UNIVERSITY OF KWAZULU-NATAL

BUSINESS INTELLIGENCE INFORMATION SYSTEMS SUCCESS: A SOUTH AFRICAN STUDY

by

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DECLARATION

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DEDICATION

This work is dedicated to my father and mother, for everything they have done for me throughout the years. Your love and support helped me put forth my full effort, and to maintain my sanity.

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ABSTRACT

Business Intelligence (BI) systems hold promise for improving organisational decision making in South Africa. Additionally, BI systems have become increasingly important over the past few decades and are one of the top spending priority areas of most organisations. Yet till now, the factors influencing the success of BI systems in South Africa have not been fully investigated. The study found no scholarly research for managers and other practitioners to assess post implementation success of BI systems in South Africa. This lack of research may directly affect managers' not knowing how best to implement BI systems and could thereby delay the successful implementation of BI systems in South African organisations.

The study extends that of DeLone and McLean (2003), conducted in developed economies by applying it to a developing economy context, namely South Africa. The DeLone and McLean (2003) model has been widely utilised to study factors that influence information systems (IS) success. This study extends the DeLone and McLean (2003) by adding a user quality factor and suggests a theoretical model consisting of six factors, which are: (1) system quality, (2) service quality, (3) information quality, (4) user satisfaction, (5) individual impact, (6) and user quality.

The theoretical model was formulated from the literature review. It was then validated and enhanced through a qualitative study of three interviews with end users of BI systems based in South Africa. The theoretical model was then presented to a panel of experts for verification. A questionnaire survey method was employed as the main method to collect data and to answer the main research question. Statistical analysis methods and Structural Equation Modelling (SEM) with SPSS was used to analyse the data. The results of the hypotheses were mixed. Three suggested that relationships were statistically significant, while the other four did not.

The study finds that information quality is significantly and positively related to user satisfaction in a BI system. The results also indicate that user quality is positively related to user satisfaction in a BI system and system quality is positively related to individual impact in a BI system.

The results have both managerial and research implications. The results of this study will add value to IS and specifically BI literature. Organisations, which have adopted BI or are planning to adopt BI, can use the important variables of the study to undertake an internal check to find out how they compare in terms of these variables. The unique contribution of this study is the identification of post implementation success factors of BI systems in a South African context. The factors identified also served in providing a set of management guidelines for the BI environment in South Africa.

Keywords: Business Intelligence, Business Intelligence System**,** data warehouse, Business Intelligence success, individual impact, information quality, service quality, user satisfaction, user quality

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LIST OF ABBREVIATIONS

ABREVIATIONS	MEANING
BI	Business Intelligence
CIOs	Chief Information Officers
CRM	Customer Relationship Management
DSS	Decision Support Systems
DW	Data warehousing
DWH	Data warehouse
ERP	Enterprise Resource Planning
ESS	Executive Support System
ETL	Extract, Transform and Load
ICT	Information and Communication Technology
IS	Information Systems
IT	Information Technology
MDM	Master Data Management
MIS	Management Information System
OLAP	Online Analytical Processing
OLTP	Online Transactional Processing
SCT	Social Cognitive Theory
SEM	Structural Equation Modelling
SPSS	Statistical Package for Social Sciences
TAM	Technology Acceptance Model
TTF	Task Technology Fit

CHAPTER 1 : INTRODUCTION

1.1 Background

BI is the use of technologies, applications and processes to gather, store and analyse data to enhance decision-making (Wixom & Watson, 2010). Over the past few decades, BI has become increasingly important and is one of the top spending priority areas of organisations and is also one of the few areas of technology that is still growing (Davenport, 2010; Foley & Manon, 2010; Gartner, 2007; Gartner, 2008; Gartner, 2009). Decision makers need accurate and timely information in order to make effective decisions resulting in BI systems becoming critical to organisational operations (Olszak & Batko, 2012; Yeoh & Koronios, 2010).

Organisations worldwide are investing heavily in BI systems in order to remain competitive and survive in the harsh economic market (Kanaracus, 2011; Gonsalves, 2008). Gartner (2011) estimated that worldwide expenditure in BI was more than US$10 billion in 2010 and is projected to remain growing at a rate of approximately 8.1 percent annually. The table below shows the worldwide BI Market Share.

Table 1.1 : Worldwide BI Market Share Analysis (Gartner, 2011)

Region	Revenue 2008($M)	Revenue 2009($M)	Revenue 2010($M)
North America	4052	4264	5021
Latin America	271	309	369
Western Europe	3260	3212	3426
Eastern Europe	243	258	266
Middle East and Africa	162	172	204
Asia and Pacific	595	698	858
Japan	357	364	378
Total	8,939	9,278	10,522

It is worth noting that according to Table 1.1 above revenue from Middle East and Africa increased from US$162m in 2008 to US$204m in 2010.

Gartner (2008) pointed out that in a survey of Chief Information Officers (CIOs) BI was selected as the No. 1 technology priority in 2008. Gartner (2008) further argued that since BI systems are perceived to be a high priority by CIOs, BI systems revenue would not be severely influenced by an economic recession. The BI market grew from 6% in 2009 to 18% in 2010 for Middle East and Africa (Gartner, 2011). While the IDC (2012) predicted a strong growth in BI for the next five-year period. In 2008, Frost and Sullivan (2008) estimated that the South African market was set to grow by about

10 percent in the near future. The current growth in the market as evidenced by Gartner (2011) validates this.

According to Mait (2009), the South African market for Information and Communication Technology (ICT) products and related services accounts for 0.6 per cent of worldwide ICT revenues. Mait (2009) further pointed out that the South African ICT market is the biggest in terms of revenue in the Middle East and Africa region. Frost and Sullivan (2008) pointed out that South Africa contributes more than 60 percent of the total revenue in the sub-Saharan African BI market. However, growth of the BI market has been slow in other countries in the region. This slow uptake is a result of low economic growth, a lack of technical expertise in these countries and the uncertainty around securing a return on investments (Frost & Sullivan, 2008).

1.2 Research Problem and Research Question

BI is increasingly being adopted by companies and has been identified as a significant growth area due to its valuable functionality and its ability to add value (Woodside, 2010). However, BI is similar to Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) in that it regularly goes over budget (Woodside, 2010). While BI has been widely adopted by many companies and other organisations in South Africa, its success is not well understood (Chaveesuk, 2010; Yeoh & Koronios, 2010). BI in South Africa is still at an early stage of adoption and there is an absence of documented proof of its practice (Ponelis, 2011).

According to Chan (2009), academic research within the BI field is still in its infancy and most of the BI literature has emanated from within the corporate world, the Information Technology (IT) industry, and vendors. Chaveesuk (2010) pointed out that most of the available research in BI concentrated on technological and operational features and there was not much study focusing on human, managerial, and strategic factors. Furthermore, Heeks (2010) argued that most IS success reports are drawn from industrialised country settings and focused on E-Government and ERP system success. The results of these reports cannot easily be translated to the South Africa context because South Africa is a developing economy.

Heeks (2002) argued that most technological solutions are designed in the developed countries' context and imported into the less developed countries. In most developing countries, shortage of expertise, high staff turnover, and limited financial resources are cited as challenges to IS implementation and utilisation (Avgerou, 2008). This means that transfer of technological solutions from the developed world does not necessarily imply that the solution will be successful in the developing world. While BI implementation does not depend entirely on IT this highlights IT's role in the implementation of a BI solution.

BI projects are difficult to implement and utilise a lot of resources, yet there are few studies on BI success factors (Yeoh & Koronios, 2010). Some of the key words and phrases that were used to check for previous research relating to the topic were: "business intelligence", "business intelligence systems", "business intelligence systems success", "post implementation success", "information systems success". Each of these keywords returned more than 50 articles when used alone – with the exception of "business intelligence systems post implementation success" which returned no results from Google Scholar and Google search engines (see Appendix J). Other search engines that were used are Proquest, Academic One File and Ebsco Host.

To further ensure the uniqueness of the study, a search was run on the Nexus Database System (January 2011), for any duplicate South African theses and dissertations. By Searching for BI related topics, only six completed and eight current BI related theses and dissertations were found (see Appendix I). No study was found that sought to identify the post implementation BI systems success factors in South Africa.

BI has many potential benefits to an adopting organisation such as: improving the decision-making process, faster and easier access to information, cost savings, and improved competitiveness (Isik, Jones, & Sidorova, 2011; Hou, 2012; Hočevar & Jaklič, 2010). Despite such potential benefits, the success rate of BI is very low (Beal, 2005; Laskowski, 2001; Legodi & Barry, 2010).

Given the absence of documented BI systems success factors specific to SA, the problem that this study seeks to address is the lack of guidance for managers in South Africa regarding how best to assess the post implementation success of BI systems. To address the problem the research focuses on identifying the factors that contribute to the success of BI systems in SA. This is relevant because a failure to address this problem might hinder the successful adoption of BI systems inspite of all its reported benefits.
Based on the discussion above, the research problem addressed in this study is identified as:
To identify the factors that contribute to the success of BI systems in organisations in South Africa.

Therefore, the research problem is broken down into a specific research question:

What are the factors that contribute to the success of BI systems in South Africa?

Four sub-questions were developed from the central research question namely:

1.2.1 Sub-question 1

What existing information systems success theoretical frameworks can be used in the context of BI systems? The purpose of this sub question was to identify and gain an understanding of existing IS success models.

1.2.2 Sub-question 2

What are the factors influencing the success of BI systems as perceived by BI end-users in South African organisations? The aim of this small-scale exploratory study was to investigate whether factors and sub factors identified in the literature review (Research sub-question 1) held in practice in a South African context.

1.2.3 Sub-question 3

What are the factors influencing the success of BI systems as perceived by BI experts in South Africa? The purpose of this sub question was to present the findings of the literature review and the small-scale exploratory study to a panel of experts for them to identify the most important factors and sub factors in a South African context. The panel were also given an opportunity to suggest new factors and sub factors.

1.2.4 Sub-question 4

To what extent does the hypothesised BI system success model fit into the identified factors? This sub question was answered in Chapter 4. This sub-question was intended to empirically test the research model developed from the last three steps.

1.3 Aim and Research Objectives

The primary aim of the study was to identify factors that contribute to the success of BI systems in South African organisations. To meet this aim, the following objectives were identified:

- To identify the factors that contribute to the success of BI systems in South Africa.

- To develop a theoretical model that will describe the relationships between all of the factors that influence BI systems success.
- To test empirically the proposed theoretical model among BI end users in organisations based in South Africa.

1.4 Justification for the Study

The following reasons justify the pursuit of this study:
Firstly, BI systems are expensive to implement yet the failure rate is estimated to be between 50% and 80% worldwide (Beal, 2005; Laskowski, 2001; Legodi & Barry, 2010). This suggests that research into the factors that influence the success of BI systems was required. This study may therefore make an important contribution to identifying post implementation success factors and sub-factors of BI systems in a South African context.

Secondly, business organisations wanting to adopt BI may benefit in the sense that they may be better able to identify the success factors and sub factors of BI thereby minimising the adoption risks associated with BI failures. Furthermore, estimates of wastage due to IT failures were estimated to be $150 billion per annum in the US and $140 billion in Europe (Dalcher & Genus, 2003). By identifying success factors this study might contribute to reducing the drain on company resources in South Africa.

Thirdly, a literature search identified only a handful of articles investigating success factors of BI systems (Joshi & Curtis, 1999; Wixom & Watson, 2001; Chenoweth, Corral & Demirkan, 2006; Hwang & Xu, 2008; Hawking & Sellitto, 2010) which mostly focused on implementation factors of success in developed economies. BI systems are not the same as the normal transactional IS (Yeoh & Koronios, 2010) therefore research in ERP and E-Commerce cannot simply be applied to the BI system context. Furthermore, Murugan, Magid and Uzoamaka (2000) argued that it is essential to determine success factors in less-developed countries since they differ culturally from developed countries. This study looks at post implementation success factors of BI systems in a South African context.

1.5 Research Design

Although the Research Design utilised as part of this study is examined in detail in Chapter 3, it is necessary to give a brief overview to facilitate an initial understanding of the study. Drawing on the

DeLone and Mclean (2003) model, this research study used a mixed methods research design where qualitative and quantitative phases occurred one after the other. A mixed method design uses both quantitative and qualitative approaches in a single study (Johnson & Onwuegbuzie, 2004).

The chosen research method was appropriate since it allowed initial qualitative exploration of the research topic on a small scale in order to gain insight into the research situation. Another reason why a mixed methods approach was chosen was to enable the researcher to incorporate the views of players from local South African organisations that confirmed findings from the literature review and made the research more robust.

A literature review was undertaken to establish an initial theoretical framework for the research study based on the DeLone and McLean (2003) model. Figure 1.1 illustrates the proposed research model.

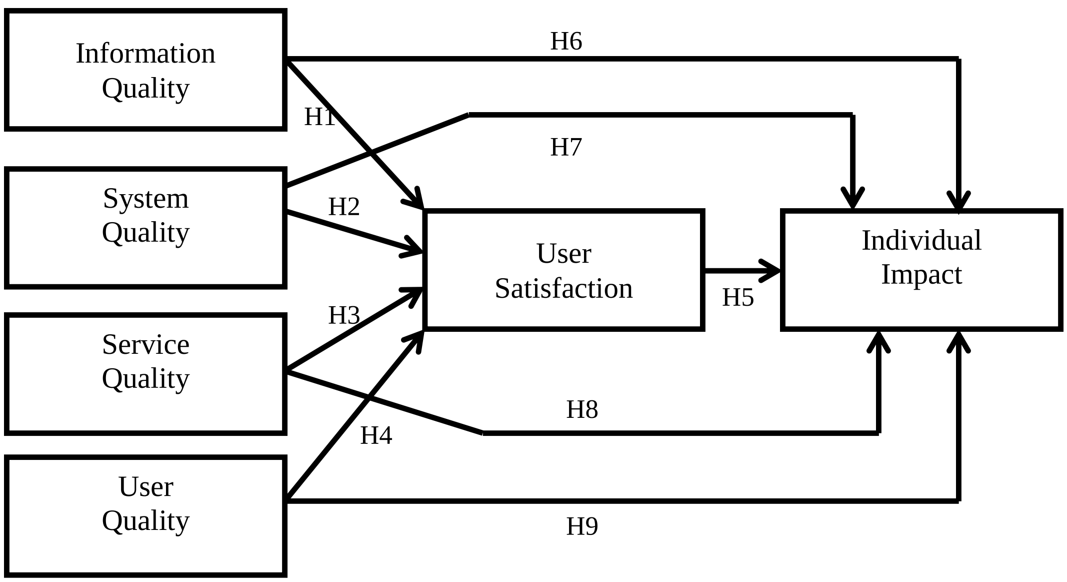


Figure 1.1: The Initial Business Intelligence Systems Success Model (Author's illustration)

The literature review helped to identify a list of generic IS success factors and sub-factors. The BI System success model hypothesises that service quality, system quality, user quality and information quality independently or together influence user satisfaction and the individual impact of the BI system. This model is discussed in detail in Chapter 3.

The second phase of the study collected mainly qualitative data using short semi-structured interviews to determine BI specific success factors and sub-factors. The second phase did not result in significant changes to the initial framework but provided support for the theoretical framework's factors and their interrelationships.

In the third phase of the study, the theoretical model was presented to a panel of experts for professional input as only a relatively small number of interviews were conducted as part of the qualitative phase of the study. The objective of the Delphi method was to investigate which of the factors and sub-factors were pivotal to BI systems success in the South African context. The final phase of the study used a questionnaire survey to empirically validate the research model.

Table 1.2 shows the research questions aligned to the instrument questions, type of data required to answer the questions and data analysis methods used to analyse the data.

Table 1.2 : Research Questions for the study

Research Question	Instrument Questions	Types of Data	Analysis
What existing information systems success theoretical frameworks can be used in the context of BI systems?	Literature Review	Secondary Data – Literature Review	Analysis of Literature
What are the factors influencing the success of BI systems as perceived by BI end users in South African organisations?	Interview Guide covers the following factors: - information quality - service quality - system quality - user quality - individual impact -user satisfaction - other factors	Primary Data – Semi Structured Interviews	Thematic Analysis
What are the factors influencing the success of BI systems as perceived by BI experts in South Africa?	Survey Questionnaire covers the following factors: - information quality - service quality - system quality - user quality -individual impact -user satisfaction -other factors as proposed by experts	Primary Data – Delphi Method. All survey questions will use a 4 point Likert Scale from Very Important to Unimportant	Summary Statistics
To what extent does the hypothesised BI system success model fit into the identified factors?	Survey Questionnaire covers the following factors: - information quality - service quality - system quality - user quality	Quantitative data from a Survey questionnaire. All survey questions used a 5 point Likert Scale from Strongly Agree to Strongly Dis-Agree	Descriptive Statistics Structural Equation Modelling

Research Question	Instrument Questions	Types of Data	Analysis
	-individual impact -user satisfaction		

1.6 Scope of the Study

This study does not include the BI system development process. The study only focuses on post implementation success and consequently focuses on organisations that have already adopted BI systems. The following questions in Table 1.3 adapted from Cameron and Whetten (1996) helps to scope the study.

Table 1.3 : Scope of Study

Questions	Approach in this study
From whose perspective is effectiveness been judged?	End users
What is the level of analysis?	Individual
What time frame is employed?	Post BI system implementation
What is the purpose of evaluation?	Managing and improving BI system performance and facilitate further positive impacts in South Africa.
What types of data are to be used?	Subjective: Perceptual data from individuals
Against which referent is effectiveness to be judged?	DeLone and McLean (2003) model

Garrity and Sanders (1998) point out that IS success can be measured at multiple levels of analysis namely at the (1) organisational level, (2) process or functional level and (3) individual level. The organisational level of IS success measures the influence of the system to such indicators as revenue, market share and return on investment (Garrity & Sanders, 1998). The process level is concerned with reducing costs and the efficient use of resources (Garrity & Sanders, 1998).

This study focuses on the individual level of analysis. At the individual level of analysis the focus is on users' perception of the utility of the BI system. This study will therefore use the end users' perceived feelings of success to measure the factors contained within the model of BI systems success. This approach has been used in a number of prior systems success studies (Al-adaileh, 2009; Freeze, Alshare, Lane, & Wen, 2010; Wu & Wang, 2006).

1.7 Assumptions

The following assumptions were made during the research study:

- The study assumes that the study participants understand the nature and purpose of BI systems.
- The study assumes the intended persons completed the survey questionnaires and such persons provided authentic and honest responses.

1.8 Ethical Considerations

Saunders, Lewis and Thornhill (2009) pointed out that research ethics relates to, gaining access, collecting data, processing and data storage, analysing data and writing up the research findings in a moral and responsible way. Permission to conduct the study was sought and granted by the Research Office of the University of KwaZulu-Natal (see Appendix A). An informed consent form was provided to participants to ensure that the participants were cognisant of the fact that their involvement was voluntary and that they could withdraw from the research process at any stage. The participants were also informed that their responses would be kept anonymous and confidential. All data are currently kept at the University of KwaZulu-Natal and only the researcher and supervisor can access the data.

1.9 Definition of Terms

The following key terms are used in this study:

1.9.1 Business Intelligence (BI)

BI is the use of technologies, applications and processes to gather, store and analyse data to enhance decision-making (Wixom & Watson, 2010). A typical BI system consists of the following components (Olszak & Ziemba, 2007): (1) Extract Transform Load (ETL) tools, (2) data warehouse (DWH), (3) online analytical processing (OLAP) tools, and (4) Data mining tools.

1.9.2 System Quality

System quality is defined as the desirable features of the system. Some of the desirable features include ease of use, system flexibility, system reliability, ease of learning, intuitiveness, sophistication, flexibility, and response times (Petter, DeLone & McLean, 2008). In the context of this study, system quality measures the desirable features of the BI system. The measures used in this study are ease of use, user friendly, responsiveness, ease of learning, stability, security, and reliability and availability.

1.9.3 Service Quality

Service quality refers to the level of support that end users get from the service provider. Measures of service quality include responsiveness, accuracy, reliability, technical competence, and empathy of the personnel staff (Petter *et al*., 2008). In this study Service quality consists of four measures namely assurance, empathy, responsiveness and knowledgeable.

1.9.4 Information Quality

Information quality refers to the desirable features of the information produced by the system. (Petter *et al*., 2008; Hwang & Xu, 2008). This study uses the following seven measures of information quality: accuracy, usefulness, timeliness, completeness, relevance, understandability[sic] and trustworthiness.

1.9.5 Individual Impact

Individual impact refers to the effect of the system on the behaviour of the end user (DeLone & McLean, 1992). Job performance, individual productivity, job effectiveness, extent of analysis in decision making, decision making quality, problem identification speed, and decision making speed are the measures used in this study.

1.9.6 User satisfaction

User satisfaction refers to the perception of the end user towards the system in relation to what the end user expected upon first use of the system (Seddon, 1997). According to Bharati (2003) if a system meets the requirements of the end users, their attitude towards the IS will be positive. Measures of user satisfaction used in this study are: efficiency, effectiveness and overall satisfaction.

1.9.7 End User

An end user is a person who uses the BI system to perform job related tasks (McAllister, 2006). In the context of this study, an end user can be a senior manager, middle manager, or operational staff or any other person who uses the BI system.

1.10 Organisation of the Study

This study is organised into six chapters.

The figure below illustrates the overall layout of this thesis.

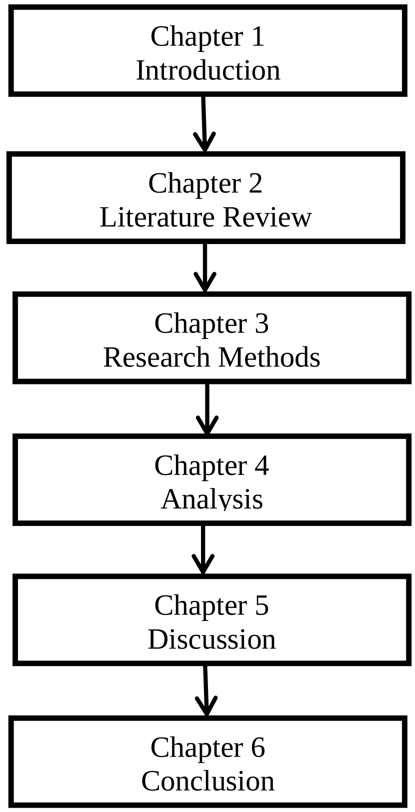


Figure 1.2: Thesis Map

A brief description of these chapters is provided below:

Chapter 1 introduces the overall background as well as the research problem, aim, and research objectives of the study. Chapter 1 furthermore describes the research design used to achieve the aim and the objectives of the study. Chapter 1 also provides a justification of the study.

