it can be inferred that effective BI governance which involves strong financial support, direct top management involvement in BI implementation, enforcement of top-down directive and effective BI training programs provision would affect the successful BI deployment in Malaysian telecommunications companies.

5.5.2 Perception of Innovation Characteristics

Diffusion of innovations (DOI) has been the primary theory utilized by researchers for grounding IT adoption research as it has been found to assist researchers in predicting the factors which lead to the adoption and use of various technologies (Cooper & Zmud, 1990; Liao, Shao, Wang, & Chen, 1999; Moore & Benbasat, 1991; Rogers, 1983, 1995). The objective of DOI is to predict patterns of innovation adoption over time based on the identification of an innovation's attributes that influence its diffusion and the categorization of adopters having dissimilar characteristics (Tornatzky & Fleisher, 1990).

Based on the work of researchers like Rogers (1995), Rogers and Shoemaker (1971) and Rothman (1974), it is proposed that user's perceptions of innovation characteristics such as complexity, compatibility and relative advantage are important in information systems success. In addition, Agarwal and Prasad (1997) suggested 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.

Based on the above rationale and considering BI system as an innovation, the final research model contests that user perceptions of BI's characteristics significantly influence the successful BI deployment. Therefore, this study considers the innovations characteristics namely relative advantage, compatibility, complexity, trialability, and observability as important factors in BI success.

5.5.2.1 Perceived BI's Relative Advantage

In this field study, Malaysian telecommunications executives' perceptions of the relative advantages of BI systems were identified to include items that were of positive values. The participants #1, #2, #4 and #8 responded that BI systems helped them to *accomplish tasks quickly* and *easy to perform their job.* According to them, BI systems should response to their needs immediately as most of their tasks involve real-time operational issues and in need of immediate response. While, participant #1, #2 and #3 expressed the view that using BI systems should *increase their work productivity and performance*.

Five of the participants identified BI systems helped in *enhancing their effectiveness of decision-making tasks* as the information they need were easily accessible. Participant #2 and #7 felt that they had *greater control* of their working life, while participant #4 felt that his *quality of work had improved* since using the systems.

The interview response below summarizes those of the interview participants for this construct, and provides an example of the support for this construct amongst interview participants.

> *"Although BI systems that we have now are not perfect, but they do serve our purpose especially in helping us makes decisions. Our company has improved a lot since using BI systems"*

Therefore, it can be inferred that perceptions of BI's relative advantage is an important influence on the Malaysian telecommunications executives' attitude towards successfully deploying BI initiatives in their organization.

6.5.2.2 Perceived BI's Complexity

Conformance with the literature, participants #1, #2, #3, #4 and #8 expressed that BI systems were hard to use. According to them BI systems were *complicated* and *involved too much work* which required specialized skilled users to perform difficult tasks. Participant #1 reported that BI products and their interfaces are 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. Participant #3 wished for a BI system that is *easy to use* in assisting him in performing his tasks.

Participants #1, #3 and #8 supported the idea that BI system was time consuming to implement and this could hinder its utilization in organizations. Participants #1, #2 and #3 highlighted the issue of BI systems were taking too long of their time to learn t o use them. One interesting comment by participant #2 on the complexity of the BI systems was '*I find the systems are very hard to operate. At first I thought once I sent them for training, they can operate the system without any problem. It didn't turn out to be the case as the system is so hard to operate….. Even the consultant who conducted the training was not competent in handling the systems….*'

The interview responses below summarize the view of the participants for this construct, and provide an example of the support for this construct amongst the interview participants.

> *"BI systems now are so complex in nature regardless of whether in-house developed or off-the-shelf packages. The systems have to be simple so that it will be easy to use, especially when the users are the upper management level"*

Therefore, this study infers that the telecommunication executives' perception of the complexity associated with using BI systems will negatively influence BI success in their organizations.

5.5.2.3 Perceived BI's Compatibility

During the field study, perceived BI's compatibility received limited response from the participants. Participant #5 expressed that BI systems should be relevant to their current working culture. Participant #8 pointed out that BI system should be adaptable to his current working style as any changes that might occur will affect their attitude towards using the systems.

The interview responses below summarize the view of interview participants for the compatibility construct, and provide an example of the support for this construct amongst interview participants.

> "*Using BI systems should fit well with the way I like to manage my work'*
> and;
> *"Using BI system should have no effect on my current working style'.*

Therefore, this study infers that the users perception of the compatibility associated with using BI systems will positively influence BI success in Malaysian telecommunications organizations.

5.5.2.4 Perceived BI's Triability

Participants of the field study failed to mentioned triability as a factor in BI success. The assumption was made based on the rationale that all the participants were very well aware of BI and has been utilizing them for a number of years. The issues of triability such as opportunity to try BI system, test run the systems or having enough time to experiment with BI system were no longer become important issues to them. However, for the consistency with the literatures and past studies on IS adoption success, this study decided to maintain the factor of perceived BI's triability as one of the determinant for successful BI deployment in telecommunications companies in Malaysia.

5.5.2.5 Perceived BI's Observability

In this study, the result visibility is the degree to which the results of BI systems are visible and can be measured in quantitative ways. BI systems' results, perceived by individuals or organizations, definitely have influence on users' perception towards its usefulness. It is believed that perceived values of BI will play critical roles in the deployment of BI in organizations thus would lead to utilization of knowledge acquired through it.

During the field study, three of the participants (participants #3, #5 and #8) insisted on seeing the rewards of using BI systems. They stressed that the rewards were in the sense that having to see the outcomes of BI system such as summary of complaint's report, billing report and yearly reports on companies' financial performance. These outcomes were crucial information to them as their decisions on organizational policies and strategies were dependent on these outcomes. Participant #3 stated that '*It is only natural for executives to self-centered where they would only to want to ask "what's in store for me"…. if they can see immediate benefits or rewards, then BI takes place….if they don't see some benefits, they will take it lightly…although the real benefits are actually to the organization as a whole but as individual they, they don't see it'.*

In addition, participants #3, #5, #7 and #8 conveyed the concern of users insisted on seeing the immediate benefits out of BI systems. Participant #10 pointed out that BI systems should be able to encourage communications among staffs in the organizations so it would becomes the push factor for users to use the system. He stressed that communications among the staff were crucial as their nature of works require group work. With the system that can encourage the communication, he said definitely it would be successfully deployed in their organization.

Therefore, this study infers that the perception of the observability associated with using BI systems is an important influence on BI success in telecommunications organizations in Malaysia that would lead to utilizations of knowledge for sustainable competitive advantage.

5.5.3 Other Factors of Successful BI Deployment

Apart from factors discussed previously, past researchers have identified many other factors related to successful BI deployment and subsequent BI-based knowledge to be used in sustaining competitive advantage in organizations. The softer side of BI success factors such as organizational culture (Moss, 2005; Buhler, 2003; Weir, 2004; Rao & Swarup, 2005; Chung, 2002; McGillivray & Faulkner, 2003), use of BI tools (Moss, 2005; Buhler 2003; Weir, 2004; Rao & Swarup, 2005; Chung, 2002; Dresner, 2006); Erikson, 2005) and business strategy (Reich & Benbasat, 2000; Eisenhardt & Sull, 2001) are shown to be significantly influence the success deployment of BI systems and its relations with utilizations of BI-based knowledge in sustaining competitive advantage. Therefore, this study considers the organizational culture, use of BI tools and business strategy as important factors.

5.5.3.1 Organizational Culture

Overall, there was only marginal support from field study participants for organizational culture to be important determinant for BI success and its relations with BI-based knowledge to be used in organization's sustainability. However, interview participants tended to be compliance with the literature by indicating that having the right culture is important. Participants #1 said that telecommunications organizations now has the right and matured culture which makes their executives aware of knowledge being the weapon for their survival as he was saying '*If executives are ignorance of the importance of knowledge, then BI would be a waste. This awareness will create a sense of urge to request for information needed in completing their tasks…..'*

Field study participants #1, #4 and #9 supported the idea of knowledge sharing culture is important in promoting utilization of knowledge but claimed that the right culture was not there yet in their organization. Participant #1 wished for the knowledge-sharing culture to be in place, so that people would realize the importance of BI in acquiring the right knowledge for their sustainability. Their views were actually in-line with the literature as the concept of knowledge-sharing was merely suggestion by BI researchers to be important factor in ensuring BI success. But in reality, culture is something that doesn't happen overnight (Katz & Townsend, 2000; Burn, 1995) and only a perfect 'fit' culture with BI is needed for successful BI deployment in organizations.

In addition, participants #2 and #10 urged that *leadership* to be an important element of organization culture in telecommunications organizations to enforce the utilization of BI-based knowledge. Their views were based on the rational that the 'obedience' nature of Malaysian telecommunications executives whom would comply with the directives from the top management. Even though people do not like to be requested to do things, they believed rigor, request and discipline use of knowledge from management are important and are essential when they are trying to implement BI systems in organizations. Pushing factor from management is believed to be a contributing factor in utilization of knowledge. They also indicated that leadership quality that emphasize on knowledge would be an excellence example for them.

Four participants (participant #1, #2, #4 and #10) stated that another important feature of culture within the telecommunication organizations was the *sense of business competition* among the employees. They stressed that telecommunications executives have to understand the nature of stiff business competition in the industry they were in and the need for them to nurture and use knowledge in order to survive. Thus the kind of awareness would create the urge in them to utilize knowledge provided by BI to win the competition.

Therefore, it can be inferred that organizational culture that facilitates knowledge sharing and learning among employees, create sense of business competition and promote leadership by example can have significant influence on the successful BI deployment, which subsequently would encourage the utilization of BI-based knowledge for sustaining competitive advantage in telecommunications companies in Malaysia.

5.5.3.2 Business Strategy

Majority of field study participants reported that their organizations adopted the analyzer type of business strategy. All of the participants except Participant #7 and #10 felt that part of their organizations' strategy was quickly adapting to new telecommunications-related products that were being introduced in the market. In addition, Participant #1, #2, #3, #4, #8 and #9 reported that another strategies used by their organizations were to carefully examine new products being introduced in the market. Another business strategy used by telecommunications companies in Malaysia as reported by all interview participants except Participant #7, #9 and #10 was to closely monitor their competitors' action. These mentioned strategies were identified as similar to the analyzer type of business strategy found in Miles and Snow's Typology. Participant #1 was positive that strategic knowledge acquired through BI systems be utilize by his organization in formulating these strategies in order to survive in the fierce competition among telecommunications companies in Malaysia. As he saying '*Getting the right thing to do in the industry is crucial for a company to survive… for example if new products or services such as 3G technology or GSM services being introduce in the market…. we have to make a wise decision whether to make the same move immediately or to wait and see….*"

Another type of business strategy which is prospector received moderate support from the field study participants. Only three participants (Participants #5, #7 and #9) reported that their organizations were 'first-in' to introduce new telecommunications products, which reflected this type of strategy. Participant #9 was quoted as saying "*It's solely because of a global trend. This is the scenario where we're pushed by a technology or current trends…. Sometimes we're not even sure what are the technologies all about but we go ahead and deploy them….*" In addition, all of them except Participant #7 and #10 reported that their organizations were quickly responding to opportunities in the industry as part of their survival strategies. Only Participant #9 insisted that his organization contribute to telecommunications' industry innovation, which reflected the real prospector type of business strategy.

The business strategy type of defender received very minimal support from the field study participants. Participants #2 and #3 mentioned that their organizations strategies were to locate safe products and services and try to maintain current products, which reflected the defender type of business strategies.

The interview responses below summarize the view of interview participants for the business strategy construct, and provide an example of the support for this construct amongst interview participants.

> "*To me it is very simple… if the business has a strategy, and then there is a need for intelligence….*"

Therefore, it can be inferred that business strategies types of prospector, analyzer and defender employed by Malaysian telecommunications companies can have significant influence on the successful BI deployment which in turn will facilitate the utilization of BI-based knowledge for their sustainable competitive advantage.

5.5.3.3 Utilization of BI Tools

This study attempted to identify the effects of BI tools types of strategic, tactical and operational on the utilization of BI-based knowledge for sustaining competitive advantage of telecommunications companies in Malaysia. The results of the field study shown that there was a strong belief among interview participants on the effects of BI tools construct in utilization of BI-based knowledge in sustaining competitive advantage. All of the ten out of ten participants reported that they used BI tools to *identify trends and patterns to detect problem and bottlenecks* in their network operations. In addition, seven of the participants mentioned that the use of BI tools *supports and compliments Customer Relationship Management* (CRM) concept in their organizations. They used BI tools in analyzing their internal data for more targeted marketing and also for more profitable pricing plans. Furthermore, all of the participants except Participant #7, #9 and #10 reported that they BI tools enabled them in *modeling customer behavior to spot usage trends and patterns*. These BI tools applications are similar in nature to data mining concept which is defined as analyzing the data in large databases to identify trends, similarities, and patterns to support managerial decision making (Zorn et al., 1999) and were considered the strategic type of BI tools.

Another BI tools category which is the tactical also received majority support from the interview participants. All participants strongly supported the notion of BI tools be use in their tactical decision-making tasks. They mentioned BI tools were definitely a great help in *performing in-depth traffic and usage patterns analysis* to reduce operational failures. In addition to that, Participants #1, #2, #3, #4 and #10 reported having used BI tools in *finding the revenue leakages and enhance revenue assurance by uncovering billable interconnect services*, which also reflected the tactical tasks.

White (2006) regards operational BI tools is used to manage and optimize daily business operations and this type of tool evolved to meet the need to respond to specific events that happen in the operational world. Majority of the interview participants supported this variable. All of them seemed to be using BI tools daily to *monitor the performance* of their organizations' network operations. This was to ensure that their telecommunications network's performance in terms of speed and coverage meet customers' expectations. Another operational use of BI tools mentioned by all participants was to *set-up the key performance indicator* (KPI) of the staffs in their organizations. The staff performances were closely monitored using BI systems throughout the year and the performance appraisal were based on the information provided by the systems. In addition to monitoring performance of both staff and network, BI tools were also used by field study participants (Participant #1, #3 and #9) to *detect fraudulent activities* in their network environment.

The interview responses below summarize the view of interview participants for the utilization of BI tools construct, and provide an example of the support for this construct amongst interview participants.

> "*The main usage of BI tools is for monitoring our network performance… we can identify whether it is over or lower than our targeted KPI'*;
>
> *"BI tools provides us with the statistics… from the information we try to understand the trend and patterns pertaining our network usage'* and
>
> "*In fact our accounts department is using data mining to do sales forecasting…."*

Therefore, based on the discussion above, it can be inferred that BI tools is important in BI success and the utilizations of BI-based knowledge in strategic, tactical and operational decision-making tasks of Malaysian telecommunication executives towards sustaining competitive advantage.

5.5.4 Successful BI Deployment

In this study, it is attempted to use user satisfaction as the measurement of the successful BI deployment construct. This construct represents the fact that a successful BI deployment will determine whether telecommunications executives will use the knowledge provided by the systems for organizations' sustainable competitive advantage.

The field study participants strongly indicated their support for this construct. All of the participants confirmed that successful BI would make the users '*system-dependent'* as well as *system-reliance* for their information-related tasks. According to them successful BI would make them depend very much on BI systems for carrying out their managerial tasks. They believed that successful BI would also mean that telecommunications executives be reliance on the systems for the information needed as they did not have any other way of acquiring them. In addition, they also believed that BI users utilized the information provided by BI systems and turn them into knowledge for decision-making activities as part of the measurement of BI success.

Participant #1, #2, #6 and #9 indicated that BI systems were successfully deployed in organizations if the users were satisfied with the systems and the information provided by the systems and it was their belief that successful BI systems would help them to be effective and efficient in their works.

The interview responses below summarize the view of interview participants for the successful BI deployment construct, and provide an example of the support for this construct amongst interview participants.

> *"The BI systems are like our heart and soul now… there's no way we can survive without the systems now…."*
>
> and
>
> *"For example currently we have about 2 millions of capacity tracking data… and the data utilization is getting higher and higher everyday… definitely we cannot afford not to have the systems…*

Therefore, it can be inferred that successful BI deployment would facilitate the utilizations of BI-based knowledge among Malaysian telecommunication executives towards sustaining their organizations competitive advantage.

5.5.5 Utilization of BI-based Knowledge for Sustainable Competitive Advantage

Majority of the interview participants confirmed the dependent variable of utilization of BI-based knowledge for sustainable competitive advantage. When asked a question on whether they used the knowledge acquired through BI in formulating strategies for sustainable competitive advantage of their organizations, majority of the participants supported the idea. Participant #1 claimed '*For me BI is the usage of data for company's strategic needs. At telecommunication's company, data like calls, traffic, billing and network, which are stored in database, will be turn into information by certain BI technique….. This information will be used for business decisions purpose….*" While Participant #6, the Senior Vice President, stressed the importance of information provided by BI system by "*Yes, definitely, I use information provided by BI systems most of the time for decision-making. If fact now we cannot live without the systems and it becomes a must to have BI systems for our survival*"

Many large and medium-sized companies have started to incorporate sustainability into their business strategies. Sustainability is about building a society in which a proper balance is created between economic, social and ecological aims (Sze´Kely & Knirsch, 2005). Participant #3 was the only participant that regard knowledge from BI can be utilized for corporate social responsibility aspects. He said '*We're a mixture between profit and community service to the government for example some areas are not viable in terms of profits to lay the telecommunications infrastructure but it's part of social obligation'*.

Therefore, it can be inferred that knowledge acquired through successful BI deployment in organizations will be used by telecommunications executives in sustaining their competitive advantages.

5.6 SUMMARY

A comprehensive field study to determine the factors and variables of successful BI deployment in telecommunications companies in Malaysia are presented in this chapter. The field study involved interviewing ten telecommunications decision makers or executives of all five telecommunications companies in Malaysia. These high-ranking executives had some level of utilization in BI systems and had utilized BI-based knowledge in their decision-making tasks. The interviews were taped and the contents with field notes were transcribed and rigorously reviewed by researcher. Using content analysis method, twelve factors and sixty-eight variables were identified and presented in a matrix form showing all the frequencies identified by the participants. The causal links between the factors were also identified.

The preliminary research model was combined with findings from the field study to form the final research model. The model characterized a comprehensive set of factors that were believed to influence the successful BI deployment that would lead to utilization of BI-based knowledge for sustaining competitive advantage of telecommunication companies in Malaysia. This model will be empirically tested and the following chapter details the development of hypotheses and questionnaire design.

CHAPTER 6

HYPOTHESES AND QUESTIONNAIRE CONSTRUCTION

6.1 INTRODUCTION

This chapter details the construction of hypotheses and the quantitative research instruments, which resulted from the finalized research model. The chapter starts with the construction of hypotheses. Then subsequent sections detail the development of research instruments and present a table of the measurement items used with their respective reference sources.

6.2 CONSTRUCTION OF HYPOTHESES

As mentioned before, the hypotheses construction is based on the finalized research model as shown in Figure 5-12 developed earlier during qualitative field study. Based on the model, an operational research model was developed for the easy construction purposes. As illustrated in Figure 6-1, this new model is slightly different from the final model where it shows specific variables impacting other variables. Using this operational model, the following hypotheses are proposed.

6.2.1 Hypotheses Relating to Firms Internal Resources

Today's firms are faced with challenge of either deploying business intelligence systems or taking risks of being left behind by competitors who now are exploiting internal resources and capabilities as their strategic weapons. The resource-based theory (RBT) postulates that firm's unique resources and capability are important in achieving and sustaining competitive advantage (Barney, 1991; Peteraf, 1993; Ravichandran & Lertwongsatien, 2005). Past studies such as Grant (1996), Golkar (2004), Garvin (1993), Buhler (2003), Thomas Jr. (2001) and Weiss (1999) have reported that knowledge-related resources and capabilities like BI initiatives have been described for its possible role in creating sustained competitive advantage. Hence, the ability of modern firms to take advantage of knowledge-related resources available is a critical component for their sustainability (Cody et al., 2002).

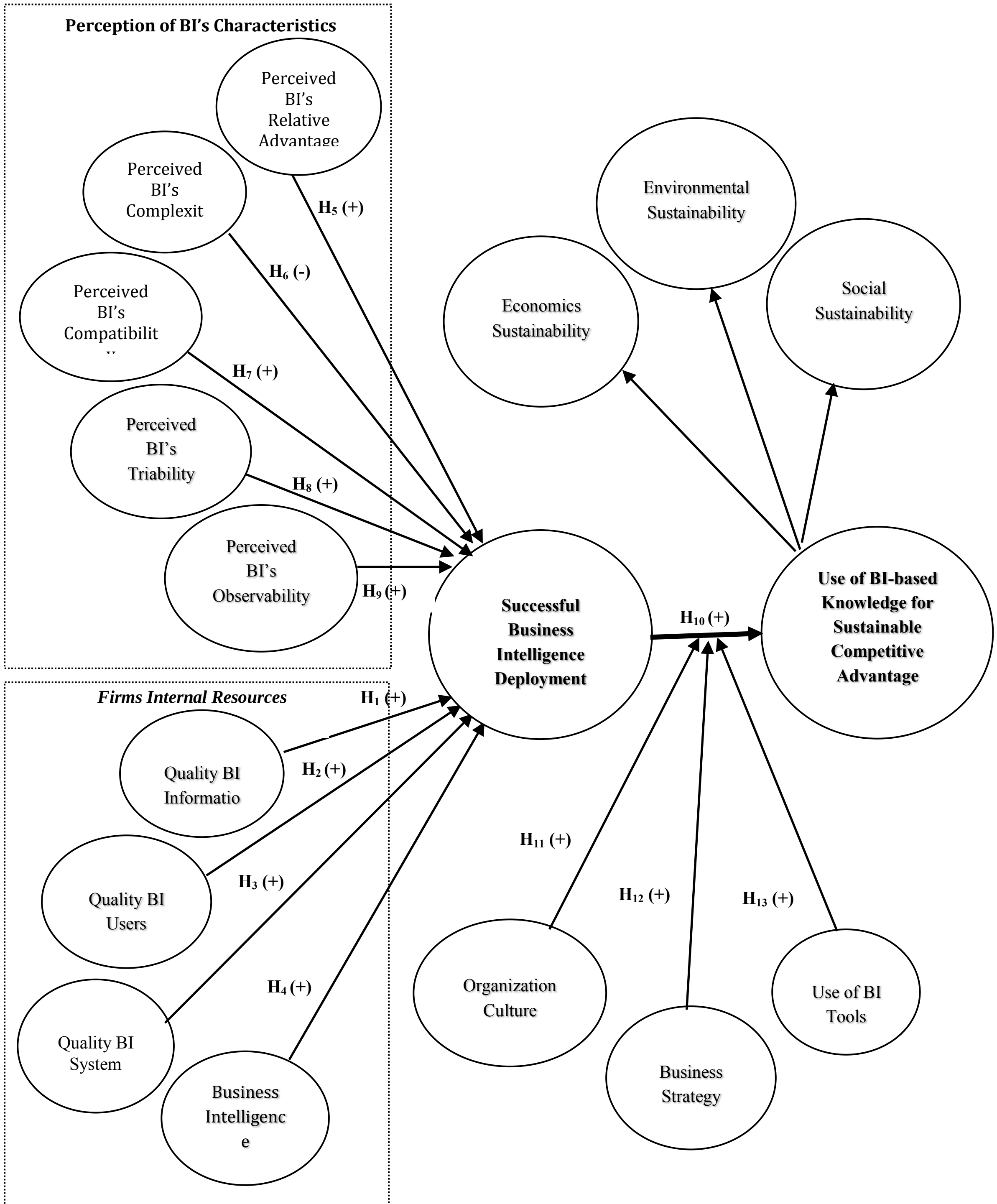

Figure 6-1 Operational Research Model of BI for Sustainable Competitive Advantage

6.2.1.1 Quality BI Information

Quality information has been mentioned as an important influence in information systems success including BI (Jedras, 2003; Burns, 2005; Nelson et al., 2005; Berndt, Hevner & Studnicki, 2003). In the context of BI systems, one of the most important factors of BI success is the quality of company's information and how the information is processed. This is evidence as quality information has been rated regularly in the industry as a top concern in most of BI projects (Brown, 1997; Firth & Wang, 1996; Orr, 1998; Schusell, 1997; Perkins, 1998; Chittenden, 1998).

It has been found that often, many end users, including managers are unaware of the quality of data they use in BI systems (Lambert, 1996). Data quality in the BI systems is generally poor and there are many foreseeable setbacks such as economic failure and ineffective planning of business strategies (Rudra & Yeo, 2000). However, the growth of data warehouses which is the main component of BI systems and the direct access of information from various sources by managers and information users have increased the need for, and awareness of, high quality information in organizations (Lee et al., 2002).

According to Knight and Burn (2005), in order to accurately define and measure the concept of information quality, information quality needs to be assessed within the context of its generation and intended use. This is because the attributes of data quality can vary depending on the context in which the data is to be used (Shankar & Watts, 2003). Traditional dimensions of information quality as accuracy, consistency, timeliness, completeness, accessibility, objectiveness and relevancy are among the attributes of quality information required by organization to make sound business decisions (Mohidin, 2007; Wang & Strong, 1996; Nelson et al., 2005; Knight & Burn, 2005).

Rudra and Yeo (2000) stressed that the lack of data quality is one of the fundamental obstacles in the current BI environment. The erroneous data can significantly affect an organization, not to mention the frustration of the users of the BI systems (Firth, 1997; Barry & Parasuraman, 1997; Miller, 1996). Perkins (1998) stated very emphatically that BI contains "trusted, strategic information" and becomes a valuable enterprise resource for decision makers. If BI users discover that it contains bad information, then BI will be ignored and will lead to its failure (Friedman, 2006). Hence, in order to avoid such frustrations and to drive true value of BI implementation, organizations are urged to focus on the quality of the data input within BI applications (Dubois, 2005).

Therefore, based on the foregoing discussions, the following hypothesis related to quality information is proposed:

Hypothesis 1 (H_1): Quality information will positively influence the successful business intelligence deployment in telecommunications companies in Malaysia.

6.2.1.2 Quality BI Users

Human factor also plays a vital role in determining successful BI deployment in a competing firm (Avery & Watson, 2004; Watson et al., 2006; Rustmann Jr., 1997; McGillivray & Faulkner, 2003). In particular, the skills of the users play a major influence in the outcome of the BI success. Quality users equipped with technical, business and analytical skills are essentials as BI values can only be tapped by these users who are capable of analyzing information and turn them into sound business decisions (Avery & Watson, 2004).

In addition, Strange and Hostman (2003) stated that utilizations of BI tools and technologies are only part of the formula for BI success. More important aspects of BI which regards to integrating company's requirements, data and priorities require people with unique skills in order to deliver the right outcome. Unfortunately, Avery and Watson (2004) stated that most enterprises have difficulty finding people with the right skills to deliver these important tasks. Hence, in ensuring BI is successfully deployed in organizations, they suggested that BI users be sufficiently trained to acquire necessary skills such as data warehouse concepts, use of data-access tools and applications, as well as the data in the warehouse and how to access them and the applications related to BI.

Thus, it can be inferred that that capability of BI users that possess required skills such as technical, business and analytical will positively influence the successful deployment of complex systems such as BI.

Therefore, with the argument discussed above, the following hypothesis related to quality users is proposed:

Hypothesis 2 (H_2): Quality business intelligence users will positively influence the successful business intelligence deployment in telecommunications companies in Malaysia.

6.2.1.3 Quality BI Systems

Past researchers considered quality system as non-existence of errors in the system, the consistency of the user interface, ease of use, quality of documentation, and quality of the program code (Davis, 1989; Seddon, 1997; Delone & McLean, 1992). Quality system is mentioned as an important factor in information systems success (Davis, 1989) as it is believed that higher quality information systems should be perceived as easier to use and ultimately have higher levels of success (Seddon, 1997; Nelson et al., 2005).

A number of researchers investigated the effects of BI on decision performance and found out the evidence that support the effects of quality BI systems on decision performance through system use (Park, 2006; Seddon, 1997). In addition, Srinivasan (1985) stated that quality system which is based on the technical details of the interface, reflecting system reliability to measure its success. Nelson et al. (2005) on the other hand regarded the construct as quality of the system that produces the information output, which can be expressed in terms of accessibility, reliability, flexibility, integration and response time and has also often been measured as the system success.

Therefore, organizations that acquire high quality BI system that are reliable, accessible, and flexible are more likely to be successful in deploying BI.

As a result, the following hypothesis is suggested:

Hypothesis 3 (H_3): Quality business intelligence system will positively influence the successful deployment of telecommunications companies in Malaysia.

6.2.1.4 Business Intelligence Governance

Past researchers such as Matney and Larson (2004), Watson et al. (2000, 2006) and Sambamurthy and Zmud (1999), find that the role of BI governance has significant impact on successful BI deployment in competing firms. Matney and Larson (2004) suggested that good BI governance that provides necessary BI infrastructure including hardware, software, staffing and strategy needed to glean intelligence from data as important factor in BI success. In addition, Geiger (2006) suggests that having governance in any BI initiatives which includes controlling, directing, establishing and enforcing related BI policies is a positive influence on BI success. He claimed that although people often think of BI governance as a constraint, but a solid governance structure actually promotes resourceful thinking within an organization.

The unconditional support of top management in terms of financial or spiritual which was regarded as part of good BI governance also contribute to the successful BI deployment in organizations (Kim, 1988; Kimberly & Evanisko, 1981). To ensure BI success, Kim (1988) suggested that BI steering committee comprises of Chief Information Officer (CIO) and a business executive, such as Chief Financial Officer (CFO), Chief Operations Officer (COO), or a senior Vice President of marketing or sales should be formed in order to sponsor and govern design, development and deployment of BI. In addition, a number of information systems research such as Yap, Soh and Raman (1992), Grover (1993), Premkumar and Rammamurthy (1995), Thong and Yap (1995), Igbaria et al. (1997), Pan and Scarborough (1998), Shim and Jones (2001), among many others, has also been stressing the importance of top management support in the adoption and diffusion of innovation. Case study by Sarkar (200) reveals that top management supports are also important to achieve successful E-Commerce implementation. Similarly, Premkumar and Roberts (1999), in their investigation of e-Commerce adoption in small businesses located in rural US communities, highlight top management support as a discriminator between adopters and non-adopters.

Fuerst and Cheney (1982) convey the same view and stated that good BI governance would provides BI users with necessary training programs to ensure BI is fully utilized and in turn would lead to its success. They suggest that user training is directly related to BI success and lack of training programs is a major reason for user dissatisfaction with their BI systems. In addition, Guimares et al. (1992) have found the importance of BI training which provides necessary competency for users to optimally utilized BI capabilities. Quaddus and Intrapairot (2001) highlighted that increasing the levels of training and decreasing training delays are the dominant policies for successful BI.

Thus, it can be inferred that effective BI governance which involves strong financial support, direct top management involvement in BI implementation, enforcement of top-down directive and effective BI training programs provision would affect the successful BI deployment in Malaysian telecommunications companies.

As per above discussion, it is hypothesized that:

Hypothesis 4 (H_4): Business intelligence governance will positively influence the successful business intelligence deployment in telecommunications companies in Malaysia.

6.2.2 Hypotheses Relating to Perceptions of Innovations Characteristics

Early diffusion research identified user characteristics, such as years of education and age, and personal communication channels as important predictors of adoption (Brancheau & Wetherbe, 1990). However, because of inability to generalize these characteristics across different technologies and settings, researchers turned to user perceptions of the technology to understand the adoptions decisions. Theory of innovation diffusion (Rogers, 1995) has provided an important set of theoretical constructs are important in influencing adoption and diffusion. These constructs are called 'perceived characteristics of innovation' and include complexity, compatibility, triability, observability and relative advantage.

Studies such as Davis, Bagozzi and Warshaw (1992), Belassi and Fadalla (1998), Kwon and Zmud (1987), Rogers and Shoemaker (1971), Rothman (1974), Thong (1999), just to name a few, have found the importance of the innovation characteristics in the adoption and diffusion of information systems. Agarwal and Prasad (1997) 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 (1982) also found that factors of relative advantage, compatibility and complexity constantly relate to adoption. Premkumar and Ramamurthy (1995) concluded that relative advantage, technical compatibility, and cost influence the decision to adopt electronic data interchange (EDI).

In addition, Pankratz et al. (2002) indicated that the way potential users perceive these characteristics is critical and that these perceptions account for 49-87% of the variance in whether or not they adopt. Other research into IT innovations offers support for the importance of users' perceptions of the characteristics of an innovation in determining the innovation's subsequent use (Mathieson, 1991; Van Slyke, Lou & Day, 2002).

Therefore, the study developed the following hypotheses that are related to perceived characteristics of innovation factors of Perceived BI's Relative Advantage, Perceived BI's Compatibility, Perceived BI's Triability, Perceived BI's Complexity and Perceived BI's Observability, which were identified in the research model.

6.2.2.1 Perceived BI's Relative Advantage

Relative advantage has been widely and consistently reported to have a positive impact on the adoption process (Tornatzky and Klein 1982; Rogers 1995; Daylami et al. 2005; Syed et al. 2007). Tornatzky and Klein (1982) found relative advantage to be an important factor in determining adoption of new innovations. Aubert & Hamel (2001) in their study on adoption of smart cards in the medical sector found that relative advantage of the system for the medical professional is directly linked to the obligation for the client to use the card.

Likewise, as BI systems allow data gathering, data storage, and knowledge management with analytical tools to present complex and competitive information to planners and decision makers. In view of the advantages that BI, it would thus be expected that individuals who perceive BI as advantageous would also be likely to use BI and this would lead to successful BI deployment in the organizations.

According to Watson et al. (2002), firm have to perceive advantages of BI before adopting them due to high-risk nature of BI systems. BI can only be deployed successfully if users can perceived its full potential (Watson et al., 2004) and these potentials are categorized into tangible and intangible benefits. The field study's participants confirmed with the literature that BI's relative advantage such as accomplish task quickly, improve quality of work, easy to perform job, easy to perform job, enhance effectiveness, increase productivity and greater control are the determinants of BI success.

Thus, it can be inferred that perceived BI's relative advantage is likely to influence telecommunications executives to use BI systems in their decision-making tasks and this would lead to the successful BI deployment in their organizations.

Therefore, the following hypothesis is proposed:

Hypothesis 5 (H_5): The higher the executives' perceived relative advantage of using business intelligence systems, the more likely that business intelligence will be successfully deployed in telecommunications companies in Malaysia.

6.2.2.2 Perceived BI's Complexity

Perceived complexity, which is the conceptual opposite of perceived ease of use (Moore & Benbasat, 1991), is defined as the degree to which an innovation is viewed as being difficult to use (Rogers, 1995). Empirical research validates the impact of perceived complexity on potential users' intentions to use a variety of IT innovations including groupware (Van Slyke, Lou & Day, 2002), smart card systems (Plouffe et al., 2001) and information retrieval systems (Venkatesh & Morris, 2000).

Past researchers has also indicated that an innovation with substantial complexity requires more technical skills and needs greater implementation and operational efforts to increase its chances of adoption (Cooper and Zmud 1990; Dickerson and Gentry 1983; Damanpour, 1996; Ettlie, 1986; Tornatzky & Klein, 1982; Syed et al. 2007). Syed et al. (2007) found out complexity have negative effect on e-commerce adoption. In addition, Bradford & Florin (2003) in their study on the implementation success of enterprise resource planning (ERP) systems reveal that perceived complexity of ERP has negative impact on its success.

As BI system involves difficult tasks such as analysing massive data, forecasting and predicting the companies' future, it is likely that potential BI users may feel that BI systems are complex to use, and hence would be unlikely to utilize them. Garza (2007) stressed that BI tools must be easy to use, but at the same time must provide significant power and flexibility to ensure users would utilize them to the full potential.

Findings from field study also 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.

Therefore, this leads to the hypothesis:

Hypothesis 6 (H_6): The lower the perceived complexity of using business intelligence by telecommunications executives, the more likely that business intelligence will be successfully deployed in telecommunications companies in Malaysia.

6.2.2.3 Perceived BI's Compatibility

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 (2003) 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. Perceived compatibility has also been shown to be the best perception-based indicator of use intentions in using groupware (Van Slyke, Lou & Day., 2004).

A number of studies have found compatibility to be positively associated with adoption (Grover & Goslar, 1993; Syed et al. 2007; Lee et al. 2003). 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 (Schubart & Einbinder, 2000). In Tornatzky and Klein's meta-analysis of innovation adoption, they find that an innovation is more likely to be adopted when it is compatible with individuals' job responsibilities and value system.

Thong (1999) further added that if IS are compatible with existing work practices then SMEs will be more likely to adopt them. In addition, Lee and Xia (2006) suggested that technical compatibility will positively influence EDI implementation. The results of empirical study by Elbertsen and Reekum (2008) show that ERP adoption by mid-sized enterprises is most significantly explained by the compatibility of the software configuration with the firm's business processes. Grandon and Pearson (2004) report that compatibility between e-Commerce and a firm's culture, values, and processes is an important factor. Similarly, Mirchandani and Motwani (2001) emphasize compatibility of e-Commerce with existing business processes.

Several studies also confirm that compatibility is found to be a significant predictor of perceived usefulness and perceived ease of use of telemedicine technology (Chau & Hu, 2001), electronic tax paying systems (Fu et al., 2006), broadband Internet (Oh et al., 2003), e-Customers Relation Management (Tung, 2007), online nursing courses (Chang & Tung, 2008), computer aided software engineering (CASE) technology (Ramiller, 1994), electronic logistics systems (Tung et al., 2008), and virtual stores (Chen et al., 2004).

The field study participants also identified perceived BI's compatibility of BI system played an important role in BI success. Most participants expressed that BI systems should be relevant to their current working culture and should be compatible with all aspects of their work. Any changes that might occur as a result of using BI will affect their feeling towards BI, and in turn would affects BI success.

BI has been viewed as 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.

On the grounds of the above evidence, the following hypothesis related to BI's perceived compatibility is proposed:

Hypothesis 7 (H_7): The higher the executives' perceived compatibility of using business intelligence, the more likely that business intelligence will be successfully deployed in telecommunications companies in Malaysia.

6.2.2.4 Perceived BI's Triability

Rogers (1995) 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.

Empirical research validates the impact of perceived triability on potential users' intentions to use a variety of IT innovations including e-learning (Zhang et al. 2009), B2B marketplace (White et al. 2007) and information retrieval systems (Venkatesh & Morris, 2000). In a study on B2B adoption in hospital by White et al. (2007), the result showed the importance of triability factor to hospital professionals where new procedures could be tested before being rolled out more widely. The triability factor becomes a key element in increasing the spread of EDI, since using it on approval enables the potential users to improve their perception of the benefits to be gained, without any of the risks involved in the adoption of EDI (Jime´nez-Martı´nez & Polo-Redondo 2004).

Inconsistent with the literature, the 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 8 (H_8): The greater the perceived trialability of business intelligence by telecommunications executives, the more likely that business intelligence will be successfully deployed in telecommunications companies in Malaysia.

6.2.2.5 Perceived BI's Observability

Rogers' (1995) 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 (Rogers, 1995). However, perceived observability has received equivocal support in empirical studies. A potential explanation for this is offered by Moore and Benbasat (1991), 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 (Moore & Benbasat, 1991). This distinction has been supported empirically (Moore & Benbasat, 1991; Agarwal & Prasad, 1997).

The visibility of the results of an innovation 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 (Lundblad, 2003).

A number of studies have shown the significance of perceived observability in the success of new innovations such as mobile phone adoption (Wei & Zhang 2008), decision support systems (Chiasson & Lovato 2001), e-commerce (Ling, 2002) and communications technology (Ilie et al. 2005).

Therefore, this study proposed the following hypothesis related to perceived BI's observability:

Hypothesis 9 (H_9): The greater the perceived observability of business intelligence by the telecommunications executives, the more likely that business intelligence will be successfully deployed in telecommunications companies in Malaysia

6.2.3 Hypotheses Relating to Successful BI Deployment

The resource-based theory (RBT) postulates that unique resources and capabilities poses internally by firms would bring sustainable competitive advantage. At its core, the RBT focuses on identifying and determining the value of firm resources and capabilities (Teng & Cummings, 2002) and how firms can acquire, maintain, deploy, and develop resources and capabilities in a manner that establishes and sustains their competitive advantage (Berman et al., 2002; Knott, 2003; Zott, 2003; Ahuja & Katila, 2004).

Firm's resource is often defined in terms of assets that a firm owns or has access to (Warren, 2002) and it can be tangible assets such as facilities and process technology, or intangible, as in the case of patents, brand name, reputation and trade secrets (Hall, 1992). Firm's capability refers to a firm's capacity to deploy and reconfigure those resources to improve productivity (Makadok & Barney, 2001). Capabilities constitute individual skills, tacit forms of knowledge and social relations that are embedded in a firm's routines, managerial processes, forms of communication and culture (Pandza et al., 2003).

Many researchers (Hislop et al. 2000; Clarke & Turner 2004; just to name a few) stated that knowledge have been linked to RBT and suggested that it has become the mechanisms to facilitate firms acquiring greater competitive advantage. Firm's competitive advantage is considered to result from its unique knowledge and how it manages the knowledge (Huang, 2008; Levitin & Redman, 1998; Mata et al., 1995; Joglar & Chaparro, 2007). In this study, it is believed that successful BI deployment within the organizations would produce the necessary knowledge needed to achieve and sustain their competitiveness.

Kelley (2005) supported the idea of knowledge as organizational resources and posited that organizations depend on knowledge for their survival (Buhler, 2003). Organizations now are boasting chief information officers (CIO), chief learning officers (CLO) and chief knowledge officers (CKO) as new executive level positions to reflect the increasing importance of knowledge in every organization (Synnott, 1987).

Davis (2001) supported the concept of BI in gaining competitive advantage. He noted that Japanese is the BI masters and insisted on BI as an innovation is a legitimate business function (Nonaka & Takeuchi, 1995). Thomas Jr. (2001) believe that BI is especially valuable in gaining information about competitive environment especially in competitors, new technology, public policy and market forces and useful for predicting the future environment in which a company will operate. The Montague Institute Review (2001) also advocates BI as an effective tool for coping with and understanding competition. Weiss (1999) suggested embedding BI for the entire strategic planning process.

With the discussion above, the following hypothesis related to successful BI deployment is proposed:

Hypothesis 10 (H_{10}): Successful business intelligence deployment will positively influence the use of business intelligence-based knowledge for Malaysian telecommunications company's sustainable competitive advantage.

6.2.4 Moderating Influence of Organizational Culture, BI Tools and Business Strategy

Many researchers have mentioned the need for moderating variables to be included in the studies of knowledge-related technologies success (Ye et al. 2006). According to Chin et al. (2003) moderators are important to the development of theory. Nevertheless, prior studies that have been conducted on knowledge-related success or adoption mostly focused on direct factors and their influences on its success, overlooking the role of moderating variables. To fill this gap, this study adopt variables such as organizational culture, utilization of BI tools and business strategy as moderators of the relationships between successful BI deployment and utilization of BI-based knowledge in sustaining competitive advantage.

6.2.4.1 Hypotheses relating to Organizational Culture

Organization culture has been mentioned as important aspect in the success of knowledge-related initiatives such as knowledge management systems and BI (Moss, 2005; Buhler, 2003; Weir, 2004; Rao & Swarup, 2005; Chung, 2002; McGillivray & Faulkner, 2003; Jones et al., 2006). Organization culture is refers to as a system of shared meaning or common perception held by members that distinguishes the organization from the others (Frates & Sharp, 2005; Schein, 1985).

According to Moss (2004), large percentage of BI applications fails not because of technology but organizational culture and infrastructure dysfunctions. Firms that instill the right organizational culture are foreseen to be successful in deploying BI initiatives. Buhler (2003) posits creating a culture of 'learning organization' has become an important strategic objective for many firms that hinges on the acquisition of information.

McDermott & O'Dell (2001) found out that culture does play an important role in the success of a knowledge management effort. They found many examples where well designed knowledge management tools and processes failed because people believed they were already sharing well enough, that senior managers did not really support it, or that, like other programs, it too would blow over. Companies that successfully implement knowledge management do not try to change their culture to fit their knowledge management approach. They build their knowledge management approach to fit their culture. As a result, there is not one right way to get people to share, but many different ways depending on the values and style of the organization.

A study by Chuang (2004) indicates that organizational resources such as appropriate culture encourage humans to create and share knowledge within a firm. Keen (1997) believes that the main source of sustainable competitive advantage through IT is the IS culture. Culture is considered a forgotten asset because it is often neglected when deploying new technologies. Weir (2004) added that a good combination of knowledge sharing culture and appropriate technologies and tools will boost business performance. Matney and Larson (2004) stressed that choosing the right BI tools is a key success factor because the tools are the part that end users see and touch, it is their interface. Their requirements are the main factor that drives the tools selection. Croteau and Bergeron (2001) and Clemons (1986) further indicated that Business Strategy (BS) has to be integrated with technology in the overall IS deployment framework in order to realize its full potential. Consistent with the work of Chuang, Weir, Keen, Croteau and Bergeron, Clemons and Matney & Larson, the proposed model argues that Organizational Culture, Business Strategy and Use of BI tools moderate the impact of use of BI-based knowledge for Sustainable Competitive Advantage.

Therefore, this study postulates the following hypothesis relating to organizational culture:

Hypothesis 11 (H_{11}): Organizational culture will moderate the relationship between successful business intelligence deployment and use of BI-based knowledge for sustainable competitive advantage of telecommunications companies in Malaysia.

6.2.4.2 Hypotheses relating to Business Strategy

Business strategy has been used as a moderator and mediator in studying information system adoption (Wang & Ahmad, 2009; Reimann, Schilke & Thomas, 2009). Wang and Ahmad (2009) found evidence that business strategic orientation has a moderating effect on e-Commerce adoption. Other studies have also been conducted to find the relationship between business strategy and organizational performance (Miller, 1987; Venkatraman, 1989b; Zahra & Covin, 1993; Parnell et al., 1996).

A number of researchers employed Miles and Snow's Typology (Snow & Hrebiniak, 1980; Hambrick, 1983; Conant et al., 1989; Namiki, 1989; Smith et al., 1989; Tavakolian, 1989; Thomas et al., 1991; Abernethy & Guthrie, 1994; Karimi et al., 1996) in their research. This type of typology reflects a complex view of organizational and environmental processes, as well as the attributes of product, market, technology, organizational structure and management characteristics (Smith et al., 1989). The most common observation is that the prospector, analyzer and defender strategies usually contribute to organizational performance, while the reactor strategy contributes negatively to it (Conant et al., 1989; Namiki, 1989; Snow & Hrebiniak, 1980).

Previous finding suggest the need for business strategy to be integrated with technology in the overall BI deployment framework (Choteau & Bergeron, 1999; Clemons, 1986). Croteau and Bergeron (2001) regarded business strategy as the outcome of decisions made to guide an organization with respect to the environment, structure and processes that influence its organizational performance.

Therefore, this study postulates the following hypotheses that relate to business strategy:

Hypothesis 12a (H_{12a}): Prospector type of business strategy will moderate the relationship between successful business intelligence deployment and use of BI-based knowledge for sustainable competitive advantage in Malaysian telecommunications companies.

Hypothesis 12b (H_{12b}): Analyzer type of business strategy will moderate the relationship between successful business intelligence deployment and use of BI-based knowledge for sustainable competitive advantage in Malaysian telecommunications companies.

Hypothesis 12c (H_{12c}): Defender type of business strategy will moderate the relationship between successful business intelligence deployment and use of BI-based knowledge for sustainable competitive advantage in Malaysian telecommunications companies.

Hypothesis 12d (H_{12d}): Reactor type of business strategy will moderate the relationship between successful business intelligence deployment and use of BI-based knowledge for sustainable competitive advantage in Malaysian telecommunications companies.

6.2.4.3 Hypotheses relating to Use of BI Tools

The literature also suggests that effective utilization of BI tools is important in BI success (Moss, 2005; Buhler 2003; Weir, 2004; Rao & Swarup, 2005; Chung, 2002). Dresner (2006) and Erikson (2005) warned BI developers to be careful in choosing the number of BI tools. According to them, too many tools lead to confusion and soaring training costs, while too few tools frustrate the users. Dresner recommended the developer to think strategically about the toolset. Verdoes (2007) added that one of the challenges for BI tools is to make the complex analytics easy-to-use for the end users, in order to achieve maximum business potential.

Dennis and Wixom (2002) presented a meta-analysis that investigates moderator of GSS tool and its influence on the overall effects of group support systems (GSS). They found out that the GSS tool (level 1 or level 2) influences decision quality where decision quality is higher when using level 2 tools. Level 1 tools support the exchange of information, whereas, level 2 tools are designed to aid in decision-making.

In term of BI, there are varieties of tools that differ in many ways. Rather than focusing on the multitude of individual features available, this study instead examines a fundamental issue that transcends the current version of different tools. BI tools are composed of two classes (Carvalho & Ferreira, 2001; Chung et al., 2002) – (1) end-user query, reporting, and analysis, and (2) advanced analytics. The first class includes ad hoc query and multidimensional analysis tools as well as dashboards and production reporting tools, while the second class includes data mining and statistical software. Kelly (2005) added that BI tools include dashboards, data mart, data mining, data warehouse, extract, transform, and load (ETL), online analysis processing (OLAP), portal, and scorecards.

Based on the foregoing discussions, the hypothesis relating to use of BI tools is proposed as follows:

Hypothesis 13a (H_{13a}): Operational use of business intelligence tools will moderate the relationship between successful business intelligence deployment and use of BI-based knowledge for sustainable competitive advantage in Malaysian telecommunications companies.

Hypothesis 13b (H_{13b}): Tactical use of business intelligence tools will moderate the relationship between successful business intelligence deployment and use of BI-based knowledge for sustainable competitive advantage in Malaysian telecommunications companies.

Hypothesis 13c (H_{13c}): Strategic use of business intelligence tools will moderate the relationship between successful business intelligence deployment and use of BI-based knowledge for sustainable competitive advantage in Malaysian telecommunications companies.

There were also the first order of variables added in the model namely Economic Sustainability, Social Sustainability and Environmental Sustainability. This was based on the construct of utilization of BI-based knowledge for sustainable competitive advantage which considers these three aspects.

The full set of the hypotheses are illustrated in Figure 7.1, which was reproduced to improve readers' readability from Figure 6.1 of the final BI for Sustainable Competitive Advantage model.

6.3 DEVELOPMENT OF RESEARCH INSTRUMENT

This section details the instrument that was developed based on the final research model. The main objective of this study is to identify the factors influencing the successful BI deployment that would lead to utilization of knowledge in sustaining competitive advantage of telecommunication companies in Malaysia.

6.3.1 BI for Sustainable Competitive Advantage Questionnaire

A questionnaire was developed to measure the factors and variables of the combined model described in Chapter 5. The measurement items were based on previous works from various BI literatures and findings from field study. The survey contained demographic information, as well as eighty-two instrument items that were measured on a six-point Likert type scale, ranging from 'Strongly Disagree' to 'Strongly Agree'. The six-point Likert scale was employed in this study with the rationale that most Asian respondents in the past had the tendencies of selecting the middle point.

There are eight sections in the questionnaire. In the first section (Section 1), the survey instrument requested the respondents to fill-in secondary information about themselves and their organizations. There are eight categorical questions including gender, age, education, current position, years in current organization, years in current position, field of works and organization's growth status.

The rest of the 7 sections were concerned with statements regarding BI. Those statements encompass the variables and factors in successful BI deployment and its relationship with sustainable competitive advantage. In section 2, respondents were asked to provide their opinions on the statements regarding internal organizational resources namely quality information, quality BI users, quality BI systems and BI governance. In section 3, the respondents' opinions on the statements regarding the successful BI deployments were requested. This is followed by section 4 where the respondents were asked to rate their opinion regarding their perceptions of five BI characteristics namely BI's relative advantage, triability, observability, compatibility and complexity. Section 5, section 6 and section 7 are concerned with statements relating to moderating factors where respondents were requested to rate their opinion on whether organizational culture, business strategy and use of BI tools would affect use of BI-based knowledge in sustaining companies' competitive advantage. The last section which is section 8 concerned with statements on utilization of BI-based knowledge in sustaining competitive advantage.

6.3.2 Measurement Instruments

This section describes the development of measurement instruments based on the comprehensive BI for Sustainable Competitive Advantage model. The model contains fourteen factors, namely Quality Information, Quality Users, Quality Systems, BI Governance, Successful BI Deployments, Perceived BI's Relative Advantage, Perceived BI's Compatibility, Perceived BI's Triability, Perceived BI's Observability, Perceived BI's Complexity, Organizational Culture, Business Strategy, Use of BI Tools and Utilization of BI-based Knowledge in Sustaining Competitive Advantage. For each of the fourteen factors, multiple item measures were applied to provide comprehensive evaluation. As mentioned before, measurements of the factors were based on the final model of BI for Sustainable Competitive Advantage evolving from the field study (Chapter 6) and related literature (Chapter 2).

The details of the measures for each factor are presented below.

6.3.4.1 Quality BI Information

Quality information factor reflects the information posses internally by competing firms that has an influence on BI success. Quality information factor was measured by nine items as per final model. The following nine items namely accuracy, accessibility, completeness/adequacy, currency, presentable format, availability, relevance, trustworthy and security were devised to measure this construct in the questionnaire. Table 7-1 details the measurement items and their related references for the quality information construct.

Table 6-1 Measurement of Quality BI Information

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Accuracy	BI systems should produce accurate and correct information that I need to perform my tasks	Literature/ Interviews	Nelson et al.(2005); Dijcks (2004); Jarke et al. (1999); Rieh (2002)
Accessibility	BI systems should always provide information that I need anywhere and anytime	Literature/ Interviews	Dijcks (2004); Jarke et al. (1999); Jeong & Lambert (2001)
Completeness/ Adequacy	Information from BI systems should be complete and adequate enough for me to perform my tasks	Literature/ Interviews	Nelson et al. (2005); Dijcks (2004); Jarke et al. (1999)

Currency	Information from BI systems should always be current and up to date	Literature/ Interviews	Nelson et al. (2005); Dijcks (2004); Jarke et al. (1999); Rieh (2002)
Presentable/ Format	BI systems should produce information in a presentable format and should be easily understood and interpreted	Literature/ Interviews	Nelson et al. (2005); Dijcks (2004); Jarke et al. (1999)
Availability	BI systems should provide information from internal as well as external sources	Literature/ Interview	Jarke et al. (1999)
Trustworthy/ Integrity	Information provided by BI systems should always be of high integrity and trustworthy	Literature/ Interview	Jarke et al. (1999)
Relevance	BI systems should produce relevant information that meet company's requirements	Literature/ Interview	Yong et al. (2004)
Security	Information from BI systems should be secured and free from threats	Literature/ Interview	Jarke et al. (1999)

6.3.4.2 Quality BI Users

The construct of Quality User refers to the influence of BI users' capabilities on BI success. This construct was measured with nine variables and Table 6-2 below details the nine measures and their related references used in the questionnaire.

Table 6-2 Measurement of Quality BI Users

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Technical skilled	BI users should posses technical knowhow to ensure BI is successfully used in the organization	Literature/ Interviews	Avery & Watson (2004); Biere (2003)
Business skilled	BI users should be knowledgeable in their business or working environment	Literature/ Interviews	Avery & Watson (2004); Biere (2003)
Analytical	Ability to analyze data from	Literature/	Avery & Watson

skilled	BI systems is essential to ensure BI is successfully used in the organization	Interviews	(2004); Biere (2003)
Competence	BI users should be competence in carrying out their tasks and responsibilities	Literature/ Interviews	Imhoff and Pettit (2004)
Understand requirements	Understanding of organization's unique requirements is a must in ensuring BI success	Literature/ Interviews	Imhoff and Pettit (2004)
Determine to use data	BI users should have the determination to use and make action based on available data	Literature/ Interviews	Imhoff and Pettit (2004)
Ability to utilize data	Ability to utilize data is essential for BI users to ensure BI success	Literature/ Interviews	Imhoff and Pettit (2004)
Willingness to optimize BI	Users willingness to make full use of BI capabilities is essential to ensure BI success	Literature/ Interviews	Imhoff and Pettit (2004)
Integrity	BI users must have high integrity in performing their tasks and responsibilities	Interviews	

6.3.4.3 Quality BI System

The construct of Quality System is about the influence of characteristics of BI systems on successful BI deployment, which in turn will have impact on utilization of BI-based knowledge for sustainable competitive advantage. This construct was measured with six items as shown in Table 6-3 below:

Table 6-3 Measurement of Quality BI System

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Functionality	BI systems should be fully functional as per their intended purposes	Literature/ Interview	Jarke et al. (1999)
Reliability	BI systems should be reliable and users can depend on BI operations	Literature/ Interviews	Nelson et al. (2005); Jarke et al. (1999)

Flexibility/ Maintainability	BI systems should be flexible enough to meet my organization's current and future needs	Literature/ Interviews	Nelson et al. (2005); Jarke et al. (1999)
Integration	BI systems should effectively combine data from different areas of the company	Literature/ Interviews	Nelson et al. (2005); Jarke et al. (1999)
Accessibility	BI systems should allow information to be readily accessible to me	Literature/ Interviews	Nelson et al. (2005); Jarke et al. (1999)
Response time	*BI systems should return answers to my requests quickly and in a timely manner*	Literature/ Interviews	Nelson et al. (2005); Jarke et al. (1999)

6.3.4.4 BI Governance

The construct of BI Governance deals with the belief that good governance of BI on organizations will an impact on BI success, which will in turn influence the utilization of BI-based knowledge in sustaining organizations' competitive advantage. This construct was measured based on five variables. The following Table 6-4 shows the measurement items and their references that were devised to measure this construct in the questionnaire.

Table 6-4 Measurement of BI Governance

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Manage Implementation	Upper management should provide sufficient support and commitment during design, development and implementation of BI systems	Literature/ Interviews	Matney & Larson (2004); Watson et al. (2004); Sherman (2001); Sujitparapitaya et al. (2003)
Enforce top-down directive	Enforcement by the upper management in using BI systems among executives will increase BI success	Literature/ Interviews	Sherman (2001); Sujitparapitaya et al. (2003)
Management support	Strong involvement and support from the management including moral and financial in implementing BI will increase its success	Literature/ Interviews	Sherman (2001); Sujitparapitaya et al. (2003)

Policy	A corporate-wide policy, standards and procedures regarding BI should be established in ensuring its success	Literature/ Interviews	Sujitparapitaya et al. (2003)
Training program	Organization should provide appropriate training and support program as well as periodical retraining program for all levels of BI users in ensuring BI success	Literature/ Interviews	Avery & Watson (2004); Sujitparapitaya et al. (2003)

6.3.4.5 Successful BI Deployment

The construct of Successful BI Deployment refers to utilizations and user satisfaction on BI systems. A satisfied BI users means users are relying on BI for acquiring knowledge in their decision making tasks and BI helps them in completing their managerial tasks efficiently and effectively. This construct was measured basely on the six dimension measurements coming out from field study and literature. The following Table 6-5 details the items measures that were devised to measure this construct in the questionnaire.

Table 6-5 Measurement of Successful BI Deployment

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Use	BI users should use BI systems and the information provided by the systems in carrying out their tasks and responsibilities in the organization	Literature/ Interviews	Ives, Olson & Baroudi (1983)
Rely	BI users should rely on BI systems to get information that they need to perform their job in the organization	Literature/ Interviews	Chen et al. (2000)
Utilize	BI users should utilize information provided by BI systems for making decision in the organization	Literature/ Interviews	Chen et al. (2000)
Accomplish tasks quickly	Using BI systems should enable users to accomplish their tasks more quickly	Literature/ Interviews	Seddon et al (1994)

User Satisfaction	The content of information from BI systems should sufficiently meet the users' decision-making requirements	Literature/ Interviews	(Caldeira, 2003); Chen et al. (2000); Ives, Olson & Baroudi (1983)
Help to be effective and efficient	Overall, BI systems should help users to be effective and efficient in their job	Literature/ Interviews	Chen et al. (2000)

6.3.4.6 Organizational Culture

The construct of Organizational Culture refers to the opinion that certain characteristics of culture instilled in the organizations such as knowledge-sharing, competitor-oriented, customer-oriented, continuous learning and perform-and-reward would influence BI success that in turn would encourage the utilization of BI-based knowledge in sustaining competitive advantage. The construct was measured by five items as shown in Table 6-6 below:

Table 6-6 Measurement of Organizational Culture

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Competitor Orientation	Use of BI systems supports the 'competitor-oriented' culture of my organization	Literature/ Interviews	Gotteland & Boule (2006)
Knowledge Sharing	Use of BI systems provide the knowledge to be shared among staff in my organization	Literature/ Interviews	Buhler (2003); Weir (2004)
Customer Orientation	Use of BI systems supports the 'customer-oriented' culture of my organization	Literature/ Interviews	Gotteland & Boule (2006)
Continuous Learning/ Improvement	The support for continuous learning and improvement within my organization motivates me to use BI systems	Interviews	
Perform-and-Reward	'Perform-and-reward' culture motivates to use BI systems to improve my performance	Interviews	

6.3.2.7 Use of BI Tools

Use of BI Tools construct refers to utilization of BI tools in making operational, tactical and strategic decision making. In other words, in using BI tools Telco executives are able to make informed or educated decision based on available knowledge provided by BI systems.

Eight items were used to measure this construct and Table 6-7 details the variable, measurements and related references used in the questionnaire.

Table 6-7 Measurement of Use of BI Tools

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Monitor Telco network performance (Operational)	BI systems are used to monitor the performance of my organization's network operations to ensure that they meet customers' expectations	Literature/ Interviews	Moss (2005); Buhler (2003); Weir (2004); Rao & Swarup (2005); Chung (2002)
Monitor staff performance	BI systems are used in setting up the key performance indicator (KPI) of the staffs in my organization	Literature/ Interviews	Moss (2005); Buhler (2003); Weir (2004); Rao & Swarup (2005); Chung (2002)
Fraud Detection	BI systems are used to detect fraudulent activities in a real-time manner	Literature/ Interviews	Moss (2005); Buhler (2003); Weir (2004); Rao & Swarup (2005); Chung (2002)
Perform traffic and usage patterns (Tactical)	BI systems are used to perform in-depth traffic and usage pattern analysis to reduce operational failures	Literature/ Interviews	Moss (2005); Buhler (2003); Weir (2004); Rao & Swarup (2005); Chung (2002)
Find revenue leakages	BI systems are used to find the revenue leakages and enhance revenue assurance by uncovering billable interconnect services	Literature/ Interviews	Moss (2005); Buhler (2003); Weir (2004); Rao & Swarup (2005); Chung (2002)
Model customer behaviour (Strategic)	BI systems enable users to model customer behaviour to spot usage trends and patterns	Literature/ Interviews	Moss (2005); Buhler (2003); Weir (2004); Rao & Swarup (2005); Chung (2002)
Support CRM	BI systems can support and compliment Customer Relationship Management (CRM) for more targeted marketing and services and for more profitable pricing plans	Literature/ Interviews	Moss (2005); Buhler (2003); Weir (2004); Rao & Swarup (2005); Chung (2002)
Identify trends and patterns	BI systems can be utilized to perform analysis on historical data to identify trends and	Literature/ Interviews	Moss (2005); Buhler (2003); Weir (2004); Rao &

	patterns to detect service problems and bottlenecks		Swarup (2005); Chung (2002)

6.3.2.8 Perceived BI's Observability

The Perceived BI's Observability reflects the perceptions of the telecommunications executives on whether the outcome of BI systems can be seen or observed. BI systems are also expected to provide means for communication among executives in order for BI to be successful. Two items were used to measure this construct as shown in the following Table 6-8.

Table 6-8 Measurement of Perceived BI's Observability

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Visible	BI users should be able to see the outcome of BI system that have been implemented in their organization	Literature/ Interviews	Rogers (1995); Tan & Teo (2000); Pankratz, Hallfors & Cho (2002); Mustonen-Ollila (1998); Tan & Teo (2000); Teng, Grover & Guttler (2002);
Encourage communication	BI systems are able to encourage communication among staffs in the organization	Literature/ Interviews	Pankratz, Hallfors & Cho (2002); Mustonen-Ollila (1998); Tan & Teo (2000); Teng, Grover & Guttler (2002);

6.3.2.9 Perceived BI's Triability

The construct of Perceived BI's Triability refers to opportunity to try BI systems before actually using them. This is to ensure that users will have sufficient time to test run the systems in ensuring that BI would be successfully deployed in organizations. Three items were used to measure this constructs and is depicted in Table 6-9.

Table 6-9 Measurement of Perceived BI's Triability

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Opportunity to try	BI users should be given the opportunity to try BI systems before actually using it	Literature/ Interviews	Rogers (1995); Tan & Teo (2000); Pankratz, Hallfors & Cho (2002); Mustonen-Ollila (1998); Tan & Teo (2000); Teng, Grover & Guttler (2002);
Test run	BI users should perform test runs on the BI system before actually using it	Literature/ Interviews	Pankratz, Hallfors & Cho (2002); Mustonen-Ollila (1998); Tan & Teo (2000); Teng, Grover & Guttler (2002);
Enough time to experiment	BI users should be given enough time to experiment the BI system before actually using it	Literature/ Interviews	Pankratz, Hallfors & Cho (2002); Mustonen-Ollila (1998); Tan & Teo (2000); Teng, Grover & Guttler (2002);

6.3.2.10 Perceived BI's Complexity

This construct deals with the belief that users' perceptions on complexity of BI system have impact on its success. On the other hand, if users perceived BI system as ease-of-use then the percentage of BI success would be higher. The Perceived BI's Complexity construct were measured with four items as shown in Table 6-10.

Table 6-10 Measurement of Perceived BI's Complexity

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Time consuming	Using BI system take too much time from my normal duty	Literature/ Interviews	Rogers (1995); Tan & Teo (2000); Fliegel & Kivlin (1962); Venkatesh et al. (2003); Thomson et al. (1991)
Complicated	Working with BI systems are so complicated, it is difficult to understand what is going on	Literature/ Interviews	Venkatesh et al. (2003); Thomson et al. (1991)
Too much work	Using BI systems involve too much time doing mechanical operations (e.g.: data input, integrate data and so on)	Literature/ Interviews	Venkatesh et al. (2003); Thomson et al. (1991)
Too long to learn	It takes too long to learn how to use BI systems to make it worth the effort	Literature/ Interviews	Venkatesh et al. (2003); Thomson et al. (1991)

6.3.2.11 Perceived BI's Compatibility

The Perceived BI's Compatibility construct refers to whether BI systems can fit the way executives manage their tasks without affecting their current working style. BI systems are supposed to be compatible with the norms of current working environment of the executives to ensure its success deployment in any organizations. This construct was measured based on three dimensions as tabled out in Table 6-11.

Table 6-11 Measurement of Perceived BI's Compatibility

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Compatible	Using BI systems should be compatible with all aspects of my work	Literature/ Interviews	Rogers (1995); Tan & Teo (2000); Fliegel & Kivlin (1962); Venkatesh et al. (2003)
Fits well	Using BI systems should fit well with the way I like to manage my work	Literature/ Interviews	Rogers (1995); Tan & Teo (2000); Fliegel & Kivlin (1962); Venkatesh et al. (2003)
No effect on working style	Using BI systems should has no effect on my current working style	Literature/ Interviews	Venkatesh et al. (2003)

6.3.2.12 Perceived BI's Relative Advantage

The Perceived BI's Relative Advantage refers to the benefits perceived by the telecommunications executives of BI systems. These benefits could be in terms of speed of accomplishing their tasks, improve quality of their work and so on. Six items were used to measure this construct and is shown in the following table.