Chapter 2 presents a review of relevant literature and provides a theoretical background for the research. The chapter begins by defining BI. Drawing from different sources the chapter also provides a detailed examination of key characteristics of BI systems. Chapter 2 also provides an overview of the international and SA BI industry. In addition, the characteristics of BI systems and how they differ from transactional IS will be discussed.

The chapter also outlines the importance of BI. Chapter 2 proposes a BI systems success model based on the DeLone and McLean (2003) model. The proposed model includes the following factors: information quality, system quality, service quality, user quality, user satisfaction, and individual impact.

Chapter 3 describes the research methods and tools used to collect data for this study. This is done by presenting the methods of data collection and the analytical and statistical methods, which will be used to analyse the data.

Chapter 4 presents the results of the study. The study results are presented in a logical sequence, in the order in which the research sub-questions of the study have been formulated.

Chapter 5 discusses the study's results, explaining the meaning of the findings in relation to the literature and the possible implications of the findings.

Chapter 6 is the last chapter of this research study. This presents the conclusions, the contribution of the study to the existing body of knowledge, the limitations of the study, and discusses opportunities for further research.

Books, Journal articles and other material used to complete the study are provided in the Bibliography. The questionnaire, invitation letter, consent form, snapshots, ethical clearance and other supplementary material used for this study are provided in the appendices.

1.11 Summary

Chapter 1 provides an introduction of the study and outlines the scope of the study. This introductory chapter has eleven sections. Section 1.1 presents the study background. Section 1.2 discusses the Research Problem and identifies the Research Question addressed in the study. Section 1.3 explains the research aim and objectives while section 1.4 provides the Justification for the Study. Section 1.5 briefly describes the Research Design that was used to evaluate the study and section 1.6 outlines the Scope of the Study. The assumptions and ethical considerations are discussed in section 1.7 and 1.8 respectively. Section 1.9 provides a definition of key terms and concepts used in the study and section 1.10 describes the overall organisation of the study. Finally, Section 1.11 provides a summary of the chapter. The following chapter, Chapter 2 presents the literature review that supports this study.

CHAPTER 2 : LITERATURE REVIEW

2.1 Introduction

The problem that the study seeks to address is the lack of formal guidance for managers in South African organisations to assess the post implementation success of BI systems. This problem results partly from absence of documented BI systems success factors specific to South Africa. As alluded to in the previous chapter a number of sources were utilised in the compilation of this section of the study including electronic databases, online search engines and online electronic journals. The following are some terms that were used in searching for references related to the problem statement: "business intelligence", "business intelligence systems", "business intelligence systems success", "information systems success", "post implementation success", and "post implementation systems success". IS success as a key word was used to conduct a broad search that included all forms of IS, including BI systems as a form of IS. BI was then used as a key word to narrow down the search and focus on the main subject of investigation.

The previous chapter provided a background to the study, introduced the problem statement, justified the study, and outlined the scope of the study. This chapter presents an overview of the literature relevant to this research study. This chapter is structured into nine sections. Section 2.2 discusses the evolution and definition of the term BI. Section 2.3 examines in detail the components of a BI system. The benefits and importance of BI systems are identified in Section 2.4. The fifth section, Section 2.5 explores the worldwide BI Market and briefly discusses the South African BI landscape. In Section 2.6 prior BI and DW success studies are identified. Section 2.7 presents an overview of IS success theories in general. In section 2.8 a discussion of the research model is presented. The last section gives an overall summary of the chapter.

2.2 Definitions of Business Intelligence

While traditional IT systems are designed for optimising data capture, their ability to offer flexible reporting solutions to understand the information and the influence of the information on the business (Hawking & Sellitto, 2010) is limited and this limitation has led to the emergence of new applications such as BI systems. BI is a relatively new area in the field of IS and as such, it is important to understand the meaning of the term BI.

There are numerous terms used to define BI. Essentially, term BI refers to the use of technologies, applications and processes to gather, store and analyse data to enhance decision-making in a business (Wixom & Watson, 2010). Similarly, Negash (2004) argued that BI systems provide decision makers with valuable information derived from operational data and analytical tools. BI applications provide the ability to transform data into information and to gain knowledge through analytical tools in order to support decision-making (Martin, Maladhy & Venkatesan, 2011).

Martin *et al*. (2011) furthermore described BI as a process of providing information to the right people in order for them to contribute to the benefits of the business through improved decision-making. BI is the use of the DWH to methodically store and manage operational data, and through the use variety of statistical and analytical tools and data mining techniques to analyse operational data in order to provide analytic reports and decision support information for various business activities (Wang, Fan & Xu, 2012).

Negash (2004) claimed that the term BI has substituted the use of the terms decision support, Executive Information Systems (EIS) and Management Information Systems (MIS). In contrast, Rouhani, Asgari and Mirhosseini (2012) claim that the term BI is occasionally used interchangeably with the term EIS. Rouhani *et al*. (2012), further point out that BI systems are Decision Support Systems (DSS) that provide periodic reports derived from historic data.

The Data-driven DSS have been termed differently in the past including data-oriented DSS (Alter, 1980), retrieval-only DSS (Bonczek, Holsapple & Whinston, 1981), EIS, OLAP systems and lately BI. Yeoh and Koronios (2010) likewise defined a BI system as a set of tools, technologies and approaches for making data available. Furthermore, the data is transformed to a valuable resource for the organisation (Yeoh & Koronios, 2010).

To provide a snapshot of the business, huge volumes of data from different sources of an organisation are combined into a logical unit. This integration results in meaningful information being delivered to the right people for improved decision-making (Yeoh & Koronios, 2010). That there is little agreement in the literature on a shared definition of BI this is not unusual as it is a study area that is still being established (Ponelis, 2011). Petrini and Pozzebon (2009:3) pointed out that BI could be separated into two broad approaches namely managerial approach and technical approach. They further explained the two approaches as follows:

- Managerial Approach - focus on the process of gathering data from different sources and of analysing them in order to generate relevant information; and
- Technical Approach - focus on the technological tools that support the process described in the Managerial Approach (Petrini & Pozzebon, 2009).

In contrast, Rouhani, Asgari and Mirhosseini (2012:63) identify three approaches:

- Managerial Approach - focus on improving management decision making;
- Technical Approach - focus on tools supporting the processes associated with intelligence in the management approach; and
- Enabling Approach - focus on value-added capabilities in support of information.

Furthermore, Rouhani *et al*. (2012) pointed out that regardless of the differences between the two approaches to BI discussed above, they share the following similarities: (1) the goal is to gather, analyse and exchange information, and (2) they provide organisations with support in the strategic decision-making process. Table 2.1 below identifies some definitions of BI identified by Işık (2010).

Table 2.1 : BI Definitions (Işık, 2010)

BI Definition	**Author(s)**	**Definition Focus**
A system that takes data and transforms into various information products.	Eckerson (2003)	Technological
An architecture and a collection of integrated operational as well as decision-support applications and databases that provide the business community with easy access to business data.	Moss and Atre (2003)	Technological
A system that combines data collection, data storage and knowledge management with analytical tools so that decision makers can convert complex information into competitive advantage.	Negash (2004)	Technological
An umbrella term that encompasses data warehousing (DW), reporting, analytical processing, performance management and predictive analytics	White (2004)	Technological
The use and analysis of information that enable organisations to achieve efficiency and profit through better decisions, management, measurement and optimisation	Burton and Hostmann (2005)	Organisational
An umbrella term for decision support	Alter (2004)	Organisational

BI Definition	Author(s)	Definition Focus
Results obtained from collecting, analysing, evaluating and utilising information in the business domain.	Chung, Zhang, Huang, Wang and Chen (2004)	Organisational
Organised and systemic processes which are used to acquire, analyse and disseminate information to support the operative and strategic decision making.	Hannula and Pirttimaki (2003)	Technological
Both a process and a product, that is used to develop useful information to help organisations survive in the global economy and predict the behaviour of the general business environment	Jourdan, Rainer and Marshall (2008)	Organisational
A managerial philosophy and tool that helps organisations manage and refine information with the objective of making more effective decisions	Lonnqvist and Pirttimaki (2006)	Organisational
A set of concepts, methods and processes that aim at not only improving business decisions but also to support realisation of an enterprise's strategy.	Olzak and Ziemba (2003)	Organisational
Extraction of insights from structured data	Seeley and Davenport (2006)	Technological
A system designed to help individual users manage vast quantities of data and help them make decisions about organisational processes	Watson, Abraham and Chen (2004)	Organisational
A combination of products, technology and methods to organise key information that management needs to improve profit and performance	Williams and Williams (2010)	Organisational
A set of methodologies and technologies for gathering, storing, analysing, and providing access to data to help users make better business decisions	Keyes (2006)	Technological
The ability to access and analyse information as needed and to utilize this information to make sound business decision	Ghoshal (1987)	Organisational
Combine data gathering, data storage, and knowledge management with analytical tools to present complex and competitive information to planners and decision makers.	Negash and Gray (2006)	Technological

BI Definition	Author(s)	Definition Focus

The term BI was popularised in the late 1980s (Buchanan & O'Connell, 2006), but has been in use since 1958 as an actionable goal obtained from insightful understanding of stored facts (Luhn, 1958). Only in the 1990s did BI become a widely used term in corporate and IT communities (Chen, Chiang & Storey, 2012).

Recently big data and big data analytics have been used to define huge and complex data sets that utilise advanced and unique data management systems (Chen *et al*., 2012). Although the term BI has become one of the latest IT buzzwords, the organisational pursuit for BI is not new (Williams & Williams, 2010). These pursuits are analysed below.

Firstly, DSS were used in the 1970s and 1980s, by businesses to tackle complex business decisions. Examples include revenue optimisation models in asset intensive businesses such as the airline industry, the hotel industry and the logistics industry as well as logistics network optimisation techniques used in industries that face complex distribution challenges (Williams & Williams, 2010). According to Williams and Williams, (2010) DSS range from sophisticated, customised analytical tools running on mainframe computers to spread-sheet based products running on personal computers.

Secondly, EIS were also an early attempt to deliver actionable intelligence and analyses to support management planning and to control activities (Williams & Williams, 2010). EIS were mainly used on mainframes and intended mainly for use by upper management, these systems were expensive and inflexible (Williams & Williams, 2010).

As BI applications and high performance ITs have come onto the market, EIS applications have been replaced and extended by BI applications such a scorecards, dashboards, performance management and other analytical applications. BI as it is understood today is said to have evolved from the DSS, which began in the 1960s and developed throughout the mid-80s. DSS originated in the computer-aided models created to assist with decision making and planning. From DSS, data warehouses, EIS, OLAP and BI came into focus in the late 1980s.
Williams and Williams (2010) further stated that DSS and EIS express the aspiration of managers to exploit information to improve profits and performance and that can be seen as steps along a

progressive path. Similarly, Olszak and Ziemba (2007) argued that existing MIS have not always met decision makers' expectations, such as: making decisions quickly, monitoring their competitors and analysing information from different angles. According to Arnott and Pervan (2005), DSS are a part of the IS that concentrates on aiding and informing executive decision-making.

In terms of current professional practice, DSS include personal DSS, group support systems, EIS, OLAP, data warehousing (DW), and BI (Arnott & Pervan, 2005). Different companies have gone through the following data provision stages (Ponniah, 2010:10): (1) Ad hoc Reports*:* This was the earliest stage. Users, especially from marketing and finance, would send requests to IT for special reports. IT would write special programs, typically one for each request, and produce the ad hoc reports; (2) Special Extract Programs*:* This stage was an attempt by IT to anticipate somewhat the types of reports that would be requested from time to time. IT would write a suite of programs and run the programs periodically to extract data from the various applications. IT would create and keep the extract files to fulfil any requests for special reports. For any reports that could not be run off the extracted files, IT would write individual special programs; (3) Small Applications: In this stage, IT formalised the extract process. IT would create simple applications based on the extracted files. The users could stipulate the parameters for each special report. The report printing programs would print the information on user-specific parameters. Some advanced applications would also allow users to view information through online screens; (4) Information Centres (ICs): In the early 1970s, some major corporations created what were called ICs. The IC typically was a place where users could go to request ad hoc reports or view special information on screens. These were predetermined reports or screens. IT personnel were present at these information centres to help the users to obtain the desired information; (5) DSS*:* In this stage, companies began to build more sophisticated systems intended to provide some semblance of strategic information. Again, similar to the earlier attempts, these systems were supported by extracted files. The systems were menu-driven and provided online information and also the ability to print special reports. Many such DSS were for marketing; and (6) EIS*:* This was an attempt to bring strategic information to the executive desktop. The main criteria were simplicity and ease of use. The system would display key information every day and provide the ability to request simple, straightforward reports. However, only pre-programmed screens and reports were available. After seeing the total countrywide sales, if the executive wanted to see the analysis by region, by product, or by another dimension, it was not possible unless such breakdowns were already pre-programmed This limitation caused frustration and EIS did not last long in many companies (Ponniah, 2010).

The diagram below illustrates the evolution of MIS (Olszak & Ziemba, 2007).

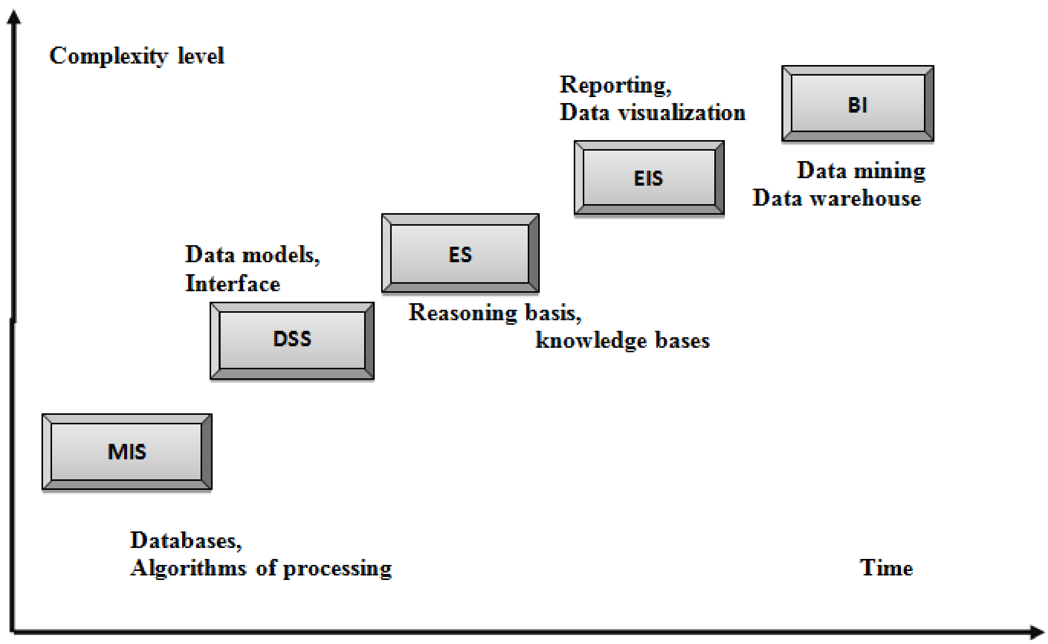


Figure 2.1: Evolution of Management Information Systems (Olszak & Ziemba, 2007)

Using IS to support decision-making has been important to business over the past decades. The evolution of DSS, can be traced from the early spreadsheet based DSS to the DSS based upon artificial intelligence. The categories under which DSSs can be categorised are (Power, 2007:1043):

(1) Model-driven DSS*:* emphasise access to and manipulation of a statistical, financial, optimisation, or simulation model. Model-driven DSS use data and parameters provided by users to assist the decision maker to analyse a situation; they are not necessarily data-intensive systems;

(2) Communication-driven DSS*:* support more than one person working on a shared task;

(3) Data-driven DSS or Data-oriented DSS*:* emphasise access to and manipulation of a time series of internal company data the systems however can be extended to support external data; (4) Document-driven DSS*:* manages, retrieves, and manipulates unstructured information in a variety of electronic formats providing the user with access to these sources; and

(5) Knowledge-driven DSS*:* provide specialised problem-solving expertise stored as facts, rules, procedures, or in similar structures, these systems are similar to expert systems.

EIS are data-oriented DSS that provide reporting about the nature of an organisation to management, despite the executive title, they are used by all levels of management (Power, 2007). Ponniah

(2010:70) claims all past attempts to provide decision makers with critical information were unsuccessful, listing the following as some of the reasons; (1) IT received ad requests that it could not handle with limited resources, (2) changing requirements and (3) users dependence on IT to provide the information they needed.

Table 2.2 summarises the differences between BI, ESS and DSS.

Table 2.2 : Comparison Summary of BI systems, ESS and DSS (Power, 2007)

Component	DSS	ESS	BI
Knowledge Management			x
Content Management			x
Performance Management			x
End-User Tools	x	x	x
Querying / Reporting	x	x	x
Analysis	x	x	x
Database Management System	x	x	x

While a variety of definitions of the term BI have been suggested, this study will use the definition first suggested by Wixom and Watson (2010) who saw BI as the use of technologies, applications and processes to gather, store and analyse data to enhance decision-making.

2.3 Characteristics of Business Intelligence Systems

Having defined what BI means, this section will explore the typical components of a BI system. BI systems are not similar to line of business IS (Yeoh & Koronios, 2010) and hence studies that have researched ERPs and E-Commerce cannot easily be used to the BI system context. The purpose of this section is to highlight the characteristics of BI systems that make them different from other IS such as ERPs and E-commerce systems, which have been the focus of many prior studies (DeLone & McLean, 1992; DeLone & McLean, 2003; Seddon, 1997). By discussing the characteristics of the BI systems, the researcher seeks to further motivate the need for the study by contrasting BI systems with ERP systems.

Martin *et al*. (2011:1215) claim that a typical BI system consists of a DWH, an ETL tool and analytical tools. They further defined a DWH as an unified storage of data merged from various data sources using ETL tools. The organisational data enter the BI cycle through the operational system (Martin *et al*., 2011). Before the data is stored in the DWH, the data is transformed to meet the defined data quality and format standards. After the data has been extracted, transformed and loaded, it is stored in the DWH (Trninic, Đurković & Raković, 2011).

Similarly Turban, Sharda, Delen and King (2011:12), classified a BI system into four main components: (1) a DWH environment; (2) business analytics; (3) business performance management ; and (4) a user interface such as the dashboard. However, what Turban *et al*. (2011) failed to do in this classification is to emphasise the importance of ETL tools. On the other hand, Ponniah (2010) identified the following three components of a BI system: (1) Data acquisition; (2) Data storage; and (3) Information delivery. These components are explained in detail below. Ponniah (2010:83) explained each component in detail as follows:

The first component is Data Acquisition. The Data Acquisition stage covers the process of extracting data from multiple sources, moving all the extracted data to the staging area, and preparing the data for loading into the repository (Ponniah, 2010). The two main components of this area are data sourcing and data staging which is the place where all the extracted data is put together and prepared for loading into the DWH. The function and services for the Data Acquisition area are (Ponniah, 2010:83): (1) Data Extraction: Select data sources from multiple sources and determine the types of data and (2) Data Transformation: transform extracted data to data for the data warehouse repository. Clean data, de-duplicate, and merge. De-normalise extracted data structures as required by the dimensional model of the DWH.

The second component is the Data storage. This stage covers the process of loading the transformed data from the staging area into the data warehouse repository. The function and services for this area are the following: (1) Load the data into the data warehouse tables and (2) Optimise the loading process (Ponniah, 2010:83).

The third component is the Information delivery: The information delivery component makes it easy for the users to access the information directly from the DW. The function and services for this area are the following (Ponniah, 2010:83) : (1) Allow users to browse the DWH content, (2) Enable queries of aggregate tables for faster results and analysis, (3) Provide multiple levels of data granularity , and (4) Perform complex analysis using OLAP (Ponniah, 2010).

Similarly, Olszak and Batko (2012:138), point out that BIS are composed of the following set of essential components:

- ETL*:* these are tools that are responsible for data transfer from operational or transaction systems to data warehouses;

- DWH*:* provides some room for thematic storing of aggregated and analysed data. Analysing, reporting and presentation tools such as: OLAP (tools which allow users access and which analyse and model business problems and share information that is stored in a DWH), data mining (tools for determining patterns, generalisations, regularities and rules in data resources), reporting and ad hoc inquiry (tools for creating and utilising different synthetic reports), drill down reports; and
- Presentation layers that include customised graphical and multimedia interfaces or dashboards to provide users with information in an accessible form (Olszak & Batko, 2012:138).

Gartner (2012) defined a BI platform as a platform that delivers the following 12 capabilities identified in Table 2.3. The definition by Gartner (2012) covers almost all the aspects covered by all other authors (Olsak & Batko, 2012; Ponniah, 2010; Martin *et al*., 2011; Turban *et al*., 2011). The BI platform is ordered into three groups of functionality namely Integration, Information Delivery and Analysis.

Table 2.3 : Gartner's BI platform capabilities (Gartner, 2012)

Integration	**Information delivery**	**Analysis**
BI infrastructure	Reporting	OLAP
Metadata management	Dashboards	Advanced visualisation
Development	Ad hoc query	Predictive modelling and data mining
Workflow and collaboration	Microsoft Office integration	Scorecards

Gartner (2012:2) lists and discusses the 12 BI platform capabilities:

BI infrastructure: All tools in the platform use the same security, metadata, administration, portal integration, object model and query engine, and should share the same look and feel;

Metadata management: Not only should all tools leverage the same metadata, but the offering should provide a robust way to search, capture, store, re-use and publish metadata objects such as dimensions, hierarchies, measures, performance metrics and report layout objects.

Development tools: The BI platform should provide a set of programmatic development tools and a visual development environment, coupled with a software developer's kit for creating BI applications, integrating them into a business process, and/or embedding them in another application. The BI platform should also enable developers to build BI applications without coding by using wizard-like components for a graphical assembly process. The development environment should also support

Web services in performing common tasks such as scheduling, delivering, administering and managing. In addition, the BI application can assign and track events or tasks allotted to specific users, based on predefined business rules. Often, this capability can be delivered by integrating with a separate portal or workflow tool (Gartner, 2012).

Collaboration: This capability enables BI users to share and discuss information, BI content and results, and/or manage hierarchies and metrics via discussion threads, chat and annotations, embedded either in the BI platform or through integration with collaboration, social software and analytical master data management (Gartner, 2012).