Table 6-12 Measurement of Perceived BI's Relative Advantage

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Accomplish task quickly	Using BI systems should enable me to accomplish tasks more quickly	Literature/ Interviews	Rogers (1995); Tan & Teo (2000); Fliegel & Kivlin (1962); Venkatesh et al. (2003); Thomson et al. (1991)
Improve quality of work	Using BI systems should improve the quality of the work I do	Literature/ Interviews	Venkatesh et al. (2003); Thomson et al. (1991)
Easy to perform job	Using BI systems should makes it easier to perform my job	Literature/ Interviews	Venkatesh et al. (2003); Thomson et al. (1991)
Enhance effectiveness	Using BI systems should enhance my effectiveness	Literature/ Interviews	Venkatesh et al. (2003); Thomson

	on the job		et al. (1991)
Increase productivity	Using BI systems should increase my productivity	Literature/ Interviews	Venkatesh et al. (2003); Thomson et al. (1991)
Greater control	BI systems should give me better control over my work	Literature/ Interviews	Pankratz, Hallfors & Cho (2002); Mustonen-Ollila (1998); Tan & Teo (2000); Teng, Grover & Guttler (2002); Chiasson & Lovato (2001)

6.3.2.13 Use of BI-based Knowledge for Sustainable Competitive Advantage

Use of BI-based Knowledge for Sustainable Competitive Advantage is the stage where executives make decisions to use knowledge provided by BI. In sustaining competitive advantage, three important aspects have to be taken into consideration namely economic, social and environment. Eight items were used to measure this construct. Table 6-13 details the items, measurements and related references used in the questionnaire.

Table 6-13 Measurement of Use of BI-Based Knowledge for Sustainable Competitive Advantage

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Create long-term sustainable operations (Economics)	My organization should use knowledge from BI systems to create a long-term plan of sustainable operations that deliver a good return	Literature/ Interviews	Sachs et al. (2006)
Long-term success	In planning to achieve our financial goals and building a long-term success, my organization should utilize information provided by BI systems	Literature/ Interviews	Sachs et al. (2006)
Improve customer service	BI systems should provide knowledge needed for my organization to improve customer service that	Literature/ Interviews	Griffiths & Finlay (2004); Sachs et al. (2006)

	would retain customer loyalty		
Deliver quality, value and excellent service to customers	Overall, BI systems should provide sufficient knowledge for my organization to deliver quality, value and excellent services to our customers	Literature/ Interviews	Sachs et al. (2006)
Develop honest relationship with suppliers	My organization should utilize knowledge from BI systems to develop honest and transparent relationship with suppliers	Literature/ Interviews	Sachs et al. (2006)
Plan for employees fair working environment (Social)	Appropriate and adequate knowledge from BI systems should be used by my organization to plan for employees' fair and safe working environment	Literature/ Interviews	Sachs et al. (2006)
Provide information for local community support	BI systems should provide adequate and appropriate information for my company to do planning for support and communication with local community	Literature/ Interviews	Sachs et al. (2006)
Provide knowledge for environmental impact (Environment)	BI systems should provide appropriate and adequate knowledge for my organization to manage environmental impacts in a responsible manner	Literature/ Interviews	Sachs et al. (2006)

6.3.2.14 Business Strategy

Business strategy is important in sustaining competitive advantage of organizations. 4 types of business strategy have been defined namely prospector, analyzer, defender and reactor. Eight items were used to measure this construct. Table 6-14 details the items, measurements and related references used in the questionnaire.

Table 6-14 Measurement of Business Strategy

VARIABLE	MEASUREMENT	SOURCE	REFERENCES
Prospector	Use of BI systems can help my organization to be 'first-in' in attaining new products and services in Malaysian telecommunication industry	Literature/ Interviews	Croteau & Bergeron (2001); Clemons (1986)
	My organization can respond rapidly to early signals of opportunities in the industry using information provided by BI systems	Literature/ Interviews	Croteau & Bergeron (2001); Clemons (1986)
	Using BI systems can contribute to my organization to lead in innovation in telecommunication industry in Malaysia	Literature/ Interviews	Croteau & Bergeron (2001); Clemons (1986)
	BI systems enable my organization to adopt quickly to a promising innovations in the telecommunication industry in Malaysia	Literature/ Interviews	Croteau & Bergeron (2001); Clemons (1986)
Analyser	BI systems provide knowledge for my organization to carefully examine the innovations	Literature/ Interviews	Croteau & Bergeron (2001); Clemons (1986)
	BI systems can be used to monitor competitors' actions in the telecommunication industry	Literature/ Interviews	Croteau & Bergeron (2001); Clemons (1986)
Defender	Information provided by BI systems enable my organization to try to locate a safe niche in a relatively stable products and services domain	Literature/ Interviews	Croteau & Bergeron (2001); Clemons (1986)
	BI systems provide adequate knowledge for my organization to try to maintain a limited line of products/services	Literature/ Interviews	Croteau & Bergeron (2001); Clemons (1986)

6.4 PRE-TESTING OF THE RESEARCH INSTRUMENT

The research instrument used in the quantitative phase of the study was evaluated using pre-testing method. According to Straub (1989), the draft of a research instrument needs to be qualitatively examined in the pre-test stage. The basis of pre-testing was to evaluate the survey instrument before it was administered to the whole population of telecommunication industry in Malaysia. The objective was to identify any potential weaknesses and to confirm the clarity and validity of the instrument. The pre-test was conducted mainly to ascertain that all the items used were suitable for the intended audience of telecommunications' executives in Malaysia. This was to minimize risk that the instrument has not included particular important items, or on the other hand, had included items that may not belong in the domain. The pre-test was also used to confirm the required time needed by the respondents to complete the survey.

Alreck and Settle (1995) stated that pre-test can be used as a means of validating the research instrument (Thong & Yap, 1995). They suggested that a method to administer a draft instrument is to distribute it to a limited sample and then follow-up by interviewing the sample. Subjects can be selected from colleagues, respondent surrogates or even actual respondents and the sample for pre-test can be a convenient sample (Cooper & Emory, 1995).

During the pre-test stage, e-mail and telephone interviews were incorporated. A convenience sample of five executives from telecommunications companies in Malaysia that met the research criteria has been used for this pre-test. The executives were contacted by telephone and were invited to participate in pre-testing the questionnaire. The drafts of the research instrument were sent via e-mail attachments to the participants. They were given at least one week to read and examine the drafts, thus they had enough time to provide valuable suggestions. Following the completion of the questionnaire, each of the respondents was interviewed to discuss the validity and reliability of the content of the instrument. The use of interview method in pre-test was suggested by Straub (1989). The follow-up interviews attempted to identify any problems or weaknesses with the questionnaire such as question ambiguity and scales format (Thong & Yap, 1995). During the interview process, which took about 20-30 minutes for each participant, the researcher verbally posed the questions and wrote the important results on paper.

The pre-test also measured how complex the instrument was and the length of time taken to complete the survey. With high-level executives, surveys that are perceived to be complex and time-consuming would have a greater chance of failure, and therefore lead to poor response rate (Thong & Yap, 1995). Therefore, this study considered that providing the potential survey participants with an accurate estimate of how long the questionnaire would take to complete was important, as executives in telecommunications in Malaysia are likely to be constrained with time. The time estimate also provided a good guide on how well participants would respond to the survey requests.

In general, the feedback on the complexity of the instrument was positive. The majority of the respondents can easily understand the content and no significant difficulties were found in answering the questionnaire. Participants benchmarked the time taken to complete the survey to be between 15-20 minutes. However, useful criticism and suggestions were obtained. For instance, one suggestion, among others, was to revise the demographic question number 7, since the target sample was executives across departments in the telecommunications industry.

The feedback obtained from this pre-test phase was used to further refine the instrument for the next phase of the study. A copy of the finalized survey instrument can be found in appendix A. The data collected from these five participants from pre-testing phase were not included in the final sample of the main study.

6.5 SUMMARY

This chapter presented the thirteen hypotheses that were derived from the final research model developed in the previous chapter. This chapter also detailed the development of the questionnaire, which was survey instrument. The factors and items used in the survey instrument were derived from the final research model, developed in the previous chapter. This chapter also summarized the sources of the factors with their associated items, used in the survey instrument. The process of the pre-testing the survey instrument and the findings of the pre-test were also discussed in the final section of this chapter. The following chapter will discussed the analysis of the quantitative data in the survey.

CHAPTER 7

RESULTS OF DATA ANALYSIS VIA STRUCTURAL EQUATION MODELING

7.1 INTRODUCTION

This chapter describes the data analysis process of the industry-wide survey data acquired through questionnaire survey. For the purpose of analyzing the data, structural equation modeling (SEM) approach was undertaken in this study as briefly described in the Section 4.5.6 of Chapter 4. Section 7.2 details the administration of the telecommunications industry-wide survey. The sections that follow detail the results of the SEM-based Partial Least Squares (PLS) analysis of the quantitative data.

The PLS framework was used to evaluate the measurement model for item reliability, internal consistency, convergent validity and discriminant validity. This is followed by the analysis of the structural model using bootstrapping procedure to evaluate the significance of the paths in the model and to measure the explained variance, R^2. Preceding the PLS analyses is a summary of the key demographics and mean of the respondents. The significance of the paths in the revised model was used to evaluate the hypotheses developed earlier in Chapter 6.

7.2 ADMINISTRATION OF THE INDUSTRY-WIDE SURVEY

The data collection method used in this study involves 3 stages over the period of almost 6 months. The first stage survey was administered to a sample of 1,000 telecommunications executives through contact persons. To increase the response received from the initial 1,000 surveys, the study administered follow up phone calls and reminders. 325 usable questionnaires were eventually obtained.

Prior to data analysis, the study performed a non-response bias analysis and data screening in ensuring the data collected were fit for the analysis.

7.2.1 Non-Response Bias Assessment

Any survey has to be concerned with the issue of "non-response bias". Non-response bias refers to a situation in which people who do not respond to a questionnaire have opinions that are systematically different from the opinions of those who do respond. Response bias is directly related to the attitude and predisposition of respondents especially in mail surveys (Alreck & Settle, 1995). These types of surveys inherently have the problem of non-response bias as the survey content influences the decision to participate. However, in most survey cases some form of tolerance is required as is it impossible to entirely eliminate the bias (Alreck & Settle, 1995). The non-response bias could be evaluated by comparing some of the demographic and other key attributes of respondents (Innes & Mitchell, 1995). The standard way to test for non-response bias is to compare the responses of those who respond to the first mailing of a questionnaire to those who respond to subsequent mailings. Those who return subsequent mailings are, in effect, a sample of non-respondents to the first mailing, and they are representative of that group.

In this study, the non-response bias was assessed by using the Man-Whitney U test. The test is non-parametric that allows assessments to be made on whether the independent samples are from the same population. The non-response bias analysis assessed the mean responses of the different samples in terms of key demographics and variables related to the respondents' perceptions towards BI deployments. The telecommunication industry samples consisted of 156 respondents from the first group, 126 from the second group and 43 from the third group. However, the second and third group are grouped together and regarded as late responses. The responses of the two different samples were coded as follows:

- Group 1 were coded as 1
- Group 2 were coded as 2

The Mann-Whitney U-test compared the following key demographics amongst the different samples:

- Age
- Education
- Company's growth

The test also compared the following key perspective on BI success deployment in telecommunications companies:

- BI systems should produce information in a presentable format and should be easily understood and interpreted
- Upper management should provide sufficient support and commitment during design, development and implementation of BI systems
- BI systems are used to monitor the performance of my organization's telecommunication operations to ensure that they meet customers' expectations

The results are detailed in Table 7-1.

Table 7-1 Mann-Whitney U-Tests for Group 1 and Group 2 Samples

Item	Z value	Significance
Age	0.004	Yes
Education	0.100	No
Company's growth	0.353	No
BI systems should produce information in a presentable format and should be easily understood and interpreted	0.580	No
Upper management should provide sufficient support and commitment during design, development and implementation of BI systems	0.390	No
BI systems are used to monitor the performance of my organization's telecommunication operations to ensure that they meet customers' expectations	0.470	No

Since the z-value of the variable "Age" falls in the critical range, the null hypothesis is rejected, and hence there is significance difference between these two groups of respondents. All other demographics values were not significant. The analysis also showed that none of the perceptions towards BI success related variables were significant. The presence of deviation in one variable is tolerable since it is impossible to totally eliminate the likelihood of non-response bias (Alreck & Settle, 1995). Therefore, it was reasonable to conclude that non-response bias is negligible and the two samples can be combined for data analysis.

7.2.2 Data Screening

Before data analysis process took place, the properties of data had to be assessed in advance. Researchers have to review responses of individual questionnaire, and then transfer the information from questionnaires to a format for statistical analysis (Neuman, 1998; 2000). All questionnaires were sorted out based on inappropriate responses or incompleteness. Overall, the survey responses were reported having fifteen invalid responses. The raw data which showed some missing values, which were thus imputed by Estimated Means (EM) method (Green et al., 2001; Little & Rubin, 1987; Rao & Toutenburg, 1995).

7.3 DEMOGRAPHIC INFORMATION

As mentioned in earlier chapters, respondents for this survey were specifically Malaysian telecommunications executives whom were involved in decision-making and had experiences in using BI systems in their respective organizations. The type of respondents in this research may account for low response rate, especially among senior managers. Jones, Taylor and Spencer (1995) caution that questionnaires targeted at senior executives would yield lower response rates than questionnaires completed by junior executives.

The following sections will discuss the characteristics of the respondents, organized by gender, age, education, current position, tenure, duration in current position, field of work and their company's growth rate.

7.3.1 Gender

The usable returned samples showed that out of 310 responses received, 233 are male respondents.

Table 7-2 Respondents by Gender

Gender	Frequency	Percent
Male	223	71.9
Female	87	28.1

As noted in Table 7-2, a huge majority, which is 71.9% of respondents, are male. This is not a surprising fact as the respondents were executives from telecommunications industry, which is an engineering-based industry. Engineering-based companies mostly employ professionals from engineering related field which were known to be dominated by male workers. It could also be attributed to the facts that the participants were from the higher level decision-making group in telecommunications companies as decision-makers in any organizations are generally male as compared to female.

7.3.2 Age

As part of the survey response, participants were asked to state their age group. The age group profiles are detailed in Table 7-3. A large majority (75%) of respondents were Malaysian telecommunications executives in their middle age. They were between the ages of 31 to 40 years old (42.3%) and this is followed closely by the executives from the age group of 41 to 50 years (33.2%).

Table 7-3 Respondents by Age Group

Age Group	Frequency	Percent
20 years or below	3	1
21 to 30 years	48	15.5
31 to 40 years	131	42.3
41 to 50 years	103	33.2
51 years or above	25	8.1

Surprisingly, Malaysian telecommunications industry consisted of quite a number of young executives that were below 30 years of age, which takes up about 16.5% and 3 executive who were even below 20 years. It is also noted that executives that are more mature (51 years and above) are also contributing to the industry, which is about 8.1%.

7.3.3 Education Level

The profile in Table 7-4 shows the level of highest education attained by the participants. As expected, 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. It is assumed the 6.8% of them who did not have tertiary education, attended technical school instead. It is also interesting to note from Table 7-4 that the rest of the executives were high

school leavers. They probably were from the rank-and-file cases, who got promoted to a higher level
of positions.

Table 7-4 Respondents by Education Level

Highest Education Attained	Frequency	Percent
High School or equivalent	29	9.4
Technical School	21	6.8
Tertiary	176	56.8
Master’s Degree or Higher	84	27.1

7.3.4 Tenure

It is noted from Table 7-5 that 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.

Table 7-5 Respondents by Tenure

Years in Organization	Frequency	Percent
Less than 2 years	21	6.8
2 to 5 years	35	11.3
5 to 10 years	70	22.6
10 to 15 years	100	32.3
More than 15 years	84	27.1

A small percentage (6.8%) is relatively new to the organizations, having served less than 2 years. Some of them (27.1%) have served the organizations for more than 15 years, can be considered loyal workers, and it is no doubt they are given the mandate of making decision on behalf of the respective organizations.

7.3.5 Position

Table 7-6 depicts that majority of the respondents were executives officers, accounting approximately 54% of the total responses.

Table 7-6 Respondents by Position

Position	Frequency	Percent
Vice President or above	1	0.3
Assistant Vice President	1	0.3
Senior Director	8	2.6
Director	18	5.8
Department Manager	47	15.2
Section Manager	39	12.6
Section Head	29	9.4
Executive Officers	167	53.9

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 Director and 2.6% were Senior Director. It is also interesting to note from Table 7-6 that a Vice President and an Assistant Vice President took their time to fill in the questionnaires.

7.3.6 Years in Current Position

Meanwhile, it is observed from Table 7-7 that 61% of the respondents have been in their current position for more than 3 years, with approximately 27% had more than 6 years experience. The number of respondents who were relatively new to their current positions with less than 1-year experience is 37, which accounted for approximately 12% of the total responses.

Table 7-7 Respondents by Number of Year in Current Position

Years in Current Position	Frequency	Percent
Less than 1 year	37	11.9
1 to 3 years	84	27.1
3 to 6 years	105	33.9
More than 6 years	84	27.1

7.3.7 Field of Work

As expected, the majority of the respondents are from engineering field, accounting for approximately 44.5% of the total useable responses. Being in telecommunications industries, most of the BI users are involved in engineering-related works such network monitoring.

Table 7-8 Respondents by Field of Work

Field of Work	Frequency	Percent
Finance	17	5.5
Marketing	30	9.7
Legal	0	0
Commercial	2	0.6
Customer Services	22	7.1
Facilities/Maintenance	9	2.9
Human Resource	16	5.2
Production	4	1.3
Information Technology	30	9.7
Quality Control	7	2.3
Accounting	0	0
Purchasing	5	1.6
Manufacturing Services	1	0.3

Sales	14	4.5
Planning	15	4.8
Engineering	138	44.5

Table 7-8 shows that the rest of the respondents are diverted into various supporting field of work, which was quite evenly distributed. They were from departments of 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%). However, it is also noted that none of the executives from Legal and Accounting departments responded to the questionnaires.

7.3.8 Organizational Growth Status

As part of the survey response, participants were also asked to state the status of their organizations in terms of growth. They were asked to choose between 'growing', 'holding steady', 'just surviving' or 'shrinking' in their questionnaire forms. The results show in Table 7-9 suggests that the Malaysian telecommunications companies seemed to be in different growth stages. As expected, majority (85.8%) of the respondents said that their companies were either growing (60%) or holding steady (25.8%). On the other hand, the rest of the respondents felt that their companies are just surviving (8.7%) or even shrinking (5.5%).

Table 7-9 Respondents by Organizational Growth Status

Organizational Growth Status	Frequency	Percent
Growing	186	60.0
Holding Steady	80	25.8
Just Surviving	27	8.7
Shrinking	17	5.5

7.4 DATA ANALYSIS VIA STRUCTURAL EQUATION MODELING (SEM)

The industry-wide survey data were analyzed using SEM technique. Being confirmatory rather than exploratory data analysis approach, SEM was chosen to validate the BI for Sustainable Competitive Advantage model. The model as shown in Figure 7-1 was constructed in the earlier phase of the study.

The finalized number of data collected from the industry-wide survey was 310 and the number was considered sufficient for PLS-based data analysis. In terms of number of cases, the guideline in PLS analysis stated that the sample should have at least ten times more data-points than the number of items in the most complex formative constructs in the model (Gefen et al., 2000). Thus, in this study, the total of 310 cases in the data set satisfied the minimum requirement.

It should be noted that PLS has been designed to accommodate both formative and reflective types of indicators of constructs (Barclay et al., 1995). Reflective indicators 'reflect' the latent construct and are expressed as a function of the construct. They measure the same underlying dimensions and should be correlated. While, formative indicators, on the hand, 'cause' the latent construct and the construct is a function of the formative measures. They represent different dimensions of the construct and thus are not assumed to be correlated.

In this study as illustrated in Figure 7-1, all seventeen variables were identified as composed of reflective indicators, measuring the identical dimensions to reflect their corresponding latent constructs. For example in the case of Quality Information construct, items of Accuracy, Accessibility, Completeness, Currency, Presentable and Relevance are viewed to be measuring the same dimensions. Thus, all the items under Quality Information were considered as reflective indicators in PLS analysis.

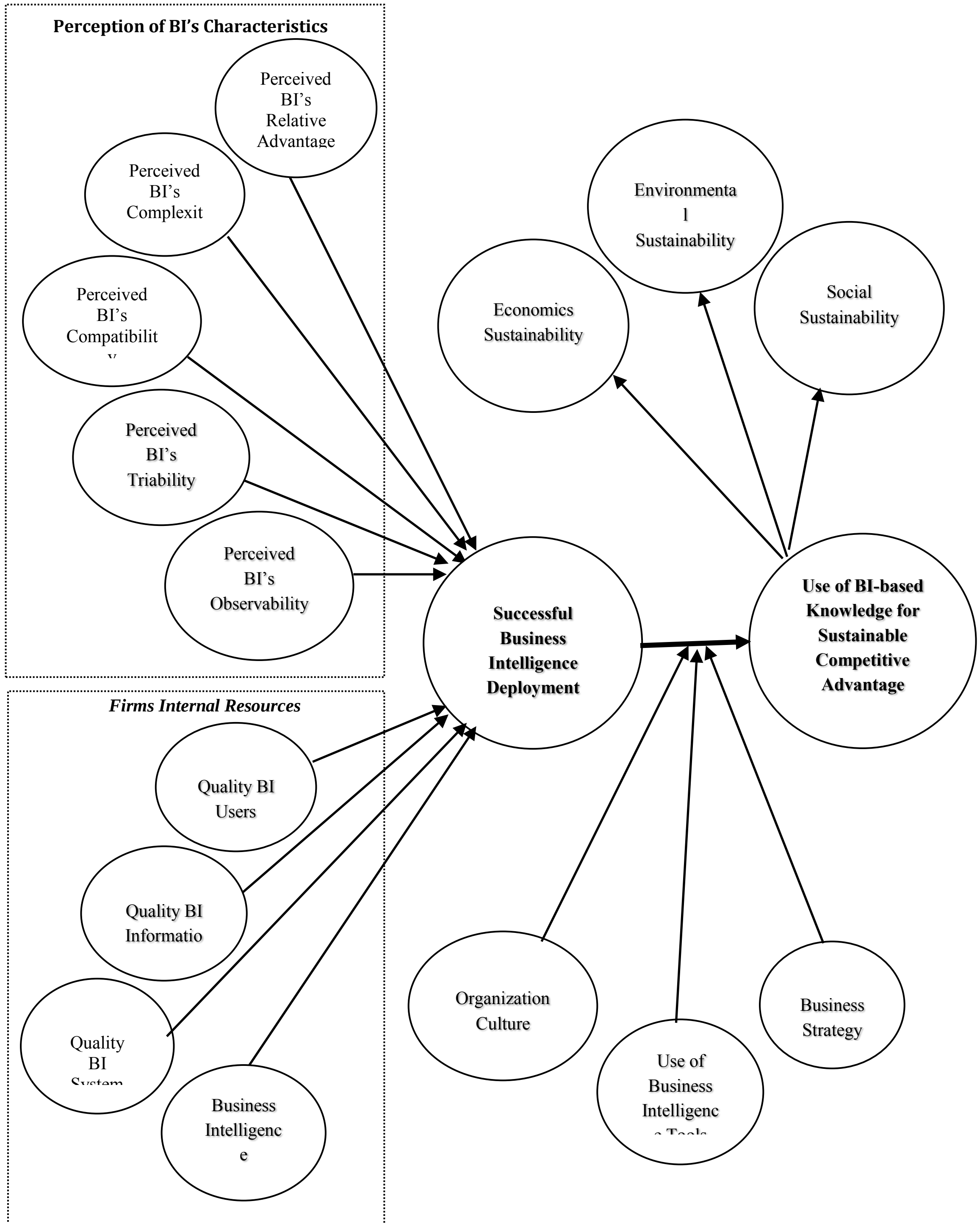

Figure 7-1 BI for Sustainable Competitive Advantage Model

The following sections discuss in detail the process of data analysis using PLS-based SEM undertaken in this study.

7.4.1 Assessment of Business Intelligence for Sustainable Competitive Advantage Model

Generally, PLS performs model assessment in two sequential stages as:

- Assessment of Measurement Model
- Assessment of Structural Model

Such a sequence is made to ensure that reliable and valid constructs are obtained before attempting to draw conclusions from the relationships among constructs in the model. The following sections will discuss in detail the two stages of PLS assessment procedure.

7.4.1.1 Assessment of the Measurement Model

It is very clear from the literature that the first essential tests of a model are test of reliability and validity. Reliability is defined as the consistency of measurement and in examining how reliable the measurement is and validity is defined as the accuracy of a measurement and assessing how accurate the measurement is (Holmes-Smith, 2001).

Testing the measurement model includes the estimation of the reliability coefficients of the measures, and also an examination of the convergent and discriminant validity of the research instrument. The construct reliability measures the reliability of the latent construct which means examining the internal consistency of a set of measures rather than a single variable. It provides the information on how well a set of observed variables reflects the common latent construct (Holmes-Smith, 2001). The higher the construct liability the better it is. It is suggested that measurement of properties need to first be satisfied before proceeding to the assessment of structural model (Barclay, Higgins & Thompson, 1995; Fornell & Larcker, 1981).

The following section will discuss the measurement model assessment by measuring individual item reliability, internal consistency and discriminant validity Barclay, Higgins & Thompson, 1995; Fornell & Larcker, 1981).

7.4.1.1.1 Measurement of Item Reliability

Item reliability is concerned with the level of random error in a particular construct, and the item reliability analysis provides an estimation of the amount of variance in the item's measure that is due to the construct (Barclay, Higgins & Thompson, 1995). PLS program was conducted to measure the degree to which each of the items loaded on their respective constructs. Based on Hair et al. (1988, p. 11) guidelines, the criterion of 0.50 is applied to determine the adequacy of the reliability coefficients obtained for each measure. This is to imply that there is more shared variance between the construct and its measure than error variance (Hulland, 1999; Carmines & Zeller, 1981).

The final BI model consists of 82 observed variables and the results of PLS analysis on their item reliability is shown in Table 7-10. It was observed that almost all items load highly to their respective construct except for item 'Complicated' and 'Too Many Mechanical Works' for Complexity construct.

Table 7-10 Initial Item Loadings of the Model

CONSTRUCT	ITEMS	REF	LOADING
Quality Users (QU)	Technical Skilled	QU1	0.5485
	Business skilled	QU2	0.7459
	Analytical skilled	QU3	0.7304
	Competence	QU4	0.7401
	Understand requirements	QU5	0.7574
	Determine to use data	QU6	0.7466
	Ability to utilize data	QU7	0.6560
	Willingness to optimize BI	QU8	0.7266
	Integrity	QU9	0.7478
Quality System (QS)	Functionality	QS1	0.7847
	Reliability	QS2	0.8015
	Flexibility	QS3	0.6632
	Integration	QS4	0.7673
	Accessibility	QS5	0.7890
	Response time	QS6	0.7690

Quality Information (QI)	Accuracy	QI1	0.6862
	Accessibility	QI2	0.7082
	Completeness	QI3	0.8257
	Currency	QI4	0.8118
	Presentable/ Format	QI5	0.7279
	Availability	QI6	0.7000
	Trustworthy/ Integrity	QI7	0.7994
	Relevance	QI8	0.7971
	Security	Q19	0.7913
BI Governance (BG)	Manage Implementation	BG1	0.7075
	Enforce top-down directive	BG2	0.7681
	Management support	BG3	0.7645
	Policy	BG4	0.7972
	Training program	BG5	0.7787
Successful 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
Use of BI-based Knowledge for Sustainable Competitive Advantage (SCA)	Create a long-term plan	SCA1	0.7404
	Achieve our financial goals	SCA2	0.6977
	Improve customer service	SCA3	0.7173
	Deliver excellent services	SCA4	0.7062
	Develop honest with suppliers	SCA5	0.7020
	Fair and safe working environment	SCA6	0.7378
	Support for local community	SCA7	0.7006
	Manage environmental impacts	SCA8	0.7387
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	0.6793
	Complicated	CX2	**0.2365**
	Too many mechanical work	CX3	**0.2857**
	Too long to learn	CX4	0.5746
Triability (TR)	Opportunity to try	TR1	0.8964
	Enough time to experiment	TR3	0.8671
	Test run	TR2	0.8964
	Enough time to experiment	TR3	0.8671
Observability (OB)	Visible	OB1	0.8899
	Encourage communication	OB2	0.9171
Sustainability-Economics (ECON)	Create a long-term plan	SCA1	0.9041
	Achieve our financial goals	SCA2	0.8445
	Improve customer service	SCA3	0.8310
Sustainability –Social (SOC)	Deliver excellent services	SCA4	0.7423
	Develop honest with suppliers	SCA5	0.7633
	Support for local community	SCA7	0.7796
Sustainability – Environment (ENV)	Fair and safe working environment	SCA6	0.9014
	Manage environmental impacts	SCA8	0.9000
Organizational Culture (CUL)	Support 'competitor-oriented'	OC1	0.8179
	Support 'knowledge-sharing'	OC2	0.8346
	Support 'customer-oriented'	OC3	0.7843
	Support 'continuous learning'	OC4	0.8161
	Perform-and-reward	OC5	0.7380
BI-Tool-Operational (BT-O)	Monitor operations	BT1	0.9370
	Set-up Key Performance Indicator	BT2	0.9297
BI-Tool-Tactical (BT-T)	Detect fraud	BT3	0.8606
	Perform traffic and usage pattern	BT4	0.8963
	Find revenue leakages	BT5	0.8886
BI-Tool-Strategic	Model customer behaviour	BT6	0.8987

(BT-S)	Support CRM	BT7	0.8675
	Identify trends and patterns	BT8	0.8753
Business-Strategy-Prospector (BS-P)	'First-in' in attaining products and services	BS1	0.9326
	Respond rapidly to early signal	BS2	0.9458
Business-Strategy-Analyzer (BS-A)	Lead in innovation	BS3	0.9233
	Adopt quickly to innovations	BS4	0.9074
Business-Strategy-Defender (BS-D)	Carefully examine innovations	BS5	0.9131
	Monitor competitions	BS6	0.9023
Business-Strategy-Reactor (BS-R)	Locate a safe niche	BS7	0.9313
	Maintain a limited line of products	BS8	0.8968

PLS output of the initial BI model shows that items CX3 (Complexity) and CX4 (Too many mechanical works) had loading less than 0.5, the cut-off point suggested by Hair et al. (1988). These two items were later removed from the model for further analysis. Although variables 'Complexity' and 'Too many mechanical works' have been suggested to be significant in influencing the successful diffusions of a new innovation (Rogers, 1995), they were not necessarily the major indicators for measuring the successful deployment of BI systems in the context of telecommunication companies in Malaysia. BI systems are specifically used by executives to help them in decision-making tasks, supposedly easy-to-use instead of complex and involved too many mechanical works.

Decision for removal the items were based on the fact that removing these items would not change or weaken the underlying constructs (Nunnaly & Berstein, 1994). Discarding these items was deemed necessary to prevent the lessening of the estimates of the relationships among the constructs. Therefore, the BI model was modified and later having 79 observed variables for further model evaluation.

The revised model with the remaining 79 observed variables was run again by PLS-Graph and the results showed that all the constructs now had loading of more than 0.5 as shown in Table 7-11.

Table 7-11 Final Item Loadings of the Model
(After low loading items removal)

CONSTRUCT	ITEMS	REF	LOADING
Quality Users (QU)	Technical Skilled	QU1	0.5485
	Business skilled	QU2	0.7459
	Analytical skilled	QU3	0.7304
	Competence	QU4	0.7401
	Understand requirements	QU5	0.7574
	Determine to use data	QU6	0.7466
	Ability to utilize data	QU7	0.6560
	Willingness to optimize BI	QU8	0.7266
	Integrity	QU9	0.7478
Quality System (QS)	Functionality	QS1	0.7847
	Reliability	QS2	0.8015
	Flexibility	QS3	0.6632
	Integration	QS4	0.7673
	Accessibility	QS5	0.7890
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Quality Information (QI)	Accuracy	QI1	0.6862
	Accessibility	QI2	0.7082
	Completeness	QI3	0.8257
	Currency	QI4	0.8118
	Presentable/ Format	QI5	0.7279
	Availability	QI6	0.7000
	Trustworthy/ Integrity	QI7	0.7994
	Relevance	QI8	0.7971
	Security	Q19	0.7913
BI Governance (BG)	Manage Implementation	BG1	0.7075
	Enforce top-down directive	BG2	0.7681
	Management support	BG3	0.7645
	Policy	BG4	0.7972
	Training program	BG5	0.7787
Successful BI	Use	SD1	0.7269

Deployment SD)	Rely	SD2	0.7304
	Utilize	SD3	0.8312
	Accomplish tasks quickly	SD4	0.8253
	Satisfy	SD5	0.8158
	Effective and efficient	SD6	0.8117
Use of BI-based Knowledge for Sustainable Competitive Advantage (SCA)	Create a long-term plan	SCA1	0.7404
	Achieve our financial goals	SCA2	0.6977
	Improve customer service	SCA3	0.7173
	Deliver excellent services	SCA4	0.7062
	Develop honest with suppliers	SCA5	0.7020
	Fair and safe working environment	SCA6	0.7378
	Support for local community	SCA7	0.7006
	Manage environmental impacts	SCA8	0.7387
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	CX4	0.8929
Triability (TR)	Opportunity to try	TR1	0.8964
	Enough time to experiment	TR3	0.8671
	Test run	TR2	0.8964
	Enough time to experiment	TR3	0.8671
Observability (OB)	Visible	OB1	0.8899
	Encourage communication	OB2	0.9171
Sustainability-Economics (ECON)	Create a long-term plan	SCA1	0.9041
	Achieve our financial goals	SCA2	0.8445
	Improve customer service	SCA3	0.8310

Sustainability –Social (SOC)	Deliver excellent services	SCA4	0.7423
	Develop honest with suppliers	SCA5	0.7633
	Support for local community	SCA7	0.7796
Sustainability – Environment (ENV)	Fair and safe working environment	SCA6	0.9014
	Manage environmental impacts	SCA8	0.9000
Organizational Culture (CUL)	Support 'competitor-oriented'	OC1	0.8179
	Support 'knowledge-sharing'	OC2	0.8346
	Support 'customer-oriented'	OC3	0.7843
	Support 'continuous learning'	OC4	0.8161
	Perform-and-reward	OC5	0.7380
BI-Tool-Operational (BT-O)	Monitor operations	BT1	0.9370
	Set-up Key Performance Indicator	BT2	0.9297
BI-Tool-Tactical (BT-T)	Detect fraud	BT3	0.8606
	Perform traffic and usage pattern	BT4	0.8963
	Find revenue leakages	BT5	0.8886
BI-Tool-Strategic (BT-S)	Model customer behaviour	BT6	0.8987
	Support CRM	BT7	0.8675
	Identify trends and patterns	BT8	0.8753
Business-Strategy-Prospector (BS-P)	'First-in' in attaining products and services	BS1	0.9326
	Respond rapidly to early signal	BS2	0.9458
Business-Strategy-Analyzer (BS-A)	Lead in innovation	BS3	0.9233
	Adopt quickly to innovations	BS4	0.9074
Business-Strategy-Defender (BS-D)	Carefully examine innovations	BS5	0.9131
	Monitor competitions	BS6	0.9023
Business-Strategy-Reactor (BS-R)	Locate a safe niche	BS7	0.9313
	Maintain a limited line of products	BS8	0.8968

7.4.1.1.2 Internal Consistency of Constructs

After the reliability assessment was completely done to satisfaction, the model was undergone another assessment to measure the internal consistency of the constructs. As discussed in the previous section, internal consistency is concerned with the measure of reliability of a construct. The Fornell and Larcker (1981) measure of internal was employed in this study.

Table 7-12 Internal Consistency of Constructs

CONSTRUCT		COMPOSITE RELIABILITY	AVE
Quality Users	QU	0.904	0.540
Quality System	QS	0.893	0.583
Quality Information	QI	0.926	0.581
Relative Advantage	RA	0.922	0.663
Compatibility	CB	0.858	0.672
Triability	TR	0.894	0.739
Observability	OB	0.899	0.816
Complexity	CX	0.907	0.830
Use of BI-based Knowledge for SCA	SCA	0.895	0.516
Successful BI Deployment	SD	0.909	0.626
BI Governance	BG	0.875	0.583
Sustainability – Economics	ECO	0.895	0.740
Sustainability – Social	SOC	0.806	0.580
Sustainability - Environment	ENV	0.896	0.811
BI Tool – Operational	BTO	0.931	0.871
BI Tool – Tactical	BTT	0.913	0.778
BI Tool – Strategic	BTS	0.912	0.775
Organizational Culture	CUL	0.898	0.638
Business Strategy – Prospector	BSP	0.937	0.882
Business Strategy – Analyzer	BSA	0.912	0.838
Business Strategy – Defender	BSD	0.903	0.824
Business Strategy – Reactor	BSR	0.911	0.836

The internal consistency of the constructs in the BI model was computed by evaluating the value of composite reliability and the Average Variance Extracted (AVE). These two values which were produced by PLS-Graph software were later carefully examined for the acceptability level. The suggested acceptable value of composite reliability is 0.7 or higher

(Barclay, Higgins & Thompson, 1995; Fornell & Larcker 1981) and AVE of 0.5 or higher. Utilizing the formula to calculate the value of composite reliability in section 5.6.7.1a in chapter 5, the model was evaluated for internal consistency (Fornell & Larcker, 1981). Although this measurement is similar to the CronBach Alpha measure of internal consistency, Fornell and Larcker (1981) argued that their measure is an improved method as they claimed that the number of items in the model does not affect their measure.

It is shown in Table 7-12 that all constructs used in BI model exceeded the suggested minimum requirement of 0.7 for composite reliability. The values of all the constructs are more than 0.8, which were considered high. The constructs of 'Quality Users', 'Quality Information', 'Relative Advantage', 'Complexity', 'Successful BI Deployment', 'BI Tools – Operational', 'BI Tools – Tactical', 'BI Tools – Strategic', 'Business Strategy – Prospector', 'Business Strategy – Analyzer', 'Business Strategy – Defender' and 'Business Strategy – Reactor' in fact showed high scores of more than 0.9.

Fornell and Larcker (1981) also recommended an additional evaluation of internal consistency by observing AVE of every construct in the model. AVE is the averaged variance shared between a construct and its measures and the value provided by PLS output is recommended to be equal or greater than 0.5. The results as can be seen from Table 7-12 reveals that the AVE values of all constructs exceed the recommended threshold. The constructs of 'Observability', 'Complexity', 'Sustainability – Environment', 'BI Tools – Operational', 'Business Strategy – Prospector', 'Business Strategy – Analyzer', 'Business Strategy – Defender' and 'Business Strategy – Reactor' showed relatively high scores of higher than 0.8.

7.4.1.1.3 Discriminant Validity

The model now had undergone two rigorous tests of item reliability and internal consistency. The next test was to determine the discriminate validity, which refers to the degree to which constructs differ with each other in the same model (Barclay, Higgins & Thompson, 1995; Hulland, 1999). Typically, PLS assess discriminant validity by examining the correlation at both (1) construct and (2) item level.

At Construct Level

Discriminant validity assessment measures the extent to which a given construct differs from other constructs (Barclay, Higgins & Thompson, 1995; Hulland, 1999). The first test is to ensure than a construct should not share more variance with its measures than it shares with other constructs in BI model. Fornell and Larcker (1981) proposed using the AVE, where the value of AVE should be greater than the variance shared with other constructs in the model. This study used the square root of the AVE of a construct to assess the discriminant validity, as suggested by Igbaria, Guimaraes and Davis (1995b). Barclay, Higgins and Thompson (1995b) also suggested that the model is assessed to have acceptable discriminant validity if the square root of the AVE of a construct is larger than its correlation with other constructs. Table 7-13 presents the correlation matrix for all 22 constructs used in BI model. The diagonal elements shown in this matrix are the square roots of the constructs' AVE and the off-diagonal values indicate the correlation with other constructs. For the model to demonstrate discriminant validity, the diagonal values should be greater than the off-diagonal elements in the corresponding rows and columns (Barclay, Higgins & Thompson, 1995; Hulland, 1999). As seen from the matrix in Table 7-13, all items on the diagonal of the matrix are greater than the items in corresponding rows and columns. Thus, all constructs in the model met the first criterion of discriminant validity test.

At Item Level

The second criterion for discriminant validity is at item level. In order to satisfy the second criterion an item should not load higher on another construct than it does on the construct it aims to measure (Barclay, Higgins & Thompson, 1995; Hulland, 1999). By using results from PLS analysis, cross-loading analysis is performed and the result can be seen at Table 7-14. It is noted that all items loaded higher on the construct that they were measuring than they did on the other constructs in BI model. Thus, all constructs in the model met the second discriminant validity criterion.

7.4.1.2 Assessment of Structural Model

As discussed in the previous chapter, the structural model of BI for Sustainable Competitive Advantage was done in terms of the explanatory power and significance of paths among the constructs (Chin & Newsted, 1999). PLS allows a technique called bootstrapping to make an assessment of the structural BI model. The bootstrapping technique employs a test that is similar to the traditional t-test and the results are used to interpret the significance of the paths between model constructs (Barclay, Higgins & Thompsons, 1995). This method also produces the squared multiple correlation or R^2 values that are accessed as a measure of the predictive power of the model for the endogenous constructs (Barclay, Higgins & Thompsons, 1995). The R^2 values are interpreted in a similar manner to the results of multiple regression analysis (Barclay, Higgins & Thompsons, 1995). The R^2 for observed variables tell how well the observed variables measure their underlying latent constructs both individually and as a group. It is calculated as the square of observed variable's standardized PLS-Graph loading. The R^2 for the structural equation reflects the proportion of variance of dependent variables explained by the variables in the structural equation (Joreskog & Sorbom, 1996). The values of R^2 range from 0 to 1. Holmes-Smith (2001) recommended that R^2 should exceed 0.5, while Santosa et al. (2005) suggested 0.1 to be an acceptable R^2 value.

Table 7-13 Correlation and Discriminant Validity of Constructs for BI Model

	QU	QS	QI	RA	CB	TY	OB	CX	SCA	SD	BG	ECO	SOC	ENV	BTO	CUL	BTT	BTS	BSP	BSA	BSD	BSR
QU	*.735*																					
QS	*.556*	**.764**																				
QI	.619	.650	**.762**																			
RA	.495	.614	.520	**.814**																		
CB	.439	.528	.482	.745	**.913**																	
TY	*.283*	.383	.266	.309	.332	**.859**																
OB	*.409*	.487	.485	.531	.517	.431	**.903**															
CX	*.000*	-.047	-.057	.039	.067	.237	.080	**.911**														
SCA	*.605*	.520	.588	.573	.534	.308	.559	.026	**.717**													
SD	*.491*	.570	.532	.644	.563	.299	.520	.060	.585	**.791**												
BG	*.510*	.669	.569	.528	.394	.315	.447	.104	.469	.587	**.763**											
ECO	*.512*	.498	.521	.450	.402	.264	.449	-.116	.840	.474	.393	**.860**										
SOC	*.562*	.435	.553	.507	.476	.237	.517	.011	.923	.540	.419	.652	**.762**									
ENV	*.484*	.397	.429	.533	.516	.302	.481	.218	.815	.498	.398	.444	.737	**.900**								
BTO	*.471*	.370	.457	.465	.469	.160	.401	.020	.565	.512	.332	.452	.544	.461	**.933**							
CUL	*.481*	.526	.482	.554	.581	.239	.577	-.022	.654	.602	.496	.585	.602	.485	.587	**.799**						
BTT	*.457*	.405	.437	.507	.505	.162	.391	-.020	.608	.545	.388	.484	.589	.495	.748	.640	**.882**					
BTS	*.438*	.394	.298	.411	.387	.218	.393	.029	.478	.491	.396	.411	.442	.375	.625	.506	.772	**.880**				
BSP	*.377*	.369	.360	.503	.523	.179	.483	.034	.542	.471	.282	.440	.503	.455	.482	.595	.533	.526	**.939**			
BSA	*.402*	.323	.396	.429	.418	.149	.438	.074	.564	.443	.309	.434	.529	.500	.504	.558	.535	.494	.792	**.915**		
BSD	*.384*	.345	.399	.383	.478	.171	.378	.103	.568	.396	.301	.425	.548	.503	.456	.565	.551	.479	.640	.705	**.908**	
BSR	*.367*	.279	.365	.388	.349	.179	.366	.298	.491	.386	.356	.331	.495	.452	.422	.441	.446	.427	.496	.556	.557	**.914**

Note: the bold elements in the main diagonal are the square roots of AVE

Table 7-14 Cross Loadings of Items in BI Model

	QU	QS	QI	RA	CB	TY	OB	CX	SCA	SD	BG	BTO	BTT	BTS	CUL	BSP	BSA	BSD	BSR
QU4	**.750**	.468	.499	.424	.369	.203	.311	.056	.501	.368	.394	.317	.307	.305	.353	.285	.329	.306	.299
QU5	**.754**	.386	.540	.323	.385	.239	.313	.023	.477	.335	.343	.397	.386	.271	.387	.276	.310	.315	.316
QU6	**..756**	.478	.530	.452	.361	.269	.462	.037	.498	.398	.456	.341	.305	.267	.373	.267	.291	.212	.317
QU8	**.731**	.386	.409	.365	.303	.201	.271	-.004	.416	.345	.382	.341	.345	.378	.334	.288	.291	.285	.328
QU9	**.752**	.397	.487	.401	.296	.215	.285	-.077	.458	.419	.400	.452	.415	.365	.416	.287	.284	.283	.211
QU2	**.737**	.328	.397	.264	.253	.120	.228	.017	.432	.360	.323	.282	.346	.353	.331	.278	.291	.354	.251
QU3	**.736**	.435	.432	.319	.313	.199	.288	-.030	.421	.326	.348	.317	.303	.321	.318	.344	.351	.292	.226
QU7	**.659**	.381	.304	.344	.297	.214	.214	-.032	.327	.327	.342	.315	.274	.323	.298	.185	.207	.213	.201
QS1	.487	**.785**	.535	.484	.425	.279	.422	-.114	.439	.416	.521	.322	.324	.291	.440	.307	.262	.265	.221
QS2	.415	**.802**	.497	.461	.391	.303	.350	-.029	.383	.399	.511	.288	.312	.343	.361	.280	.244	.252	.200
QS4	.474	**.767**	.530	.519	.473	.339	.401	.086	.427	.473	.551	.273	.349	.301	.431	.295	.242	.286	.274
QS5	.318	**.789**	.388	.454	.354	.262	.319	-.092	.339	.387	.485	.207	.234	.296	.337	.214	.193	.247	.154
QS6	.451	**.769**	.563	.503	.459	.278	.395	-.018	.450	.563	.534	.375	.373	.326	.488	.345	.312	.307	.235
QS3	.375	**.663**	.420	.348	.250	.299	.328	-.097	.300	.288	.440	.165	.208	.227	.291	.205	.194	.186	.167
QI3	.502	.579	**.823**	.437	.432	.181	.403	-.084	.474	.455	.496	.371	.384	.249	.406	.292	.326	.311	.284
QI4	.517	.543	**.812**	.397	.377	.243	.339	-.043	.483	.404	.446	.389	.359	.277	.389	.255	.286	.308	.238
QI5	.475	.438	**.734**	.387	.342	.248	.438	.118	.456	.367	.398	.370	.281	.168	.353	.308	.369	.284	.396
QI6	.472	.436	**.697**	.447	.382	.205	.281	.097	.352	.367	.406	.275	.262	.167	.296	.224	.268	.293	.263
QI7	.474	.480	**.800**	.417	.405	.204	.333	-.101	.476	.447	.424	.405	.410	.256	.436	.346	.332	.381	.229
QI8	.475	.488	**.803**	.369	.357	.183	.385	-.130	.482	.407	.423	.382	.335	.214	.361	.269	.255	.209	.251
QI9	.536	.485	**.798**	.399	.387	.232	.467	-.031	.552	.438	.450	.427	.402	.242	.422	.312	.355	.383	.375
QI1	.345	.550	**.678**	.380	.339	.135	.333	-.215	.344	.367	.428	.245	.278	.212	.332	.192	.184	.237	.102
QI2	.430	.470	**.700**	.348	.279	.185	.332	.010	.366	.390	.439	.221	.245	.248	.280	.250	.322	.318	.353

Table 7-14 Cross Loadings of Items in BI Model (con't)

	QU	QS	QI	RA	CB	TY	OB	CX	SCA	SD	BG	BTO	BTT	BTS	CUL	BSP	BSA	BSD	BSR
RA1	.377	.474	.470	**.768**	.536	.270	.458	.036	.506	.486	.450	.384	.388	.288	.429	.399	.342	.308	.359
RA2	.408	.515	.396	**.851**	.591	.226	.451	.101	.441	.506	.449	.328	.399	.332	.437	.412	.367	.316	.364
RA3	.368	.461	.373	**.846**	.581	.266	.382	.065	.445	.529	.463	.346	.387	.327	.389	.348	.342	.283	.328
RA4	.460	.518	.459	**.847**	.642	.238	.457	.045	.492	.568	.446	.410	.425	.327	.455	.452	.389	.296	.344
RA5	.429	.547	.456	**.791**	.586	.265	.385	-.063	.389	.519	.408	.382	.385	.353	.438	.377	.274	.283	.205
RA6	.370	.482	.385	**.779**	.696	.247	.462	.006	.525	.530	.366	.418	.486	.327	.553	.465	.375	.385	.295
CB1	*.410*	.487	.462	.693	**.888**	.320	.487	.020	.509	.517	.360	.409	.456	.332	.516	.437	.321	.404	.285
CB2	*.414*	.519	.461	.691	**.906**	.289	.514	.038	.489	.547	.419	.417	.441	.340	.540	.496	.404	.432	.347
CB3	*.200*	.205	.177	.393	**.638**	.219	.164	.181	.253	.237	.086	.334	.344	.295	.343	.341	.319	.351	.206
TY1	*.174*	.301	.175	.199	.178	**.813**	.248	.209	.242	.212	.248	.064	.064	.123	.163	.086	.125	.112	.087
TY2	*.208*	.320	.190	.244	.273	**.896**	.360	.227	.218	.233	.254	.087	.099	.125	.183	.108	.074	.097	.122
TY3	*.319*	.359	.295	.330	.383	**.867**	.465	.184	.317	.307	.299	.227	.221	.275	.254	.235	.172	.209	.226
OB1	*.419*	.463	.475	.492	.485	.458	**.890**	.055	.457	.437	.395	.334	.320	.334	.448	.405	.337	.290	.291
OB2	*.327*	.422	.408	.470	.453	.330	**.917**	.088	.548	.500	.412	.387	.384	.375	.587	.464	.447	.387	.366
CX1	*.024*	-.058	-.074	.036	.079	.143	.059	**.929**	.029	.060	.059	.052	.003	.034	.017	.047	.085	.124	.278
CX4	*-.028*	-.026	-.025	.035	.039	.306	.091	**.893**	.017	.049	.138	-.023	-.045	.018	-.064	.011	.046	.059	.264

Table 7-14 Cross Loadings of Items in BI Model (con'

	QU	QS	QI	RA	CB	TY	OB	CX	SCA	SD	BG	BTO	BTT	BTS	CUL	BSP	BSA	BSD	BSR
SCA1	.476	.452	.462	.474	.387	.236	.402	-.107	**.743**	.424	.405	.425	.422	.392	.513	.398	.369	.381	.312
SCA2	.402	.416	.459	.344	.301	.212	.364	-.072	**.709**	.359	.284	.363	.395	.306	.446	.332	.411	.363	.275
SCA3	.442	.416	.422	.339	.346	.232	.392	-.118	**.715**	.439	.322	.378	.433	.362	.551	.406	.341	.351	.269
SCA4	.453	.381	.412	.373	.335	.171	.419	-.092	**.710**	.393	.236	.384	.424	.363	.489	.420	.354	.364	.302
SCA6	.450	.360	.410	.489	.447	.220	.475	.132	**.737**	.444	.364	.431	.487	.384	.505	.466	.500	.502	.429
SCA7	.381	.262	.419	.299	.312	.206	.389	-.001	**.709**	.375	.312	.397	.420	.311	.441	.322	.380	.413	.259
SCA8	.422	.355	.362	.471	.485	.325	.391	.260	**.732**	.453	.353	.398	.405	.292	.369	.354	.400	.403	.384
SCA5	.450	.352	.433	.489	.441	.164	.371	.121	**.689**	.467	.412	.464	.504	.336	.445	.408	.476	.476	.575
D1	.394	.409	.445	.470	.398	.216	.406	.077	.445	**.727**	.434	.383	.438	.410	.447	.359	.334	.295	.298
SD2	.316	.385	.295	.404	.389	.142	.335	.107	.361	**.730**	.411	.398	.382	.318	.402	.274	.322	.249	.277
SD3	.461	.487	.402	.568	.547	.268	.405	.020	.469	**.831**	.503	.413	.397	.432	.536	.424	.354	.319	.268
SD4	.406	.538	.478	.520	.383	.255	.457	.048	.460	**.825**	.550	.362	.386	.350	.465	.352	.341	.266	.306
SD5	.386	.409	.419	.509	.484	.233	.406	-.004	.508	**.816**	.424	.442	.481	.407	.482	.393	.371	.377	.333
SD6	.359	.468	.467	.564	.460	.284	.448	.055	.516	**.812**	.458	.439	.501	.406	.511	.418	.378	.365	.351
BG1	.359	.471	.376	.351	.195	.207	.234	.070	.265	.391	**.708**	.164	.123	.213	.229	.166	.194	.158	.176
BG2	.459	474	.455	.441	.358	.225	.394	.122	.425	.547	**.768**	.308	.377	.385	.422	.297	.308	.303	.406
BG3	.297	.597	.443	.348	.275	.224	.236	-.044	.313	.414	**.765**	.197	.311	.288	.384	.150	.213	.252	.164
BG4	.439	.497	.464	.451	.370	.256	.403	.136	.421	.459	**.797**	.338	.378	.343	.444	.245	.248	.236	.311
BG5	.366	.531	.423	.409	.274	.294	.415	.092	.336	.396	**.779**	.232	.246	.246	.387	.188	.187	.171	.250

Table 7-14 Cross Loadings of Items in BI Model (con't)

	QU	QS	QI	RA	CB	TY	OB	CX	SCA	SD	BG	BTO	BTT	BTS	CUL	BSP	BSA	BSD	BSR
BT1	*.462*	.396	.439	.451	.451	.162	.384	-.028	.514	.498	.378	**.937**	.709	.623	.564	.475	.446	.424	.389
BT2	*.416*	.292	.413	.416	.424	.136	.364	.067	.512	.458	.239	**.930**	.687	.541	.531	.423	.496	.427	.400
BT3	*.371*	.333	.412	.410	.420	.152	.274	.033	.513	.443	.324	.649	**.861**	.567	.487	.354	.403	.420	.386
BT4	*.414*	.381	.395	.451	.429	.137	.368	-.056	.577	.502	.371	.680	**.896**	.721	.623	.523	.539	.518	.390
BT5	*.425*	.356	.347	.480	.488	.139	.392	-.027	.515	.496	.327	.647	**.889**	.751	.577	.527	.466	.517	.405
BT6	*.407*	.380	.287	.372	.413	.220	.431	.014	.481	.480	.371	.567	.733	**.899**	.529	.460	.454	.483	.388
BT7	*.393*	.311	.243	.372	.316	.185	.317	.047	.389	.441	.362	.555	.650	**.868**	.420	.504	.469	.408	.409
BT8	*.353*	.343	.252	.342	.275	.164	.271	.019	.379	.365	.308	.527	.647	**.875**	.366	.428	.379	.361	.328
OC1	*.380*	.391	.321	.411	.427	.088	.389	-.077	.486	.479	.374	.446	.491	.398	**.818**	.477	.421	.432	.326
OC2	*.461*	.459	.494	.513	.521	.200	.527	-.023	.598	.575	.465	.502	.587	.498	**.835**	.560	.552	.497	.408
OC3	*.341*	.426	.385	.365	.368	.239	.365	-.071	.503	.440	.361	.472	.481	.322	**.784**	.397	.385	.448	.271
OC4	*.383*	.427	.346	.432	.501	.152	.445	-.080	.515	.439	.333	.509	.509	.430	**.816**	.484	.430	.501	.315
OC5	*.341*	.390	.357	.476	.496	.276	.570	.167	.496	.454	.438	.409	.475	.355	**.738**	.444	.422	.370	.435
BS1	*.304*	.333	.294	.436	.446	.150	.426	.003	.481	.418	.248	.408	.450	.429	.542	**.933**	.721	.571	.423
BS2	*.400*	.358	.379	.505	.531	.184	.478	.057	.534	.465	.280	.492	.546	.554	.574	**.946**	.765	.629	.505
BS3	*.385*	.310	.392	.384	.387	.154	.438	.081	.539	.413	.287	.473	.485	.443	.539	.783	**.923**	.630	.535
BS4	*.350*	.281	.330	.402	.378	.116	.360	.053	.492	.397	.278	.448	.494	.464	.481	.661	**.907**	.663	.481
BS5	*.369*	.329	.369	.345	.462	.170	.394	.092	.530	.382	.247	.413	.494	.450	.521	.625	.717	**.913**	.522
BS6	*.328*	.296	.355	.350	.404	.140	.289	.096	.501	.336	.301	.416	.507	.420	.505	.535	.559	**.902**	.489
BS7	*.350*	.301	.353	.402	.405	.159	.352	.260	.489	.397	.345	.440	.482	.460	.483	.505	.526	.577	**.931**
BS8	*.319*	.201	.312	.298	.215	.170	.315	.289	.402	.301	.303	.322	.320	.307	.307	.392	.488	.428	**.897**

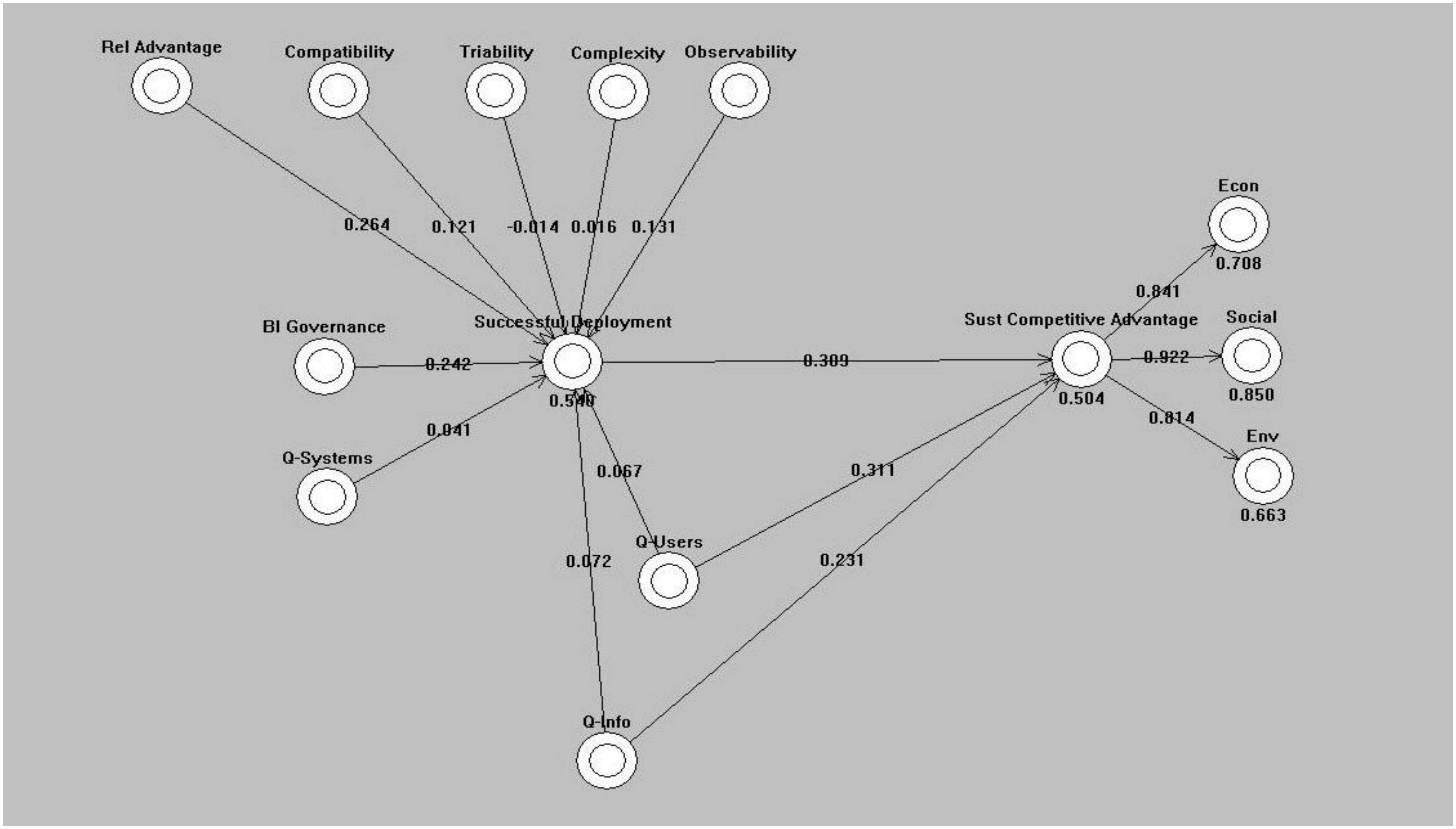

Figure 7-2 BI Model by PLS-Graph

The following sections will describe the detail of the assessment procedure undertaken in this study for the main model of BI for Sustainable Competitive Advantage as shown in Figure 7-2 (the figure was a snapshot from the output from PLS-Graph 3.0 software). The procedure includes the R^2 values and the hypothesis testing of the second order model. It should be noted that the model also include the first-order factors of economics, social and environment underlying the higher-order factor. The effects of three moderating variables on the relationship between successful BI deployment and utilization of BI-based knowledge for sustainable competitive advantage are also discussed in the next section.

7.4.1.2.1 The Explanatory Power (R^2 Values) of the Main BI Model

The R^2 values or explanatory powers reflect the amount of variance explained by the model or the predictive power of the model. The value reflects the proportion of variance of dependent variables explained by the variables in the structural equations. A small R^2 values reflect weak relationships and indicates that the model is not good (Joreskog, 1993). The values of R^2 range from 0 to 1 and it is recommended that the R^2 should exceed 0.1 for the model to be considered good (Santosa et al., 2005).

Table 7-15 shows the R^2 values for the main BI model. It shows that the model explains 54% of the variance in Successful BI Deployment, 50% of the variance in Utilization of BI-based Knowledge for Sustainable Competitive Advantage, 71% of the variance in Economics Sustainability, 85% of the variance in Environment Sustainability and 66% of the variance in Social Sustainability.

Table 7-15 R^2 Values of the Constructs

Construct	R^2 Value
Successful BI Deployment	0.54
Utilization of BI-based Knowledge for Sustainable Competitive Advantage	0.50
Sustainability – Economics	0.71
Sustainability – Environment	0.85
Sustainability – Social	0.66

In this study, the PLS results show that the model exhibits explanatory power in the neighborhood of 54% in the Successful BI Deployment. It means that the model explained 54% of the variance in the Successful BI Deployment, which is reasonably good (Holmes-Smith, 2001). Therefore, another 46% of the overall variance in the model is unexplainable by this study. For the Utilization of BI-based Knowledge for Sustainable Competitive Advantage, the model explained 50% of the variance, which means another 50%, is not explained in this model. It is interesting to note that the percentage of variance explained of constructs economics, environmental and social were relatively high.

7.4.1.2.2 Hypothesis Testing for the Main Model of BI for Sustainable Competitive Advantage

To test the hypotheses, PLS employs a technique called bootstrapping. Bootstrapping employs a test similar to the traditional t-test and the result can be used to interpret the significance of the paths between models constructs (Barclay, Higgins & Thompsons, 1995).

The output which shows the result of the structural model of BI for Sustainable Competitive Advantage via PLS-Graph is diagrammatically represented in Figure 7-2. The path coefficients and t-statistics results of the bootstrapping calculations are summarized in Table 7-16 below.

Table 7-16 Results of Hypothesis Testing

Hypothesis		Finding		Support of Hypothesis
		β	t-value	
H_1	Quality information will positively influence the successful business intelligence deployment in telecommunications companies in Malaysia	0.072	1.394	Not Supported
H_2	Quality BI users will positively influence the successful business intelligence deployment in telecommunications companies in Malaysia	0.067	0.596	Not Supported
H_3	Quality business intelligence system will positively influence the successful BI deployment of telecommunications companies in Malaysia	0.041	0.181	Not Supported
H_4	Business intelligence governance will positively influence the successful business intelligence deployment in telecommunications companies in Malaysia	**0.242**	**3.914**	**Yes*** Highly Supported**

H_5	The higher the perceived relative advantage of using business intelligence, the more likely that business intelligence will be successfully deployed	**0.264**	**3.555**	**Yes*** Highly Supported**
H_6	The lower the perceived complexity of using business intelligence, the more likely that business intelligence will be successfully deployed in telecommunications companies in Malaysia	**0.016**	0.413	Not Supported
H_7	The higher the perceived compatibility of using business intelligence, the more likely that business intelligence will be successfully deployed in telecommunications companies in Malaysia	**0.121**	1.673	**Yes* Supported**
H_8	The greater the perceived trialability of business intelligence, the more likely that business intelligence will be successfully deployed in telecommunications companies in Malaysia	-0.014	0.237	Not Supported
H_9	The greater the perceived observability of business intelligence, the more likely that business intelligence will be successfully deployed in telecommunications companies in Malaysia	**0.131**	2.323	**Yes* Supported**
H_{10}	Successful business intelligence deployment will positively influence the use of business intelligence-based knowledge for Malaysian telecommunications company's sustainable competitive advantage	**0.309**	5.795	**Yes*** Highly Supported**

Note: * indicates significance at $t_{0.05} > 1.645$
** indicates significance at $t_{0.01} > 2.326$
*** indicates significance at $t_{0.001} > 3.090$

This study also further runs the analysis to explore how BI deployments can support the management of sustainable competitive advantage in the Malaysian telecommunications companies. The PLS analysis of the first order constructs of Economics, Social and Environmental shows highly significant results on sustainable competitive advantage.

The result of the hypotheses testing of the full model will be described in detail in Section 7.5. The results of main model together with moderating effects of business strategy, organizational culture and use of BI tools will also be discussed.