Reporting: provides the ability to create formatted and interactive reports. In addition, BI platform vendors should handle a wide array of reporting styles (for example, financial, operational and performance dashboards), and should enable users to access and fully interact with BI content delivered consistently across delivery platforms including the Web, mobile devices and common portal environments (Gartner, 2012).

Dashboards: This subset of reporting includes the ability to publish formal, Web-based or mobile reports with intuitive interactive displays of information, including dials, gauges, sliders, check boxes and traffic lights. These displays indicate the state of the performance metric compared with a goal or target value. Increasingly, dashboards are used to disseminate real-time data from operational applications or in conjunction with a complex event-processing engine (Gartner, 2012);

Ad hoc query: This capability enables users to ask their own questions of the data, without relying on IT to create a report. In particular, the tools must have a robust semantic layer to allow users to navigate available data sources. These tools should include a disconnected analysis capability that enables users to access BI content and analyse data remotely without being connected to a server-based BI application. In addition, these tools should offer query governance and auditing capabilities to ensure that queries perform well (Gartner, 2012).

Microsoft Office integration: In some use cases, BI platforms are used as a middle tier to manage, secure and execute BI tasks, but Microsoft Office (particularly Excel) acts as the BI client. In these cases, it is vital that the BI vendor provides integration with Microsoft Office applications, including support for document and presentation formats, formulas, data ‘refreshes’ and pivot tables. Advanced integration includes cell locking and write-back (Gartner, 2012).

Search-based BI: This applies a search index to both structured and unstructured data sources and maps them into a classification structure of dimensions and measures (often, but not necessarily leveraging the BI semantic layer) that users can easily navigate and explore using a search (Google-like) interface. This capability extends beyond keyword searching of BI platform content and metadata (Gartner, 2012).

Mobile BI: This capability enables organisations to deliver reports and dashboard content to mobile devices (such as smart phones and tablets) in a publishing and/or interactive (bidirectional) mode, and takes advantage of the interaction mode of the device (tapping, swiping and so on) and other capabilities not commonly available on desktops and laptops, such as location awareness (Gartner, 2012).

OLAP: this enables end users to analyse data with extremely fast query and calculation performance, enabling a style of analysis known as 'slicing and dicing' Users are able to easily navigate multidimensional drill paths. In addition, users have the ability to write-back values to a proprietary database for planning and 'what if' modelling purposes. This capability could span a variety of data architectures (such as relational or multidimensional) and storage architectures (such as disk-based or in-memory) (Gartner, 2012).

Interactive visualisation: This gives users the ability to display numerous aspects of the data more efficiently by using interactive pictures and charts, instead of rows and columns. Over time, advanced visualisation will go beyond just slicing and dicing data to include more process-driven BI projects, allowing all stakeholders to better understand the workflow through a visual representation (Gartner, 2012);

Predictive modelling and data mining: This capability enables organisations to classify categorical variables and to estimate continuous variables using advanced mathematical techniques. BI developers are able to integrate models easily into BI reports, dashboards and analysis, and business processes (Gartner, 2012).

Scorecards: These take the metrics displayed in a dashboard a step further by applying them to a strategy map that aligns key performance indicators (KPIs) with a strategic objective. Scorecard metrics should be linked to related reports and information in order to do further analysis. A scorecard implies the use of a performance management methodology such as Six Sigma or a balanced scorecard framework (Gartner, 2012).

On the other hand, SAS (2010) identify a BI platform by identifying what it must offer. According to SAS (2010), a system cannot be regarded as true BI unless it satisfies four criteria. These criteria are analysed below.

Firstly, the criteria of Breadth is said to integrate functions and technologies from across the organisation. BI integrates data from different aspects of the organisation including operational and transactional systems, multiple databases in diverse formats, and from all contact channels. Consequently, the information flow will go beyond functional silos, organisational boundaries, computing platforms and specialised tools (SAS, 2010).

Depth is the second criteria identified by SAS (2010). According to SAS (2010) BI needs to reach all users who need to use it in a way that is relevant to them. SAS (2010) further explains that: A true BI solution provides appropriate interfaces and tools for users at different levels of the organisation, who have profoundly different needs. The results of analysis should be easily disseminated across all functional areas and organisational levels, so everyone can contribute to the organisation’s success.

Thirdly, the criteria of completeness is said to be an end-to-end BI platform. BI success does not just happen at the application layer. In addition, BI is not just query and reporting. BI depends on a chain of applications and technologies working together from a common data foundation to create a single, verifiable version of the truth (SAS, 2010).

The fourth criteria is advanced analytics. According to SAS (2010), advanced analytics provides predictive insights, not just hindsight. OLAP is a important component of advanced analytics. SAS (2010) further points out that BI requires predictive analytics, such as forecasting, scenario planning, optimisation, and risk analysis.

Data is important in the decision-making process, and businesses need to ensure that they have the right data. The fifth criteria is Data Quality. All major researchers identify data quality as an important factor to improve the return on BI investment (SAS, 2010).

Lastly, the Intelligence storage criteria meets the information needs of intelligence applications. The BI platform must be able to extract data from many sources, prepare it for analysis, and deliver it swiftly to the applications and platforms that need (SAS, 2010).

A weakness with this set of criteria, however, is that a solution must satisfy all the set criteria to be considered a true BI platform. The key problem with this is that it can be almost impossible for a solution to meet the above criteria

Kimball and Ross (2002) divided the BI architecture into the following four components (see Figure 2.2 below): (1) Operational Source Systems; (2) Data Staging; (3) Data Presentation Area; and (4) Data Access Tools.

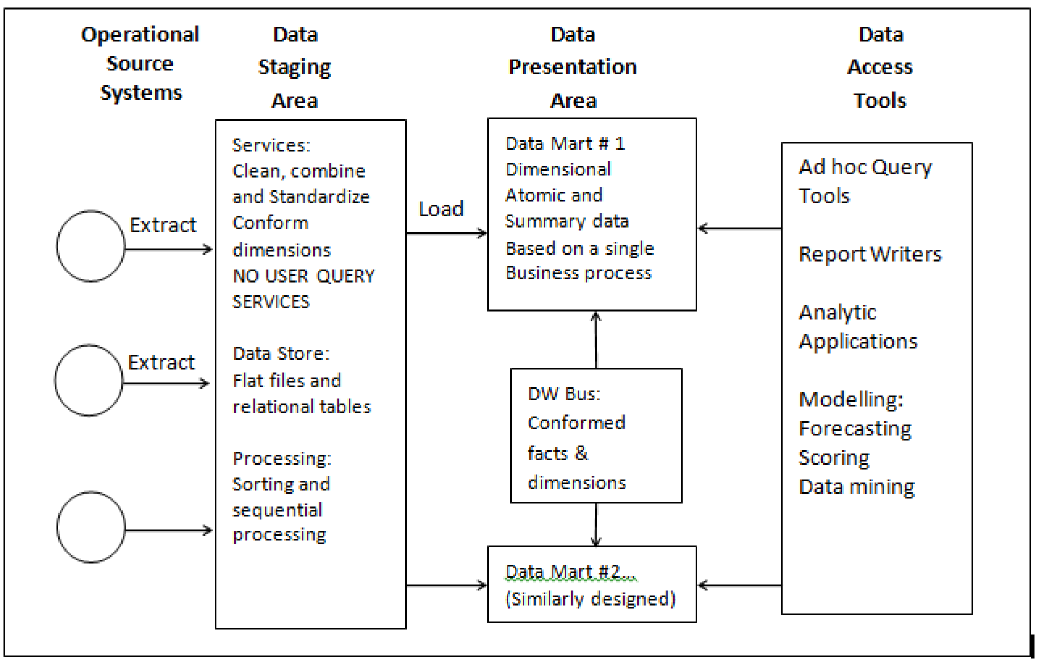


Figure 2.2: A Typical BI Architecture (Kimball & Ross, 2002)

These four components are discussed below:

The Operational Source Systems contain all the data that an organisation might require for analysis. This represents the different data sources that feed data into the DWH. Source systems are not part of the BI environment. Operational Source Systems feed the BI solution and so they are at the basis of your whole architecture (Balaceanu, 2007).

The second component identified is the Data Staging Area. Chi (2012) defines a data staging area as a buffer zone between the Operational Data Store (ODS) and the DW. He (Chi, 2012) further explains that data from the source system needs intermediate processing before reaching the DWH. The staging area stores data on its way to the final presentation to the DWH (Kimball & Carseta, 2011).

The third component is the data presentation area. The data presentation area is where data is organised, stored, and made available for direct querying by users, report writers, and for other analytical applications (Kimball & Ross, 2002)

The fourth component is the Data Access Tools. Data Access Tools leverage on the presentation area for analytic decision-making (Kimball & Ross, 2002). The business analytics environment is the second core component in BI where OLAP tools are located to enable users to generate on-demand reports and queries in addition to conducting analysis of data (Turban *et al*., 2011).

Turban *et al*. (2011) further stated there are five basic OLAP operations that can be used to analyse multidimensional data, namely: (1) Roll-up or drill-up (2) Drill-down (3) Slice (4) Dice (5) Pivot. The term BI is closely associated with the term DW (Olszak & Batko, 2012). A DW may or may not be a component of the BI architecture (Howson, 2008).

Kimball, Ross, Thornthwaite, Mundy and Becker (2009) pointed out that because the industry has not reached a consensus regarding the term BI they use the term DW/BI to mean a broad end-to-end system. Furthermore, they point out that some researchers contend that you can theoretically implement a BI system without a DWH. They further point out that the query-able data in the DW/BI system is referred to as the DWH and the value adds analytics as BI applications and that, the DWH is the foundation of BI system.

A DWH is a subject-oriented, non-volatile, and integrated, time variant collection of data that is used for decision making (Chi, 2012:55). Kumar (2012:358) explains each component in detail as follows:

- Subject-oriented means the data is arranged and optimised to provide variety of analysis requirements from diverse functional departments within an organisation;

- Integrated means the data warehouse combines operational data derived from different departments and strategic business units of the organisation. The DW is allowed to use consistent naming conventions, measurement standards, encoding structures and data attribution characteristics;
- Time-variant means the data are periodically loaded into the DW, all time-dependent aggregations need to be recomputed; and
- Non-volatile means the DW data is static. Data in the warehouse system is read-only generally; data in the database is rarely changed. Data in the warehouse database are updated or refreshed on a periodic, incremental or on a full refresh basis.

Kimball, Reeves and Ross (1998) define a DWH as the query able source of data in the organisation. To further provide better understanding of BI systems a table summarising the difference between OLTP and OLAP systems is shown in Table 2.4.

Table 2.4: Difference between OLTP and OLAP Systems (Corr & Stagnitto, 2011)

Criteria	OLTP	OLAP
Purpose	Execute individual business processes ('turning the handles').	Evaluate multiple business process ('watching the wheels turn')
Transaction Type	Insert, select, update, delete	Select
Transaction Style	Predefined: predictable, stable	Ad-hoc: unpredictable ,volatile
Optimised for	Update efficiency and write consistency	Query performance and usability
Update frequency	Real time when business events occur	Periodic (daily) via scheduled ETL (extract, transform, and load) moving to near real time.
Query Complexity	Low	High
Row per transaction	Tens	Millions
Data model diagram	Entity Relationship Diagram	Star Schema
Design technique	Entity Relationship Modelling	Dimensional Modelling

Operational systems support the execution of business processes, while data warehouses support the evaluation of business processes (Corr & Stagnitto, 2011). Oppel (2009) claims that the data in a DWH is stored as star schemas consisting of a fact table in the middle, surrounded by dimension tables (Oppel, 2009). Kimball (2006) divided the tables of a DWH into two families: fact tables and dimension tables. Fact tables contain all numeric values that can be aggregated, for example units sold.

Data in the dimension table describe the facts in the fact table. For example, the product name and product category are stored in the product dimension table. Similarly, Adamson (2010) argued that in a dimensional design, measurements are referred to as facts and context descriptors are called dimensions. In a star schema, each dimension table is allocated a surrogate key. The column is a unique identifier created exclusively for the data-warehouse. The surrogate key is the primary key of the dimension table. The fact table comprises all the surrogate keys that link to each of the associated dimension tables (Adamson, 2010).

BI systems are different from ERP systems as highlighted in this section. The purpose of this section was to highlight the key difference between OLAP systems and OLTP systems further justifying the importance of the study, as prior studies conducted in the ERP area cannot easily be adapted to the BI context.

2.4 The Importance of Business Intelligence

This section gives an overall view of the importance of BI in business, which helps define the significance of the research. BI systems are regarded highly in terms of the benefits that the organisation is supposed to gain after implementing a BI solution (Clavier, Lotriet & van Loggerenberg, 2012). These perceived benefits show why there is a rush for companies to adopt BI. However, most BI and DW projects fail and the failure rate is estimated to be between 50% and 80% worldwide (Beal, 2005; Laskowski, 2001; Legodi & Barry, 2010).

With the evidence of BI failures, there is a critical need for organisations to develop a coherent BI strategy to ensure that the benefits of such initiatives can be realised, and the pitfalls avoided. Financial engineering, banking, consulting companies, insurance industry, IT companies, manufacturing concerns, health service, telecommunication and business companies are ranked among the business branches that most often use and derive benefits from BI (Horokova & Skalska, 2013).

Table 2.5 shows the contemporary application of BI systems in various areas.

Table 2.5 : BI Application (Olszak & Ziemba, 2007)

BI Application	**Benefits**
Retail Industry	• Forecasting. Using scanning data to forecast demand and based on the forecast, to define inventory requirements more accurately. • Ordering and replenishment. Using information to make faster decisions about items to order and to determine optimum quantities. • Marketing. Providing analyses of customer transactions (what is selling, who is buying). • Merchandising. Defining the right merchandise for the market at any point in time, planning store level, refine inventory. • Distribution and logistics. Helping distribution centres manage increased volumes. Can use advance shipment information to schedule and consolidate in-bound and outbound freight. • Transportation management. Developing optimal load consolidation plans and routing schedules • Inventory planning. Helping identify the inventory needed level; ensure a given grade of service.
Insurance	• Claims and premium analysis. The ability to analyse detailed claims and premium history by product, policy, claim type and other specifics. • Customer analysis. Analyse client needs and product usage patterns, develop marketing programs on client characteristics, and conduct risk analysis, improving client service. • Risk analysis. Identify high-risk market segments and opportunities in specific segments, relate market segments, and reduce frequency of claims.
Banking, finance and securities	• Customer profitability analysis. Determine the overall profitability of individual customer, current and long term, provide the basis for high-profit sales and relationship banking, maximise sales to high-value customers, and provide the means to maximise profitability of new products and services. • Credit management. Establish patterns of credit problem progression by customers class and type, warn customers to avoid credit problems, to manage credit limits, evaluate the bank's credit portfolio, reduce credit losses. • Branch sales. Improve customer services and account selling, facilitate cross selling, improve customer support, strengthen customer loyalty.
Telecommunications	• Customer profiling and segmentation. Determine high-profit product profiles and customer segments. Provide detailed, integrated customer profiles, development of individualised frequent-caller programs, and determination of future customer needs.

BI Application	Benefits
	• Customer demand forecasting. Forecast future product needs or service activity, provide a basis for churn analysis and control for improving customer retention.
Manufacturing Industry	• Sales. Provide analyses of customer-specific transaction data • Forecasting. Forecast demand, define inventory requirements. • Ordering and replenishment. Order optimum quantities of items. • Purchasing. Helping distribution centres manage increased volumes. • Distribution and logistics. Can use advance shipment information to schedule and consolidate inbound and outbound freight. • Transportation management. Developing optimal load consolidation plans and routing schedules. • Inventory planning. Identify the inventory level needed, ensure a given grade of service.

Olszak and Ziemba (2007:138) argued that BI Systems support decision making in different areas of the organisation, including the following:

- financial analyses that involve reviewing of costs and revenues, calculation and comparative analyses of corporate income statements, analyses of corporate balance sheet and profitability, analyses of financial markets and sophisticated controlling;
- marketing analyses that involve analyses of sales receipts, sales profitability, profit margins, meeting sales targets, time of orders, actions undertaken by competitors, stock exchange quotations;
- customer analyses that concern time of maintaining contacts with customers, customer profitability, modelling customers' behaviour and reactions, customer satisfaction;
- production management analyses that make it possible to identify production bottlenecks and delayed orders, thus enabling organisations to examine production dynamics and to compare production results obtained by departments or plants;
- logistic analyses that enable management to identify partners in the supply chain;
- analyses of wage related data including wage component reports made with reference to the type required, reports made from the perspective of a given enterprise, wage reports distinguishing employment types, payroll surcharges, personal contribution reports and analyses of average wages; and

- personal data analyses that involve examination of employment turnover, employment types, presentation of information on individual employee's personal data (Olszak & Ziemba, 2007).

Comparatively, Howson (2008) claimed that BI gives an insight into the dynamics of business. Furthermore, BI can only provide business value when it is used effectively (Howson, 2008). Green (2007) argued that the key to providing the right information is to ask the right questions based on the eight value drivers.

Cross-pollination of the value drivers identifies three major components to BI within a business enterprise (Green, 2007): (1) Relationship intelligence: An understanding of how the interactions between knowledge workers influence the organisational performance; (2) Competence intelligence: An understanding of how the proficiency of knowledge workers influences organisational performance; and (3) Structure intelligence: An understanding of how the organisation's infrastructure environment influences organisational performance.

Table 2.6 illustrates the questions that can be a product from the combination of customer and competitor information. The BI that results from the cross-pollination establishes reason, basis and knowledge, for actions (Green, 2007:18).

Table 2.6 : Hybrid mix of customer and competitor information (Green, 2007)

Value driver	Information	Potential questions
Customer	Acquisition	What is the ratio of new to old customers?
	Satisfaction	Who are the satisfied customers?
	Longevity	Who are the loyal customers?
	Profitability	Who are the profitable customers?
Competitor	New markets	Who are the competitors?
	Market share	What are new potential markets?
	Image	What is the company image?
	Reputation	What is the company's reputation?
	Branding	What is the company's branding?
Employee	Hiring	What is the ratio of new to old employees?
	Satisfaction	Who are the satisfied employees?

Value driver	Information	Potential questions
	Productivity	Who are the productive employees?
	Competencies	Who are the competent employees?
	Experience	Who are the experienced employees?
	Education	Who are the educated employees?
	Position	What positions do employees occupy?
Information	Internal availability	What is the availability of internal information?
	External availability	What is the availability of external information?
	Market studies	What is the availability of market studies?
	Benchmarks	What is the availability of benchmarks?
	Benchmarks	What is the availability of trend studies?
Partner	Satisfaction	Who are the satisfied partners?
	Productivity	Who are the productive partners?
	Competencies	Who are the competent partners?
Process	Business activities	What are the effective and efficient business activities?
	Work methods	What are the effective and efficient work methods?
Product/Service	Products	What are the profitable products?
	Sales	How many sales?
Technology	Software	What is the software?
	Hardware	What is the hardware?
	Databases	What is the database?

BI allows organisations to make knowledgeable business decisions and therefore it can be a source of competitive advantage (Ranjan, 2009). Similarly, Vitt, Luckevich and Misner (2010), argue that the primary goal of BI is to help people make more informed decisions that improve an organisation's performance and enhance its competitiveness in the market place. They further claim that BI aids better decision making by analysing whether or not actions are resulting in progress toward company objectives. In addition, they assert that making better decisions for an organisation is best accomplished with clearly stated sets of objectives and a plan for achieving them.

BI supports management in making more informed decisions at both strategic and operational levels. Data from various sources are analysed. In addition, Vitt *et al*. (2010), claim that analysis leads to insights and insights further improve the business when acted upon. Ranjan (2009:63) asserts that BI reveals: (1) the position of the firm in comparison to its competitors; (2) changes in customer behaviour and spending patterns; (3) the capabilities of the firm; (4) market conditions, future trends, demographic and economic information; (5) the social, regulatory, and political environment; and (6) what the other firms in the market are doing.

This is in agreement with Howson (2008:3) who stated that BI provides managers with information to know what is going on in the business. Information is accessible on a timely and flexible basis to provide a view of: (1) how sales are tracking in various regions and by various product lines, (2) if expenses are on plan or running over budget, (3) if warehouse capacities are at optimal levels and (4) if sales pipelines are where they should be. Equally Rouhani *et al*. (2012), argue that the aim of BI is to assist in the processing of information into managerial knowledge and intelligence.

Hočevar and Jaklič (2010:100) divided the benefits of BI into four main categories. The benefits are discussed next. Firstly, Measurable (quantifiable) benefits are those that can clearly be measured, for example, reducing the time needed to carry out certain tasks, savings achieved by purchasing one software solution instead of another, an increase in revenue and profit (Hočevar & Jaklič, 2010:100).

Secondly, indirectly quantifiable benefits are mostly linked to customer satisfaction. Introducing new technology can improve customer service, which has a positive impact on user satisfaction, resulting in, for example, larger sales volumes, and the increased loyalty of customers returning to purchase again, the winning of new customers. Customer satisfaction is typically assessed by surveys, by monitoring the volume of business, the re-order ratio as well as other, less formal ways (Hočevar & Jaklič, 2010:100).

The third benefit is non-measurable benefits that include a higher quality of work, the better motivation of employees, the effects of IT on an improvement of communication in the organisation, higher quality knowledge sharing between employees. The main problem in assessing these benefits is that they may only be assessed in a subjective way, which does not provide reliable information about their real value (Hočevar & Jaklič, 2010:100). The last benefits identified are unpredictable benefits. Unpredictable benefits are, for example, be new solutions and the ideas of creative individuals (Hočevar & Jaklič, 2010:100).

According to Elena (2011), BI can be utilised for five business purposes in order to drive business value. The first business purpose is measurement. Measurement is about providing performance metrics and benchmarking which allows business leaders about progress towards business goals (Elena, 2011).

The second business purpose identified by Elena (2011) is analytics. Elena (2011) defines analytics as a program that provides business with quantitative data to make informed decisions. Analytics includes data mining, statistical analysis, Predictive analytics, Predictive modelling, and business process modelling,

The other importance of BI is providing Reporting and Enterprise Reporting. Reporting frequently involves data visualisation. Elena (2011) points out that business purpose includes a program that builds infrastructure for strategic reporting to serve the strategic management of a business, and not operational reporting.

The fourth business purpose identified by Elena (2011) is collaboration. Elena (2011) points out that this business purpose includes a program that gets different areas to work together through data sharing and electronic data interchange. The last business purpose is Knowledge Management. This includes a program to make the company data driven through strategies and practices to identify, create, represent, distribute, and enable adoption of insights and experiences that are true business knowledge (Elena, 2011).

Bhansali (2007:15) identified five main benefits of the BI for an organisation:

- Decision Support: this refers to the ability of the DWH to provide business decision support data by integrating information from multiple sources and making it available for querying and analysis;
- Data Analysis: this refers to the ability of the DWH to allow decision makers to analyse data without interfering with the transaction processing system. It also helps in accessing, aggregating, and analysing large amounts of data from diverse sources to understand historical performance or behaviour and to predict and manage outcomes.

- Improves Efficiency: this refers to the ability of the DWH to provide a single version of the truth and better data analysis, shrinking the information delivery time between an event‘s occurrence and business decision making, saving time for its users, and providing support for customer focused business strategies.
- Enhanced Integrated Data: this refers to the ability of the DWH to include data from multiple sources, to integrate data across time and to provide views obtained from trend analysis of the data. It eliminates inconsistencies in data, and minimise data redundancies.
- Customer Management: this refers to the ability of the data warehouse to provide the foundation upon which to build a customer relationship management (CRM) strategy. It assists management to respond to the current and potential needs of the customers, and it increases customer retention and revenue from existing customers (Bhansali, 2007:15).

The above section highlights some of the benefits of a BI system to an organisation. Even though there can be many uses and advantages of BI systems, as identified above, there are several shortcomings. Some of the criticisms of BI systems are summarised as follows (Ramanigopal , Palaniappan & Mani, 2012:36):

- Piling of Historical Data**:** the major objective of a BI system is to stockpile past data about a firm's deals and to reveal it in such a way that it assists professionals to make decisions. On the other hand, this information generally amounts to a small portion of what the firms actually require to function, besides its restrained worth. While in other situations, the user may not have interest in historical data as many markets that the company regulates are in frequent alteration;
- Cost*:* BI at times can be a little too much for small as well as for medium sized enterprises. The use of such system can be expensive for basic business transactions;
- Complexity*:* another disadvantage of BI could be its complexity in implementation of data. It can be so intricate that it can make business techniques rigid to deal with. In the view of such premise, many business experts have predicted that these intricacies can ultimately throttle any business;
- Limited use*:* like all improved technologies, BI was first established keeping in consideration the buying competence of affluent firms. Even today, BI system cannot be afforded by most of the companies. Although, traders in the past few years have started modifying their services towards medium and small sized industries, but the fact is that many of such firms does not consider them to be highly essential, for its complexity;

- The selected BI tool doesn’t live up to the hype: many project managers have been duped by the silky smooth promises of a BI sales team;
- Resistance to change: most BI implementations will encounter some form of resistance from people within designated user groups. This often occurs when the value and usefulness of the project has not be clearly communicated;
- Failing to account for change: the culture, environment and focus of any business is subject to change. Therefore, BI requirements, project scope/parameters, reporting needs, data models and data sources will always be in a state of relative flux. Failing to account for these likely (or practically inevitable) changes between the requirements gathering and implementation phase of a BI project can lead to the introduction of a BI solution that fails to reflect true business needs and is poorly aligned with organisational goals;
- Poor data quality: Neglecting adequately to clean data and to implement stringent data change management policies, before going live, will culminate in disaster. Delivering meaningless and inaccurate reports will damage the perception of the BI project ;
- User adoption is poor: A project manager‘s and BI team‘s worst nightmare: The go button is firmly pressed, but the only activity on the BI platform is the slow, depressing roll of cyber tumbleweed;
- Over promising and under-delivering: Promising to provide reporting and analytics for all and then delivering a handful of in actionable reports for a few will reduce user confidence in the usefulness of the BI project and the likelihood of on-going executive sponsorship;
- Scope Creep: Even if developers follow the above advice, and develop a realistic delivery schedule, things can still very easily and very quickly get out-of-hand;
- Locking everything down from the beginning: this can mean that when business priorities have changed, the data collecting and the report types do not change;
- Losing financial backing: For a multitude of reasons – some legitimate, some political – project funding can cut (Ramanigopal *et al*., 2012) ; and
- Too many moving parts make it hard to access information and to attain insight: Many BI tools are made up of different applications and components to satisfy both reporting and analysis necessities. Navigating between these modules can be cumbersome and restrictive, particularly for nontechnical business users (Ramanigopal *et al*., 2012).

This section identifies advantages of BI and its application. However, the newness of BI and the fact that it is fundamentally different from traditional IS has led to many failures. This underlines the importance of this research to produce guidelines to help companies identify elements that might guide successful BI implementation.

2.5 The Business Intelligence Market

The BI software industry hardly existed 15 years ago, now a number of big BI companies provide extensive BI solutions at competitive rates in comparison to the cost of the legacy systems (Vitt *et al*., 2010). As an illustration, the global BI income reached $12.2 billion in 2011, which is a 16.4 per cent growth from 2010 income (Gartner, 2012). Furthermore, according to Gartner (2012) in 2011 the BI analytics and PM software market was the second-fastest growing segment in the overall global software market.

Gartner (2012) further reported that the top five vendors constitute three quarters of the market through a combination of acquisition, integration and up sell/cross-selling activities. SAP is the dominant vendor in the joint worldwide BI, analytics and PM software, accounting for 24 per cent of the market (see Table 2.7). SAP is followed by Oracle, SAS Institute, IBM and Microsoft (Gartner, 2012).

Table 2.7: Worldwide BI, Analytics and Performance Management Revenue (Gartner, 2012)

Company	2011 Revenue	2011 Market Share (%)	2010 Revenue	2010 Market Share (%)	2010-2011 Growth (%)
SAP	2,883.5	23.6	2,413.1	23.0	19.5
Oracle	1,913.5	15.6	1,645.8	15.7	16.3
SAS Institute	1,542.8	12.6	1,386.5	13.2	11.3
IBM	1,477.6	12.1	1,222.0	11.6	20.9
Microsoft	1,059.9	8.7	913.7	8.7	16.0
Other Vendors	3,363.8	27.5	2,931.1	27.9	14.8
Total	12,241.0	100.0	10,512.2	100.0	16.4

The Gartner 2012 magic quadrant for BI platforms report presents main software vendors that can be considered by organisations seeking to use BI platforms (see Figure 2.3).The Magic Quadrant is a graphical representation of a marketplace for a specific period. It depicts Gartner's analysis of how certain vendors measure up against criteria for that marketplace.

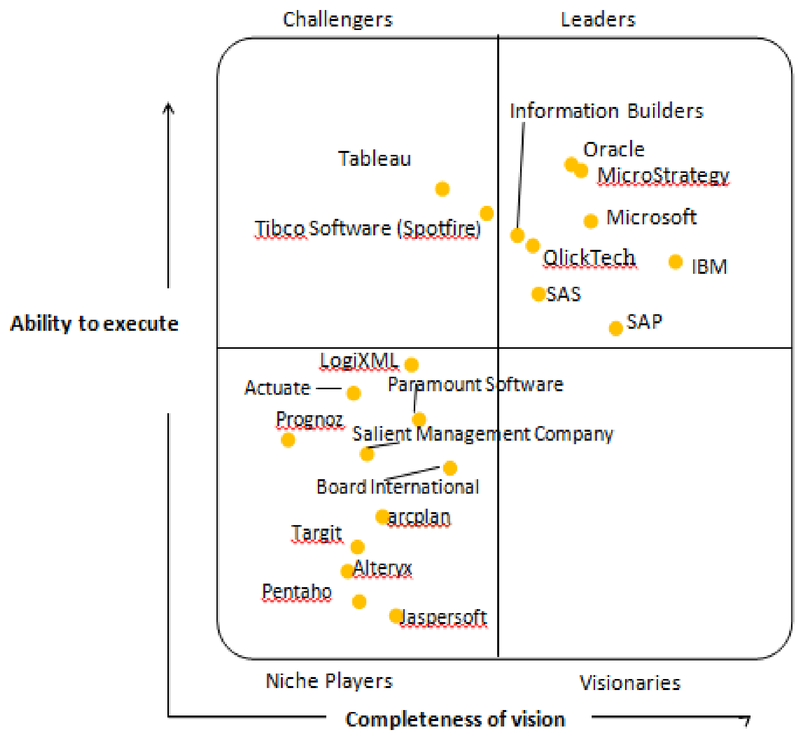


Figure 2.3: Magic Quadrant for BI Platforms (Gartner, 2012)

According to the magic quadrant for BI above the BI market leaders are: Microsoft, SAP, Oracle, Micro-strategy, IBM, SAS, Information Builders and QlickTeck. Similarly, Forrester (2012) identifies IBM, Microsoft, SAP, SAS and Micro-Strategy as leaders in their study. Gartner (2012) defines each of the quadrant descriptors in the Magic Quadrant for BI Platforms:

Leaders**:** Leaders are vendors that are reasonably strong in the breadth and depth of their BI platform capabilities and can deliver on enterprise wide implementations that support a broad BI strategy. Leaders articulate a business proposition that resonates with buyers, supported by the viability and operational capability to deliver on a global basis (Gartner, 2012).

Challengers: Challengers offer a good breadth of BI platform functionality and are well positioned to succeed in the market. However, they may be limited to specific use cases, technical environments or application domains. Their vision may be hampered by a lack of coordinated strategy across the various products in their BI platform portfolio, or they may lack the marketing effort, sales channel, geographic presence, industry-specific content, and awareness offered by the vendors in the Leaders quadrant (Gartner, 2012).

Visionaries: Visionaries are vendors that have a strong vision for delivering a BI platform. They are distinguished by the openness and flexibility of their application architectures, and they offer depth of functionality in the areas they address, but they may have gaps relating to broader functionality requirements. A Visionary is a market thought-leader and innovator. However, it may have yet to achieve sufficient scale or there may be concerns about its ability to grow and provide consistent execution (Gartner, 2012).

Niche Players: Niche Players are those that do well in a specific segment of the BI platform market such as reporting or dash-boarding or that have limited capability to innovate or outperform other vendors in the market. They may focus on a specific domain or aspect of BI, but are likely to lack depth of functionality elsewhere. Niche players may have gaps relating to broader BI platform functionality. Alternatively, Niche Players may have a reasonably broad BI platform, but have limited implementation and support capabilities or relatively limited customer bases, such as in a specific geography or industry. Niche players may not yet have achieved the necessary scale to solidify their market positions (Gartner, 2012).

There is not much information about BI relating to Africa. The available literature does not differentiate between the African and international BI markets (Clavier, 2013). The big companies identified in this section such as SAP, IBM, Oracle, Microsoft and SAS also dominate the South African BI market (Clavier, 2013).

Clavier (2013) agrees by pointing out that many of the BI giants operate in South Africa and internationally. This is probably the reason why many of the same trends on BI vendors are observed in South African and international BI literature (Clavier, 2013). This is not to imply that the same success factors will exist in South Africa as in other countries. This is only to illustrate that the advanced economies of the world, mainly in North America and Europe set the pace and direction of ICT innovation (Avgerou, 2008).

To further illustrate her point on the congruence between the South African and international BI markets, she (Clavier, 2013) points out how, in a case study, senior managers from a South African bank, utilised international and not local vendor guides when selecting vendors to implement their BI solutions (Clavier, 2013). The South African BI landscape might be similar to most advanced economies of the world such as USA and Canada but the factors that affect BI success which are the focus of this study in a South African context are expected to be different.

2.6 Previous Studies

This section reports on prior research related to success factors in BI and DWH. The research on BI systems success is very limited (Yeoh & Koronios, 2010). The purpose of this section is to discuss some of the reported BI and DWH success studies found in the literature. The reason why DWH is included in this study is that DWH is a component of BI and most prior studies focused on this component of BI.IS success in general is discussed in the next section.

Whereas most researchers who examine BI success take a DWH approach to study the success factors (Wixom & Watson, 2001; Thomann & Wells, 1999; AbuAli & AbuAddose, 2010; Little & Gibson, 2003; Shin, 2003; Hayen, Rutashobya & Vetter, 2007), few researchers take an entire BI system approach (Yeoh & Koronios, 2010).

The study by Wixom and Watson (2001) proposed a model for analysing the success of DWH projects. The Wixom and Watson (2001) model is depicted in Figure 2.4.

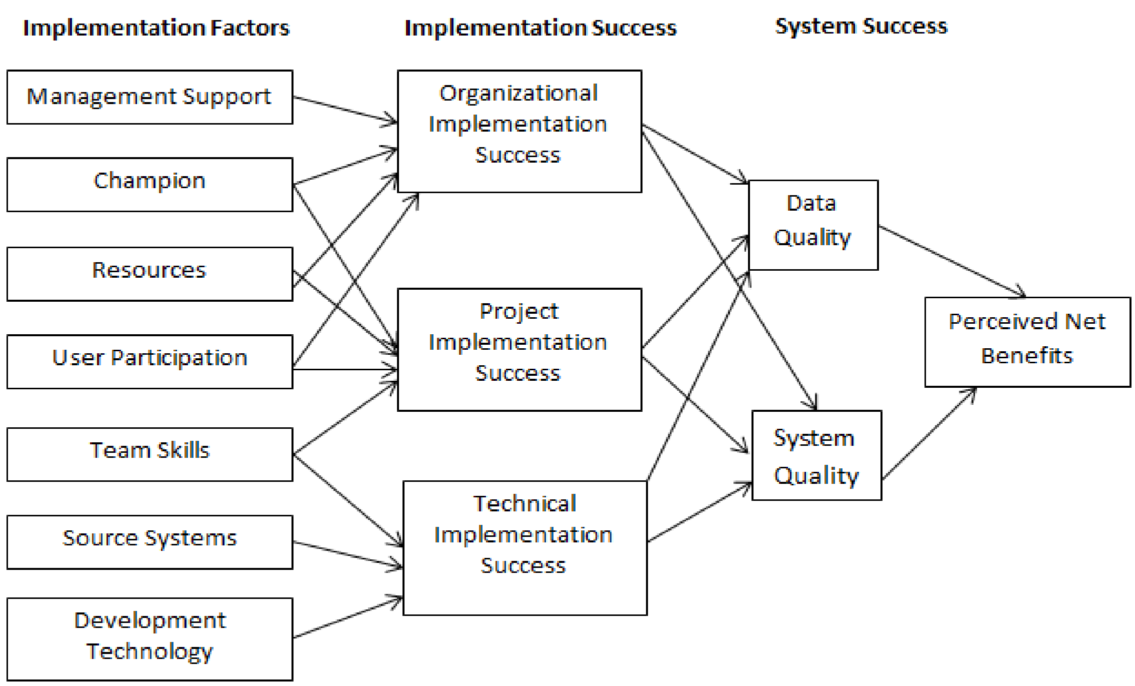


Figure 2.4: Data-warehouse Success Model (Wixom & Watson, 2001)

Wixom and Watson (2001) conducted a quantitative experimental study into the implementation factors that influence the success of DWH systems amongst American businesses. A champion, resources, user participation, and team skills were identified as the four factors that accounted for 44% of the variation in success rates of DWH systems (Wixom & Watson, 2001).

Schieder and Gluchowski (2011) pointed out that the following factors could cause the low explanatory power of the model: Wixom and Watson (2001) omitted “use” and “user satisfaction” constructs established in previous research on success factors. They justified their decision by stating that in infrastructure systems such as the DWH, it is difficult to identify users (Wixom & Watson, 2001).

Furthermore, they point out that data suppliers can best evaluate the success of a DW initiative, since end-users might have a distorted view of DWH because they only have indirect access by using front-end application systems (Wixom & Watson 2001). Another point of criticism concerning the Wixom and Watson (2001) model is that it uses the original DeLone and MacLean (1992) model, which has been considered obsolete since 2003 (DeLone & McLean, 2003). Schieder and Gluchowski (2011) further pointed out that a modification of the Wixom and Watson (2001) model is required to explain DWH success in particular and BI success in general.

The Wixom and Watson (2001) model explored both pre-implementation and post-implementation factors in the developed world whereas this study seeks to identify post implementation success factors of BI systems in a developing country context. Furthermore, this study utilises the Updated DeLone and McLean (2003) model. In contrast to the Wixom and Watson (2001) study, this study seeks to identify key factors of the entire BI system and not only a portion of the system.

Yeoh and Koronios (2010) proposed a framework for the entire BI system that comprised some of the success factors from DeLone and McLean (1992). Although their study focussed on the entire BI system, it was conducted in a developed economy context.

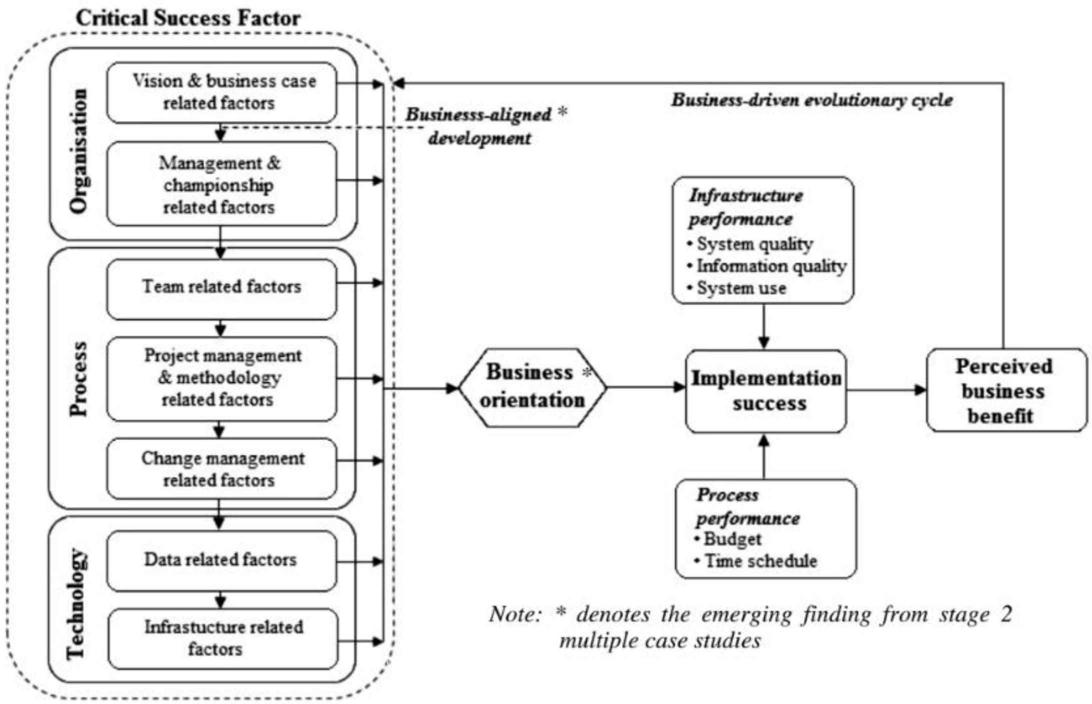


Figure 2.5: Framework for Implementation of BI systems (Yeoh & Koronios, 2010)

Adamala and Cidrin (2011) claimed that in the model, system quality, information quality and system use are grouped together and labelled infrastructure performance. They noted further that an equal factors *g*roup process performance was proposed, encompassing classical project management variables like budgets and time schedules.

The authors (Yeoh & Koronios, 2010) emphasised a different set of factors, divided into three broad categories: organisation (vision and business case related factors, management and championship related factors), process (team related factors, project management and methodology related factors, and change management related factors) and technology (data related factors, infrastructure related factors).

All the above factors contribute to business orientation, which in turn, together with the previously mentioned infrastructure and process performance factors lead to implementation success and, subsequently, to perceived business benefit. Like the Wixom and Watson (2001) model, the study by Yeoh and Koronios (2010) focused on pre-implementation, implementation and post-implementation success factors.

Using a similar approach to the Wixom and Watson (2001) study, a study by Hwang and Xu (2008) proposed a BI success model depicted in Figure 2.6.

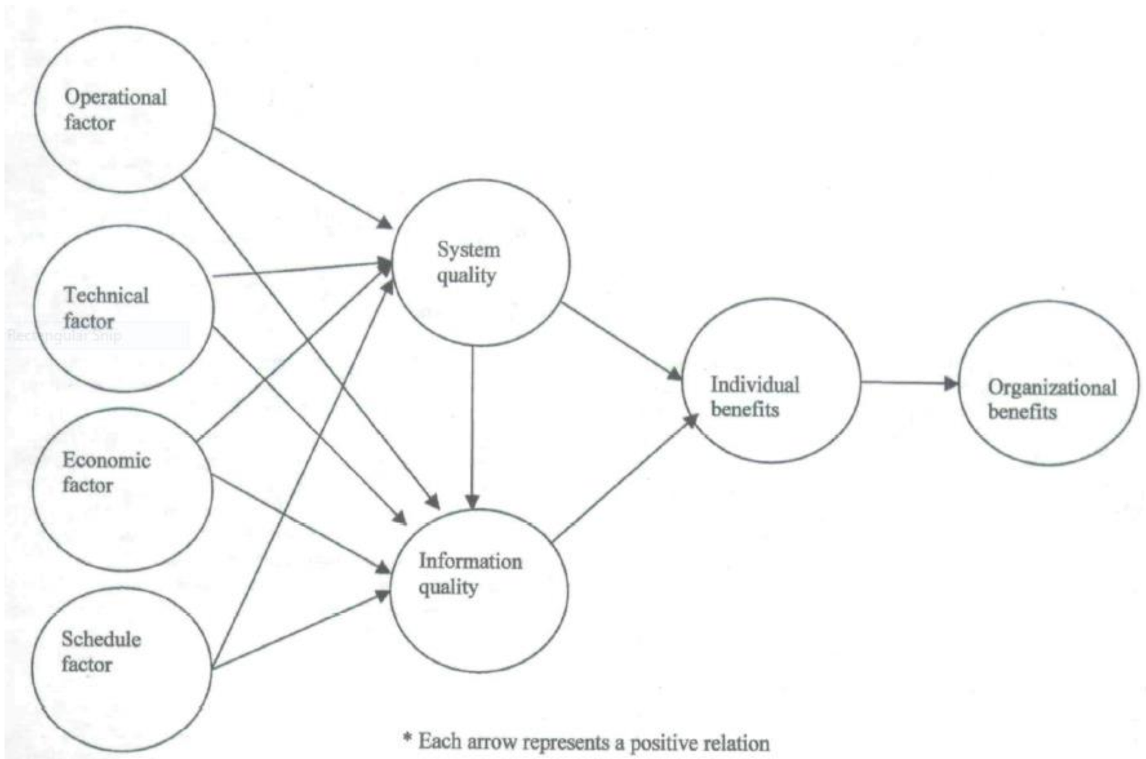


Figure 2.6: Structural model of BI success (Hwang & Xu, 2008)

The model consisted of critical success factors and system success factors (Jamaludin & Manson, 2011). The DWH success model is depicted by four factors: system quality, information quality, individual benefits, and organisational benefits. The critical success factors are represented using four categories: operational, technical, schedule, and economic (Jamaludin & Manson, 2011).