7.4.1.3 Assessment of Structural Model for Moderation Effects

To assess the effects of moderating variables in the model, this study tested eight models. These models which are based on the combination of factors that hypothesize to moderate the relationship between the successful BI deployment and the utilization of BI-based knowledge in sustaining competitive advantage of telecommunications companies in Malaysia, which have been defined earlier are:

Model 0: Direct interaction effect

Model 1: Moderating effect of Use of BI Tools

Model 2: Moderating effect of Business Strategy

Model 3: Moderating effect of Organizational Culture

Model 4: Moderating effect of Use of BI Tools and Business Strategy

Model 5: Moderating effect of Use of BI Tools and Organizational Culture

Model 6: Moderating effect of Business Strategy and Organizational Culture

Model 7: Moderating effect of all the three factors

A procedure for formulating and testing the interaction effects suggested by Chin et al. (2003) was employed in this study. The calculated R^2 values for each model are used to make comparison with the R^2 of the main effects. These comparisons were made to assess the strength of moderating effect of Use of BI Tools, Business Strategy, Organizational Culture, Use of BI Tools and Business Strategy, Use of BI Tools and Organizational Culture, Business Strategy and Organizational Culture as well as the three moderating factors in total respectively.

The overall effect sizes for the interaction which are denoted by f^2s were calculated using the formula as suggested by Chin et al. (2003) below. Cohen (1988) stated that the size of small, medium large effects requires at least 0.02, 0.15 and 0.35 of f^2 values respectively.

$$f^2 = [R^2 \text{ (interaction effect model)} - R^2 \text{ (main effect model)}] \,/\, [1 - R^2 \text{ (main effect model)}]$$

Table 7-17 summarizes the PLS results of all 8 models and Figure 8.3 shows the results of the full direct and interaction effects (Model 7) in this study. As noted in Figure 7.3, only direct effect of organizational culture is depicted as it is the only significance relationship found in the model.

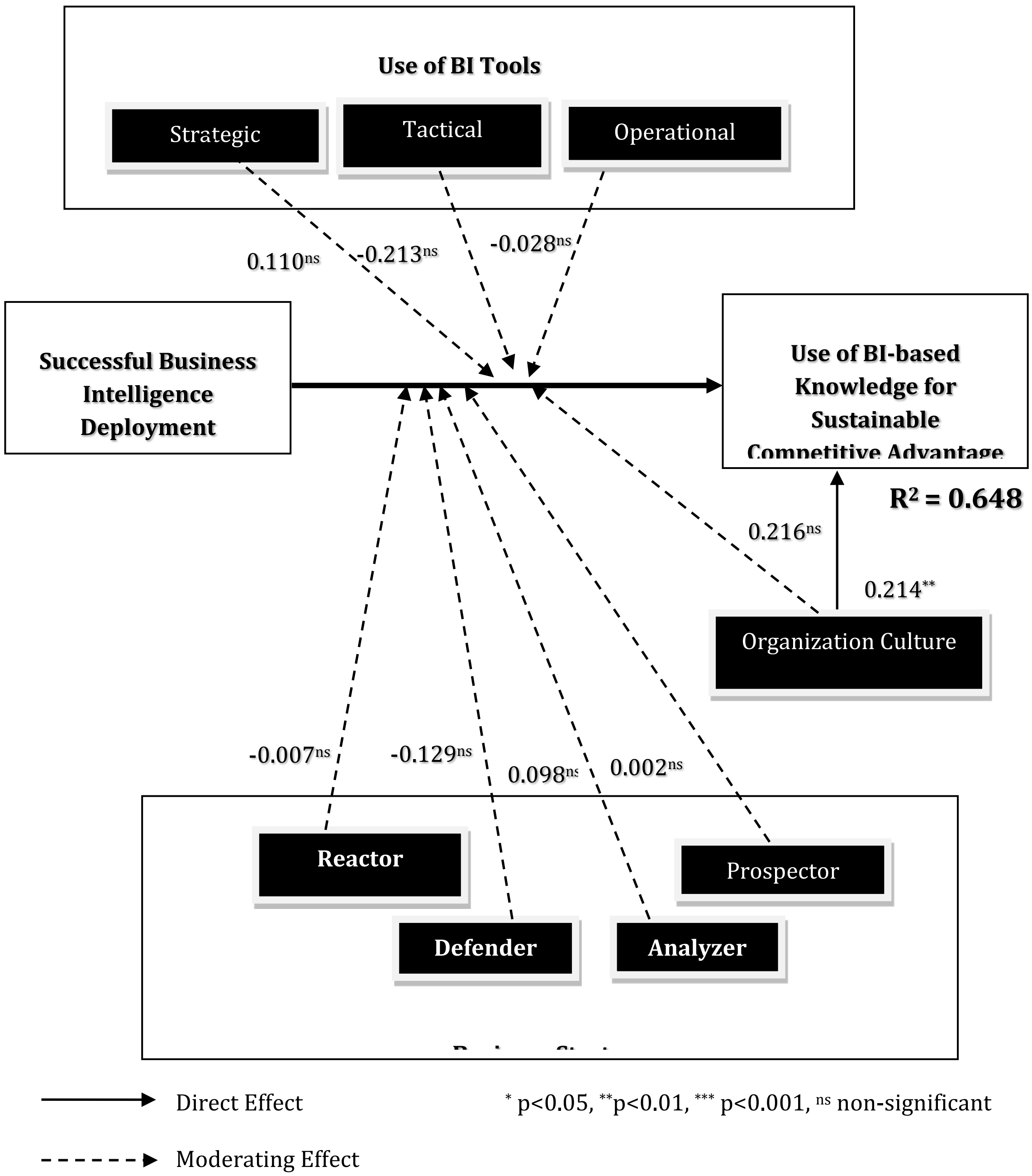

Figure 7-3 PLS Results of Model 7 (Full Model)

7.5 TESTING OF HYPOTHESES

This section details the hypotheses testing results inclusive of the direct and moderating effects in the BI for Sustainable Competitive Advantage model. The results of the hypotheses testing which are summarized in Table 7.15 are first discussed. Then the discussion on the interactions effects of moderating variables are discussed based on the eight interactions models shown in Table 7-16.

7.5.1 Hypotheses H_1, H_2, H_3

Hypothesis H_1 was tested to explore the important role that quality information provided by BI systems plays in stimulating the use of BI-based knowledge in sustaining competitive advantage by influencing the successful information system deployment in organizations. However in this study, the role of quality information in the process of deploying business intelligence systems found to be non-significant (β=0.072 and t-value=1.394), even though such influence was suggested in previous studies of information systems success (Jedras, 2003; Burns, 2005; Nelson et al., 2005). Therefore, the hypothesis was rejected.

Similar findings were found in hypothesis H_2 and Hypothesis H_3 where the tests were to ascertain that the respective quality users and quality BI systems would affect successful BI deployment in telecommunications companies in Malaysia. Both factors were found to be non- significant (β=0.067 and t-value=0.596 for quality users; β=0.041 and t-value=0.181 for quality systems). These findings were contradictory with the prediction of the study that these two important factors had active roles in business intelligence success as mentioned in many previous studies (Avery & Watson, 2004; Watson et al., 2006; Rustmann Jr., 1997; White, 2005; Strange & Hostman, 2003; McGillivray & Faulkner, 2003; Imhoff & Pettit, 2004). Therefore, both hypothesis H_2 and H_3 were rejected.

7.5.2 Hypothesis H_4

Hypothesis H_4 is concerned with the role of business intelligence governance in stimulating the use of BI-based knowledge in achieving organizations sustainable competitive advantage by influencing the successful BI deployment. There was overwhelming statistical evidence to support this hypothesis in this study, where the standardized path coefficients from BI governance to successful BI deployment was 0.242 with t-value of 3.914. This hypothesis found to be significance at 0.001 level. Therefore, it can be inferred that BI governance especially strong financial support and direct management involvement in BI implementation, plays an important role in its success that would eventually encourage people to use knowledge provided by BI for decision-making tasks.

7.5.3 Hypothesis H_5, H_6, H_7, H_8, H_9

Hypothesis H_5 predicted that if the users perceived BI as beneficial to them, then the possibility of BI will be successfully deployed in organizations will be high. In this study, the effect of perceived BI's relative advantage found to be highly significant (β=0.264, t-value= 3.555, significance at 0.001 level) and therefore, hypothesis H_5 was accepted. As a result, it can be inferred that users' perceptions on BI's benefits or relative advantages have a direct positive effect on BI success.

Hypothesis H_6 proposed that if the users perceived low complexity of BI systems, then the higher the success of the systems. In this study, the effect of perceptions of BI's complexity on BI success was found to be statistically not significant (β=0.016, t-value= 0.413). This result gave some good indication as the insignificance of the hypothesis would mean that the users found BI systems were not complex. Therefore, hypothesis H_6 which was related to perceived BI's complexity by users on BI success was rejected.

Hypothesis H_7 was concerned with exploring the effect of perceived BI systems' compatibility on BI success. As expected, the study found that it was statistically significant (β=0.121, t-value= 1.673, significance at 0.05 level) for perceptions of BI's compatibility to influence the successful BI deployment in organizations. Therefore, the hypothesis was accepted. Hence, it can be inferred from the result that perceptions on compatibility to working life have a direct positive effect on BI success in organizations.

Similar finding was observed on hypothesis H_9. The study found positive result for the effect of perceived BI's observability on BI success. The higher the perceptions on BI's observability, the higher the likelihood of BI to be successfully deployed in organizations was statistically found to be significant (β=0.131, t-value=2.323). Therefore, hypothesis H_8 was accepted. Hence, it can be inferred that perceived BI's observability has a direct positive effect on successful BI deployment.

On the contrary, hypothesis H_8, are concerned with exploring the effect of users' perception of BI systems' triability on BI success. The result shows that this factor on BI perceptions was not statistically significant (β=-0.014, t-value=0.237). Therefore, the hypothesis was rejected and the study inferred that users' perceptions on BI's triability do not have direct positive influence on BI success.

7.5.4 Hypothesis H_{10}

It was stated in hypothesis H_{10} that there is a positive relationship between successful BI deployment and the utilization of BI-based knowledge for sustainable competitive advantage in telecommunications firms in Malaysia. The study found that the influence of BI systems success on utilization of knowledge was very high as shown in the test result. The relationship was found to be highly significant (β=0.309, t-value= 5.795 at 00.01 level). Therefore, the hypothesis was accepted. As a result, it can be inferred that BI success has a positive effect on the use of BI-based knowledge for sustaining firm's competitive advantage.

7.5.5 Testing of the hypotheses related to Moderating Factors

This study used eight different models (Model 0 to Model 7), which vary in terms of combination of direct and interaction effects, to measure the relationship of successful BI deployment and use of BI-based knowledge for sustainable competitive advantage. The following discussions are based on the results of the different models which are depicted in Table 7-17.

7.5.5.1 Model 0 (Exclusive of Interactions)

Model 0 analyzes the association between successful BI deployment and use of BI-based knowledge for sustainable competitive advantage without the interaction effects as specified in Hypothesis H_{10}. Successful BI deployment is found to be positively related to use of BI-based knowledge for sustainable competitive advantage.

7.5.5.2 Model 1 (Direct and interactions effect of Use of BI Tools)

In model 1, further insights are gained by investigating the direct and moderating effects of operational, tactical and strategic use of BI tools on the relationship of successful BI deployment and use of BI-based knowledge for sustainable competitive advantage. The results show that all of the interaction effects were not significant (β=-0.130, t-value=0.871 for H_{13d}, β=0.032, t-value=0.206 H_{13e}, β=-0.115, t-value=0.921 for H_{13f}.). As for the direct effects of these three types of factor, the tactical use of BI tools (H_{13b}) turned out to be significant with β=-0.274, t-value=3.359). Therefore, all the hypotheses related to interaction effects of use of BI tools were rejected with the exception of H_{13b} and the study inferred that use of tactical BI tools has a direct effect on the utilization of BI-based knowledge for sustainable competitive advantage.

7.5.5.3 Model 2 (Direct and interactions effect of Business Strategy)

In model 2, the direct and moderating effects of the different types of business strategy of prospector, analyzer, defender and reactor were tested on the relationship between successful BI deployment and use of BI-based knowledge for sustainable competitive advantage. The results show that all of the interaction effects (β=0.031, t-value=0.537 for H_{12e}, β=-0.085, t-value=0.770 H_{12f}, β=-0.062, t-value=0.203 for H_{12g} and β=-0.062, t-value=0.613 for H_{12h}) and the direct effects (β=0.072, t-value=1.085 for H_{12a}, β=0.084, t-value=1.317 H_{12b}, β=0.081, t-value=1.384 for H_{12d}) were not significant except hypothesis H_{13c} (β=0.178, t-value=3.123). Therefore, all the hypotheses related to direct and interaction effects of business strategy were rejected with the exception of H_{13c} and the study inferred that use of defender business strategy has a direct effect on the utilization of BI-based knowledge for sustainable competitive advantage.

7.5.5.4 Model 3 (Direct and interactions effect of Organizational Culture)

In model 3, the direct and moderating effects of organizational culture were tested on the relationship between successful BI deployment and use of BI-based knowledge for sustainable competitive advantage. The results show that the interaction effects (β=0.050, t-value=0.623) for H_{11b} was not significant, while H_{11a}, the direct effect (β=0.367, t-value=6.376) was significant. Therefore, the hypothesis of interaction effects of organizational culture was rejected and the study inferred that organizational culture has direct effect on the utilization of BI-based knowledge for sustainable competitive advantage.

7.5.5.5 Model 4 (Direct and interactions effect of Use of BI tools and Business Strategy)

In model 4, the study further investigate the direct and interaction effects of the combination of use of BI tools and business strategy on the relationship between successful BI deployment and use of BI-based knowledge for sustainable competitive advantage. The results show that all of the interaction effects and the direct effects were not significant except for direct effects of tactical (β=0.220, t-value=2.312), strategic use of BI tools (β=-0.138, t-value=1.845), and defender business strategy (β=0.144, t-value=2.105). Therefore, all the hypotheses related to direct and interaction effects of combination of use of BI tools and business strategy were rejected with the exception of H_{13b}, H_{13c}, H_{12c}.

7.5.5.6 Model 5 (Direct and interactions effect of Use of BI Tools and Organizational Culture)

Similar to Model 4 the direct and interaction effects of the combination of use of use of BI tools and organizational culture on the relationship between successful BI deployment and use of BI-based knowledge for sustainable competitive advantage were tested. The results present similar findings that all of the interaction effects and the direct effects were not significant except for direct effects of tactical business strategy (β=0.162, t-value=1.781) and organizational culture (β=0.280, t-value=3.755). Therefore, all the hypotheses related to direct and interaction effects of combination of use of BI tools and organizational culture were rejected with the exception of direct effect of tactical business strategy and organizational culture on use of BI-based knowledge for sustaining competitive advantage.

7.5.6.7 Model 6 (Direct and interactions effect of Business Strategy and Organizational Culture)

This model is also similar to the previous two models, where the combination of business strategy and organizational culture were tested. The results show that all of the interaction effects and the direct effects were not significant except for direct effects of organizational culture (β=0.255, t-value=4.162) and defender business strategy (β=0.119, t-value=1.835). Therefore, all the hypotheses related to direct and interaction effects of combination of business strategy and organizational culture were rejected with direct effects of organizational culture and defender type of business strategy.

Table 7-17 PLS Results for Direct and Interaction Effects of Eight Models

Variable		Model 0 (Initial)		Model 1 (Direct & Interaction of BI Tools)		Model 2 (Direct & Interaction of Business Strategy)		Model 3 (Direct & Interaction of Culture)		Model 4 (BI Tool & Business Strategy)		Model 5 (BI Tool & Culture)		Model 6 (Business Strategy & Culture)		Model 7 (Full Model)	
		ß	**t-value**	**ß**	**t-value**	**ß**	**t-value**	**ß**	**t-value**	**ß**	**t-value**	**ß**	**t-value**	**ß**	**t-value**	**ß**	**t-value**
Independent Variable																	
H_{10}	**SD**	**0.309**	**5.795 *****	**0.207**	**3.264 *****	**0.209**	**4.170 *****	**0.158**	**2.903 ****	**0.181**	**3.006 *****	**0.131**	**1.927 ***	**0.147**	**2.581 ****	**0.139**	**2.311 ****
Moderating variable: BI Tools																	
H_{13a}	BTO			0.083	1.254					0.070	0.976	0.076	1.112			0.065	0.916 ns
H_{13b}	BTT			**0.274**	**3.359 *****					**0.220**	**2.312 ****	**0.162**	**1.781 ***			0.142	1.472 ns
H_{13c}	BTS			-0.058	0.819					**-0.138**	**1.845 ***	-0.029	0.438			-0.076	1.035 ns
H_{13d}	SD x BTO			-0.130	0.871					-0.021	0.129	-0.081	0.599			-0.028	0.190 ns
H_{13e}	SD x BTT			0.032	0.206					-0.055	0.307	-0.179	1.040			-0.213	1.046 ns
H_{13f}	SD x BTS			0.115	0.921					0.068	0.578	0.135	1.030			0.110	0.951 ns
Moderating variable: Business Strategy																	
H_{12a}	BSP					0.072	1.085			0.064	0.912			0.024	0.375	0.023	0.338 ns
H_{12b}	BSA					0.084	1.317			0.063	0.828			0.069	0.982	0.045	0.610 ns
H_{12c}	BSD					**0.178**	**3.123 *****			**0.144**	**2.105 ***			**0.119**	**1.835 ***	0.106	1.585 ns
H_{12d}	BSR					0.081	1.384			0.074	1.208			0.079	1.329	0.076	1.274 ns
H_{12e}	SD x BSP					0.031	0.537			0.031	0.183			0.055	0.383	0.002	0.013 ns
H_{12f}	SD x BSA					-0.085	0.770			0.119	0.994			0.034	0.319	0.098	0.841 ns
H_{12g}	SD x BSD					-0.062	0.203			-0.074	0.776			-0.022	1.289	-0.129	1.311 ns
H_{12h}	SD x BSR					-0.062	0.613			-0.037	0.371			-0.041	0.481	-0.007	0.077 ns

Moderating variable: Culture													
H_{11a}	CUL				**0.367**	**6.376 *****		**0.280**	**3.755 *****	**0.255**	**4.162 *****	**0.214**	**2.826 ****
H_{11b}	SD x CUL				0.050	0.623		0.191	1.162	0.097	1.003	0.216	1.229 ns
R^2		**0.504**	**0.574**	**0.594**	**0.581**		**0.621**	**0.615**		**0.624**		**0.648**	
f^2			**0.14**	**0.18**	**0.16**		**0.24**	**0.22**		**0.24**		**0.29**	
Note: * - significant at p<0.05, ** - significant at p<0.01, *** - significant at p<0.01, ns - not significant													

Model 0: exclusive of interaction effects

Model 1: with moderating effect of Use of BI Tools

Model 2: with moderating effect of Business Strategy

Model 3: with moderating effect of Organizational Culture

Model 4: with moderating effect of Use of BI Tools and Business Strategy

Model 5: with moderating effect of Use of BI Tools and Organizational Culture

Model 6: with moderating effect of Business Strategy and Organizational Culture

Model 7: with moderating effect of all the three factors

SD – Successful Deployment

BSP – Prospector Business Strategy

BSA – Analyzer Business Strategy

BSD – Defender Business Strategy

BSR – Reactor Business Strategy

CUL - Organizational Culture

BTO – Operational Use of BI Tools

BTT – Tactical Use of BI Tools

BTS – Strategic Use of BI Tools

7.5.6.8 Model 7 (Direct and interactions effect of all the moderating factors)

Model 7 is used to further investigate the direct and interaction effects of the combination of all the moderating factors defined in this study. The results show that all of the interaction effects and the direct effects were not significant except for direct effects of organizational culture (β=0.214, t-value=2.826). Therefore, all the hypotheses related to direct and interaction effects of combination of the use of BI tools, organizational culture and business strategy were not supported. Only direct effect of organizational culture is statistically proven to have an effect on use of BI-based knowledge for sustaining competitive advantage.

7.6 SUMMARY

This chapter has presented the results of the analysis of the nation-wide survey of the Malaysian telecommunication industry, obtained through the primary method of survey questionnaire. The questionnaire was sent to 1,000 telecommunications executives throughout the country, through the contact persons. A criterion for the respondents to participants in this study was they should be the users of BI and had to be involved in some level of decision making tasks in their organizations. A total of 325 usable responses were collected after several reminders to the contacts persons were made and thus resulted in 32.5% effective response rate. The respondents were shown to be varied in terms of working experience in the company, current position, main job area, and education.

Data analysis using PLS techniques showed that two of the items loaded poorly on their respective constructs. The items with low loadings were 'Complicated' and 'Too many mechanical works'. The decision was made to omit these low-loading items from the model and thus excluding from the analysis. A discussion of the discarded items was provided. Further PLS analysis of the measurement model for convergent analysis showed that all values exceeded the 0.7 reliability benchmark, as suggested by Nunnaly (1978). The discriminant analysis indicated that the AVE values were greater than the correlation measurements, and that all items loaded higher on the constructs that they were measuring than on other constructs in the model.

The analysis of the structural model using bootstrap method showed that the model explained 54% of the variance in successful BI deployment, while 50% of the variance in the utilization of BI-based knowledge for sustainable competitive advantage. However, the result of hypothesis testing which was based on the final business intelligence model showed that 5 out of 10 hypotheses were supported. Thus, five of the paths found in the modified business intelligence model were significant. The significant paths were (1) business intelligence governance to successful BI deployment, (2) perceived BI's compatibility to successful BI deployment, (3) perceived BI's relative advantage to successful BI deployment, (4) perceived BI's observability to successful BI deployment and (5) successful BI deployment to utilization of BI-based knowledge for sustainable competitive advantage. These five suggested hypotheses were accepted with t-values that were over 1.645.

The study also tests the moderating influences of organizational culture, use of BI tools and business strategy on the relationship between successful BI deployment and use of BI-based knowledge for sustainable competitive advantage. Eight models were used for the test by having different combinations of these factors. The results show non-significance for all the hypotheses related to the moderating factors suggested in this study. However, some of these factors shown to have direct effects of the relationship. These are: tactical use of BI tools in Model 1, 4 and 5; strategic use of BI tools in Model 4; defender type of business strategy in Model 2, 4 and 6; organizational culture in Model 3, 5, 6 and 7.

The PLS results reported in this chapter will be discussed and interpreted in detail in the following chapter.

CHAPTER 8

DISCUSSIONS AND IMPLICATIONS

8.1 INTRODUCTION

This chapter presents the interpretation and discussions of the results of the Structural Equation Modelling (SEM) described in Chapter 7. These findings will be discussed in terms of the major research questions and the fourteen hypotheses proposed in Chapter 6. The proposed research model is also analyzed by examining the direct effects of firm's internal resources and perceptions of BI's characteristics on successful BI deployment that would lead to use of BI-based knowledge for sustainable competitive advantage. The chapter will aslo analyze the moderating effects of organizational culture, use of BI tools and business strategy on successful BI deployment and use of BI-based knowledge for companies' sustainable competitive advantage. The research implications will also be discussed and the chapter will conclude by presenting a summary of the results.

8.2 INTERPRETATION AND DISCUSSION OF THE RESULT

Evidence from Chapter 7 showed that, overall, the developed research model explains the successful BI deployment that leads to use of BI-based knowledge for sustainable competitive advantage in telecommunications companies in Malaysia. However, the findings did not support the moderating effects proposed in the model.

Hypotheses testing was performed by examining the t-values and standardized structural coefficients. The results of the testing of the hypotheses are detailed in Table 7-16 in Chapter 7. It reveals that out of nine hypotheses related to successful BI deployment, four were statistically significant. These are (1) BI Governance; (2) Perceived BI's Relative Advantage, (3) Perceived BI's Compatibility, and (4) Perceived BI's Observability. Another important hypothesis on the influence of Successful BI Deployment on Use of BI-based Knowledge for Sustainable Competitive Advantage was found to be significant. The first-order factors of economic, social and enviroment underlying the use of BI-based knowledge for sustainable competitive advantage were also found to be highly significance. In regard to the remaining hypotheses, there were no statistical evidence to conclude the significance of these relationship.

As hypothesized in the study, the firm's internal resources of BI gorvernance and the perceptions of BI as an innovation were seen to have an influence in the success of BI deployment in telecommunications organizations. Consequently, the findings showed that a successful BI deployment has an effect on the utilization of BI-based knowledge in sustaining competitive advantage of the organizations. The positive use of these knowledge acquired through successful BI deployment, ultimately leads to organizations sustainability in terms of economic, social and environment.

These findings confirmed the appropriateness of the research model in using the Resource-based Theory (RBT) and Diffusion of Innovations Theory as its theoretical basis underpinning the model. The following sections discuss the findings related to the individual hypothesis proposed earlier.

8.2.1 Hypotheses Related to Firms Internal Resources

The first research question, "*What are the major issues related to successful deployments of BI in Telco industry in Malaysia?*, was explored through the following hypotheses. The first three hypotheses are based on quality factors and the last hypothesis is related to the governance of BI initiatives. The results of the testing of the hypotheses are discussed in detail below.

8.2.1.1 Hypothesis H_1

The lack of evidence to support hypothesis H_1 indicated that quality information is not a significant determinant of successful BI deployment in telecommunications firms in Malaysia. This finding was not consistent with the findings of previous studies such as Jedras (2003), Burns (2005), Nelson et al. (2005), Wang and Strong 1996, Nelson et al. (2005), among many others that put a strong emphasis on quality information in regards to information systems success. These findings were surprising as the government of Malaysia through its many initiatives, has been promoting knowledge and quality information to be one of the major factors in achieving Vision 2020 (Mohamad, 2000). It was expected that these government initiatives would have raised the awareness of the importance of information quality among the citizens, especially executives. These finding also were contradictory with the findings from the field study that highly supported the idea of having information quality provided by BI systems for their informed decision making.

However, this research is not alone in providing evidence of a non-significant relationship between quality information and successful BI deployment. For example, in some previous studies by Rudra and Yeo (2000), Ramamurthy et al. (2008) and Mohiddin (2007), also found that quality information did not directly influence IS success deployment. Rudra and Yeo (2000) in their study on user perceptions of quality information in using data warehouse among large firms in Australia, found out that there were mixed reactions on the quality information issue. Majority of the users were uncertain of the quality of information delivered by the systems and hence did not think it is important. Ramamurthy et al. (2008) also found out in their study that the quality of the existing data did not emerge as a determinant of data warehouse adoption.

This non-significance finding was also supported by Mohiddin (2007) in her study on the effect of information quality on success of information systems deployment in Brunei. The study concluded that the information quality factor was also not important. The similar findings could be due to the fact that both countries are developing countries, which are still surviving in terms of acquiring and deploying technological infrastructures. To the developing countries, the quality issues such as information quality are still not very important yet (Mohiddin, 2007). It is also anticipated that the Malaysian executives' decision-making are still strongly based on their intuition, experience and top-down directives. Knowledge acquired through BI-based initiatives were used merely as a supplementary knowledge in their decision-making tasks.

8.2.1.2 Hypothesis H_2

In hypothesis H_2, quality users were hypothesized to be one of the important factor for successful BI deployment. Avery and Watson (2004) argued that human factor plays a vital role in determining successful BI deployment in a competing firm. By taking into account of the influence of the skills particularly technical, business and analytical of the BI users, this study attempted to support the argument by Avery and Watson (2004). However, contrary to the other findings of the relationsip between quality users and successful BI deployment

(Avery & Watson, 2004; Watson et al., 2006; Rustmann Jr., 1997), there was no evidence in this research to suggest that quality users is significantly associated with successful BI deployment. This study did not agree that human element is the critical determinant of successful BI deployment although many have proven it empirically in their previous studies (Avery & Watson, 2004; Watson et al., 2006). Davenport et al. (1992) also report that intended changes due to IS seldom materialize because the *politics of information* are poorly managed. As a result, many IS applications fail to meet performance expectations due to human factors.

The possible explaination for the non-significance of this relationship is that, most of the respondents in the survey were in higher positions (some of them were even the vice presidents of the company) and with higher educational backgrounds (some of them were Phd degree holders). The issues of BI users should be equipped with technical, business and analytical skills as essentials in BI deployment is not a big issue to these executives. As decision makers in big telecommunications companies, their main responsibilities are on strategic matters rather than operational. The deployments and utilizations of BI tools and technologies are expected to be handled by their various supporting BI teams. In today's highly competitive market environment, all level of executives have to be equipped with some level of technical, business and analytical skills. These skills are essentials as BI values can only be tapped by the users who are capable of analyzing information and turn them into sound business decisions (Avery & Watson, 2004).

8.2.1.3 Hypothesis H_3

A similar pattern is observed in hypothesis H_3, where the finding did not support quality BI systems as one of the important factors in successful BI deployment. These findings did not support the findings from the studies by Seddon (1997) and Nelson et al. (2005), which found that the higher the quality of information systems, the higher the likelihood of its successful deployment. The Malaysian telecommunications executives did not consider the technical details of BI systems such as non-existence of errors in the systems, the consistency of user interface, response time, quality of documentation and quality of program codes, as important in BI success deployment.

Similar to the reasons for the findings on quality users' factor, these high-level executives leave all the technicalities of the BI systems to their respective BI teams. The other possible explanation for this is that the required technicalities for BI systems in their organizations is already in place and are available to them. They have thus become familiar with those technologies and as a result may tend to take this availability as granted. However, this finding was not surprising, given the low level of support that this construct received in the field study interviews. The field study participants who were mostly higher-level executives in Malaysian telecommunications companies did not find an issue with the notions of having quality BI systems in their organizations.

8.2.1.4 Hypothesis H_4

The strong evidence in support of H_4 suggest that BI governance is a determinant of successful BI deployment. This is in accordance with the studies of Matney and Larson (2004), Watson et al. (2004), Watson et al. (2006), and Sambamurthy and Zmud (1999). It must be noted, however, that almost every study of the relationship between governance and successful BI deployment has been carried out in western countries. Based on this finding, it can shed some light on how the companies of the developing countires should govern their BI initiatives. Based on the above significant relationship, it is possible to interpret that BI governance is a pillar of successful BI deployment in telecommunications industry in Malaysia. Having a good BI governance in place in terms of strong financial support, direct involvement in BI implementation, provide alignment for BI and business, enforce top-down directive as well as provide effective BI training and retraining programs is a requirement for company executives – those who enact internal corporate governance – to accomplish the duties assigned to them.

The study supported the traditional notion of unconditional support of top management in terms of financial or spiritual, which is regarded as part of good BI goverance in ensuring BI success deployment in any organizations (Kim, 1988; Kimberly & Evanisko, 1981). It was suggessted that BI steering committee comprises of high-level executives such as Chief Information Officer (CIO), Chief Operations Officer (COO), or a senior Vice President of marketing or sales be formed in order to sponsor and govern the design, development and deployment of BI (Kim, 1988).

The practical significance of these findings is that organization, through its strong management activities, could play an important role in realizing their dream of having good

BI iniatives in place. Effective BI governance that provides necessary BI infrastructure including hardware, software, staffing and strategy are deemed neccessary in ensuring BI success. This study agrees with Fuerst and Cheney (1982) in providing BI users with necessary training programs to ensure BI is fully utilized and in turn would lead to its success deployment. Controlling, directing, establishing and enforcing related BI policies is also part of an effective governance.

8.2.2 Hypotheses Relating to Innovation Perception

The theory of innovation diffusion (Rogers, 1995) proposed that the characteristics of an innovation plays a big role in the adoption of new innovations. This study has shown that the theory has relevance to understanding the successful BI deployment and tested this model in a telecommunications industry in Malaysia.

This study identified characteristics of systems that impact on the successful BI deployment that would lead to utilization of knowledge provided by the systems for decision making tasks. The innovation studied, the BI systems, is a somewhat more complicated innovation than those typically studied in diffusion research. The main aim of successful BI deployment is to enable executives to fully utilize knowledge from BI systems. This is a new phenomenon for some of the executives and it is one that requires a great deal of skills and dedication.

Despite these challenges, the perceived attributes of relative advantage, compatibility, triability, complexity and observability appear to be useful in determining the success of BI deployments. This is important because it shows that the perceived attributes can be used to explain not only the successful deployment of simple information systems, but also the successful deployment of higher-level or strategic type of innovations such as BI.

The results of the testing of the hypotheses related to BI's characteristics perceptions are discussed in detail in the following sections.

8.2.2.1 Hypothesis H_5

Based on the findings of Tornatzky and Klein (1982), Rogers (1995), Daylami et al. (2005) and Syed et al. (2007), the impact of perceived relative advantage of BI among executives towards successful BI deployment was tested by hypothesis H_5. The perceived relative advantage of an innovation has been widely and consistently reported to have a positive impact on the adoption process in various innovations. The structural model showed this relationship to be statistically significant. Therefore, this study provides support that the principals of innovation theory (Rogers, 1995) and the number of studies (Rogers & Shoemaker, 1971; Rothman, 1974; Chiasson & Lovato, 2001; Schubart & Einbinder, 2000; Ramamurthy et al. ,2008; Pankratz et al., 2002; Watson et al., 2004; Aubert & Hamel, 2001; 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 (Watson et al., 2004). The literature also showed that BI can only be deployed successfully if users can perceived its full potential (Watson et al., 2004; Aubert & Hamel, 2001) and these potentials are categorized into tangible and intangible benefits. Among the advantages of BI systems perceived by the Malaysian telecommunications executives are quick to accomplish their tasks, improve the quality of their works, easier to perform their jobs, enhance their effectiveness and productivity. BI systems are also perceived to provide a better control over their jobs. This finding was also supported in the interviews, where respondents indicated that it was their preference to use BI as it would ease a lot their managerial works and they would have greater control. Thus, factor of relative advantage is in fact extremely important in facilitating the deployment process of BI, particularly when it provides direct and tangible benefits as well as valued attributes associated with the use of the systems.