The association between the critical success factors and success factors was tested using data collected from a survey of 100 DW professionals. The study found that technical constructs positively influences information quality, while economic and operational factors have a positive impact on system quality. In addition, it found that system quality is positively related to information quality, which also has a positive relationship with individual benefits.

Using a slightly different approach to their study above, another study by Hwang, Ku, Yen and Cheng (2004) investigated the critical factors affecting the acceptance of BI systems in banks in Taiwan.

The emphasis of the study was on Organisational, Environmental, and Project factors (Hwang *et al*., 2004). Fifty questionnaires were sent to users in Taiwanese banks.

After a study of previous literature, 10 factors affecting the success of BI projects were identified namely: size of bank, champion, top management support, internal needs, degree of business competition, selection of vendors, skills of project team, organisation resources, user participation, and assistance of information consultants Hwang *et al*. (2004:23). The study concluded that top management support, size of the bank, effect of a champion, internal needs, and degree of business competition influences the acceptance of BI systems in the banking industry in Taiwan.

Shin (2003) conducted a different kind of study to understand BI success factors. The study investigated the influence of system quality, information quality, and service quality on user satisfaction. The study found that user satisfaction is strongly influenced by data quality. In general, the study indicates that the IS success model introduced by DeLone and McLean (2003) provides a good framework to understand the success of BI systems.

Almabhou, Saleh and Ahmad (2012) conducted a study to understand quality factors that affect DW success. The study models the relationship between six quality factors and the net benefits of DW systems. The study used a quantitative method to validate the research model using a questionnaire survey. The questionnaire measured 6 independent constructs and 1 dependent construct (Almabhou, *et al*., 2012).

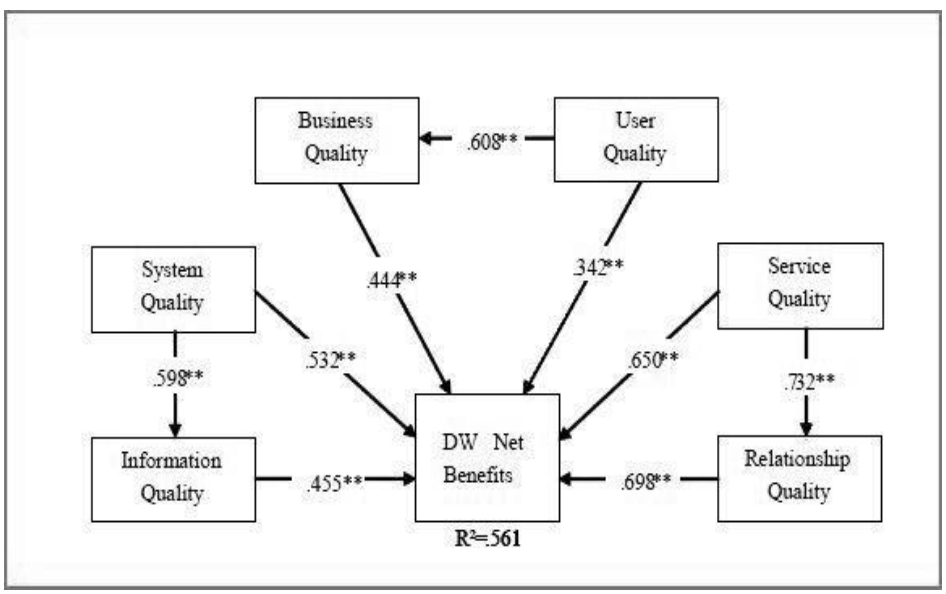


Figure 2.7: DWH Net Benefits (Almabhou *et al.*, 2012).

The study found that information quality, system quality, business quality, user quality, service quality and relationship quality all have a positive relationship with the net benefits of a DWH system (Almabhou, *et al*., 2012).

Similarly, Hayen *et al*. (2007) investigated DWH success using satisfaction of users, system quality, and the perceived usefulness of specific applications as specific factors. The authors suggested a DW success model and a case study of a financial institution in the United States of America to validate the model.

The results from the study identify a strong association between the system quality, data quality and perceived net benefits factors. The study also demonstrated that management support and adequate resources could assist organisational issues that come up during DWH implementations. Furthermore, the results show that resources, user participation, and highly skilled project team members increase the probability that data warehouse systems will be successful. Finally, the results illustrate that the implementation success with organisational and project factors will influences the system quality of the DWH.

While the above studies have contributed to our understanding of IS success, these approaches were not conducted in a South African context and were mainly focused on the DWH. Few studies have studied BI systems success in South Africa (Clavier *et al.*, 2012). A study in South Africa by Nkuna (2011) investigated factors that influence BI system usage in a South African Financial institution (Nkuna, 2011). The investigation employed factors derived from three theoretical models, namely technology acceptance model (TAM), task technology fit (TTF) and social cognitive theory (SCT). A questionnaire was sent to 682 BI system users in a South African financial institution (Nkuna, 2011).

The findings of the study indicated support for the joint use of constructs from the three theoretical frameworks, explaining 65% of BI system usage variance (Nkuna, 2011). Furthermore, the perceived usefulness of a BI system reflected a stronger influence as a factor of BI system usage over the beliefs that the system was easy to use, and the belief that it was aligned to the performance of business tasks.

The present study differs from prior studies in that it investigates use success when an organisation has adopted a BI system. Furthermore, the study uses the DeLone and McLean (2003) success model as the foundational framework to identify success factors whereas the Nkuna (2011) study used the TAM model to identify how users came to accept and use a technology.

Another South African based study by Dawson and Van Belle (2013) investigated the main critical success factors that affected BI success in a South African financial institution. The study by Dawson and Van Belle, (2013) utilised a Delphi-technique method with project participants from various BI systems in diverse business units of a South African financial services company.

Based on their study, four main categories were identified. These categories (Dawson & Van Belle, 2013:1) are: (1) committed management support and a champion; (2) business vision; (3) user involvement; and (4) data quality. The difference between the present study and the Dawson and Van Belle (2013) is that Dawson and Van Belle (2013) measure critical success factors of BI systems.

Critical success factors are those things that must go well for the BI system to warrant success (Rockart, 1979). The present study is looking at post implementation success criteria of BI systems, however the results of this study can be used to inform critical success factors.

The table below is a summary of identified BI and DWH success studies. The BI/DWH success studies represented in the table below are some of the factors identified in the available literature.

Table 2.8: Previous Studies

Author(s)	Objective	Outcome	Future research
AbuAli and AbuAddose (2010)	To discover the main critical success factors affecting DWH implementation.	Five main categories of success factors: organisational, project, technical, environmental, and education.	
Ramamurthy, Sen and Sinha (2008)	To examine the key factors of DWH adoption.	Five factors: organisational commitment, absorptive capacity, organisational size, relative advantage, and complexity.	Three factors (1) Flexibility, (2) Responsiveness, and (3) Absorbed Slack could be included in future research.
Hwang and Xu (2008)	To examine the relationships between CSF's and DW success dimensions.	Structural model.	New variables and measures can be added easily.
Hayen *et al*. (2007)	To identify factors that potentially	Three main categories of	Suggested to apply IS

Author(s)	Objective	Outcome	Future research
	affects DWH success.	success factors: organisational, project, and technical.	implementation knowledge to an infrastructure of DW.
Hwang *et al.* (2004)	To investigate the factors influencing adoption of DW technology in the banking industry in Taiwan.	Five factors identified: top management support, size of the bank, effect of a champion, internal needs, and degree of business competition	Future research can be focused on integration of DW technology with other ITs such as CRM and ERP.
Shin (2003)	To investigate the effect of system quality, information quality, and service quality on user satisfaction for DW.	System quality affects user satisfaction.	IS success model introduced by DeLone and McLean (2002) can become a good framework in understanding the success of DW.
Mukherjee and Dsouza (2003)	To improve the chance of success implementation for DWH.	Three phases for DW implementation: Pre-implementation, Implementation, and Post-Implementation phases).	More longitudinal studies in factors that impact upon DW implementations need to be conducted.
Wixom and Watson (2001)	To identify significant relationships between system quality and data quality factors and perceived net benefits.	Data quality and System quality affects Net benefits.	Future research is needed to understand warehouse data quality and the factors that affect it.
Haley (1997)	To identify the key Success Factors in DW implementation.	Organisational and project factors are positive influences on DW success.	There is a great need for academic research in the area of DW success.

As discussed above, some attempts have been made to explore and examine BI systems in South Africa (Dawson, 2013; Nkuna, 2011). These studies have studied different aspects of BI and do not study the post implementation success factors of BI systems which is the purpose of the present study. Investigators have correspondingly defined and measured diverse success factors and DW success factors.

For instance, user satisfaction was utilised as a degree for success in an investigation conducted by Shin (2003), but not in the others (Wixom & Watson, 2001; Hayen *et al*., 2007; Hwang & Xu, 2008). However, in the examination of the IS success literature, no previous research was found that explicitly aimed at investigating the post implementation success of BI systems in a South African context (see Appendix I).

These success factors may pose a constraint to South African organisations that want to implement BI systems. In order to mitigate these factors one needs to determine the extent to which these factors influence BI success in a developing context. The main aim of this section was to identify prior DWH and BI studies, thus this section was to be the introduction and a stepping-stone to build the rest of the research by identifying what companies should do to avoid failures and risk in the implementation of BI systems. The next section of this chapter discusses generic IS success theories.

2.7 Information Systems Theories

The previous sections defined the various concepts involved in BI whereas this section discusses the notion of what constitutes a good or successful BI system. IS success is multi-faceted phenomenon and lacks a commonly accepted definition (Kaiser & Ahlemann, 2010). To establish the success of IS many prior studies were consulted. According to Wong (2010) many studies have that defined IS success were based on several factors. This section identifies and discusses some existing IS success models.

There are a number of possible indicators of a successful IS that have been suggested by various studies (Lucas, 2000). Some of the proxies used by other researchers are:

(1) Information Quality (Bailey & Pearson, 1983; Doll & Torkzadeh, 1988; DeLone & McLean (1992, 2003) ;
(2) User Satisfaction (Ginzberg, 1981; Bailey & Pearson, 1983; Doll & Torkzadeh, 1988);
(3) Ease of use (Doll & Torkzadeh, 1988; Davis, 1989); and

(4) Use (Davis, 1989).

Additionally, Lucas (2000) pointed out that unless a set of success measures is agreed upon it will be difficult to evaluate the quality of systems. Garrity and Sanders (1998:20) noted that if researchers have robust success metrics, numerous questions may be addressed such as:

(1) what are the best software development practises in a given industry, by particular systems type in a given organisational context?
(2) is there a best or at least a better project management approach? What influence does a project management approach have on the final delivered system?
(3) Do modelling techniques such as data flow diagrams and Entity Diagram diagrams result in better systems?
(4) What role should prototyping and joint application development play in systems development?
(5) What role does technology play in facilitating job enrichment?
(6) What combination of IT planning approaches result in the best portfolio of systems applications?
(7) How are economic performance measures of success related to user satisfaction measures of success?

DeLone and McLean (2003) agreed with this view by stating that the assessment of IS success or effectiveness is essential to aid understanding the value and usefulness of IS management activities and IS investments. Fortune and Peters (2005:18) suggested that there are distinct aspects against which success can be assessed: (1) the implementation process, where they see the key issue as efficiency measure in terms of criteria such as being on schedule, to budget, and meeting technical goals; (2) the value and usefulness of the project as perceived by project teams, in effect this is the projects teams' judgment about how professional a job was completed and finally (3) the client's satisfaction with the project delivered.

The focus of IS success at the individual level is on the user's perception of utility and satisfaction. Since BI systems are a form of innovative IS, prior study on success frameworks for IS can aid in understanding the success of BI systems. According to Smart (2009), research exploring IS success can be grouped into two distinct sets of models. The first set of models is the technology acceptance models (Davis, 1989; Szajna, 1994; Venkatesh & Davis, 2000) and the second set is the user satisfaction models (Baily & Pearson, 1983; Seddon & Kiew, 1994; DeLone & McLean, 1992, 2003).

Smart (2009) further differentiated between the two groups as follows: Technology acceptance literature focuses on attitudes, beliefs and behaviour of individuals, and user satisfaction literature focuses on IS attributes such as: reliability, accuracy, usage and impact. The most obvious first choice when trying to determine BI success factors is to look at IS in general (Adamala & Cidrin, 2011). This section discusses models related to IS success from the user satisfaction models, namely the DeLone and McLean (1992) IS Success Model, Seddon's (1997) Model and the Updated DeLone and McLean (2003) IS Success Model.

2.7.1 The DeLone and McLean's Information Systems Success Model

The DeLone and McLean (1992) model builds on the studies of Shannon and Weaver (1949) and Mason (1978). According to Shannon and Weaver (1949), problems are present in three hierarchical levels namely: (1) a technical level, (2) a semantic level and (3) an effectiveness level. DeLone and McLean (1992) conducted an extensive analysis of IS literature in an effort to build the numerous factors linked with IS, and proposed the concept of the IS success model (Ghandour, Benwell & Deans, 2010).

The DeLone and McLean (1992) model suggested six major factors of IS success, namely:
(1) System quality;
(2) Information quality;
(3) Use;
(4) User satisfaction;
(5) Individual impact; and
(6) Organisational impact.

The DeLone and McLean model of 1992 is shown in Figure 2.8.

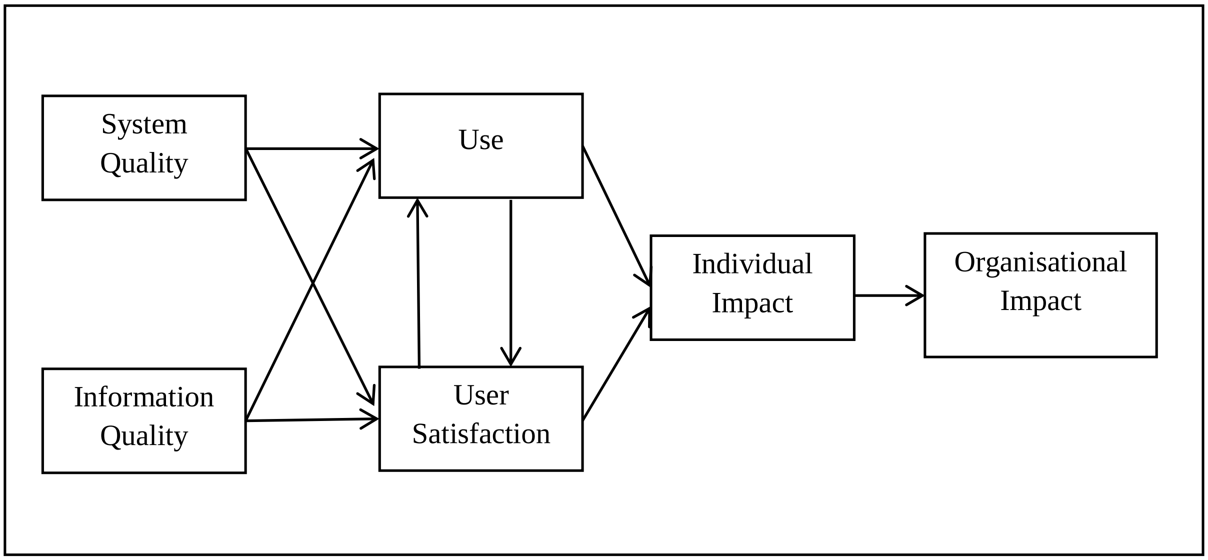


Figure 2.8: DeLone and McLean IS Success Model (DeLone & McLean, 1992)

The DeLone and McLean model of 1992 proposed that: information quality and system quality have an effect on use and user satisfaction and that these factors affect each other. Use and user satisfaction have an influence on individual impact, which in turn affects organisational impact. The table below summarises the dimensions and factors identified by the DeLone and McLean model.

Table 2.9 : The DeLone and McLean dimensions (Reyes, 2000)

Dimension	**Definition**	**Measure or Indicator Used**
System quality	The quality of the information processing system.	Response time, resource utilisation, system reliability, system accessibility, ease of use, perceived usefulness of IS, usefulness of specific functions.
Information quality	The quality of IS output	Accuracy, precision, timeliness, completeness, relevance, format of reports.
Use	The recipient’s consumption of the output of an information system.	Frequency of use, motivation to use, use versus non-use, use in support of cost reduction, management strategy planning, competitive thrust.
User satisfaction	The recipient’s response to the use of the output of an information system.	User information satisfaction, decision-making satisfaction, user satisfaction with interface.
Individual impact	The effect of information on the behaviour of the recipient.	Time taken to complete a task, decision quality, forecast accuracy, change in decision-making behaviour, value in assisting decision-making, productivity improvement, personal effectiveness.

Dimension	Definition	Measure or Indicator Used
Organisational impact	The effect of information on organisational performance.	Profit performance, overall cost-effectiveness, overall manager productivity, return on assets, market share, stock price, inventory ordering costs.

The main conclusions of the DeLone and McLean (1992) paper were as follows (DeLone & McLean, 2002:11):

- The multidimensional and interdependent nature of IS success requires careful attention to the definition and measurement of each aspect of this dependent variable. It is important to measure the possible interactions among the success dimensions in order to isolate the effect of various independent variables with one or more of these dependent success dimensions;
- Selection of success dimensions and measures should be contingent on the objectives and context of the empirical investigation; but where possible, tested and proven measures should be used;
- Despite the multidimensional and contingent nature of IS success, an attempt should be made to significantly reduce the number of different measures used to measure IS success so that research results can be compared and findings validated;
- More field study research should investigate and incorporate organisational impact measures;
- The IS Success Model clearly needs further development and validation before it could serve as a basis for the selection of appropriate IS measures.

DeLone and McLean (1992) did not suggest how to confirm the model but they recommended to IS researchers to refine and test it. According to DeLone and McLean (2003) between 1992 and 2003 approximately 300 articles in refereed journals cited and reviewed the IS success model. Seddon (1997) argued that the DeLone and McLean (1992) model must exclude system usage from the model and rather use net benefits.

Pitt, Watson and Kavan (1995) proposed a modification of the DeLone and McLean (1992) model to include a service quality component. Seddon (1997) challenged the combining of a process and variance model. DeLone and McLean (2003:16) in response to the criticism explained that as a process model there are three parts of the IS model namely: (1) the creation of a system; (2) the use of the system; and (3) the benefits of the system.

According to Kurian, Gallupe and Diaz (2000) during the nine-year period 1988-96, the number of studies into the success of IS increased, with 68 articles that focused on system quality being published. This compares to 12 articles acknowledged by DeLone and McLean for the period 1981-1987. Table 2.10 is a summary of number of studies grouped by year and category.

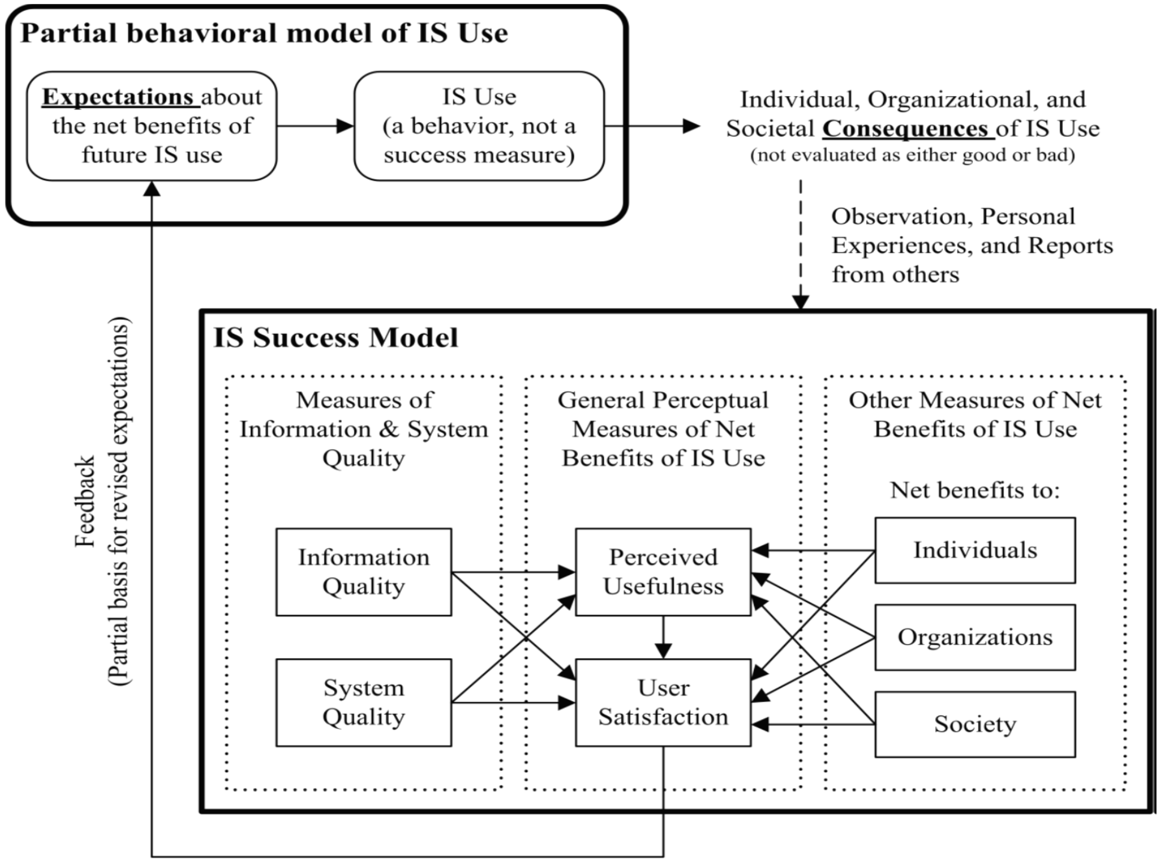
Table 2.10 : Yearly Numbers of Articles by Category (Kurian *et al.*, 2000)

	Studies								
	1988	1989	1990	1991	1992	1993	1994	1995	1996
System Quality	12	14	8	3	4	10	10	3	4
Information Quality	2	7	5	4	5	8	4	5	4
Use	6	6	7	8	11	9	10	10	11
Satisfaction	8	6	7	5	3	5	7	8	7
Individual Impact	17	10	10	6	6	10	10	11	12
Organisation Impact	21	25	28	25	17	39	28	39	35

2.7.2 The Seddon Information Systems Success Model

Seddon (1997) argued that the DeLone and McLean model of 1992 was unclear and mis-specified. Additionally, Seddon (1997:244) stated that the DeLone and McLean (1992) model was a grouping of three distinct models. The first model is a variance model of IS success, in which the independent variables are system quality and information quality, and the dependent variable is IS use as a proxy for benefits from use and user satisfaction. The second is a variance model of IS use as a behaviour. Thirdly it uses a process model of IS success, in which IS use is an event that necessarily precedes outcomes such as user satisfaction, individual impact and organisational impact.

Rai, Lang and Welker (2002) claimed that the combination of the models into one model of IS success creates a misunderstanding regarding the interpretation of boxes and arrows in the DeLone and McLean model. In some cases, boxes and arrows recommend a process interpretation and in other cases they suggest a causal interpretation (Rai, *et al.*, 2002). Figure 2.9 is a depiction of the Seddon (2007) model. The Seddon (1997) Model is divided into two parts.



Key:

Rectangular boxes:	IS Success model
Rounded boxes:	Partial behavioral model of IS Use
Solid-line arrows:	Independent (necessary and sufficient) causality
Dotted-line arrow:	Influence (not causal, since observer's goals are unknown)

Figure 2.9: The Seddon's IS Success Model (Seddon, 1997)

The first part is a partial behavioural model of IS use, this part acknowledges that expectations for IS use are critical in IS success. The second part is the IS Success Model (Kurian *et al*., 2000:45). Seddon (1997) suggested four new use variables: (1) Expectations; (2) Consequences; (3) Perceived Usefulness; and (4) Net Benefits to Society. Seddon (1997) further stated that the model might not be valid in all conditions and that it required empirical validation.

2.7.3 The Updated DeLone and McLean's Information Systems Success Model

The DeLone and McLean (2003) model addressed the pros and cons of the original model by adding two new success dimensions. The Updated DeLone and McLean IS Success (2003) model is shown in Figure 2.10.

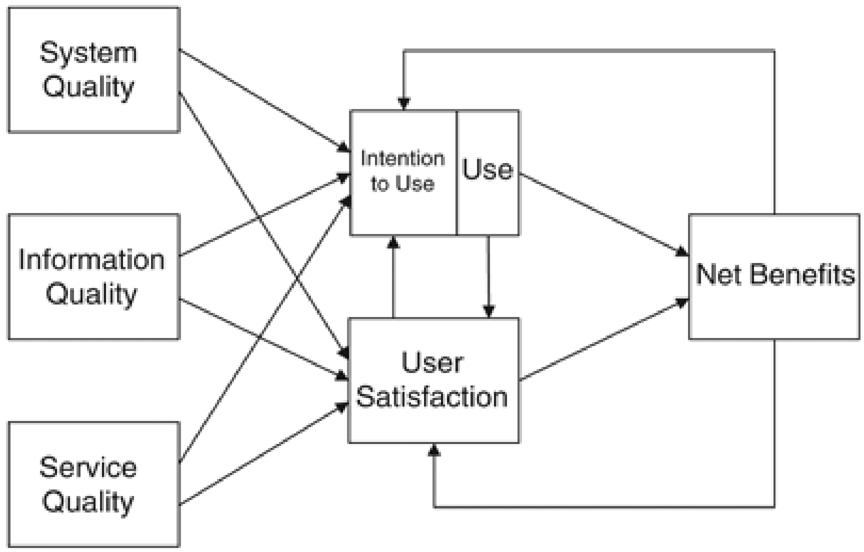


Figure 2.10: Updated DeLone and McLean IS Success Model (DeLone & McLean, 2003)

The model argues that system quality, information quality and service quality, individually and jointly affect user satisfaction and use (DeLone & McLean, 2003). The more users are happy with the IS, the more users will utilise the IS, and this determines the benefits that users obtain from using the IS. The benefits then strengthen the users' intention to use, their actual use, and their satisfaction with the IS (DeLone & McLean, 2003).

According to Ghandour, Benwell and Deans (2010) the Updated DeLone and McLean (2003) IS Success Model is similar to the communication theory of Shannon and Weaver (1949) and has three criteria of success namely:

- Technical*:* how accurately the message is transferred to the customer. This is measured by system quality in the Updated DeLone and McLean (2003) IS Success Model,
- Semantic: how precisely the customer is receiving the intended message. This is measured by information quality in the Updated DeLone and McLean (2003) IS Success Model, and
- Effectiveness: level reflecting the impact of the benefit accrued to the stakeholder through utilisation and feedback when the system is in use.

The similarity is detectable in the updated DeLone and McLean (2003) IS Success Model in the categories: by use, user satisfaction and net benefits. DeLone and McLean (2003) listed the following as the main differences between the original and updated models:

- the addition of the service quality variable to show the importance of service and support in successful ecommerce systems;

- the addition of a measure for user attitude; and
- replacing the original dimensions of organisational and individual impact with net benefits. Net benefits is an idealised comprehensive measure of the sum of all past and expected future benefits, less all past and expected future costs, attributed to the use of an information technology application (Seddon, 1997). Individual impact can be measured using job performance; and decision-making performance and organisational impact can be measured using various instruments such as organisational performance, return on investment and profits (DeLone & McLean, 2003).

2.7.4 Comparing the Information Systems Success Theories

Three IS success theories were discussed with a view of selecting one for use in a developing country context like South Africa. Factors for comparing the different IS success theories are adapted from Garity and Sanders (1998). Table 2.11 provides a summary of the comparisons.

Table 2.11 : Comparison of IS Success Theories (Ssemaluulu, 2012)

Model and Criteria	DeLone and McLean, 1992	Seddon, 1997	DeLone and McLean, 2003
Well Tested and Validated	Yes	No	Yes
Simplicity	Yes	No	Yes
Flexible	No	No	Yes
Captures all factors relevant to DCs	No	No	No

Flexibility of the theory to be applied to different contexts is one of the criteria. Flexibility is defined as being capable of adapting to a particular situation or use (Hornby, 2002). Of the theories discussed, the DeLone and McLean (2003) model was deemed flexible for use in a South African context. For example, the DeLone and McLean (2003) substituted the factors, individual impact and organisational impact from the DeLone and McLean (1992) with net benefits, thus allowing for benefits to be analysed at multiple levels. Another criterion is simplicity, which is defined as easy to understand or explain (Hornby, 2002).

Numerous studies (Petter *et al.*, 2008; Seddon, 1997; Seddon & Kiew, 1994) have identified the DeLone and McLean (1992, 2003) as the most tested and validated models of the theories reviewed. According to Ssemaluulu (2012), one of the measures for choosing a model for use is that users should have confidence in the theory. A well-tested and validated theory inspires confidence in users (Petter *et al.*, 2008). The 1992 article of DeLone and McLean was identified to be the single-most cited IS Success article in IS literature (Lowry, Karuga & Richardson, 2007).

While not attempting to cover all available research, many studies have applied the DeLone and McLean's original and updated models to assess various types of IS (Lai & Yang, 2009; Brown & Jayakody, 2008; Bernroider, 2008; Hwang & Xu, 2008; Medina & Chaparro, 2008; Hakkinen & Hilmola, 2008; Wang & Liao, 2008).

2.8 The Research Model

This section focuses on the research model for understanding BI systems success in South Africa. To do so, the traditional IS success models discussed in the previous section are extended to BI. The DeLone and McLean (2003) 's model has grown in popularity among scholars who have attempted to test and validate the model's effectiveness (Rai *et al*, 2002; Garrity & Sanders, 1998; Igbaria & Tan, 1997; Seddon, 1997; Seddon & Kiew, 1994; Wixom & Watson, 2001; Glorfeld, 1994). This clearly shows that the model has gained theoretical and empirical support as a model for studying IS success.

The DeLone and McLean IS Success Model (2003) served as the underlying framework for the present study. The proposed research model for this study was developed by incorporating factors derived from an examination of the research literature on IS success. In the study, the suggested theoretical framework includes five factors: information quality, individual impact, system quality, service quality, and user satisfaction based on DeLone and McLean (2003). The model also includes a sixth factor user quality derived from Almabhou *et al*. (2012) study discussed in the previous sections. The study by Almabhou *et al*. (2012) found that the user quality construct has a positive relationship to the net benefits of a DWH system.

To choose success factors and specific sub factors depends on the application being evaluated for example, an e-commerce application would have some similar success factors and some different success factors compared to a BI system (Petter *et al*., 2008; Dinter & Schieder, 2011). In order to investigate whether the theoretical framework held in practice, three semi-structured interviews with BI end users were conducted. The interviews were also used to identify any additional success factors not emanating from the literature review. The initial research model consists of 57 sub factors arranged under 6 factors of success.
The theoretical framework of the study is depicted in Figure 2.11

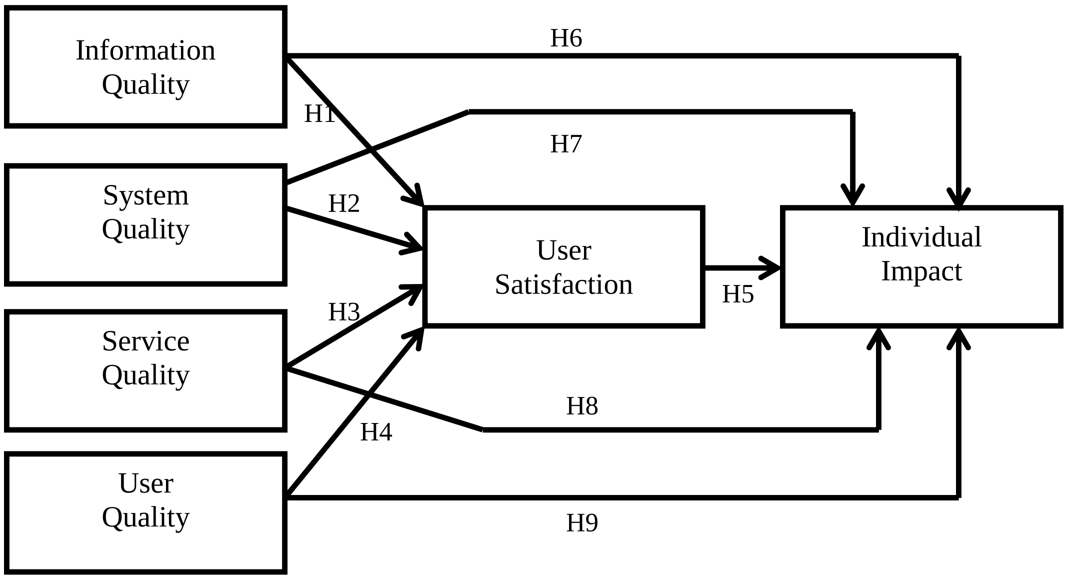


Figure 2.11: The Initial Business Intelligence Systems Success Model (Author's illustration)

This study hypothesises that information quality, system quality, service quality and user quality singularly or jointly have an effect on user satisfaction and individual impact of a BI system. The more users are satisfied with the BI system determines the benefits that users obtain from using the BI system.

Unlike the DeLone and McLean (2003) model, the use dimension was excluded from the research model. The DeLone and McLean (2003) model received a lot of criticism that centred on the use dimension (Barki & Huff, 1985; Gelderman, 1998; Seddon, 1997; Young, 1989; Yuthas & Young, 1998). DeLone and McLean (1992) pointed out that that use is only appropriate in a success model when the use is not compulsory. Seddon (1997) argued that the main factor the researchers are trying to measure is usefulness and not use. IS use is not essential in BI system success because it is not the use of BI system that is under study rather it is the impact of that use that is being scrutinised (Hwang & Xu, 2008).

In the Updated DeLone and McLean (2003) model, individual impact and organisational impact are combined into a new construct named Net Benefits. This study focuses on the individual level of analysis, therefore the construct Net Benefits is replaced by the Individual Impact construct.

Another change made to the Updated DeLone and McLean (2003) model is the removal of the feedback arrow from individual impact construct to the user satisfaction. The reason for the removal is that this study only collects data at a point in time and consequently this study does not assess the impact of individual impact on user satisfaction. Longitudinal data will need to be collected to study the impact of individual impact on user satisfaction which is beyond the scope of this study.

Another difference between the proposed model and the Updated DeLone and McLean (2003) model is the addition of the user quality factor. Chaveesuk (2010) argued that most of the available studies in BI concentrated on technological and operational features and there was not much study focusing on human, managerial, and strategic factors.

So in order to have a human factor in the model user quality was added to the model. The semi-structured interviews confirmed the importance of quality BI users to the success of the BI systems. The true value of BI may only be realised if the users are able to utilise the information effectively by turning it into sound business decisions (Avery & Watson, 2004). The inclusion of the user quality factor is a recognition that a lack of skilled BI users may lead to BI failure.

2.8.1 Information Quality

The researcher uses the IS success theory discussed in the previous section as a lens to explore the success of BI systems in South Africa. The information quality construct from the DeLone and McLean model (2003) was used to explore the influence of information quality on BI systems success in South Africa. The information for a BI system typically resides in a DW. Quality information is an essential asset for any organisation (Wang, Storey & Firth, 1995). Numerous studies (Haley, 1997; Thomann & Wells, 1999; Rudra & Yeo, 2000; Wixom & Watson, 2001; Shin, 2003; Nelson, Todd & Wixom, 2005; Hwang & Xu, 2008; Holsapple & Lee-Post, 2006; Lin, 2007; Chiu *et al*., 2007; Leclercq, 2007; Wu & Wang, 2006; Almutairi & Subramanian, 2005) suggest that information quality is essential for success.

Information quality refers to the desirable features of the information produced by the system. Measures of information quality include features such as timeliness, accuracy and relevance (Petter *et al*., 2008; Hwang & Xu, 2008). Information quality consists of four dimensions: accuracy, completeness, currency, and format (Nelson, *et al.*, 2005). On the other hand, DeLone and McLean (1992) points out that information quality refers to the quality of the information the system produces

(DeLone & McLean, 1992). Shin (2003) proposed that BI implementation should include a process to increase the quality of the data.

Organisations need to focus on the quality of data that is captured by the front-end systems. This is to ensure that the information used by decision makers is accurate and able to increase productivity and efficiency. DeLone and McLean (1992) identified the following information quality dimensions in Table 2.12.

Table 2.12 : Information Quality Measures (DeLone & McLean, 1992)

Information Quality Measures	
Accuracy, Precision, Currency, Timeliness, Reliability, Completeness, Conciseness, Format, Relevance	Bailey and Pearson (1983)
Perceived usefulness of specific report items	Blaylock and Rees (1984)
Perceived importance of each information item	Jones and McLeod (1986)
Currency, Sufficiency, Understandability, Freedom from bias, Timeliness, Reliability, Relevance to decisions, Comparability, Quantitativeness	King and Epstein (1983)
Report accuracy, Report timeliness	Mahmood (1987)
Report usefulness	Mahmood and Medewitz (1985)
Completeness of information, Accuracy of information, Relevance of reports, Timeliness of reports	Miller and Doyle (1987)
Usefulness of information	Rivard and Huff (1984)
Report accuracy, Report relevance, Understand ability, Report timeliness.	Srinivasan (1985)

This study uses the following seven measures of information quality: accuracy, usefulness, timeliness, completeness, relevance, understandability[sic] and trustworthiness. Information relevance refers to how much the information provided by the BI system is required by the end users. If the information provided by the BI system is not needed by the end user, then the BI system can be viewed as not useful to the end user (Huizingh, 2000). Usefulness refers to the assessment by the end user that the information from the BI system will increase their ability to perform tasks (Gehrke & Turban, 1999). The usefulness of information have been associated to the success of many IS (Davids, 1989).

Understandability of information can be described as how clear and how good the information from the BI system is. The BI system should provide information which is easy to interpret and easy to understand. If the end users are unable interpret and understand the information provided by the BI system, they won't be able to extract any value by using the system (Huang, Lee and Wang, 1999).

On the other hand, a BI system that provides accurate information is one that provides information that is correct, has no errors and is relevant to the end users of the information (Matsumura, 1996). Completeness of information refers to the delivery of complete information from the BI system (Ozkon, 20081). The BI system should present the end user with a complete picture and should not leave room for the end user to guess.

Timeliness refers to the ability of the BI system to provide the end user with the required information on time (Ozkon, 2008). It is important that the end users of the BI system receive the information in a timely manner in order to perform tasks or make decisions.

Trustworthiness refers to the ability of the BI system to provide information that is valid and credible (Kim, 1999). A BI system that delivers reliable information is one that delivers dependable and consistent information (Daft & Lengel, 1986).

The purpose of this study is to identify factors and sub factors that contribute to the success of BI systems in South Africa. The above section is relevant because it illustrates sub factors of information quality identified in available literature for other IS. Factors and sub factors chosen depend on the application being evaluated (Petter *et al*., 2008).

The relationship between information quality and user satisfaction has strong support in the literature (Iivari, 2005; Wu & Wang, 2006; Bharati, 2002; Leclercq, 2007). Some researchers have found a significant positive relationship between information quality and user satisfaction at the individual unit of analysis (Holsapple & Lee-Post, 2006; Lin, 2007; Chiu et al.,2007; Halawi, McCarthy & Aronson (2007); Leclercq, 2007; Kulkarni, Ravindran & Freeze, 2006.; Wu & Wang, 2006; Almutairi & Subramanian, 2005; Hunton & Flowers, 1997). Thus, the following hypothesis is proposed in this study:

H_{10}: Information quality is not related to user satisfaction in a BI system.

H_{1A}: Information quality is related to user satisfaction in a BI system.

The association between information quality and individual impact has moderate support in the literature (Petter *et al*., 2008). Some researchers have found a significant positive relationship between information quality and individual impact at the individual unit of analysis (Seddon & Kiew, 1994; Santos, Takaoka & de Souza, 2010). Thus, the following hypothesis is proposed in this study:

H_{60}: Information quality is not related to individual impact in a BI system.

H_{6A}: Information quality is related to individual impact in a BI system.

2.8.2 System Quality

System quality is an essential factor in successful BI implementation (Seddon, 1997). The system quality construct from the DeLone and McLean (2003) model will be used to investigate the influence of system quality on BI systems success in South Africa. System quality comprises of five key dimensions: flexibility, reliability, response time, accessibility, and integration (Nelson, *et al*., 2005).

Seddon (1997) defined systems quality as the consistency of the user interface, ease of use, and quality of documentation and maintainability of the program code. Likewise, Petter *et al*. (2008) defined system quality as the desirable features of an IS. They identify the following sub factors of system quality: ease of use, system flexibility, system reliability, and ease of learning, as well as system features of intuitiveness, sophistication, flexibility, and response time. DeLone and McLean (1992) identified the following system quality dimensions in the table below.

Table 2.13 : System Quality Measures (DeLone & McLean, 1992)

System Quality Measures	
Convenience of access, flexibility of the system, integration of systems, response time	Bailey and Pearson (1983)
Realisation of user expectations	Barki and Huff (1985)
Reliability, response time, ease of use, ease of learning	Barki and Huff (1985)
Response time	Barki and Huff (1985)
Perceived usefulness of IS	Franz and Robey (1986)
Usefulness of DSS features	Goslar (1986)
Usefulness of specific functions	Hiltz and Turoff (1981)
Resource utilisation, investment utilisation	Kriebel and Raviv (1980)
IS sophistication (use of new technology)	Lehman (1986)
Flexibility of system	Mahmood (1987)
Stored record error rate	Morey (1982)
Response time, system reliability, system accessibility	Srinivasan (1985)

The measures used in this study are ease of use, user friendly, responsiveness, ease of learning, stability, security, and reliability and availability. The end user perception of ease of use can be described as the extent to which the end user believes that the use of the BI system will be free of effort (Davis, 1989). How end users perceive the ease of use of the BI system is vital in the decision to use the BI system. An end user's perception of how easy it is to use the BI system commonly increases as they gain more knowledge and confidence of the system (Hackbarth, Grover & Yi, 2003).

Ease of learning can be described as how easily the end user understands the tasks to be performed on the BI system. Ease of learning should measure the competence of the users' skills and the required familiarity of the user with the BI system (Gallis, Arisholm & Dyba, 2003). The end user should not have to use a lot of mental effort to interact with the BI system (Kim, 1999).

System reliability can be defined as the ability of the BI system to accurately and dependably perform the required services (Bharati & Berg, 2003). A BI system has to have a high degree of reliability; the end users should be confident that the system will be available for use whenever they need to use it.

Responsivenss can be described as the time elapsed between the end user's input into the BI system and the BI system response to the input (Thum, Boucstein, Kuhman & Ray, 1995). The quality of the BI system is influenced by the end user's response time experience. If the system is slow the user will be unsatisfied with the BI system (DeLone & McLean, 2003). Hoxmeier and DiCesara (2000) agrees with DeLone and McLean (2003) in that long response times cause a low satisfaction with the BI system.

System quality has been studied widely in IS literature as an important factor for IS success and has generally been confirmed among investigators (Doll & Torkzadeh, 1988; Guimaraes *et al*., 2007; Davis, 1989). Many researchers found a positive relationship between system quality and user satisfaction at the individual level of analysis (Halawi *et al.*, 2007; Hsieh & Wang, 2007; Iivari, 2005; Leonard & Sensiper, 1998; Nonaka & Takeuchi, 1995).

Thus, this study proposes the following hypothesis:

H_{20}: System quality is not related to user satisfaction in a BI system.

H_{2A}: System quality is related to user satisfaction in a BI system.

Some studies found a positive relationship between system quality and individual impact (Amoli, 1996; Goodhue, 1995; Seddon & Kiew, 1994; Wixom & Todd, 2005). However, other studies found no association between system quality and individual impact (Goodhue & Thompson, 1995).
Thus, this study proposes the following hypothesis:

H_{70}: System quality is not related to individual impact in a BI system.

H_{7A}: System quality is related to individual impact in a BI system.

2.8.3 Service Quality

The service quality construct from the DeLone and McLean (2003) model was used to explore the influence of service quality on BI systems success in South Africa. Service quality refers to the level of support that end users get from the service provider. Measures of service quality include responsiveness, accuracy, reliability, technical competence, and empathy of the personnel staff (Petter, *et al*., 2008). According to Pitt *et al*. (2005), service quality is the quality of user support when using the system. Similarly, Graver, Jeong and Segars (1996), defined service quality based on the degree of disparity between what the customer expects of in terms of service standard and their perceptions of service performance.