8.2.2.2 Hypothesis H_6

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. Complexity, which is determined by the degree to which an innovation is perceived to be difficult to understand and use, has been noted to be another important determinant of innovation adoption (Rogers, 1995). Past researchers has also indicated that an innovation with substantial complexity requires more technical skills and needs greater implementation and operational efforts to increase its chances of adoption (Cooper & Zmud 1990; Dickerson & Gentry 1983; Damanpour, 1996; Ettlie, 1986; Tornatzky & Klein, 1982; Syed et al. 2007; Syed et al., 2007; Bradford & Florin, 2003). IT literature is replete with horror stories of failed implementations due to overt/covert resistance to adopt IT innovations that are complex (Ramamurthy et al., 2008). It is also suggested that the perceived complexity of an innovation leads to resistance due to lack of skills and knowledge (Rogers, 1983). This resistance to new technologies leads to lower satisfaction and system performance. BI's executives that perceived greater complexity were less likely to indicate that they had fully adopted the BI systems (Cooper & Zmud, 1990; Dickerson & Gentry, 1983).

In this study, the result did not support the influence of perceived BI's complexity on successful BI deployment. The common sense of "the more complex, the less likelihood of acceptance" for innovations seems not to be true for the Malaysian telecommunications executives. They appeared not afraid of BI's complex technologies and happy to embrace them although BI systems involve difficult tasks such as analysing massive data, forecasting and predicting the company's future (Eiss, 2003). This finding is highly valuable and may have important implications for other telecommunications companies to promote BI initiatives. Organizations wishing for powerful but easy-to-use BI systems could simulate the systems that are being used in the Malaysian telecommunications companies.

8.2.2.3 Hypothesis H_7

A number of studies have found users perceptions on compatibility of an innovation to be positively associated with adoption (Grover & Goslar, 1993; Syed et al. 2007; Lee et al. 2003). This study contests that compatibility of BI systems with an individual's work style and skills was associated strongly with satisfaction and continued use of the BI systems. Therefore, this theorised that perceived compatibility of the BI systems could influence the successful deployment of BI in organizations.

The findings of this study supported the statistical significance of perceived compatibility of BI systems in increasing the success of BI deployment in organizations. The result supported the notion that the higher the perception of BI users of compatibility of BI systems, the higher its success deployment. Executives perceptions about the compatibility of BI systems with their values, experiences and needs appear to be a predictor of BI success deployment in telecommunications organizations. This finding implies that executives who enjoy using BI systems in their daily works may find BI congruent with their lifestyles and preferences. This suggests that the fundamental dimension that needs to be assessed before a massive deployment of BI initiatives in telecommunications organizations is the compatibility of the innovation (BI systems) with the executives' norm and environment as it underlies the importance for successful deployment.

8.2.2.4 Hypothesis H_8

As to hypothesis H_8, another characteristic of innovation namely triability is used in this study to measure BI success deployment. Based on the arguement 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, this factor was included in this study. This study agreed that 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.

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. The possible reason could be due to the fact that the most of the executives in telecommunications companies have been using BI systems for a number of years. They could not anticipate good reason of trying the systems before using them and triability would no longer be an issue. 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.

8.2.2.5 Hypothesis H_9

The last factor influencing successful BI deployment of an innovation characteteristics type is observability. The observability refers to whether the outcomes of BI systems are visible to the users. Taking that into cosiderations, hypothesis H_9 suggests that when executives perceive the outcome upon deploying BI systems, they were more likely to fully adopt the systems.

In this study, observability appears to be a significanct factor related to successfull BI deployment in telecommunications companies in Malaysia. 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 (in reports form) required for their decision-making tasks. Telecommunications executives also perceive BI systems as an advantage particularly in encouraging and improving communications among staffs in their organizations (Lundblad, 2003). This is important as observing others using the system not only increases the adoption, but it also strengthens the perceived ability to judge whether the system has a relative advantage over another, whether it is compatible with existing systems, and whether or not it is sufficiently simple to understand and implement.

The result was consistent with the result of the field study and supports those previous studies that have shown the significance of perceived observability in the success of new innovations such as mobile phone adoption (Wei & Zhang 2008), decision support systems (Chiasson & Lovato 2001), e-commerce (Ling, 2002) and communications technology (Ilie et al. 2005).

8.2.3 Hypothesis Relating to Successful BI Deployment and Use of BI-based Knowledge for Sustainable Competitive Advantage

The third research question, "*The How can BI help telecommunication companies in Malaysia sustain their competitive advantage?*" was explored through hypothesis H_{10}. The result of the hypothesis testing is discussed below.

8.2.3.1 Hypothesis H_{10}

There was strong statistical evidence to support that successful BI deployment influences the use of knowledge provided by BI systems for sustaining competitive advantages in the Malaysian telecommunication organizations. The corresponding t-value for this relationship is relatively high (t=5.795), suggesting a strong relationship of these two factors. The result was consistent with previous study by Hislop et al. (2000) that postulated successful BI deployment can create unique resources or capabilities, in this case knowledge within the competing firms, that would bring sustainable competitive advantage.

The result supported the notion that successful BI deployment within organizations would produce the necessary knowledge needed in strategic decision-making. Based on Resource-based Theory (Barney, 1991), these knowledge which is acquired and owned internally by organizations, could be unique resources and capabilities needed to achieve and sustain their competitiveness. This may implies that organizations, which successfully deploy BI initiatives would posses these ability to acquire neccessary information and knowledge (Chuang, 2004). BI systems in this context would be knowledge-acquiring or knowledge-generating engine for them to compete in the competitive business world. BI also has been regarded among the prime technologies and tools that support for knowledge creation in organizations. These comprehensive and timely knowledge provided by BI is crucial in their operative to strategic decision making.

The findings explain why many telecommunications companies are now clamoring to adopt and deploy BI systems. Embarking on BI initiatives enable them to generating new products, improving business operations and customer service as well as enhancing organizational efficiency. BI will specifically allow them the path to business insight by following the process of integration of data from disparate internal and external data sources, applying analysis tools and techniques to understand the information within the data, making decisions and taking actions based on this gained insight. Consequently, there would be more organizations from other industries that could see the value of BI and commence on their investments in BI.

8.2.4 Hypotheses Relating to Organizational Culture, Use of BI Tools and Business Strategy as Moderating Factors

The second research question, "*What type of BI technologies and tools are needed in telecommunication strategic business decisions in helping telecommunication companies sustain their competitive advantage*? and the last research question, "*How do organization culture and business strategy impact the deployment of BI in sustaining firm's sustainable competitive advantage*? were explored through the following hypothesis relating to moderating factors of organizational culture, business strategy and use of BI tools. The result of the hypotheses testing are discussed below.

8.2.4.1 Effects of Organizational Culture

Organization culture has been associated with the success deployment of knowledge-related system and use of knowledge in gaining and sustaining competitive advantage (Moss, 2005; Buhler, 2003; Weir, 2004; Rao & Swarup, 2005; Chung, 2002; McGillivray & Faulkner, 2003; Jones et al., 2006; McDermott & O'Dell, 2001). Appropriate organizational culture is considered vital in encouraging humans to create and share knowledge within a firm and is believed to be the important source for sustainable competitive advantage. With respect to

BI success deployment, organizational culture may also be important variable in the competing firms. Therefore, this study attempted to examine the moderating impact of organizational culture on the relationships between BI success deployment and use of BI-based knowledge in sustaining competitive advantage (hypothesis H_{11}) in telecommunications companies in Malaysia.

As shown in Table 7-17, four models (Model 3, Model 5, Model 6 and Model 7) were used to tests the effects of both direct and moderating effects of organizational culture on use of BI-based knowledge for sustainable competitive advantage. The findings of the study did not support any of the moderating effect of organizational culture on successful BI deployment and use of BI-based knowledge for sustainable competitive advantage. The possible reason is because the executives failed to relate organizational culture on the deployment of BI systems and the knowledge provided by the systems. They may feel that information and knowledge for their decision-making is not fully acquired through BI systems yet as they could acquire some information from other sources.

However, the results of the test on the direct effect of organizational culture on the use of BI-based knowledge on sustainable competitive advantage were found to be significant in all the four models. The results indicate that the Malaysian telecommunications executives support the importance of having the right culture such as knowledge-sharing and organizational-learning in utilizing BI-based knowledge in Malaysia (Sulaiman & Burke, 2009). Although these companies are still in their early stage of nurturing the knowledge-related culture, they have started to promote the use of knowledge for companies' sustainability (Azmi, 2010).

The implications for management are that, organization culture did play an important role in affecting executives in utilizing BI-based knowledge for sustainable competitive advantage of their organizations. To inaugurate BI deployment, the managers could make endeavours to create a knowledge-intensive culture for people to believe that knowledge sharing actively reward them for their efforts. Telecommunications organizations have to be transformed into learning organizations which facilitates the learning platform for all employees and continuously transformed itself as learning is the key competency required to survive in the knowledge economy.

8.2.4.2 Effects of Business Strategy

Previous studies had found the business strategy (Wang & Ahmad, 2009; Reimann, Schilke & Thomas, 2009; Miller, 1987; Venkatraman, 1989b; Zahra & Covin, 1993; Parnellet et al., 1996) is associated with knowledge-related system success deployment and use of knowledge in gaining and sustaining competitive advantage. With respect to BI success deployment, business strategies of the competing firms may also be important variables. This study therefore, attempted to examine the impact of this factor on the relationships between BI success deployment and use of BI-based knowledge in sustaining competitive advantage in telecommunications companies in Malaysia. Four types of business strategy namely prospector, analyser, defender and reactor (Miles & Snow, 1978) has been identified to be tested.

As shown in Table 7-17, four models (Model 2, Model 4, Model 6 and Model 7) were used to tests the effects of both direct and moderating of business strategy on use of BI-based knowledge for sustainable competitive advantage. The results revealed that none of the moderating effects of business strategy were significant in all the models used. The lack of significance of business strategy as a moderator was surprising given that the interview participants had indicated that these factors could be the important factors in BI success deployment and the utilization of knowledge provided by it. A possible explanation could be the “top-down” approach directives by the top management as business strategies are the concerned of the top management in Malaysian telecommunications organizations. Most of the strategic decisions were made by highest level of managements and sometimes may have the involvement of the government (Choi et al., 2001). It can be implied that BI systems are merely putting those decisions into proper actions by providing appropriate knowledge.

However, the results on the direct effect of “Defender” type of business strategy on the use of BI-based knowledge on sustainable competitive advantage were found to be significant in three models (Model 2, Model 4 and Model 6). Although this type of business strategy received minimal support in the field study, the telecommunications executives believes that this type of business strategy will foster the use of BI-based knowledge. This implies that telecommunications companies utilize knowledge provided by BI system in order to locate safe products and services and try to maintain current products, which reflected this type of business strategies.

8.2.4.3 Effects of Use of BI Tools

The use of BI tools (Moss, 2005; Buhler 2003; Weir, 2004; Rao & Swarup, 2005; Chung, 2002) has also been associated with knowledge-related system success deployment and use of knowledge in gaining and sustaining competitive advantage. With respect to BI success, the study identified three types BI tools as strategic, tactical and operational (Loftis, 2007) and tested the effects of these factors on BI success deployment and utilization of its knowledge for sustainable competitive advantage.

Similar to the the findings of business strategy and organizational culture, this study did not support (see Model 2, Model 4, Model 6 and Model 7 of Table 8-17) the moderating effects of any of these types of BI tools. The results reveal that if BI tools are being use in telecommunications organisations, it would not influence the success of BI deployment leading to utilization of its knowledge for sustainability. As noted, one possible explanation is perhaps that the use of BI tools among high levels executives in these organizations is very rare. It is expected that the tasks involved in deploying BI such as hardware/software installations, conducting tests and adjustments were basically taken care by their IT staffs. These executives expects only the outcomes from these BI systems, in this case is the relevant information to be tabled out to them in a timely and orderly manner.

However, the results on the direct effects of the BI tools utilization on the use of BI-based knowledge for sustainable competitive advantage were interesting. The results on Model 1 and Model 5 show that "Tactical" use of BI tools was significant and Model 4 result show that "Strategic" use of BI tools was significant. The results imply that executives support the use of BI tools in acquiring knowledge for both tactical and strategic decision-making in their efforts of sustaining competitiveness of their organizations.

Some practical implications can be acquired from the results. For the managers of telecommunications companies, this study suggests that they should look into the BI tools capabilities for their tactical as well as strategic issues. As noted, BI tools can make sense and gain competitive insight into vast volume of data within organizations. Organizations can use BI tools in modelling customer behaviour and identifying trends and patterns for strategic use in telecommunications organizations. Tactical use of BI tools such as performing traffic and usage patterns, finding revenue leakages and detecting frauds can also be used.

8.2.5 Results of the First-Order Factors

The study also tested the first-order factor underlying the construct of use of BI-based knowledge in sustainable competitive advantage. These first-order factors that has been identified are economic, social and environment (Elkington, 1998). The results of the first-order factors were very promising (See Table 7-15 of Chapter 7). The explained variance R^2 for Economics factor was 71%, Environment factor was 85% and Social was 66%. The results indicate that the telecommunications executives had expressed their positive response in terms of utilizing knowledge acquired from BI systems to include these three elements of sustainibility into their companies' strategies.

The concepts of sustainibility and corporate social responsibility (CSR) have been among the most important themes to emerge in telecommunication companies (Alan, 1999). CSR programs, policies and practices have been integrated into business strategies, and decision-making processes through-out organizations now. The main aims of CSR is to meet the needs of the present without compromising the needs of the future generations (Hockerts, 2001). In this study, Malaysian telecommunications executives supported this new notions and have put positive efforts towards achieving this new set of sustainability's attributes. In terms of traditional economic's sustainability, these executives urged their organizations to use the knowledge from BI systems to create long-term success through sustainable operations that deliver good returns. It is also suggested that knowledge from BI systems be used to imporove customer service that would retain customer loyalty. Overall, the executives expressed their concerns of having to use the knowledge to deliver quality, value and excellent services to the customers.

Another important findings from the results is the sustainability of Malaysian telecommunications companies in terms of social. These companies are now more concerned of their responsibilities to the society and are incorporating appropriate social-related plans in their business strategies. Appropriate and adequate knowledge generated from BI systems is used in those strategies such as to plan for employees' fair and safe working environment. The study also supported the knowledge be used to plan for support and communication for the local communities.

The last aspect of CSR supported in this study is the environmental element, where executives have expressed their concerns that BI systems should provide appropriate and adequate knowledge for their organizations to manage environmental impacts in a responsible manner.

8.3 IMPLICATIONS TO TELECOMMUNICATIONS INDUSTRY

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. It presents a practical model of BI for sustainable competitive advantage where the factors and variables were obtained from combination of related literature and the real world. A close examination of the model reveals that all the factors determine the successful deployment of BI that ultimately will lead to sustainable competitive advantage of organizations.

Telecommunications companies planning to embark on BI can consider the variables of figure 6-12 (final combined model) as the criteria of successful BI deployment that would lead to sustainable competitive advantage. It must be noted that not all criteria will be applicable for all companies. A careful analysis is first needed to select the appropriate criteria for the company. The model shows that it is important for these companies to pay attention to both their internal resources and perceptions of innovations' characteristics factors when examining BI systems that has consequences for the entire organizations. Telecommunications companies can predict whether BI systems will be successfully deployed and knowledge provided by the systems will be fully utilized for companies' sustainability. 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. These actions can be integrated into their business processes for the purpose of maximizing business performance and optimising business impacts.

The recognition of BI governance in ensuring BI success deployment is the most significant finding in this study. Effective BI governance may include strong management support that provide sufficient funding, infrastructure, staffing and appropriate policies regarding BI. Telecommunication executives may want to look into their existing IS or BI governance in their organizations. The management should also focus on enticement and education by providing appropriate training and retraining programs for BI users.

The results also identified that telecommunications executives' perceptions towards BI's characteristics namely relative advantage, complexity, compatibility and observability are indeed important in ensuring BI is successfully deployed. The implication is that any BI system has to be easy to use and the benefits of the system have to be clearly seen by the users. BI systems are also expected to be compatible with the executives' current working styles as their main tasks are to make the right decisions for organizations rather than looking at the technicalities of BI systems.

This research also identified the direct effects of organizational culture, utilizations of BI tools and business strategy on the use of BI-based knowledge for sustainable competitive advantage. The direct effect of organizational culture on the use of BI-based knowledge for sustainable competitive advantage finding suggests that telecommunications organizations that instil the conducive organizational culture are foreseen to be successful in utilizing knowledge for their sustainability. Organizations should put more emphasize on promoting and building the appropriate knowledge-related culture such as knowledge-sharing and 'learning-organization'. The organizations' efforts of implementing these new cultures might be more fruitful when the appropriate reward systems are introduced to reward new learning behaviours among the employees.

Meanwhile, there are some important implications arising from this research, which may provide some help in understanding BI systems and organization's effort in deploying them. The significant implications for managerial practices particularly in telecommunications companies will be discussed based on several themes as follows:

BI is a need, not an option

In general, findings from this study gave some indication to the telecommunications organizations on the importance of having BI in place in order to survive the stiff competition and gain competitive advantage in the new economic era. Organizations need to have better control of their internal knowledge and more awareness of the external knowledge as these are their most important resources. Many organizations are unaware of what knowledge they possess that can be utilized effectively. BI offers value by developing a systematic process to collect and analyse the competitive environment including competitors, new technology, public policy, market forces and so on (Thomas Jr., 2001). It is a systematic process that organizes the flow of critical information, focusing on important strategic and operational issues. Hence, utilizing the available knowledge BI system has the ability to transform organization to a better market positions and help managers make sound business decisions. If effective, BI is preventive medicine that ensures senior management is not blindsided.

BI systems can make contributions to telecommunications organizations in the following areas:

- Predict telecommunications market trends of products and services
- Improve performance of telecommunications business system
- Identify profitable customers/customer segmentation
- Build long-term loyalty relationship with customers
- Identify telecommunications frauds
- Improve marketing effectiveness
- Identify network faults

BI characteristics matter to end users

The finding from this study suggests a number of important recommendations for developing and introducing BI systems in telecommunications companies. When designing and implementing BI system, the innovation characteristics (Rogers, 1995) should be given considerable precautions. Characteristics such as relative advantage (i.e., the perceived BI benefits and impact), compatibility (i.e., both technical and organizational), observability (i.e., the extent to which relative advantage or gains of BI are clear) and complexity (i.e., ease of use of BI) should not be taken for granted otherwise the end users will not use it.

Since perceived relative advantage 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. BI offers several benefits to organizations including enabling effective decision support, ensuring data quality, and improving customer service (Wixom & Watson, 2001). Beyond simply telling people that something is useful, however, the notion of usefulness must also be incorporated into the functionality and design of the system.

The observability issue works in concert with relative advantage perceptions. So that focus should also be given on communicating relevant information that emphasizes the tangibility of the benefits of using BI. Examples of efforts to highlight result demonstrability or observability include training, seminars, newsletters, the use of opinion leaders, and other public forums (Zmud, 1983).

To address the compatibility issues, BI systems developers should develop software that can automate and speed-up processes already familiar to the users. It is crucial that work patterns and work flows be thoroughly understood during the analysis stage so that systems may be designed to be compatible with preferred working style.

Top management support and involvement

For BI systems to be successfully deployed in organizations, it must be driven from the top. Senior management support and open support by upper level executives in terms of financial and spirit are vital. BI steering committee should be formed in order to sponsor and govern the design, development, and deployment of BI project (Sherman, 2001). It needs both the CIO and business executives such as CFO, COO or senior vice presidents to commit budget, time and other related resources. These high level executives should also insist and enforce BI users on the use of information-based decision making (Kimberly & Evanisko, 1981) as contrasts with decision making based on intuition or 'gut feelings'.

Direct participation and involvement by top management is among the most influential factor in ensuring BI success deployment (Ang & Teo, 1997). Simply giving the go-ahead for the BI deployment in organizations is not sufficient. Top management should show serious involvement by providing the necessary resources and leadership, setting goals and policies for BI, and showing interest by participating in BI design and development.

Creating the 'right' culture

Findings of this research show that culture significantly influence the utilization of knowledge provided by BI. Telecommunications organizations should realize that culture is important in any IS-related success including BI (Moss, 2005; Buhler, 2003). Most of BI failures were not due to technological issue but organizational culture and organizations that instil the right culture are foreseen to be more successful. In case of BI deployment, culture that nurture the use and sharing of knowledge is vital. Organization should have a culture where everyone is preparing to share knowledge and where knowledge sharing is properly rewarded. It should be noted that not everyone in the organizations can make this change easily, and new people might need to be put in place. For BI to work, the entire organization must willingly participate in intelligence gathering and sharing (Weir, 2004).

To realize this mission, the telecommunications top management need to develop new cultural and reward system within their organizations (Bansler & Havn, 2002). They should recognize and reward new learning behaviours in front of entire organization as well as to endorse, participate, and lead in knowledge sharing. By doing so, a critical mass of BI users can be achieved, and more people will be encouraged to share their knowledge and make contribution to the system (Xu & Quaddus, 2004). However, use of incentives has its downside. Care must be taken not to overemphasize rewarded behaviour as this may induce people to focus on the quantity rather than quality of knowledge contributed to the system.

Top leaders must also lead the effort, becoming the change agents within the organization who leads knowledge sharing, fostering a culture of continuous learning and improvement to enable successful BI deployment.

Effective BI governance is crucial

Findings of this study show that BI governance plays a big role in deployment of BI in telecommunications companies. Effective BI governance is required in order to successfully address both technical and organizational issues related to BI deployment. BI governance requires creating committees that have the authority and responsibility to carry out their assigned missions to manage and support BI. The committees should have the appropriate composition (e.g., size), characteristics (e.g., experience), and structure (e.g., reporting and information flows), and use of appropriate processes (e.g., frequency and length of meetings) (Watson et al., 2004). Big organizations like telecommunications could develop a BI competency centre (BICC) that comprises of core group of experts within the organizations to champion the BI technologies and define standards (Marion, 2008).

BI governance's major task is defining and implementing an infrastructure that will support organization's goal including hardware, software, staffing and strategy needed to glean intelligence from data. The appointed BI committee should look into important issues including BI and business alignment, funding, project prioritization, project management and data quality. The committee should take the initiative to establish and enforce the BI-related policies and strategies. While people always regard governance as a constraint, instead a solid BI governance structure should promote resourceful thinking within organizations (Geiger, 2006).

BI tools has to be used effectively

This study shows that effective utilizations of BI tools by telecommunications executives affect the use of knowledge provided by BI systems. Proper utilization of BI tools is another concern of BI deployment since developers are warned to be careful in choosing the most suitable tools. There are too many available BI tools in the market currently that lead to confusion and increase in training costs. The first class of tool is mainly for end-user query, reporting and analyses and the second class is for advanced analytics such as data mining. Choosing BI tools that are appropriate for their needs post a major concern to management as a one-size BI does not fit all firms. Management should think strategically about the toolset as some are very complex that requires special analytical skills to achieve maximum potentials.

The findings of this study suggest that BI tools of strategic and tactical categories to be used by telecommunications companies. Organizations should look into effective utilizations of these tools in term of these two types of their business. Examples uses of BI tools to tackle strategic and tactical decision-making tasks among telemarketers are:

- modelling customer behaviour to spot usage trends and patterns
- identifying trends and patterns to detect problem and bottlenecks in their network operations
- supporting and complimenting customer relationship managements (CRM)
- to perform in-depth traffic and usage patterns analysis to reduce operational failures
- to find the revenue leakages and enhance revenue assurance by uncovering billable interconnect services

Training is essential for BI

Findings of this study show that trainings are essential for BI to be successfully deployed in telecommunications companies in Malaysia. Training can enhance the use of BI through building up users' competence and confidence in using BI. Training will help users to overcome the fear of complexity of BI. In case of BI, users can be provided with training on how to use the tools and the data that is available to them. Users have to be made aware of the important data reside within their companies. These companies have been generating and storing tremendous amount data including call detail data, which describes the calls that traverse the telecommunication networks; network data, which describes the state of the hardware and software components in the network; and customer data, which describe the telecommunication customers.

Through training, users can be equipped with skills and knowledge required to perform their intended tasks. The appropriate training as well as retraining is very crucial in achieving strategic insights that ultimately translate to competitive advantage. Telecommunications management should be aware that the success of BI deployment lies on the quality of end-user training and support (Gangadharan & Swami, 2004). Effective trainings would include easy-to-use brochures, providing intranet-based training, and dedicated help desk that would maximise the training support (Quaddus & Intrapairot, 2001).

BI and business strategy alignment

Results of this study suggest that BI initiatives and business strategy have to be properly aligned. An important perspective in ensuring the success of BI is to identify the key strategy of business that gives most competitiveness to organizations. An alignment between BI and organizational business strategy can help in demonstrating a good example of how knowledge can generate immediate and highly visible returns to both individual and organization as a whole (Watson & Wixom, 2007). BI systems must acknowledge organizations' business strategies and business processes since the ultimate purpose of BI is to bring benefits to organizations and help organizations in achieving and sustaining competitive advantage.

Telecommunication managements are urged to embed BI into their business processes such as call centre operations and applications like campaign management to improve organizational performance, often in ways that make the analytics transparent to users. BI is longer just supporting business strategy but also help to determine it (Davenport, 2000). Out of four types of business strategy suggested by Miles and Snow's typology (1978) of prospector, analyser, defender and reactor, the findings of the study suggested the use of defender. The telecommunication executives should focus on utilizing knowledge acquired through BI to locate safe products and services and to maintain the current products.

Corporate social responsibility (CSR) is important

An important result of this study is that successful BI deployment eventually significantly influences the attainment of sustainable competitive advantage. Realising that economic aspect alone is not sufficient in sustaining state-of-the-arts organizations now, the CSR concept emerged as important theme in telecommunications companies (Alan, 1999). The findings of this study strongly suggest that these organizations should look closely in their strategies for sustainability suggested by BI. Their strategies now should be focused on social and environment aspects as well. Issues of CSR typically related to business ethics, community investment, environmental protection, human rights and workplace conditions, among others. In the light of this contextual perspective, managers have to take into account not only increased sales and profits and/or decreased costs, but also sustainable development of the business itself and of the surrounding context (Petrini & Pozzebon, 2009).

The CSR programs, policies and practices should be integrated into the business strategies and decision-making throughout the organizations. It must be noted that most of the time; they are not integrated into operative business management models, remaining detached in practice from corporate strategy and appearing more as particular actions and activities related to projects in the community, philanthropic initiatives or regular changes in business process.

8.4 SUMMARY

This chapter presented the interpretation of the results of PLS analysis for the comprehensive research model of BI for sustainable competitive advantage. The findings of the industry-wide survey among telecommunications industry in Malaysia were discussed according to suggested hypotheses in this study. The results of this study generally supported the structure of the two prominent grounding theories namely the Resource-based Theory (RBT) (Barney, 2001) and Innovation's Perceptions (Rogers, 1995), with the inclusion of Information Systems Success Model (McLean & DeLone, 1992) that were considered essential in examining the successful deployment of business intelligence, that would eventually lead to utilization of BI-based knowledge in sustaining competitive advantage of the organizations.

Among the thirteen research hypotheses, the supported proposed relationships were: (1) BI governance; perceived BI's of (2) relative advantage, (3) compatibility, (4) observability to BI success; (5) successful BI deployment to use of BI-based knowledge for sustainable competitive advantage. Overall, the influences from firm's internal resources and perception of innovations were shown to have positive impacts on BI success. There was also found to be direct positive relationship between BI success and use of knowledge in sustaining competitive advantage. However, supports for quality factors and moderating factors were not significant in this study. There was strong indication in the telecommunication industry in Malaysia in using the knowledge provided by BI systems in formulating strategies and policies regarding their sustainability in terms of social, economic and environmental.

The chapter also provides the possible explanations for the hypotheses that were not supported in this study. Although the expected significant relationship of quality factors such as information quality, quality users and quality systems were not supported in this study, it was found in this research that these factors would have influence on use of BI-based knowledge in sustaining competitive advantage. These findings were considered helpful in probing the potential obstacles in causing the difficulties in deploying BI, particularly in the setting of Malaysian telecommunication industry, as well as providing the cues for future research in exploring the role of quality factors in the process of deploying BI. Therefore, the quality constructs is retained in the research model.

In the last chapter, the thesis will conclude by presenting the summary of research, its contributions and limitations, as well as the directions of future research.

CHAPTER 9

CONCLUSION AND FUTURE DIRECTIONS

9.1 INTRODUCTION

The rational of this research has been the continous interest in BI deployment issues by academics and practitioners. The other rational was based on the fact that in comparison to Western BI literature, the body of relevant local empirical studies in Malaysia is rare. To reduce such a conspicious gap and provide a deep and rich insights into local managerial process, this research theorised an operational model of BI for sustainable competitive advantage which was grounded from Resource-Based Theory (Barney, 1991), Diffusion of Innovation Theory (Rogers, 1995) as well as Information System Success Model (Mclean & Delone, 2002).

This chapter aims to summarize the current study and offer suggestions for future research. The objective of the first section is to provide a summary of the findings of the study. This chapter also discusses the study's contribution to the body of knowledge relating not only to the BI deployment, but also the overall knowledge in the field of adoption of new technology. The chapter also discusses the limitations of the study, and concludes with discussion on opportunities for future direction for this area of research.

9.2 SUMMARY OF THE STUDY

The current research on BI was conducted based on the gap in the literature in identifying the factors affecting its successful deployment among the telecommunications companies. This study developed a research model that used the RBT, Innovation Diffusion and Information System Success Model, as well as incorporated relevant factors sourced from studies on information systems specifically BI success deployment. The constructs and variables of the initial research model, developed from the comprehensive literature review, were validated and enhanced by a qualitative field study.

The field study involved ten interviews with decision makers in four telecommunications companies in Malaysia. Using a semi-structured interview protocol, the data collected from the field study were analysed through content analysis approach. The combination of factors from the literature and field study resulted in the development of the final research model.

The final research model consisted of firm's internal resources; innovation perceptions; successful BI deployment; moderating factors of organizational culture, business strategy and use of BI tools; and use of BI-based knowledge for sustainable competitive advantage. The framework of the firm's internal resources factors, innovation perceptions factors and successful BI deployment was developed by incorporating the suggestions from RBT, Diffusion of Innovation Theory and ISS Model. The contents of firm's internal resources factors were further identified and the activities involved in implementing BI along with their influences on BI success deployment were recognized. The facts for the purpose of sustaining competitive advantage of the organizations were added, utilizing relevant studies specifically in the BI field. The measurements of the factors used in this study were mostly sourced from the theories as well from previous BI studies. These measures and some unique factors with their measuring items were assured via the field studies to be more appropriate to be used in the current study.

An industry-wide survey was conducted in the second phase of the study. A questionnaire was developed based on the combined research model. The initial research questionnaire was examined by a pre-testing method by five conveniently selected telecommunications executives. The layout and contents of the questionnaire were slightly revised according the feedbacks obtained. The main survey was administered among the telecommunications companies in Malaysia. The research questionnaires were distributed to 1000 telecommunications executives and 320 valid responses were returned, thus yielding an effective response rate of 32.5%.

The Partial Least Squares based SEM was applied for the analysis of the data. The PLS analysis followed the PLS framework by sequentially assessing the measurement model and followed by the structural model. As part of the analysis of the measurement model, items with low reliability were dropped from the model, to ensure that only reliable items were used in the revised model. The measurement model was then tested for the item reliability, convergent validity and discriminant validity. The structural model was then assessed.

Overall, the research model explained 54% of the variance in the successful BI deployment and 50% of the utilization of Bi-based knowledge for sustainable competitive advantage. The results of the hypotheses were mixed. Five suggested relationships were found to be statistically significant, while the other five were not supported. The following relationships were supported: BI governance to successful BI deployment; three of innovations characteristic of relative advantage, observability and compatibility to successful BI deployment; and successful deployment to use of BI-based knowledge for sustainable competitive advantage. On the other hand, the positive influences of quality information, quality users and quality systems as well as triability on successful BI deployment were not found to be significant. The proposed negative relationship between complexity and successful BI deployment were also not supported in this study. None of the moderating effects proposed in the study were significant. But the study found interesting finding on the direct effect of organizational culture, strategic and tactical use of BI tools as well as defender category of business strategy on use of BI-based knowledge for sustainable competitive advantage. The study also found some interesting aspects of strategies suggested by BI on the sustainability of telecommunications companies in Malaysia in terms of economic, social, and environment.

The results have both managerial and research implications. The results of this study will add value to IS specifically BI literature. Organizations, which are deploying BI or are planning to embark on BI deployment can use the important variables of the study and do an internal audit to find out how they fare in terms of these variables.

The following section presents the significant contributions that the findings of this study make to the knowledge regarding the BI deployment and its relationship with sustainable competitive advantage, especially for the telecommunications industry.

9.3 CONTRIBUTIONS

The findings generated from this study have valuable contribution to both research and practical point of views. It provides an insight into the factors that influence the Malaysian telecommunications organizations particularly, in successfully deploying BI initiatives for sustainable competitive advantage. The following sections will discuss both of the contributions.

9.3.1 Theoretical Contribution

This study represents an important contribution to theory by integrating two theoretical perspectives to identify factors that influence successful BI deployment. It draws upon innovation diffusion theory and resource-based theory concerning BI. In the context of BI for sustainable competitive advantage, this study fills a theoretical gap by developing a research model from literature and further enriched through a qualitative field study. The research model was evaluated by using an empirical data set comprising perceptions of telecommunications executives in Malaysia.

The comprehensive research model was unique in the sense that it extended the well established diffusion of innovation theory to the applications of BI, and explored the resource-based theory on BI, in the context of telecommunication business. These theories were used as the background and the research model incorporated the factors that were specific to the telecommunications companies. Therefore, this study contributes significantly to the existing literature, as there has been little evidence found in the current literature in explaining the implementation and deployment of BI in this industry.

The findings of this study strongly support the appropriateness of using innovation attributes to predict the successful BI deployment in telecommunications companies. Three of innovation attributes of relative advantage, compatibility and observability were observed to have significant influence on BI deployment. But the study shows that the other two suggested attributes of triability and complexity play no role in influencing BI success deployment. A further validated model can be used or further adapted to examine successful BI deployment in different contexts.

The finding that complexity is not significant determinant of BI deployment is another major contribution to the literature. Most studies that use diffusion of innovation theory as a theoretical framework show that complexity is a highly significant deterrent for adopting an innovation (Roger, 1995). This study has contrasted this knowledge and demonstrated that, in the context of deploying BI successfully in telecommunication companies in Malaysia; complexity does not impact on BI success deployment.

To the best of the researcher's knowledge, this study is among very few that have attempted to examine possible interactions effects in explaining knowledge utilization in BI initiatives. Most previous studies on knowledge contribution in any IS-related focused on direct effects and ignored moderating effects. Taking into account the moderating roles of business strategy, use of BI tools and organizational culture, the study developed and empirically tested a better conceptual model for understanding user perceptions on the relationship between successful BI deployment and BI-based knowledge utilization in sustaining competitive advantage. However, this study did not find any significant results for these relationships. Researchers may find other potential moderating variables and possible interactions effects are worthy of future research. Further research into this complex relationship is necessary to better understand the value of BI systems and indeed IT investments generally.

9.3.2 Practical Contribution

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. Practitioners especially BI applications developers and BI users such as business analysts and decision makers can also make use of the model to refine their thinking about BI and their firm's other strategic resources. The model suggests the types of BI investments that are most likely to be the sources of sustained competitive advantage.

The main contribution of this study is the identification of the firm's internal resources of BI governance that influenced the successful BI deployment. Effective BI governance that was distinctive in ensuring BI is successfully deployed in telecommunications organizations. For example, BI governance that provides appropriate funding, infrastructure and staffing specific for the telecommunication business were identified as the firm's internal resources are essential for BI success. Rules, regulations and policies regarding BI implementation specific for this industry were also identified as an ingredient of successful BI deployment.

Therefore, understanding of these issues related to BI governance could lead to the development of strategies that could improve the successful BI deployment.

Exploiting the innovations perception factors, the findings of this study found that certain characteristics of BI influence the rate of BI success. 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. Understanding these characteristics is becoming increasingly important due the valuable knowledge that BI provides to the participating organizations.

Viewing knowledge as a significant resource for the telecommunications business, this study attempted to discover the value of utilizing BI-based knowledge for organizations to sustain their competitive advantage. Knowledge-related initiatives has been identified essential for an organization to enhance long-term strengths (Chourides, Longbottom & Murphy, 2003), improve the work force (Zhao & Bryar, 2001) and increase the core competency (Wu & Chi-Min, 2003). Since Malaysian telecommunication companies has been deploying BI for several years, the findings of this study reveal that BI can boost their performance in several ways: improving their customer services to retain customer loyalty; closely monitoring their network and staff performances, and forecasting their network usage and fraud detections.

9.4 LIMITATIONS

Although it is believed that the findings of this study support earlier theoretical work showing the importance of perceptions in innovations as well as some internal resources, there are a few limitations that should be considered for future research. The results of the current study should be interpreted cautiously due to these possible limitations. In regard to methodological issues, first the sampling method might be of concern. The selection of participants' sample was not purely random. As explained in the research methodology chapter, the participants taking part in field study were selected based on convenience sampling. In the main survey, all of the five telecommunications companies were selected and the participants were carefully chosen through contact persons. Although contact persons were requested to randomly select the sample across departments and divisions, there could be some risk of sample bias.

The conclusions reached in the study were not of universal applications since the research was conducted in the context of telecommunications industry in Malaysia. The generalizability of the results is only limited to telecommunications organizations, because the instruments used were very specific to this particular industry. First, although the scale was effective in the present study, researchers will need to adapt items for their particular study. As with most other IS adoption research, this scale was specific to the innovation studied. Because this was a specific telecommunications industry-based innovation, it will probably be easiest for those interested in the industry research to adapt these measures. This would limit the generalizability of the findings to different geographical contexts and other industry sectors. However, some adjustments such as adaptation of the environments and industrial factors, as well as revision of the meaning of BI governance, could be made to apply to others. The results of this study might be generalized through further examinations to other countries and industries.

9.5 FUTURE RESEARCH DIRECTIONS

The future direction of this research can be summarized in the following points.

1. The research failed to prove that the variables such as organizational culture, business strategy and use of BI tools can moderate the relationship of successful BI deployment and use of BI-based knowledge for sustaining competitive advantage. So in the future, these constructs should be further investigated to identify their impacts. Improved measures for these constructs may be necceassary to be moderators. Or are they just merely the direct antecendents of the relationship?
2. It will be beneficial to compare the findings with the nature of BI deployment association in Western contexts such as the United States and European countries or even in Asian contexts such as China, Hong Kong, Japan and Singapore. Future research may consider the impact of culture that may mediate or moderate the successful BI deployment and sustaianable competitive advnatage.
3. Last but not least, this research provides a direction of using resource-based view in local IS literature. Organizations which follow this theoretical view will undertake an assessment of unique resources, capabilities, and core competencies posessed. Future research is expected to explore more about how to develop BI governance practices as distinctive firm capabilities. If these practices exist, they should be nurtured, and if not, they should be developed carefully further.

9.6 FINALLY

Finally ..... I need to thank you any reader who has reached this point. This mixed method research process was long and complicated, which has taken more than 5 years of my life. However, I have enjoyed learning and experimenting from the thorough and thoughtful contributions of others. My hope is that this research project will allow for a future contribution to local IS academicians and practitioners in Malaysia particularly as well as throughout the world.

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Appendix

Appendix A

Interview Information Sheet

Interview on Factors of Business Intelligence in Telecommunications Industry

Thank you for agreeing to be interviewed. I am Azizah Ahmad, a Ph.D candidate of Curtin University of Technology, Australia and lecturer of Information Systems at Universiti Utara Malaysia.

This interview is a preliminary field study exploring the factors affecting the successful deployment of business intelligence (BI) in telecommunications industry in Malaysia. BI has been an important issue for organization to achieve and sustain competitive advantage. In particular, I am studying how the firm's internal resources such as people, data and governance as well as organisational culture and business strategy would affect the BI deployment through executives' perceptions.

All responses will be kept confidential and the anonymity of the interviews will be respected and protected. This interview will take between 45 minutes and 1 hour to finish, and may be taped, subject to your approval. Allocating identification numbers to transcription of this interview will protect anonymity of the data source. Participation is voluntary and the participants are at liberty to withdraw at any time without prejudice or negative consequences. This exploratory interview project has been approved by the School Research Ethics Committee.

Should you have any concern in regards to this meeting following this interview, please contact me at +6013-5151700, +604-9176679, azie@uum.edu.my or my supervisor, Professor Mohammed Quaddus, Graduate School of Business, Curtin University of Technology, 78 Murray St, Perth 6000, Western Australia (Tel: +618-92662862, mohammed.quaddus@gsb.curtin.edu.au) or the Research Ethics Committee Secretary, Curtin University of Technology.

Appendix B

Interview Protocol

Background Questions

- What is your position in the organization?
- How long have you been in the organization?
- How long have you been in the telecommunications industry?
- Does your organization is using business intelligence systems now?
- Are you using business intelligence now?

Guiding Semi-Structured Questions

- General perceptions and understanding of BI
- The main factors that influence the successful BI deployment
- Usage of BI-based knowledge in decision-making activities
- Required tools for generating knowledge
- The role of organization culture in utilizing BI-based knowledge
- The role of business strategy in BI success especially in aligning between knowledge and business
- Utilization of BI-based knowledge in sustaining competitive advantage of the organization

Appendix C

Interview Script for Participant #1

Business Intelligence for Competitive Advantage: The Case for Malaysian Telecommunication Industry

Interview Script

A (Interviewer): Azizah Ahmad

B (Interviewee): Participant #1

Date: 25 March 2006

A: The content of the interview will be kept confidential and the anonymity of the interviewee will be protected. This interview will take between 45 minutes and 1 hour to finish

A: Firstly, are you willing to accept my interview and taping?

B: Yes, I don't have any problem with the interview but I am not really comfortable with the taping. Can we just do without the taping?

A: Sure. But I have to write down your answers. It may take longer than expected. Is that ok with you?

B: Sure.

A: Thanks. This research is regarding business intelligence. I would like to ask get your opinion on this matter. Can we start now?

B: Sure.

GENERAL PERCEPTION OF BI

A: Firstly, I want to ask you about general understanding of business intelligence, or BI as it will be regarded from now. Can you tell me what your understanding of BI is?

B: For me BI is the usage of data for company's strategic needs. Like in telecommunications companies, we use enormous data such as calls, traffic, billing and network that are stored in our corporate databases. These data will be turn into information by certain database technique. The information will be used for business decision purposes. That is what my understanding of BI is all about. Is that right?

A: Yes, you are right. BI is about turning available information into actionable knowledge for company's decision-making purposes.

A: Does your company currently have BI systems?

B: Yes, we have been using what you called BI systems for quite some time. We don't call them BI though but the functions are the same. We use to have system used by management such as management information system MIS, executive information system EIS and other systems that cater for management functions. The systems that we currently have are in-house developed and are linked with our operational systems. They are sometimes referred to as in-house planning tools, where users can derive certain information such as user behavior patterns and so on. We called it in-house planning tools because the systems are used by our management team to help them organize their daily management tasks including making appropriate planning for our company.

A: Good. So your company has been using so called BI systems for a number of years now. Do you use the systems as well? I mean are you the user of BI systems as well?

B: Yes, I do. In fact I was involved in the development and implementation process of some of the systems. Since I am one of the senior managements here, we had big responsibility in terms of financial and running of the systems. As you know these systems are so expensive and it requires special IT skills to develop them. Although we have our own IT staffs from IT department, we feel that as the actual users who are going to use the system were somehow have to be involved from the beginning. Our main difficult tasks were mainly to define the requirements of the systems to make sure they were developed according to our needs. It was easier said than done when it come to specifying the requirements. We were also involved in testing the systems.

A: It is good for users to be involved in the development of the systems though.

A: Do you use BI systems in your decision-making tasks?

B: Yes, of course we use them in our daily tasks. We have no other means of getting the information to do the tasks besides the BI. We totally rely on the information from the systems. I think BI has been used by almost all Telco companies for quite sometimes. But the extent of its usage differs from one company to another. As for our company we don't have full-blown BI systems that can cater for all of our decision-making need. Some of the information has to be acquired from outside sources such as market size and so on.

A: What sorts of information that is currently available to you that is provided by BI?

B: Take for example these reports are being produce directly from our operational help desk system. Help desk system will capture all the necessary reports and reporting agent called Crystal Report which integrated to it do the representation. The Crystal Report was designed based on the format that we require; it will massage the data and represent them to us. I think all telecommunications companies are very familiar with system and data because they are very advance in IT usage. For example Telekom Malaysia has been using a computerized system for the past 15 years. They use a big database system called CAS, Customer Automated Service System. This is where all the data are stored and this place is where everything takes place such as to decide, performance monitoring, what is our problem, what is our strength, what we're going to do next and so on. That's the way we do things and I don't think we can do away with the system. Reliable on the system are very high, and there's no way we can operate manually. If we're to do it manually, I think the reliability and validity as well as integrity are very much questionable, not to mention the time taken to accomplish the tasks.

A: Thank you for sharing that with me.

FACTORS THAT INFLUENCE THE SUCCESSFUL DEPLOYMENT OF BI

A: My next questions will be more on the factors. What factors do you think would make BI systems most successful?

B: A lot of factors actually. First thing that I notice about BI is that the systems are so complex in nature. The tools that we have now is too complex, regardless of whether in-house or off-the-shelf package. The systems have to be simple so that it will be easy to use, especially when the users are the upper management level. The user requirements play a major role in ensuring successful of BI systems. Users of BI systems are normally in managerial level in the organizations. Therefore the requirements are sometimes hard to define; it could vary from one manager to another. Their requirements are unique in order to support their unique decision-making tasks.

A: So you think the system has to be user-friendly in nature. Is there any other factor that would affect BI?

B: Another important factor is the systems have to affordable by the organizations, obviously. What I mean by affordable is in terms of monetary and manpower. We see a lot of expensive tools being introduced in the market by vendors currently. We are wondering how many companies can afford such systems. It requires a lot of financial and support from management. Luckily our company has both of the resources, so we can deploy BI.

A: What do you mean?

A: As you know our company is a big government-linked company that has the financial power. We also have enough manpower for that matter in terms of technicalities and functionalities. Our IT department has been dealing with in-house systems development for a number of years by now. Although some of the systems are bought or out-source to other IT vendors, but most of the systems are done by them.

A: Do you think that the involvements of technical persons are important?

B: Yes, I think it would make BI successful with the involvement of technical persons. The process behind the scene is actually so complex that requires a lot of technical skills. I strongly believe that technical staff with business skills could deliver BI systems better.

A: Do you consider yourself as a person with both skills?

B: Yes, I would say so. For your information, I was the systems analysts before promoted to my current management position. My understanding of technicalities is actually more than my business knowledge but I am still learning.

A: Do you think that quality information is important for BI success?

B: Quality information is information that meet users requirement. Yes, it's very important or else what good would it be. At the end of the day, we'll be using that information to help the organization.

A: Do you think that quality users are important for BI success?

B: I don't regard users as quality users; I would rather call them capable users. Capable users are people that utilize the information that are available to them and turn them into knowledge that can be use to benefit the organization. With that their organization's performance will be boosted. Yes, definitely I would say capable users are utmost important in BI since they are the one who use the systems.

A: Does IS Governance would play any role in making sure BI success?

B: Yes, if making sure that rules and regulations are in place. All the do's and don'ts are clearly spelled out; it will surely help BI success.

A: Any other factors that you can think of?

B: I would say survival in the competition is another important factor for BI success in Telco companies. Getting the right requirements in the industry is crucial for a company to survive. These may include some external information that may not be available in our BI systems. For example 3G technology and GSM services that are being deployed by our competitor of other Telco companies. We have to make decision whether to make the same move immediately or to wait and see. Branding or preferred network like the one that is enjoyed by Maxis Communication in Malaysian Telco industry now is another of our hurdle in surviving in this current competition. Hopefully BI can help us in discovering the right way to stay alive.

UTILIZATION OF BI TOOLS

A: What sort of BI features do you think would enable you to generate required knowledge needed in your decision-making activities?

B: Of course it has to be Windows-based application obviously with GUI capability. I would prefer some menu-driven systems that enable you to pre-define your requirements. BI systems have to be web-enables so that we can have access anywhere and anytime we need them.

A: What about the functionalities of BI? Which of those are most important to you?

B: A lot of BI features that I think benefit me the most. First are the forecasting capabilities such as forecasting on my most profitable customers and so on. Second is finding the network traffic patterns and the third is the feature that can perform our telecommunications network performance. As you know that network is our main business so its performance matters the most for us. As of now, our company focuses more on this function as far as BI is concern.

A: Any other BI functions that you can think of?

B: May be modeling customer behavior such as calling hour, overseas calls, what number they call etc. These behaviors are important to understand our customers and to be used later for our next promotional campaign. Another important function of BI based on this information could be used for fraud detection. This function is crucial as customers are now becoming cleverer and the tendency of committing the crime is high. As we can see from the example that I gave, BI can be use as both as strategic planning tool for high level management as well technical tool for operational management.

ROLE OF ORGANIZATION CULTURE IN BI SUCCESS

A: Do you feel that an appropriate organization culture plays an important role in utilizing BI systems for knowledge creation?

B: Yes, I certainly say the right culture is important in BI success. I would say that every participating company in Telco industry now have the right kind of business culture or a matured way of doing business.

A: What sort of organization culture do you think your company currently has that would enable such situation?

B. I think the most important culture is the knowledge awareness among users in the organization. If we have staffs that are ignorance of the importance of knowledge, then BI would be a waste. This awareness will create the sense of urge to request for information needed in completing their tasks. Another feature is business sense, in which managers have to really understand what business they are in. They must understand what it takes to compete in the Telco industry.

BUSINESS STRATEGY

A: Do you think business strategy plays any role in BI deployment?

B: Personally I think business strategy is a prerequisite for any company and it has to come first. I mean companies have to define the future direction in terms of mission and vision. Then only we can plan the rest that will support the identified business strategies. It could be that may be in terms of data derivation. Knowledge and other essentials will come at later stage to support the plan. In case of BI, the systems can support business strategy by providing the necessary knowledge needed in realizing them into action plans.

A: What about the alignment of knowledge and business?

B: Yes, of course it has to come together. Knowledge and business come hand-in-hand and it cannot be separated. But it can be like chicken-and-egg story. Some would say its knowledge first, and then only we know what business we are in. But on the other hand, we need business first, and then only knowledge can help. Anyway, the important thing is to realize that both are essential for the sustainability of organizations.

BI-BASED KNOWLEDGE FOR SUSTAINABLE COMPETITIVE ADVANTAGE OF THE COMPANY

A: Do you think BI-based knowledge can be utilized for your company's sustainable competitive advantage?

B. Yes, I would say it could be used. This internal knowledge from BI plus external knowledge is utilized to make certain business decision. I personally think that BI is just a tool for that purpose that can help in terms of post-process activity that enable managers to create better presentation. Like I said before, I personally cannot imagine my life without these systems as I have been depending on the information provided by the system for long time. But since I am not in a position to create vision for my company, I am not very sure whether currently the top management use the knowledge provided for our sustainability.

A: Talking about sustainability of organizations. What do you think of corporate social responsibility or we called it CSR now issue being the concern now?

B: Yes… our company is seriously into CSR now. We have started our CSR program in terms of giving something back to the community. For example, we are now in the midst of setting up telecentre in the remote areas throughout the country. These centers are meant to educate the rural communities to participate in the information and communications development. Our aim is to get as much participations as possible among the underserved communities. Hopefully the bridging digital divide in Malaysia would be achieved.

A: I think that's the end of our interview. Thank you very much for your cooperation and participation.

B: You are welcome.