Petter *et al.* (2008) further argued that if an IS is managed by a vendor then the service quality would evaluate the service quality of the vendor and not of the IS department. In such cases skill, experience, and capabilities of the support staff have been used as measures of service quality. The servqual instrument measures the gap between customers' expectation of the service quality and perceived performance of the services rendered (Parasuraman, Berry & Zeithaml, 1988). Reliability and responsiveness are two commonly used indicators of service quality (Pitt, Richard & Kavan, 1995).

According to Culiberg and Rojsek (2010) service quality refers to the gap between expectations and reality of the service provided. Servqual refers to five dimensions of quality (Culiberg & Rojsek, 2010):

- reliability: delivering the promised outputs at the stated level;
- responsiveness : providing prompt service and help to customers; reaction speed plays a vital role here;
- assurance : ability of a service firm to inspire trust and confidence in the firm through knowledge, politeness and trustworthiness of the employees;

- empathy: willingness and capability to give personalised attention to a customer; and
- tangibles: appearance of a service firm's facilities, employees, equipment and communication materials.

The studies indicate that in general, service quality has a positive influence on user satisfaction (Iivari, 2005; Gelderman, 2002; Wu and Wang, 2006; Halawi *et al*., 2007; Seddon & Kiew, 1996; McGill, Hobbs & Klobas, 2003; Almutairi & Subramanian, 2005). However, other researchers found no significant relationship between service quality and user satisfaction (Benard & Satir, 1993). The following hypothesis was tested in this study:

H_{30}: Service quality is not related to user satisfaction in a BI system.

H_{3A}: Service quality is related to user satisfaction in a BI system.

At the individual level of analysis, the association between service quality and individual impact has moderate support (Petter *et al*., 2008). The following hypothesis was tested in this study:

H_{80}: Service quality is not related to individual impact a BI system.

H_{8A}: Service quality is related to individual impact in a BI system.

2.8.4 User Satisfaction

The user satisfaction construct from the DeLone and Mclean (2003) model examines the influence of user satisfaction on BI systems success in South Africa. Numerous researchers (DeLone & McLean, 1992; Doll & Torkzadeh, 1998; Gatian, 1994; Igbaria & Nachman, 1990) have identified user satisfaction as one of the most extensively used single measure of IS success. User satisfaction refers to the perception of the end user towards the system in relation to what the end user expected upon first use of the system (Seddon, 1997).

According to Bharati (2003), if a system meets the requirements of the end users, their attitude towards the IS will be positive. Measures of user satisfaction include adequacy, effectiveness, relevance, dependability and usefulness (Urbach & Müller, 2012). Seddon and Kiew (1994) further explained that the user's level of satisfaction is based on the level to which the application meets the users' expectations. Similarly, Chiu, Hsu and Sun (2005), pointed out that user satisfaction is often regarded as an individual's feelings of pleasure or disappointment resulting from comparing an application's performance in relation to his or her expectations. Table 2.14 below is a summary of the measures evaluated by DeLone and McLean (1992).

Table 2.14 : User Satisfaction Measures (DeLone & McLean, 1992)

User Satisfaction Measures	
Overall satisfaction with DSS	Alavi and Henderson (1981)
User satisfaction (39 item instrument)	Bailey and Pearson (1983)
User information satisfaction	Barki and Huff (1985)
User satisfaction	Bruwer (1984)
Satisfaction with DSS (multi-item scale)	Cats-Baril and Huber (1987)
Top management satisfaction, personal management satisfaction	DeSanctis (1982)
User satisfaction (11 item scale)	Doll and Ahmed (1985)
User satisfaction (1 question)	Edmundson and Jeffery (1984)
Overall satisfaction	Ginzberg (1981); Mahmood (1987)
User satisfaction (Bailey and Pearson instrument)	Raymond (1987)
User satisfaction (25 item instrument)	Jenkins and Milton (1984)
Software and hardware satisfaction	Lehman (1986)
Enjoyment, satisfaction	Lucas (1981)
User satisfaction (multi item scale)	Mahmood and Medewitz (1985)
Satisfaction with the development project (Powers and Dickinson instrument)	McKeen (1983)
Information satisfaction/dissatisfaction difference between information needed and amount of information received	Olson and Ives (1981)
Controller satisfaction (modified Bailey and Pearson instrument)	Raymond (1985)
User complaints regarding Information Centre Services	Rivard and Huff (1984)
Overall user satisfaction	Rushinek and Rushinek (1986)
Overall satisfaction, decision making satisfaction	Sanders and Courtney (1985)
User satisfaction with interface	Taylor and Wang (1987)

Measures of user satisfaction used in this study are: efficiency, effectiveness and overall satisfaction. Overall satisfaction refers to the feeling and attitude the end user develops towards the factors that cause the delivery of information products and information services (Ives, Olson & Baroudi, 1983). Efficiency can be described as the ability of the BI system to maximize the return from the amount of resources used (Li, 1997).

When users are satisfied with use of a system it is hoped that this is due to derived positive benefits from using the system. User satisfaction was found to be positively related to individual impact

(Gelderman, 1998; Law & Ngai, 2007; Yoon & Guimaraes, 1995; Torkzadeh & Doll, 1999; Vlahos & Ferratt, 1995; Ang & Soh, 1997). In this study, the following hypothesis is tested:

H_{50}: User satisfaction is not related to individual impact in a BI system.

H_{5A}: User satisfaction is related to individual impact in a BI system.

2.8.5 User Quality

The user quality construct identified in the Almabhou *et al*. (2012) study will be used to explore the influence of user quality on BI systems success in South Africa. Most of the available literature on BI indicates that skilled users are crucial to the success of a BI system (Sakaguchi & Frolick, 1997; Cooper *et al.*, 2000; Wixom & Watson, 2001; Hwang *et al.*, 2004). Salmela (1997) argued that poor user quality increases the cost of both learning and using the BI system.

Almabhou *et al*. (2012) point out that few studies investigated the relationship between user quality and individual impact. In this study, the following hypotheses are suggested:

H_{40}: User quality is not related to User satisfaction in a BI system.

H_{4A}: User quality is related to User satisfaction in a BI system.

H_{90}: User quality is not related to individual impact in a BI system.

H_{9A}: User quality is related to individual impact in a BI system.

2.8.6 Individual Impact

The individual impact construct from the DeLone and McLean (2003) model will be used to examine the influence of individual impact on BI systems success in South Africa. Individual impact refers to the effect of the system on the behaviour of the end user (Seddon, 1997). This can be contrasted with Organisational impact which refers to the influence on the organisational performance such as operating cost reduction, overall productivity gains, increased sales, increased market share, increased profit, return on investment, return on assets, net income to operating expense ratio, increased work volume and product quality (DeLone & McLean, 1992)

The individual impact of an IS is context specific (DeLone & McLean, 2003; Seddon, 1997). In other words, in this study, the individual impact that can be realised needs to be based on BI, at the individual level of analysis.

Job performance, individual productivity, job effectiveness, extent of analysis in decision making, decision making quality, problem identification speed, and decision making speed are the measures used in this study. Individual productivity can be described as the increase or decrease in output while keeping the input level or resource level. If the BI system needs more inputs or delivers less output for the same amount or resources applied, then the BI system is decreasing productivity. A BI system that decreases productivity will cause the end users to negatively perceive the usefulness of the BI system constant (Ryan & Harrison, 2000).

Problem identification speed can be defined as the time elapsed between when a problem first occurs and when the problem is identified (Leidner & Elam, 1995). Decision making quality refers to the ability of the BI system to provide the user with sufficient information in order for the user to solve a problem or make an effective decision. If the BI system provides the end user with sufficient information and this information helps the user to solve the problem, the user will develop trust in the BI system.

DeLone and McLean (1992) suggest that a successful BI system should improve the decision analysis process of the end user. A BI system that helps an end user to navigate through the analysis of all the information required to make an effective decision, is a helpful because it eases the end users' efforts. DeLone and McLean (1992) identified the time taken to make a decision as an important IS success measure. If end users perceive that the BI system shortens the amount of time required to solve a problem or to make a decision, the end user will feel that the BI system is positively contributing to achieving their daily activities (DeLone & McLean, 1992).

2.8.7 Summary of Research Hypotheses

The following lists all the nine null and alternative hypotheses formulated in this chapter:

Hypothesis 1

H_{10}: Information quality is not related to user satisfaction in a BI system.

H_{1A}: Information quality is related to user satisfaction in a BI system.

Hypothesis 2

H_{20}: System quality is not related to user satisfaction in a BI system.

H_{2A}: System quality is related to user satisfaction in a BI system.

Hypothesis 3

H_{30}: Service quality is not related to user satisfaction in a BI system.

H_{3A}: Service quality is related to user satisfaction in a BI system.

Hypothesis 4

H_{40}: User quality is not related to User satisfaction in a BI system.

H_{4A}: User quality is related to User satisfaction in a BI system.

Hypothesis 5

H_{50}: User satisfaction is not related to individual impact in a BI system.

H_{5A}: User satisfaction is related to individual impact in a BI system.

Hypothesis 6

H_{60}: Information quality is not related to individual impact in a BI system.

H_{6A}: Information quality is related to individual impact in a BI system.

Hypothesis 7

H_{70}: System quality is not related to individual impact in a BI system.

H_{7A}: System quality is related to individual impact in a BI system.

Hypothesis 8

H_{80}: Service quality is not related to individual impact a BI system.

H_{8A}: Service quality is related to individual impact in a BI system.

Hypothesis 9

H_{90}: User quality is not related to individual impact in a BI system.

H_{9A}: User quality is related to individual impact in a BI system.

2.9 Summary

The purpose of the Literature Review was to provide background information on the nature of BI, which is the key concept in this study. The chapter investigated the different BI definitions found in the literature and discussed the characteristics of BI systems. This chapter also presented the theoretical framework and hypotheses associated with this study. Three IS success models were examined, reflecting the first step in the development of a research model for the study. The proposed research model was mainly derived from the empirical model of DeLone and McLean (2003). For the purpose of the current study, 6 factors namely system quality, information quality, service quality, user quality, user satisfaction and individual impact were identified as possible BI systems success factors. Nine statistical relationships between the independent variables and the dependent variables were hypothesised.

The value of this literature review is that it highlights some of the generic factors in IS success that managers could consider in assessing their IS. The literature review also informed the research design for the conduct of the study as outlined in Chapter 3.

The next Chapter presents the Research Methods that were followed in answering the research question in order to achieve the research objectives. The chapter explains how a combination of short semi structured interviews, a Delphi method and a survey were used as data collection methods. Chapter 3 also outlines the approach used in the data analysis.

CHAPTER 3 : RESEARCH METHODS

3.1 Introduction

The previous chapter presented the literature review, the theoretical basis for this research study. This chapter defines the research methods used to answer the research question for the study. The problem the researcher identified was that there were no formal guidelines available to assess post implementation BI systems success in South Africa. Search engines such as Google Scholar, Yahoo and databases such as EBSCO were employed using keywords such as BI systems success in developing countries, BI systems in South Africa to prove the lack of scholarly work in South Africa.

The main research question that guided the research methodology is: What are the factors that contribute to the success of BI systems in South Africa? The sub-questions are:

(1) What existing information systems success theoretical frameworks can be used in the context of BI systems?

(2) What are the factors influencing the success of BI systems as perceived by BI users in South African organisations?

(3) What are the factors influencing the success of BI systems as perceived by experts in South Africa?

(4) To what extent does the hypothesised BI system success model fit into the identified factors?

Information regarding relevant research methodologies was gathered from textbooks, journal articles and Internet based articles. The textbooks that were used in this study were research methods textbooks. The following are some of the search strings that were used: "data collection methods", "questionnaires," "population", "sample size", "survey methods", "Delphi", and "Delphi technique".

Chapter 3 is divided into nine sections. Section 3.2 discusses the research paradigm and the research approach is discussed in section 3.3. The research design used in this study is outlined in section 3.4. The study is divided into three main phases: a Qualitative study, a Delphi Method and a Quantitative study, which forms the dominant method of analysis. Each is discussed in sections 3.5, 3.6 and 3.7 respectively. Ethical issues for the study are highlighted in section 3.8. The last section gives an overall summary of the chapter.

3.2 Research Paradigm

According to Guba and Lincoln (2005), a research paradigm is defined as the worldview that guides the researcher in the choice of methods. Research can be categorised into three paradigms, positivist, interpretivist and critical theory (Myers, 1997). In contrast, Guba and Lincoln (205:110) identify four paradigms as follows:

- Positivism - Driven by immutable natural laws and mechanisms, an apprehendable reality is assumed to exist.
- Critical realism (also known as post-positivism) - Reality is assumed to exist, but is only imperfectly understandable due to the flawed human intellectual mechanisms and the fundamentally intractable nature of phenomena.
- Critical theory and related ideological positions - a reality that is considered to be apprehendable, that was once plastic, but that was shaped by several factors (for example social, political, cultural) over time into a series of structures that are now taken as real.
- Constructivism - in constructivism, realities are apprehendable in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature…and dependent for their form and content on the individual person or groups holding the constructions (Guba & Lincoln, 2005:110).

Table 3.1 illustrates the different research paradigms.

Table 3.1 : Research Paradigms (Guba & Lincoln, 2005)

Category	Positivism	Interpretivism	Critical Realism
Ontology	Naive realism in which an understandable reality is assumed to exist, driven by immutable natural law. True nature of reality can only be obtained by testing theories about actual objects, processing or structures in the real the world.	Relativism-local and specific constructed realities; the social world is produced and reinforced by humans through their actions and interactions.	Critical realism-'real' reality but only imperfectly and probabilistically apprehendable
Epistemology	Dualistic/objectivist; verification of hypothesis through rigorous empirical testing; search for universal laws of principles; tight	Transactional/objectivist; understanding of the social world from the participants' perspective through interpretation of their meaning and actions;	Modified dualist/ objective; critical tradition/ community; findings probably true.

Category	Positivism	Interpretivism	Critical Realism
	coupling among explanations, predictions and control.	researchers; prior assumptions, beliefs, and value. Interests always intervene to shape their investigations.	
Methodology	Hypothetical-deductive experiments/ manipulative; verification of hypotheses; mainly quantitative methods	Hermeneutical/ dialectical; interpretive case study; action research; holistic ethnography.	Modified experimental/manipulative; falsification of hypotheses; may include quantitative methods
Inquiry aim	Explanation: prediction and control	Understanding; reconstruction	Explanation: prediction and control
Nature of Knowledge	Verified hypotheses established as facts of laws	Individual and collective reconstructions sometimes coalescing around consensus	Non-falsified hypotheses that are probable facts or laws
Knowledge Accumulation	Accretion-“building blocks” adding to “edifice of knowledge”: generalisations and cause-effect linkages	More informed and sophisticated reconstructions; vicarious experience	Accretion-“building blocks” adding to “edifice of knowledge”: generalisations

Most philosophical debate has occurred along three main categories: ontology, epistemology and methodology. The different categories are briefly described below (Beynon-Davies, 2002:120):

- Ontology constitutes that branch of philosophy concerned with theories of reality. Ontological assumptions concern the essence of phenomena. Ontologies can take the position that the empirical world is assumed to be objective and hence independent of humans. They can do this by, taking a positivist or a subjective view and hence define existence only in the sense that humans create and re-create reality through their actions and interactions.
- Epistemology constitutes that branch of philosophy concerned with theories of knowledge. Epistemological assumptions concern the criteria by which valid knowledge about phenomena may be constructed and evaluated. One popular epistemological position in the natural sciences is that a theory of the world (knowledge) is true only in so much as it is not falsified by empirical events. Klein and Hirschheim (1987) pointed out that epistemology is a set of assumptions about the mode of inquiry. That is how to obtain knowledge and demonstrate that it is valid.

According to Walliman (2006), epistemology is concerned with how things become known and what can regard as acceptable knowledge in a discipline. Walliman (2006) further argues that there is a choice between two ways of acquiring knowledge: Empiricism - knowledge gained by sensory experience (using inductive reasoning) or Rationalism - knowledge gained by reasoning (using deductive reasoning)

- Methodology constitutes assumptions about which research approaches are appropriate for generating valid evidence (Beynon-Davies, 2002:120).

The purpose of this study was to determine the factors influencing the post implementation success of BI systems in South Africa. The research paradigm for this study is positivism. The choice of paradigm is also influenced by the fact that there are a number of theories in the literature that could explain the success of BI in South Africa. The positivist study is supported by an embedded interpretivist paradigm, and a qualitative field study, which serves to strengthen the richness and reliability of the positivist study.

3.3 Research Approach

Qualitative and quantitative are the two common approaches to research (Bergman, 2008). A quantitative approach seeks to quantify the data and apply statistical analysis (Malhotra, 2004). Whereas a qualitative approach involves the behaviour of people individually, in groups or in organisations (Hair, Money, Samouel & Page, 2007; Malhotra, 2004). Table 3.2 summarises different qualities of qualitative and quantitative approaches in social research.

Table 3.2 : Major characteristics of Qualitative and Quantitative Approaches (Neuman, 2000)

Deductive approach (Quantitative research)	**Inductive approach (Qualitative research)**
Objective is to test hypotheses that the researcher generates	Objective is to discover and encapsulate meanings once researcher becomes immersed in data
Measures are systematically created before data collection and are standardised as far as possible	Measures are more specific and may be specific to individual setting or researcher
Theory largely causal and deductive	Theory can be causal or non-causal and often inductive
Analysis proceeds by using statistics, tables or charts and discussing how they relate to hypotheses	Analysis proceeds by extracting themes or generalisations from evidence and organising data to present coherent, consistent picture. These generalisations can then be used to generate hypotheses

Deductive approach (Quantitative research)	Inductive approach (Qualitative research)
Concepts in the form of distinct variables	Concepts tend to be in the form of themes, motifs, generalisations and taxonomies. However, the objective is still to generate concepts
Data are in the form of numbers from precise measurement	Data are in the form of words from documents, observations and transcripts. However, quantification is still used in qualitative research
Procedures are standard and replication assumed	Research procedures are particular and replication difficult

Depending on the research question, a researcher can select either the qualitative approach or quantitative approach or select both approaches. This study used a mixed methods research design where qualitative and quantitative phases occurred one after the other. A mixed method design is a study that combines quantitative and qualitative research approaches into a single study (Johnson & Onwuegbuzie, 2004).

If a researcher understands the pros and cons of quantitative and qualitative research approaches it allows the researcher to combine both approaches (Johnson & Onwuegbuzie, 2004). Moreover, it provides a better appreciation of research problems than using one approach only (Creswell & Plano-Clark, 2007; Johnson & Onwuegbuzie, 2004). Combining both approaches also provides strength that can offset the respective weaknesses of quantitative and qualitative research (Creswell & Plano-Clark, 2007; Johnson & Christensen, 2008).

Despite their strengths, mixed methods have their weaknesses, which include the need for extensive data collection, and the need for the researchers to understand both quantitative and qualitative research approaches (Johnson & Onwuegbuzie, 2004). Other challenges as described by Johnson and Onwuegbuzie (2004) include: the belief that one should always work within one specific paradigm; mixed methods are also expensive; and mixed research is still maturing as a research paradigm.

Other obstacles include epistemological biases, inadequate researcher training, and publication biases (Polit & Beck, 2003). Greene, Caracelli and Graham (1989:260) identify five major purposes or rationales for conducting mixed methods research:

- Triangulation: seeks convergence and corroboration of results from different methods and designs studying the same phenomenon;

- Complementarity: seeks elaboration, enhancement, illustration, and clarification of the results from one method, with results from the other method;
- Initiation: involves discovering paradoxes and contradictions that lead to a re-framing of the research question;
- Development: using the findings from one method to help inform the other method; and
- Expansion: seeks to expand the breadth and range of research by using different methods for various inquiry components (Greene *et al*., 1989).

3.4 Research Design

The purpose of this study was to determine the factors influencing the post implementation success of BI systems in South Africa. The research methodology to be utilised for a specific research problem must constantly take into account the nature of the data to be collected in order to attempt to solve the research problem (Leedy & Ormrod, 2005). The research design is the outline of the study, which aims to find the answer to the research questions and hypothesis (McDaniel & Gates, 1999). The research design helps the researcher to outline the project, study settings, and type of exploration. Thus, the research design is a series of tasks that guide the data collection and analysis process to answer the research questions (Bryman & Bell, 2007; Cooper & Schindler, 2001).
Table 3.3 below presents a step-by step summary of the research design.

Table 3.3 : Step by Step Summary of the Research Design

	Step	**Research Design**
1	Collect existing literature.	Secondary research
2	Develop a theoretical framework to measure Business Intelligence success in South Africa.	Qualitative research design by means of interpretation.
3	Adapt theoretical framework if necessary.	Qualitative research design by means of semi structured interviews.
4	Adapt theoretical framework if necessary.	Quantitative research design by means of Delphi Study.
5	Based on the theoretical framework, develop an initial measuring instrument.	Qualitative research design by means of interpretation.
6	Test the instrument.	Quantitative research design by means of online survey.
7	Conduct main survey.	Quantitative research design by means of online survey.

	Step	Research Design
8	Data Analysis.	Quantitative research design.
9	Draw conclusions.	Interpretation of data.

The present study was conducted in four main sequential phases namely a Literature Review, Exploratory Study, Delphi Method, and a Questionnaire Survey Study.

3.5 Qualitative Study

The qualitative study was used to answer the research sub question: What are the factors influencing the success of BI systems as perceived by BI end users in South African organisations? Because of the newness of the study area (Ponelis, 2011); this phase used short semi-structured interviews to obtain data about BI systems in South Africa from the perspective of end users. The main objective of the semi-structured interviews was to investigate whether factors in the literature also held in practice. The exploratory phase consisted of three steps. Existing literature concerning BI success was sought in journals, books, seminar proceedings, working papers and other sources.

An initial research model of BI success was first developed based on the literature review. The next step was a field study using short semi structured interviews that were conducted with three end users of BI systems in South Africa. The number of interviews was limited to only three because after the third, the interviewer felt that no additional information was been added from the additional interviews. The interviews did not aim to draw any conclusion with regards to the study hypotheses' but were conducted to validate the identified factors in the initial framework.

3.5.1 Sample Selection

Sampling for the exploratory study phase was based upon theoretical sampling. Sampling for respondents and more data continued until there was theoretical saturation. Saturation is reached when no new data emerges (Botma, Greeff, Mulaudzi & Wright, 2010:200). The main selection criterion for the participants was that participants be end users of BI systems in South Africa for at least five years.

3.5.2 Data Collection

The aim of an interview is to collect, from the interviewee, their world view with regards to the described phenomena A researcher can use several ways to collect data namely face-to-face interviews, interviewing by telephone, and interviewing using the Internet. Structured, semi-structured or unstructured are the different types of interviews (Opdenakker, 2006). Table 3.4 highlights the features of structured, semi-structured, and unstructured interviews.