Appendix D

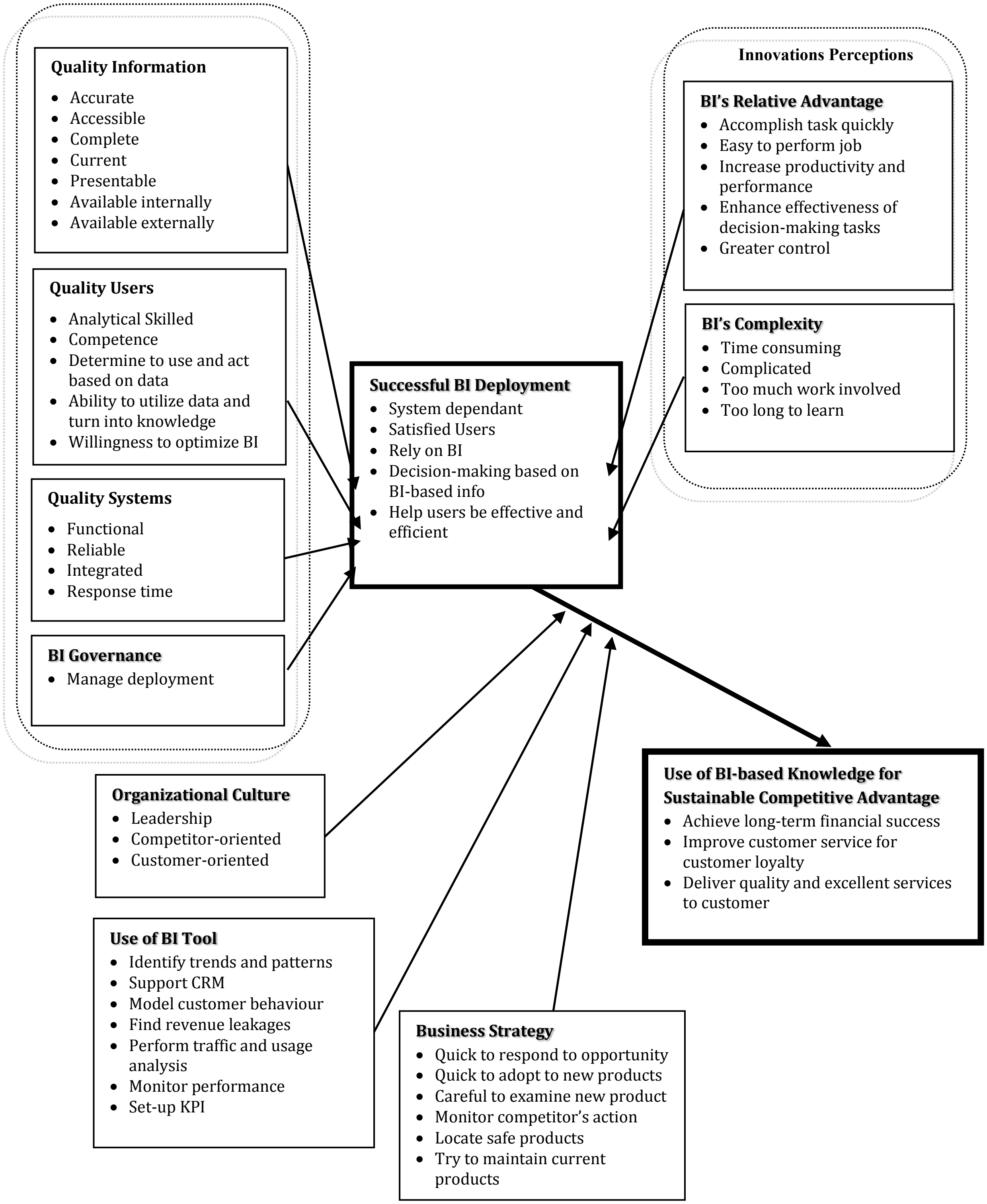

Figure 5-3 BI for Sustainable Competitive Advantage of Participant #2

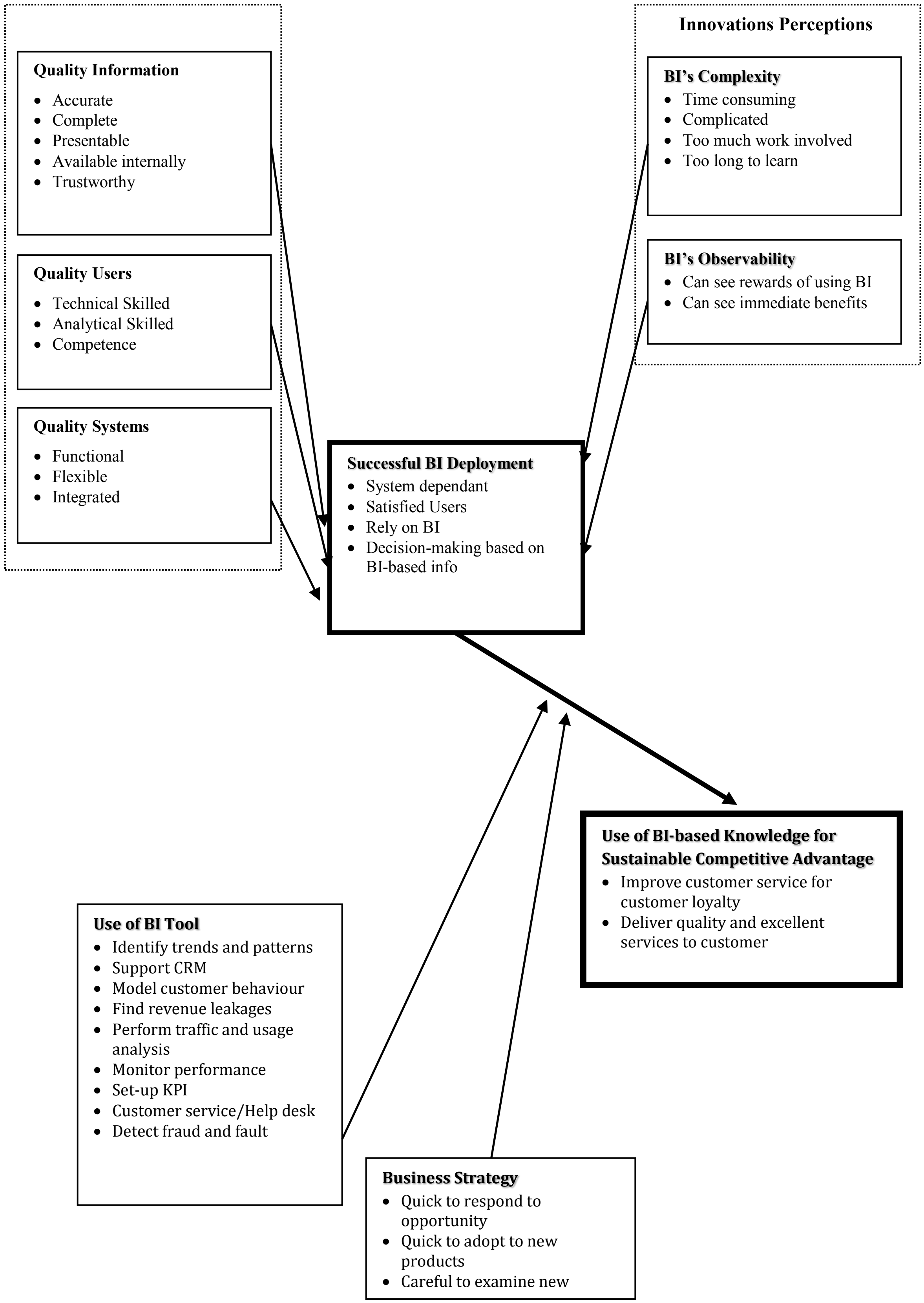

Figure 5-4 BI for Sustainable Competitive Advantage of Participant #3

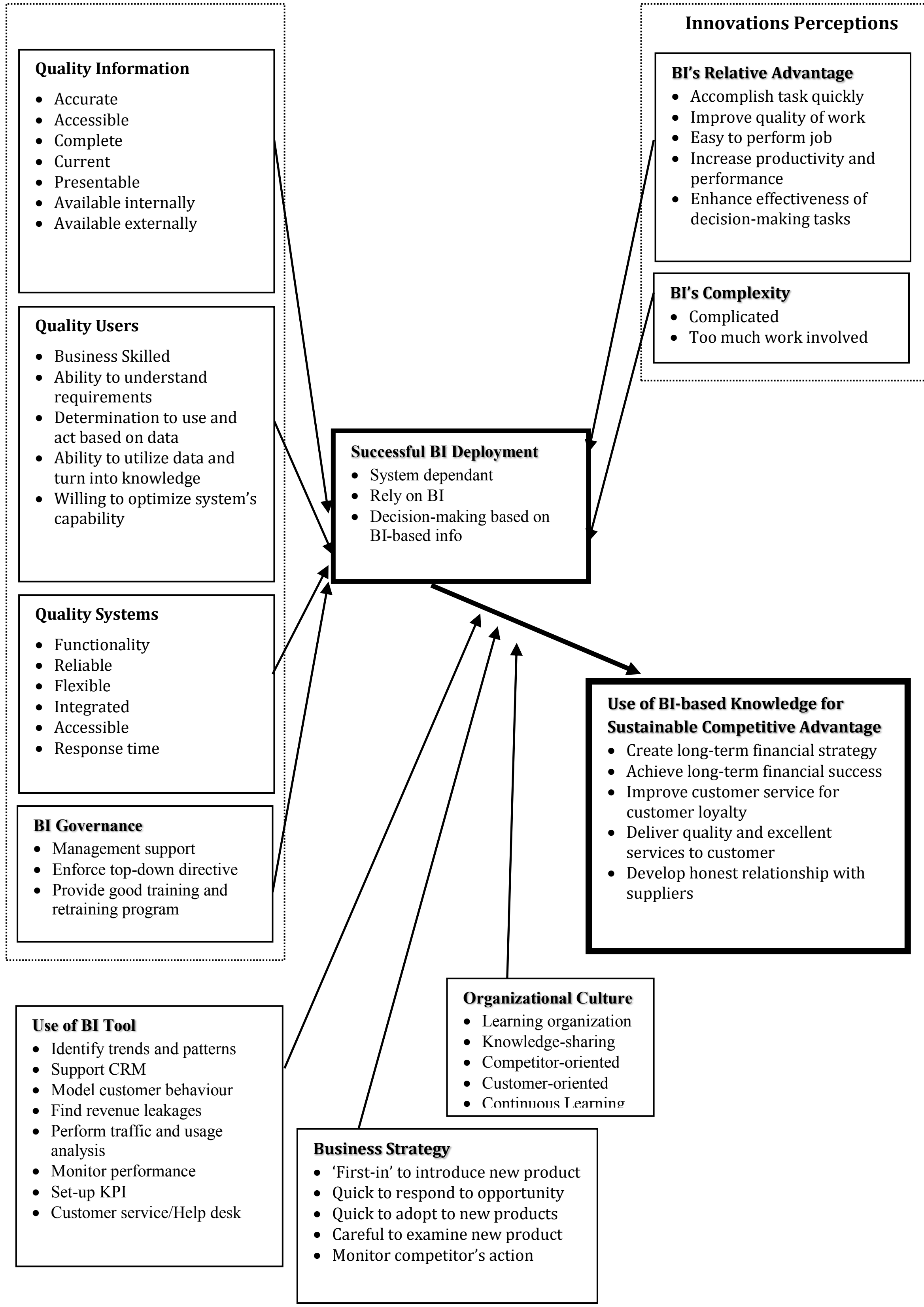

Figure 5-5 BI for Sustainable Competitive Advantage of Participant #4

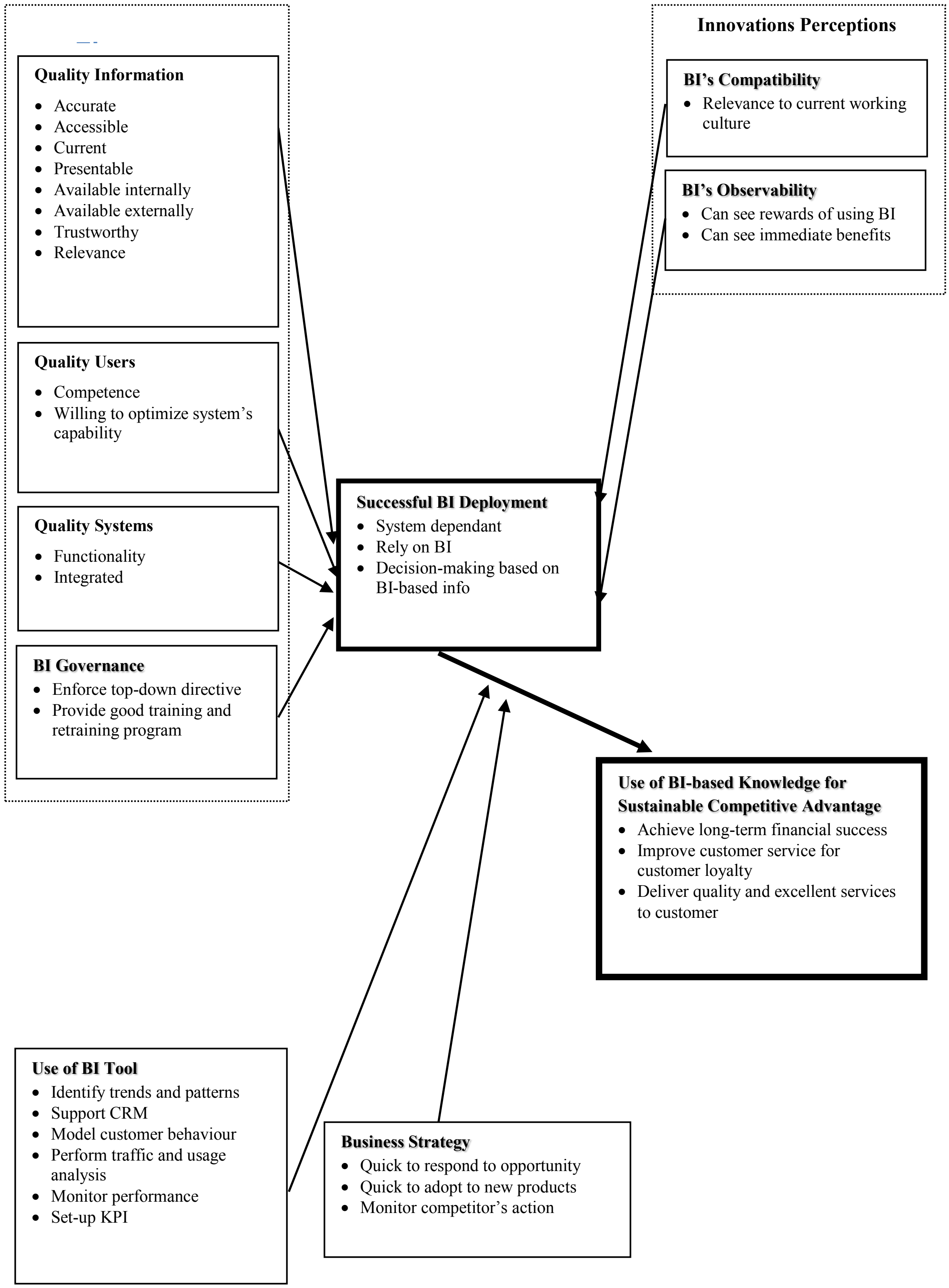

Figure 5-6 BI for Sustainable Competitive Advantage of Participant #5

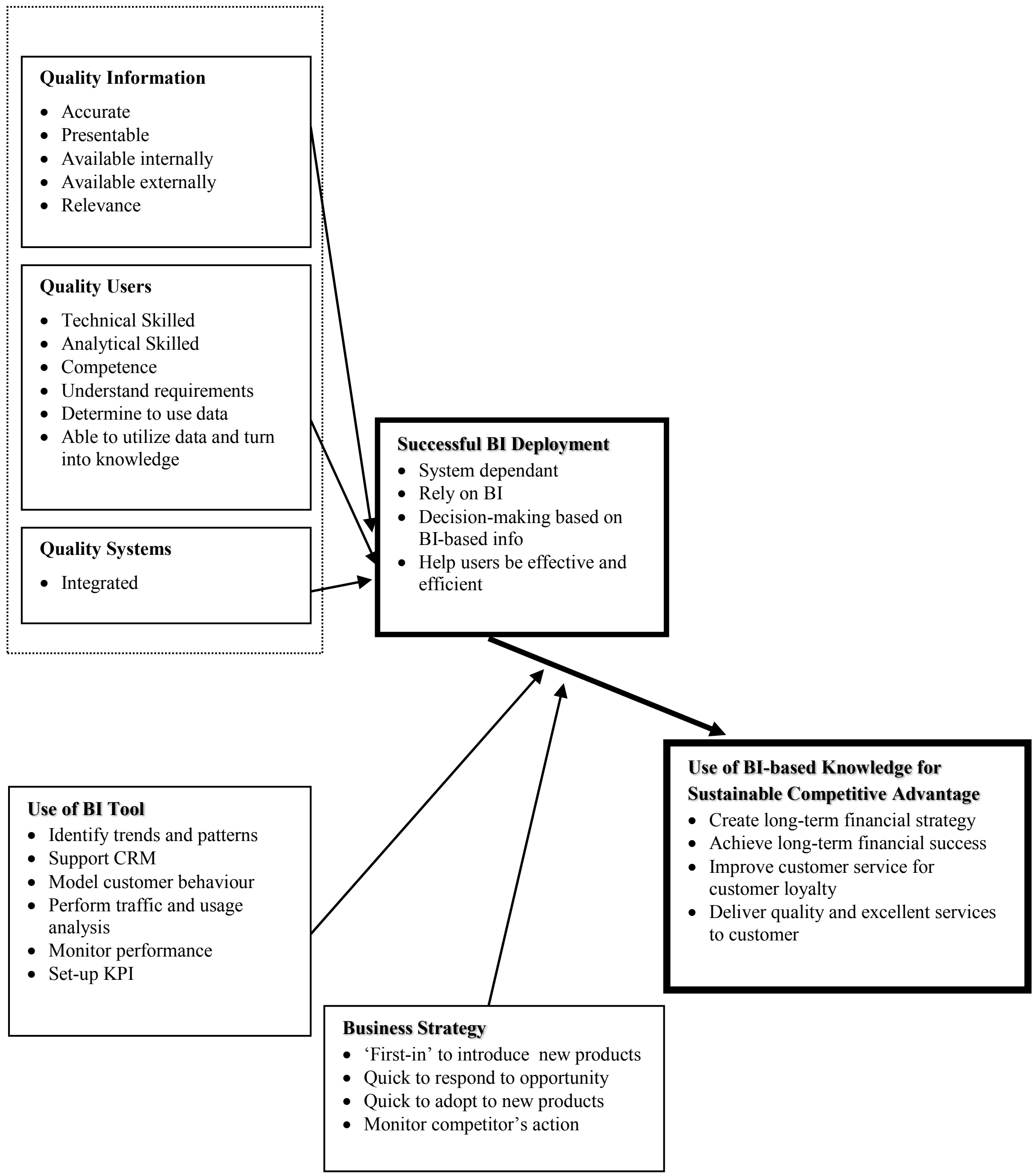

Figure 5-7 BI for Sustainable Competitive Advantage of Participant #6

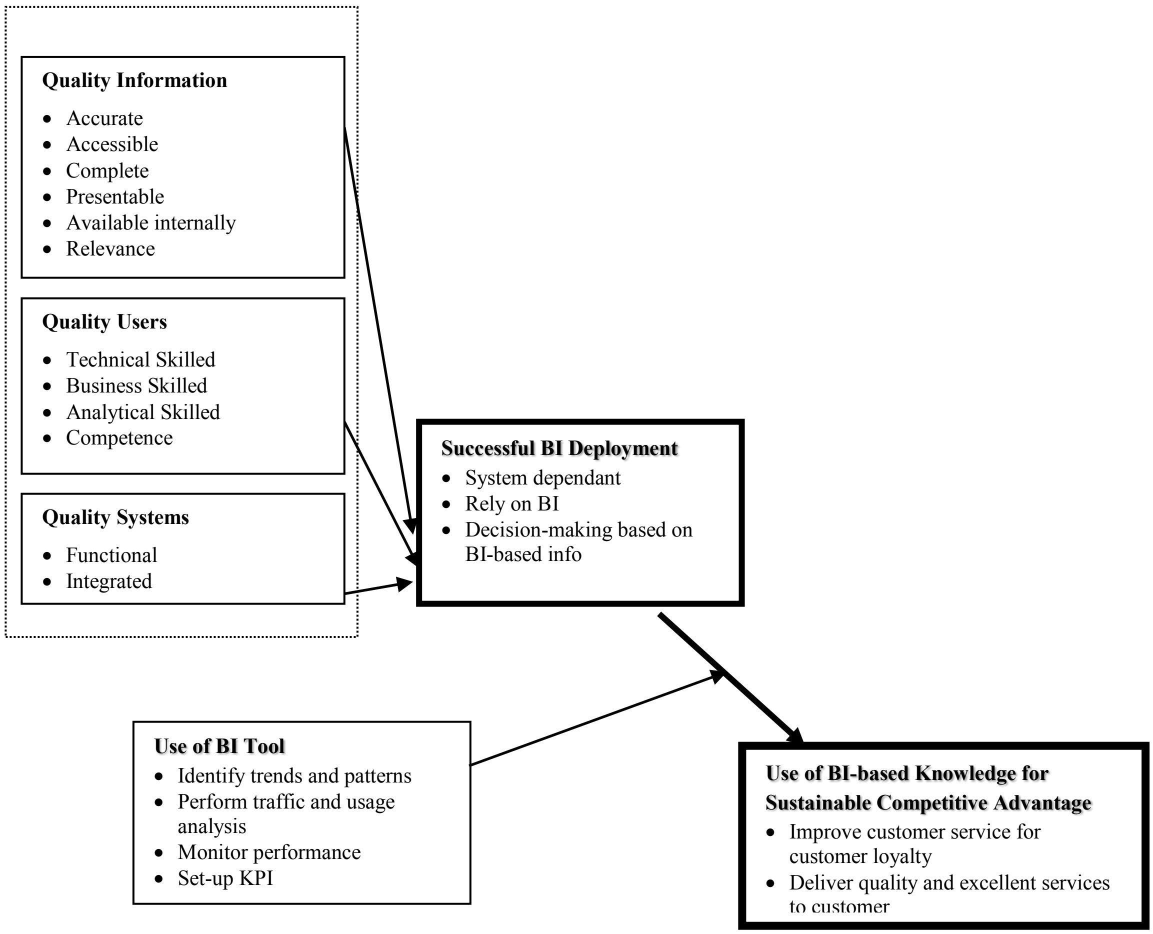

Figure 5-8 BI for Sustainable Competitive Advantage of Participant #7

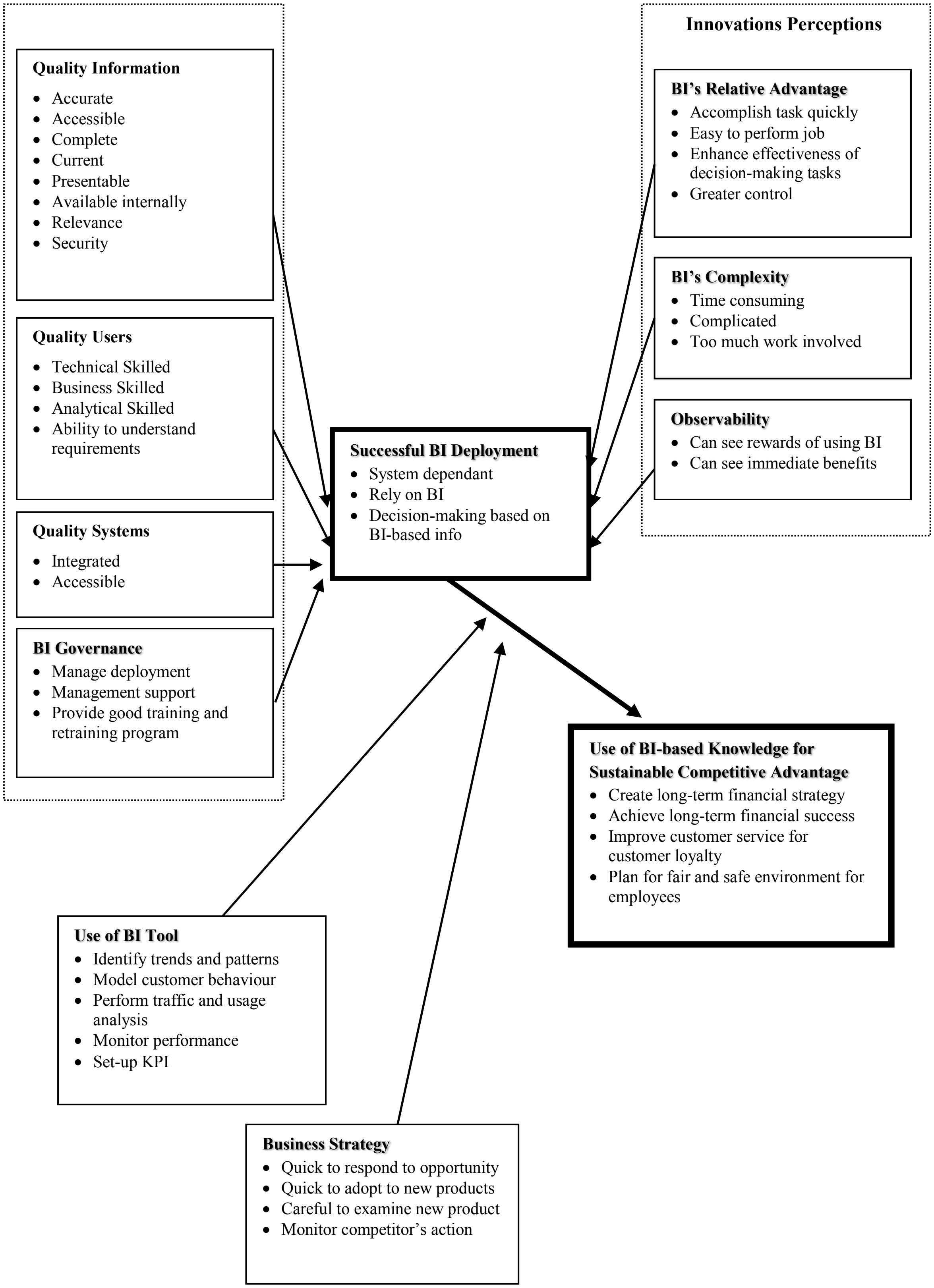

Figure 5-9 BI for Sustainable Competitive Advantage of Participant #8

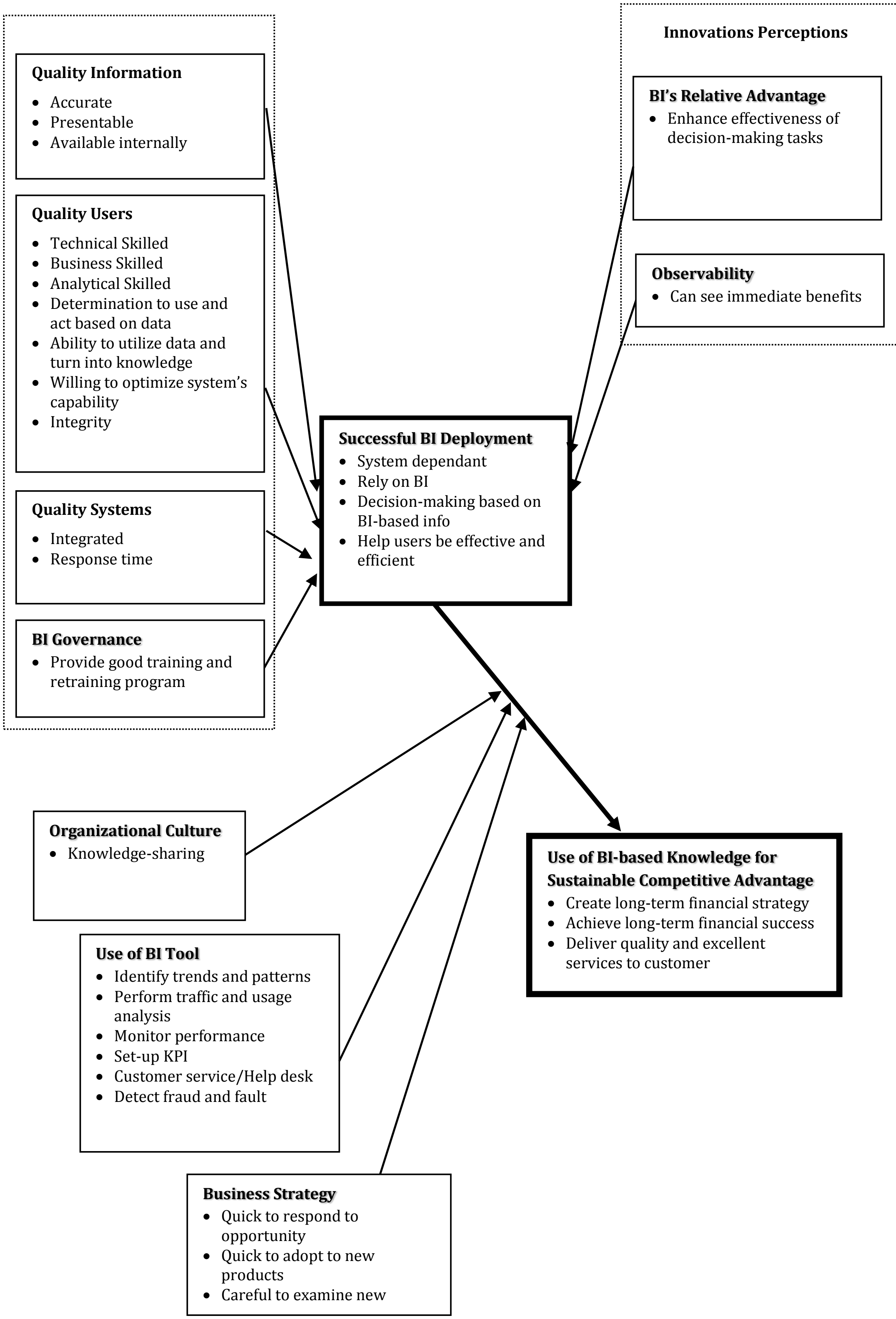

Figure 5-10 BI for Sustainable Competitive Advantage of Participant #9

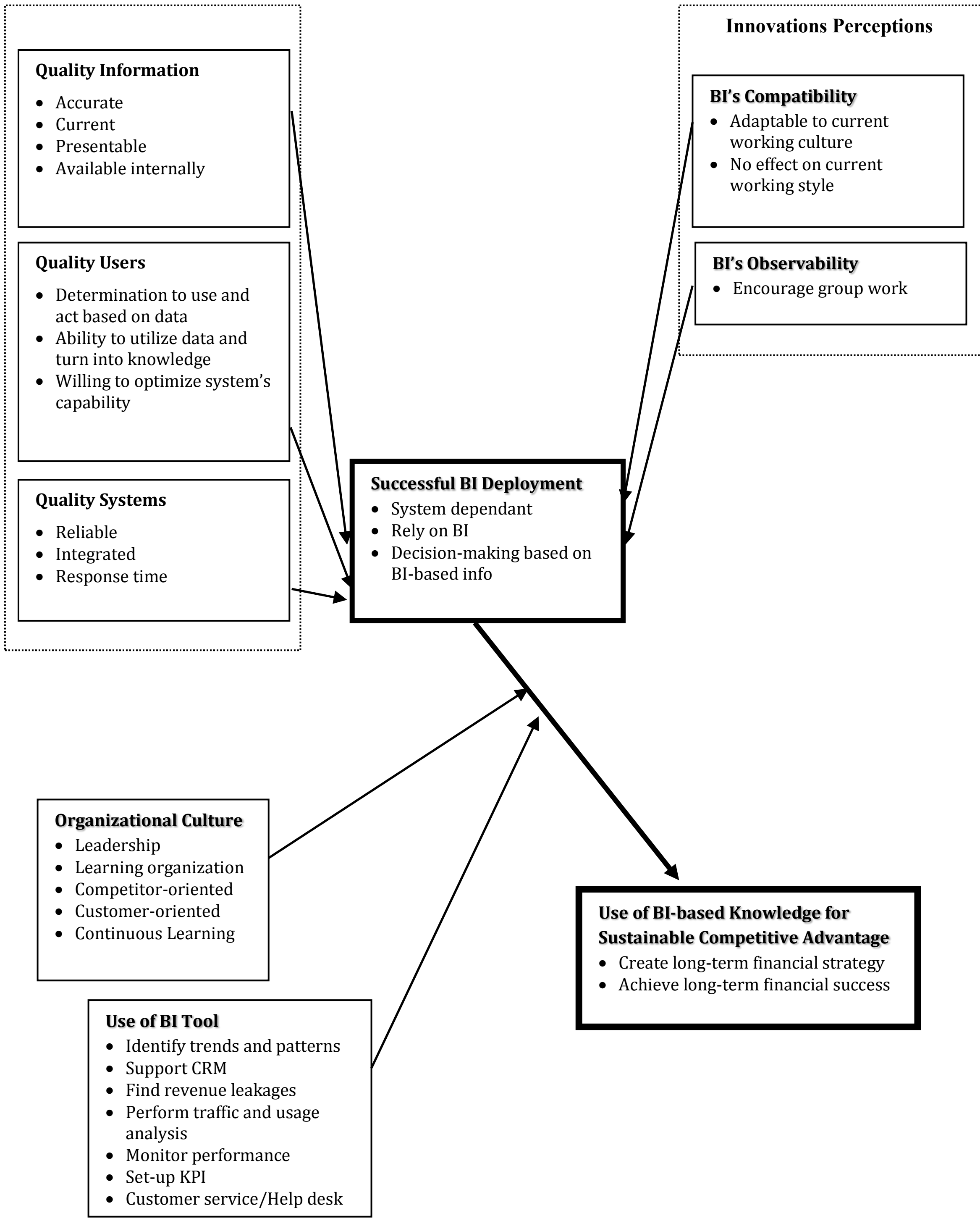

Figure 5-11 BI for Sustainable Competitive Advantage of Participant #10

Appendix D

Graduate School of Business
Curtin University of Technology
Perth, Western Australia

SURVEY OF BUSINESS INTELLIGENCE FOR SUSTAINABLE COMPETITIVE ADVANTAGE: THE CASE OF TELECOMMUNICATIONS INDUSTRY IN MALAYSIA

Graduate School of Business

BUSINESS INTELLIGENCE FOR SUSTAINABLE COMPETITIVE ADVANTAGE: THE CASE OF TELECOMMUNICATIONS INDUSTRY IN MALAYSIA

Dear Sir/Madam,

My name is Azizah Ahmad. I am a Doctoral student at the Graduate School of Business, Curtin University of Technology, Perth, Australia, conducting research in the area of "Business Intelligence" under the supervision of Professor Mohammed Quaddus of Curtin University of Technology and Associate Professor Dr Norshuhada Shiratuddin of University Utara Malaysia. In particular, I am examining the factors affecting the successful deployment of Business Intelligence in organizations.

I am writing to ask if you would be kind enough to assist in my research by completing the attached questionnaire. You can choose to fill in Malay or English version of the questionnaire. If you are unsure about certain questions, please try to give an answer that best reflects your feeling. Please answer all the questions because each one of the statement is important for this study. I would like to assure you that **your responses will be completely confidential** and no individuals will be identified in any report of the results. Please fill in the questionnaire and return it to your representative in your organization.

While I realize time can be an issue for busy individuals like yourself, your involvement would be helpful not only to me personally, but would also make an important contribution to our knowledge and education about business intelligence practices especially in telecommunication industry in Malaysia. I will be pleased to send you a specific report on the main findings of the study should they be of interest to you.

This study has been approved by the Curtin University Human Ethics Committee. If needed, verification of approval can be obtained by either writing to the Curtin University Human Research Ethics Committee, Office of Research & Development, Curtin University of Technology, GPO Box U1987, Perth 6845 or telephone 9266-2784.

Thank you for considering my request. Your assistance is greatly appreciated and should there be any further queries, my contact details are provided below. Alternatively, you may contact my supervisor, Professor Mohammed Quaddus on 61-8-92662862 or e-mail mohammed.quaddus@gsb.curtin.edu.au. or Associate Professor Dr Norshuhada Shiratuddin on 6012-580-6116 or e-mail shuhada@uum.edu.my.

Yours Sincerely,
Azizah Ahmad
PhD Candidate

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Definitions

For the purposes of this survey, we are using the following definitions:

1. **Business Intelligence (BI):** The ability to access and analyze information as needed and to utilize this information to make sound business decisions

2. **Business Intelligence Systems (BIS):** BIS combines data gathering, data storage, and knowledge management with analytical tools to present complex and competitive information to planners and decision makers.

3. **Sustainable Competitive Advantage (SCA):** SCA is achieved when a firm receives a return of investment that is greater than the industry norm and that persists for a long period of time.

Section 1: Some Information about You and Your Organization

1. Gender

___ Male ___ Female

2. Age Group (years)

___ 20 below ___ 31 to 40 ___ 51 or above
___ 21 to 30 ___ 41 to 50

3. What is your highest level of education?

___ High School or equivalent ___ Tertiary
___ Technical School ___ Master Degree or higher

4. How long have you worked for this organization?

___ Less than 2 years ___ 5+ to 10 years ___ More than 15 years
___ 2+ to 5 years ___ 10+ to 15 years

5. What is your current position in this organization?

___ Vice President or above ___ Director ___ Section Head
___ Assistant Vice President ___ Department Manager ___ Executive Officer
___ Senior Director ___ Section Manager
Other (please specify) ________________________

6. How long have you been in your current position?

___ Less than I year ___ 3 to 6 years
___ 1 to 3 years ___ More than 6 years

7. In what field (function) do you work?

___ Finance ___ Human Resource ___ Purchasing
___ Marketing ___ Production ___ Manufacturing Services
___ Legal ___ Information Technology ___ Sales
___ Commercial ___ Quality Control ___ Planning
___ Customer Service ___ Accounting ___ Engineering
___ Facilities/Maintenance
Other (please specify) ________________________

8. In terms of growth, indicate your organization's status?

___ Growing ___ Just surviving
___ Holding steady ___ Shrinking

Section 2: Organizational Resources Factors

Part A: Quality BI Information

For each of the following statement on **quality BI information**, please circle the number that indicates the extent to which you agree or disagree.

Strongly Disagree ↔ Strongly Agree

QI1	BI systems should produce accurate and correct information	1	2	3	4	5	6
QI2	BI systems should provide information that I need anywhere and anytime	1	2	3	4	5	6
QI3	Information from BI systems should be complete and adequate	1	2	3	4	5	6
QI4	Information from BI systems should always be current and up to date	1	2	3	4	5	6
QI5	BI systems should produce information in a presentable format and should be easily understood and interpreted	1	2	3	4	5	6
QI6	BI systems should provide information from internal as well as external sources	1	2	3	4	5	6
QI7	Information provided by BI systems should always be of high integrity and trustworthy	1	2	3	4	5	6
QI8	BI systems should produce relevant information that meet company's requirements	1	2	3	4	5	6
QI9	Information from BI systems should be secured and free from threats	1	2	3	4	5	6

Part B: Quality BI Users

For each of the following statement on **quality BI users**, please circle the number that indicates the extent to which you agree or disagree.

Strongly Disagree ↔ Strongly Agree

QU1	BI users should posses technical know how to ensure BI is successfully used in the organization	1	2	3	4	5	6
QU2	BI users should be knowledgeable in their business or working environment	1	2	3	4	5	6
QU3	Ability to analyze data from BI systems is essential to ensure BI is successfully used in the organization	1	2	3	4	5	6
QU4	BI users should be competence in carrying out their tasks and responsibilities	1	2	3	4	5	6
QU5	Understanding of organization's unique requirements is a must in ensuring BI success	1	2	3	4	5	6
QU6	BI users should have the determination to use and make action based on available data	1	2	3	4	5	6
QU7	Ability to utilize data is essential for BI users to ensure BI success	1	2	3	4	5	6
QU8	Users' willingness to make full use of BI capabilities is essential to ensure BI success	1	2	3	4	5	6
QU9	BI users must have high integrity in performing their tasks and responsibilities	1	2	3	4	5	6

Part C: Quality BI Systems
For each of the following statement on **quality BI systems**, please circle the number that indicates the extent to which you agree or disagree.

		Strongly Disagree	⟷				Strongly Agree
QS1	BI systems should be fully functional as per their intended purposes	1	2	3	4	5	6
QS2	BI systems should be reliable so that users can depend on BI operations	1	2	3	4	5	6
QS3	BI systems should be flexible enough to meet my organization's current and future needs	1	2	3	4	5	6
QS4	BI systems should effectively combine data from different areas of the company	1	2	3	4	5	6
QS5	BI systems should allow information to be readily accessible to me	1	2	3	4	5	6
QS6	BI systems should return answers to my requests quickly and in a timely manner	1	2	3	4	5	6

Part D: BI Governance
For each of the following statement on **BI governance**, please circle the number that indicates the extent to which you agree or disagree

		Strongly Disagree	⟷				Strongly Agree
BG1	Upper management should provide sufficient support and commitment during design, development and implementation of BI systems	1	2	3	4	5	6
BG2	Enforcement by the upper management in using BI systems among executives will increase BI success	1	2	3	4	5	6
BG3	Strong moral and financial involvement and support from the management in implementing BI will increase its success	1	2	3	4	5	6
BG4	A corporate-wide policy, standards and procedures regarding BI should be established in ensuring its success	1	2	3	4	5	6
BG5	Organization should provide appropriate training and support program as well as periodical retraining program for all levels of BI users in ensuring BI success	1	2	3	4	5	6

Section 3: BI Success

BI systems are considered **successfully deployed/used** in the organization if BI users .....

		Strongly Disagree	⟷				Strongly Agree
SD1	.... use BI systems and the information provided by the systems in carrying out their tasks and responsibilities in the organization	1	2	3	4	5	6
SD2	…. rely on BI systems to get information that they need to perform their job in the organization	1	2	3	4	5	6
SD3	…. utilize information provided by BI systems for making decision in the organization	1	2	3	4	5	6
SD4	…. accomplish their tasks more quickly by using BI systems	1	2	3	4	5	6
SD5	… feel that the content of information from BI systems sufficiently meet their decision-making requirements	1	2	3	4	5	6

SD6	… feel that BI systems can help them to be effective and efficient in their job	1	2	3	4	5	6

Section 4: Perceptions about BI Systems

For each of the following statement on **perceptions about BI systems**, please circle the number that indicates the extent to which you agree or disagree.

Strongly Disagree ⟷ **Strongly Agree**

RA1	Using BI systems should enable me to accomplish tasks more quickly	1	2	3	4	5	6
RA2	Using BI systems should improve the quality of the work I do	1	2	3	4	5	6
RA3	Using BI systems should make it easier to perform my job	1	2	3	4	5	6
RA4	Using BI systems should enhance my effectiveness on the job	1	2	3	4	5	6
RA5	Using BI systems should increase my productivity	1	2	3	4	5	6
RA6	BI systems should give me better control over my work	1	2	3	4	5	6
CB1	Using BI systems should be compatible with all aspects of my work	1	2	3	4	5	6
CB2	Using BI systems should fit well with the way I like to manage my work	1	2	3	4	5	6
CB3	Using BI systems should have no effect on my current working style	1	2	3	4	5	6
CX1	Using BI system take too much time from my normal duty	1	2	3	4	5	6
CX2	BI systems are complicated and difficult to understand	1	2	3	4	5	6
CX3	Using BI systems involve too much time doing mechanical operations (e.g.: data input, integrate data and so on)	1	2	3	4	5	6
CX4	It takes too long to learn how to use BI systems to make it worth the effort	1	2	3	4	5	6
TY1	BI users should be given the opportunity to try BI systems before actually using the systems	1	2	3	4	5	6
TY2	BI users should perform test runs on the BI systems before actually using the systems	1	2	3	4	5	6
TY3	BI users should be given enough time to experiment the BI systems before actually using the systems	1	2	3	4	5	6
OB1	BI users should be able to see the outcome of BI system that have been implemented in their organization	1	2	3	4	5	6
OB2	BI systems are able to encourage communication among staffs in the organization	1	2	3	4	5	6

Section 5: Organizational Culture

Indicate the extent to which you agree with the following statements regarding **organization culture and BI systems** in your organization.

Strongly Disagree ◄──► **Strongly Agree**

OC1	Use of BI systems supports the 'competitor-oriented' culture of my organization	1	2	3	4	5	6
OC2	Use of BI systems provide the knowledge to be shared among staff in my organization	1	2	3	4	5	6
OC3	Use of BI systems supports the 'customer-oriented' culture of my organization	1	2	3	4	5	6
OC4	The support for continuous learning and improvement within my organization motivates me to use BI systems	1	2	3	4	5	6
OC5	'Perform-and-reward' culture within my organization motivates to use BI systems to improve my performance	1	2	3	4	5	6

Section 6: Use of BI Tools

Indicate the extent to which you agree with the following statements regarding the **use of BI tools** in your organization.

Strongly Disagree ◄──► **Strongly Agree**

BS1	BI systems are used to monitor the performance of my organization's telecommunication operations to ensure that they meet customers expectations	1	2	3	4	5	6
BS2	BI systems are used in setting up the key performance indicator (KPI) of the staffs in my organization	1	2	3	4	5	6
BS3	BI systems are used to detect fraudulent activities in a real-time manner	1	2	3	4	5	6
BS4	BI systems are used to perform in-depth traffic and usage pattern analysis to reduce operational failures	1	2	3	4	5	6
BS5	BI systems are used to find the revenue leakages and enhance revenue assurance by uncovering billable interconnect services	1	2	3	4	5	6
BS6	BI systems enable users to model customer behaviour to spot usage trends and patterns	1	2	3	4	5	6
BS7	BI systems can support and compliment Customer Relationship Management (CRM) for more targeted marketing and services and for more profitable pricing plans	1	2	3	4	5	6
BS8	BI systems can be utilized to perform analysis on historical data to identify trends and patterns to detect service problems and bottlenecks	1	2	3	4	5	6

Section 7: Business Strategy

Indicate the extent to which you agree with the following statements regarding **business strategy and use of BI systems** in your organization.

Strongly Disagree ⟷ **Strongly Agree**

BS1	Use of BI systems can help my organization to be 'first-in' in attaining new products and services in Malaysian telecommunication industry	1	2	3	4	5	6
BS 2	My organization can respond rapidly to early signals of opportunities in the industry using information provided by BI systems	1	2	3	4	5	6
BS 3	Using BI systems can contribute to my organization to lead in innovation in telecommunication industry in Malaysia	1	2	3	4	5	6
BS 4	BI systems enable my organization to adopt quickly to a promising innovations in the telecommunication industry in Malaysia	1	2	3	4	5	6
BS5	BI systems provide knowledge for my organization to carefully examine the innovations	1	2	3	4	5	6
BS 6	BI systems can be used to monitor competitors' actions in the telecommunication industry	1	2	3	4	5	6
BS7	Information provided by BI systems enable my organization to try to locate a safe niche in a relatively stable products and services domain	1	2	3	4	5	6
BS 8	BI systems provide adequate knowledge for my organization to try to maintain a limited line of products/services	1	2	3	4	5	6

Section 8: Use of BI-based Knowledge for Sustainable Competitive

Disagree

Strongly Agree

Indicate the extent to which you agree with the following statements regarding the **usage of knowledge provided by BI systems for your organization's sustainable competitive advantage**.

SCA1	My organization should use knowledge from BI systems to create a long-term plan of sustainable operations that deliver a good return	1	2	3	4	5	6
SCA2	In planning to achieve our financial goals and building a long-term success, my organization should utilize information provided by BI systems	1	2	3	4	5	6
SCA3	BI systems should provide knowledge needed for my organization to improve customer service that would retain customer loyalty	1	2	3	4	5	6
SCA4	Overall, BI systems should provide sufficient knowledge for my organization to deliver quality, value and excellent services to our customers	1	2	3	4	5	6
SCA5	My organization should utilize knowledge from BI systems to develop honest and transparent relationship with suppliers	1	2	3	4	5	6
SCA6	Appropriate and adequate knowledge from BI systems should be used by my organization to plan for employees' fair and safe working environment	1	2	3	4	5	6
SCA7	BI systems should provide adequate and appropriate information for my company to do planning for support and communication with local community	1	2	3	4	5	6
SCA8	BI systems should provide appropriate and adequate knowledge for my organization to manage environmental impacts in a responsible manner	1	2	3	4	5	6

It is the end of the questionnaire. Thanks so much for your time and co-operation

REQUEST FOR INFORMATION

I would like to know the results of this survey. Please send it to:

Name of respondent : ....

Name of company : ....

Mailing address : ....

....Post Code

E-mail : ....

Delivery preference : ☐ Hard copy (post mail) ☐ Ms Word (e-mail)