Table 3.4 : Types of interviews (Gray, 2004)

Structured	**Semi-structured**	**Unstructured**
Quick to capture data	Slow and time consuming to capture and analyse data.	Slower and more time consuming to capture and analyse data.
Use of random sampling	The longer the interview the more advisable it is to use random sampling	Opportunity and snowball sampling are often used. In organisations targeting of key informants
Interview schedule followed exactly	Interviewer refers to a guide containing mixture of open and closed questions	Interviewer uses aide-memoir of topics for discussion and improvises
Interviewer-led	Sometimes interviewer led, sometimes informant led	Non-directive interviewing
Easy to analyse	Quantitative parts easy to analyse	Usually hard to analyse
Tends to a positivist view of knowledge	Mixture of positivist and non-positivist	Non-positivist view of knowledge
Respondents' anonymity easily guaranteed	Harder to ensure anonymity	Researcher tends to know the informant

This study used semi-structured interviews to collect qualitative data. A semi-structured interview refers to a series of questions where the sequence can vary and the interviewer can add or reduce questions if needed (Bryman, 2008).

Questions were developed as a guide for the semi-structured interview sessions. The interview questions were formulated with reference to the topic under study (attached in Appendix). The interview guide of the study was divided into two sections. The first section of the questionnaire was about the demographic information of the participants of the study. The second section of the questionnaire was about general BI systems success factors.

Table 3.5 maps the research questions to the question and sub-question that correspond to the interview guide. The interview guide questions are set for the researcher and not the interviewee. The interview guide was developed from factors emerging from the literature review namely information quality, service quality, system quality, user quality, and individual impact. The interviewer was flexible during the interviews to allow new factors to emerge. As indicated, the questions are cues to the interviewer concerning the information that has to be collected.

Table 3.5 : Mapping of research Questions to Interview Guide.

Main Question	What are the factors that contribute to the success of BI systems in South Africa?	Interview Guide Questions	Variable(s) and or relationship(s) measured	Statistical Tests
Sub question	What are the factors influencing the success of BI systems as perceived by BI system end users in South African organisations?	Please tell me what you understand by the term Business Intelligence?	Ice Breaker question	Thematic Analysis
		What are some of the benefits you are deriving from using BI systems?	Individual Impact	
		What do you think are the main Information Quality sub-factors that affect the use of BI systems in your organisation?	Information Quality	
		What do you think are the main System Quality sub-factors that affect the use of BI systems in	System Quality	

Main Question	What are the factors that contribute to the success of BI systems in South Africa?	Interview Guide Questions	Variable(s) and or relationship(s) measured	Statistical Tests
		your organisation?		
		Are there any other factors and sub-factors that you think affect the use of BI systems?	Emerging Factors	
		What do you think are the main Service Quality sub-factors that affect the use of BI systems in your organisation?	Service Quality	

The interview with the end users was conducted before the development of the online survey. This was to provide feedback from the interviews to inform a suitable questionnaire. Potential interviewees were contacted via e-mail and invited to participate in the interviews. Candidates who agreed to participate received a formal email invitation.

In order for the interviewees to prepare for the semi-structured interviews, they received the interview questions via email before the actual interview. The interviewees were informed about the purpose of the study at the beginning of the interviews. The interviewees were also informed that this study has formal ethical clearance from the University of KwaZulu-Natal (UKZN) and that the interviews were to be conducted in an ethical manner in adherence with UKZN research ethics policy. The semi-structured interviews took 10 to 15 minutes to complete.

3.5.3 Data Analysis

Data analysis for the exploratory phase was done using the thematic analysis technique. Boyatzis (1998) defines thematic analysis as a technique for categorising qualitative data. The data was categorised in terms of themes and patterns. The analysis of the data started in the interviewing phase. During the interview process, the researcher recoded the interviews using an audio recorder. After each interview, the researcher transcribed the audio recordings. Respondents were occasionally contacted for clarity.

In order to accurately identify themes and patterns each transcript was read several times. Excel was used to categorise and analyse the themes. This involved manually identifying repetitions and topics that reoccur and also to identify similarities and differences between responses (Ryan & Bernard, 2003). The following describes the stages involved in the analysis of data (Miles & Huberman, 1994; Berg, 2004):

Stage one – focused on single interview transcripts:

- Review all interview transcripts one at a time
- Create groupings of key words
- Identify associations among factors
- Match factors with factors from the literature
- Develop raw tables of factors, sub factors and associations of each interview in excel.

Stage two – dealt with cross transcripts:

- Recheck all the interview transcripts
- Compare the interview transcripts
- Group similar factors together
- Develop the final tables of factors, sub factors and associations in excel.

3.5.4 Bias

When using interviewing as a data collection method error and bias can easily be introduced at any of the following stages (Fox, 2009:31): asking the questions, recording the answers, coding the answers, and interpreting the answers. Saunders *et al.* (2009) point out that there are different types of bias to consider namely interviewer and interviewee bias. Interviewer bias is when comments, tone or non-verbal behaviour of the interviewer influences the responses of the interviewee. Similarly, interviewee or response bias is caused by perceptions about the interviewer (Saunders *et al*., 2009:326).

A number of approaches were taken in order to reduce the bias in this study (Saunders *et al*., 2009:328), such as making sure that interviewer is knowledgeable about the topic thus increasing the credibility of the interviewer; the interviewees were supplied with relevant information to give them an opportunity to consider the information. Furthermore, the interviewer explained the research to the interviewee in order to gain the interviewee's confidence and during the interview process the interviewer maintained a neutral tone of voice, phrasing questions clearly, and using appropriate probing questions. Finally, the interviewer ensured that the attention of the interviewee was maintained at all times.

3.6 Delphi Method

The Delphi Method was used to answer the research sub question: What are the factors influencing the success of BI systems as perceived by BI experts in South Africa? The Delphi Method was used to refine the initial theoretical framework formulated on the basis of the literature review and semi structured interviews by canvassing the opinion of experts. The Delphi Method was also used to identify the most relevant and important factors and sub factors for BI system success. Another reason the Delphi Method was used is that only three interviews were used in the qualitative phase of the study.

The Delphi method was developed by the Rand Corporation in 1944 (Gupta & Clarke, 1996). Gupta and Clarke (1996) further pointed out that even though the Delphi Technique has become popular it has been extensively modified from its original form.

Hasson, Keeney and McKenna (2000) identified the following types of Delphi; Modified Delphi, Policy Delphi and Real-time Delphi. Keeney (2009) identified ten main types of Delphi, including classical, modified, decision, policy, real time, e-Delphi, technological, online, argument and disaggregative policy (Keeney, 2009). According to Hasson and Keeney (2011) Delphi Method are easily modified because there are no guidelines for the use of the method.

The main characteristics of the Delphi technique are (Hasson *et al*., 2000; Hasson & Keeney, 2011):

- anonymity;
- expert input;
- physical separation;
- iteration, as the process takes place through a number of rounds during which a new questionnaire containing the feedback from the previous round is compiled

- statistical analysis of the responses, which allows each participant to see where his/her opinion lies when compared to the rest of the group ; and
- controlled feedback, which entails that the participants responses after each round are analysed and each respondent receives feedback during the next round (Hasson *et al*., 2000; Hasson & Keeney, 2011).

The main aim of using the Delphi Method is to reach consensus (Thompson, 1995). One advantage of the Delphi Method is anonymity in answering questions which often sets the participant at ease and provides opinions that are free from peer pressure (Goodman, 1986; Snyder-Halpern, 2002). Another advantage of the Delphi Method is that it allows people who are in different places to share their expertise without the need for a meeting (Rogers & Lopez, 2002; Murry & Hammons, 1995).

Nevertheless, some disadvantages are that its anonymity may mean that participant responses are untraceable back to the participant which can lead to a lack of accountability (Sackman, 1975). Representativeness of the sample (Dillman *et al*., 1998) and low response rates (Mullen, 2003) are other limitations of the Delphi Method.

3.6.1 Delphi Panel

Several authors have criticised the use of the term "expert" since it is not easy to define the term (Beaumont, 2003; Hasson, Keeney & McKenna, 2000; Mullen, 2003). Several researchers argue that the attention should be on ensuring that the participants are able to provide relevant information based on their knowledge and experience (Beaumont, 2003; De Meyrick, 2003; Mullen, 2003; O'Loughlin & Kelly, 2004). There are no exact guidelines for calculating the size of the panel (Mullen, 2003).

The size of the panel of a Delphi Method unlike conventional surveys does not require a statistically large number of participants to be valid (Loo, 2002; Mullen, 2003). According to Dalkey and Helmer (1963), participants should meet the following two criteria. The first recommended criterion is that experts should have knowledge and experience of the subject matter. The second criterion is that they should be representative of the profession so that suggestions may be adaptable and transferable to the general population.

On the other hand, Adler and Ziglio (1996) stated that the Delphi participants in any study should meet four requirements namely: knowledge and experience with issues under investigation; capacity and willingness to participate; sufficient time to participate in the study; and effective communication skills. In choosing expert participants for this study, each expert was required to meet at least five of the following minimum criteria (Skulmoski, 2007):

- Knowledge and experience in IS/BI.
- Academic Qualification: has an earned a degree (National Diploma/B-Degree/M-Degree/PhD).
- Experience: Industry experience of at least 8 years
- Published articles in peer reviewed journals, books and or conferences in IS/BI.
- Teaching: Has served as an instructor in the teaching of courses focusing on IS/BI or recognised related field.
- professional registration with a recognised IS or ICT registration body
- Capacity, willingness, and time to participate.

Panel participants were identified from a number of sources namely, various South African universities, as well as members of various computer societies in South Africa such as The Institute of Information Technology Professionals South Africa (IITPSA); The South African Institute of Computer Scientists and Information Technologists (SAICSIT). The identification of participants involved creating a list of e-mail addresses from the administrators of CSSA and ITSA. An invitation to participate was sent to the addresses. Furthermore, Google and Google Scholar search engines were also used to identify individuals who have published BI related articles. While LinkedIn was used to identify professionals who met the above requirements.

3.6.2 Delphi Survey Administration

Several researchers argue that a Delphi Method should not have more than three rounds in order to minimise time spent, cost and participant fatigue (Hasson *et al*., 2000; Linstone & Turoff, 1975; Mullen, 2003; Powell, 2003). De Meyrick (2003) argued that having more than three rounds in a Delphi study may make it difficult to retain high response rates. In this study, the Delphi study was conducted in two rounds. Several other studies have used two rounds to reach consensus (Mullen, 2003).

3.6.2.1 First Round

To elicit varying ideas, views, and opinions of the participants the first round is typically open ended (Keeney, Hasson & McKenna, 2001). However, in this study the traditional first round Delphi of eliciting information from the participants was replaced with the results from the literature study and semi structured interviews. This modified approach has been used by other researchers (Duffield, 1993; Jenkins & Smith, 1994), reduces the time of the process, as well as the likelihood of response fatigue.

To reduce the risk of bias of the limited options the participants are given an option to suggest other factors and sub factors at the end of the questionnaire (Hasson *et al*., 2000; Keeney *et al*., 2001). In this study, participants indicated their level of agreement with pre-formulated statements provided on a questionnaire (appendix E). A 4-point Likert-type scale was used for rating the factors. The scale levels were; very important (4), important (3), slightly important (2) and unimportant (1). The instruction to the participants was to rate the factors according to how important each factor is towards the success of a BI system.

Table 3.6 : Rating scale provided to participant in the Delphi Study

Scale	Meaning
Very important (A most relevant factor)	First-order priority. Has direct bearing on the success and meaningful use of BI systems. Must be resolved or dealt with.
Important (Is relevant to the issue)	Second-order priority. Significant impact on the success and meaningful use of BI systems but not until other factors are addressed. Does not have to be fully resolved or dealt with.
Slightly important (Insignificantly relevant)	Third-order priority. Has little importance on the success and meaningful use of BI systems. Not a determining factor or major issue.
Unimportant (No priority)	No relevance. No measureable effect on the success and meaningful use of BI systems. Should be dropped as an aspect/barrier to consider.

3.6.2.2 Second Round

To initiate the second round, an email was sent to the first round participants with the questionnaire attached. In the second round, each participant received a personalised questionnaire showing their response from the first round and a summary of the other participants' responses. The second round gave the participants an opportunity to change their ratings of the level of importance in light of the new information received.

3.6.3 Consensus of the Delphi Method

The Delphi Method is a research approach used to gain consensus through a series of rounds of questionnaire surveys, usually more than one, where information and results are fed back to panel informants between each round (Mullen, 2003). Holey, Feeley, Dixon and Whittaker (2007) suggest that consensus can be determined by the following: the aggregate of judgments, a move to a subjective level of central tendency or alternatively by confirming stability in responses with consistency of answers between successive rounds of the study.

On the other hand, Hsu and Sandford (2007) argue that there is no agreement in literature on how consensus can said to have been attained. Dajani, Sincoff and Talley (1979:83) suggested that consensus is assumed to have been achieved when a certain percentage of responses fall within a prescribed range for the value being estimated.

3.7 Quantitative Study

The survey questionnaire study was used to answer the research sub question: What are the factors influencing the success of BI systems as perceived by users using a large scale survey in the context of organisations in South Africa? The main objective of the survey conducted was to empirically test the proposed theoretical model developed for the study. The quantitative survey provided the main method to validate the model and answer the research question posed in Chapter 1.

A questionnaire was developed based on the nine hypotheses that had been formulated. The questionnaire consisted of 35 items used to measure the six constructs and was subjected to a pilot study before conducting the main survey. SEM was used to analyse the data collected in the study. The final step of the study was the interpretation of the results.

3.7.1 Sample Selection

A target population is the complete group of objects or elements relevant to the study (Hair *et al*., 2007:173). The target population for this study was limited to the perceptions of end users of BI systems of JSE listed companies. Companies listed on the JSE but with head offices located in countries outside South Africa, were not included in the list. This was done so as to have a South

African perspective of BI systems success. A major challenge was to locate a single listing of end users of BI systems (sampling frame). In the absence of any official lists the researcher used various ways to identify end users of BI systems such as: BI vendors, BI consulting companies, BI vendor user groups and JSE listed companies.

Many companies were simply un-willing to share this information. Based on the database of end users a random sampling technique was used to distribute the questionnaire to the participant. Cooper and Schindler (2003) define random sampling as a probability in which each population element has a known and equal chance of selection. This technique ensures that each participant has an equal chance to be selected from the population and produce a representative sample.

Sample size is an additional issue to be considered because it is not always possible to survey the whole population. The exact size of all BI end users in South Africa is unknown. Therefore, it was not possible to calculate a sample size however; the researcher used the statistical analysis techniques that were intended to be used in the present study to guide in the sample size.

According to Luck and Rubin (1987), a large sample size is required when using a sophisticated statistical analysis. Harris and Schaubroeck (1990) suggested a sample size of at least 200 for SEM. Similarly, Kline (2005) confirms that a path model requires a sample size of at least 200. Likewise Hair, Tatham, Anderson and Black (1998) suggested that a sample size of less than 400 but more than 200 is suitable for SEM.

3.7.2 Data Collection

The questionnaire was the main data collection instrument of the study. The aim of the questionnaire was to collect the data necessary to help quantify the degree of association between each of the six factors and 35 success items that were identified previously (Chapter 2). The questionnaire of the study was divided into two parts.

The first section of the questionnaire was about the demographic information of the participants of the study. Seven items that the researcher developed measured participants' profiles; these items were race, gender, age, qualifications, length of service, role, and industry. Table 3.7 shows the items for each concept in the first section of the questionnaire.

Table 3.7 : Items to Measure Participant's Profile

Item	Scale	Example
Race	5 Categories	African,Coloured,Indian,White,Other
Age	6 Categories	age bracket >60 or <21
Gender	2 Categories	Male or Female
Qualification	6 Categories	Matric, Diploma, Bachelor's Degree, Master's Degree, Doctorate
Role	4 Categories	Top Management, Middle Management, Operational Staff and Other
Industry		Industry Sector
Length of Service	4 Categories	< 1 year or >10 years

The questions asked in this section provided demographic data regarding the research participants. This information can be used to compare this sample with other samples used in different studies.

The second part of the questionnaire was about the dependent as well as the independent variables of the study. The main dependent variables in the second sections are User Satisfaction and Individual Impact. The main independent variables are System Quality, Information Quality, User Quality and Service Quality. The survey instrument designed was based on the BI success model proposed in the previous chapter. All items on the questionnaire were measured on a 5-point Likert scale from strongly disagree to strongly agree. A copy of the full questionnaire can be found in the appendix.

Each construct in the study had at least two items in order to increase the reliability. The questions in the study were modified from related prior studies relating to IS success. The questions were designed to ask the respondent to evaluate their organisational BI systems.

Table 3.8 : Survey Instrument Constructs.

Construct	Item	Description	Literature Source
System Quality	SQ1	Availability	(DeLone & McLean,1992) (Watson & Wixom, 2001)
	SQ2	Ease of Use	
	SQ3	Ease of Learning	
	SQ4	Responsiveness	
	SQ5	Stability	
	SQ6	User Friendly	
	SQ7	Secure	
	SQ8	Reliability	
Information Quality	IQ1	Usefulness	(DeLone & McLean,1992) (Watson & Wixom, 2001)
	IQ2	Completeness	
	IQ3	Accuracy	
	IQ4	Timelines	
	IQ5	Trustworthy	
	IQ6	Understandability	
	IQ7	Relevance	
User Quality	UQ1	Business Skills	(Wixom & Watson, 2001)

Construct	Item	Description	Literature Source
	UQ2	Technical Skills	
	UQ3	Analytical Skills	
User Satisfaction	US1	Efficiency	(DeLone & McLean, 2003)
	US2	Effectiveness	
	US3	Overall Satisfaction	
Service Quality	SS1	Assurance	(Yoon & Suh, 2004)
	SS2	Empathy	
	SS3	Responsiveness	
	SS4	Knowledgeable	
Individual Impact	IB1	Job Performance	(Hou, 2012)
	IB2	Individual Productivity	
	IB3	Job Effectiveness	
	IB4	Extent of Analysis in Decision Making	
	IB5	Decision Making Quality	
	IB6	Problem Identification Speed	
	IB7	Decision Making Speed	

3.7.2.1 System Quality

The System Quality construct was measured using eight items adapted from DeLone and McLean (1992); Watson and Wixom (2001). The items asked the respondents if the BI system is easy to use, user friendly, easy to learn, always does what it should, responds quickly, always available for use, secure and if it is stable to use.

3.7.2.2 Information Quality

The Information Quality construct was measured using seven items taken from DeLone and McLean (1992); Watson and Wixom (2001). The items found out from the respondents if the BI system provides complete, accurate, clear, timely, trustworthy information that meets their needs and is presented in a useful format.

3.7.2.3 Service Quality

The Service Quality construct was measured using four items adapted from Yoon and Suh (2004). The items asked the respondents if the BI service team is: knowledgeable, shows empathy, is responsive and responds quickly to their requests.

3.7.2.4 User Quality

The User Quality variable was measured using three items adapted from Wixom and Watson (2001). The items asked the respondents on their opinion of the following characteristics of a BI end user technical skills, business skills and analysis skills.

3.7.2.5 User Satisfaction

The User Satisfaction variable was measured using three items adapted from DeLone and McLean (2003). The items asked the respondents if the BI system is efficient, effective and they are satisfied overall.

3.7.2.6 Individual Impact

The Individual Impact variable was measured through the use of seven items adapted from Hou (2012). The items asked the respondents if the BI system they use improves their job performance, individual productivity, job effectiveness, extent of analysis in decision making, decision making quality, problem identification speed and decision making speed.

There are advantages and disadvantages of using a questionnaire. The table below summarises some of the advantages of using a questionnaire.

Table 3.9 : Advantages and Disadvantages of the Questionnaire Technique (Gay, 1992)

Advantages	**Disadvantages**
Easy to administer, quick to fill in	Analysis is time consuming
Easy to follow up	It is difficult to get a list of good questions together
Data are quantifiable	Some respondents do not answer honestly
Makes tabulation of responses quite effortless	Effectiveness depends very much on reading ability and comprehension of individuals
Facilitates the direct comparison of groups and individuals	Response rate is often low, due to fear of lack of anonymity
Appropriate for large samples	Difficult to get questions that explore in depth
Provides direct responses of both factual and attitudinal information	Respondents try to provide the "correct responses"

Despite the disadvantages listed above, the following principles were taken into consideration when developing the questionnaire (Gay, 1992:224): the questionnaire was deliberately constructed for clarity and simplicity, avoiding using long questions, the questionnaire only asked simple questions that respondents could answer easily while following a natural logic and order. Also the questionnaire ensured that all the possible responses are covered.

3.7.3 Pilot study

A pilot study is a trial run done in preparation for the major study (van Teijlingen & Hundley, 2001). The researcher conducted a pilot study with five end users of BI systems before the main survey to check if the respondents would be able to understand the questions and instructions of the questionnaire. The pilot-study was administered in the same manner as the final questionnaire. The pilot study participants were encouraged to comment on the questionnaire in order to make changes. A copy of the final questionnaire is presented in Appendix D.

3.7.4 Reliability and Validity

The reliability of the study method refers to the stability of the instrument and its ability to produce consistent results when repeated (Leedy & Ormrod, 2001). A measure is therefore considered reliable if it generates consistent results. Internal consistency is a standard measure of reliability. Internal consistency is based on the assumption that the items of a scale ought to measure the same factor, and therefore are highly related (Cooper & Schindler, 2007; Hair *et al.*, 1998). Cronbach's Alpha method (Cronbach, 1951) was used for this purpose, as it was a popular technique among researchers (Bryman, 2008; Zikmud, 2003).

A reliability estimation of 0.70 or above indicates good reliability, while a reliability between 0.60 and 0.70 may be accepted if the other pointers of a model's construct validity are good (Hair, Black, Babin, Anderson & Tatham, 2006). Although 0.70 is normally the lower limit for Cronbach-alpha coefficients, it may be reduced to 0.60 for exploratory research purposes (Hair *et al*., 2006). Cronbach-alpha coefficients that are greater than 0.80 are considered good (Hair *et al.*, 2006). The reliability of the measuring instrument employed in the present study was measured using Cronbach-alpha coefficients. Therefore, Cronbach-alpha coefficients were used to decide which items would be integrated as measures of the specific constructs. The software programme SPSS 21 for Windows was utilised to establish these Cronbach-alpha coefficients.

The validity of the research instrument refers to the degree to which the instrument measures what it is intended to measure (Leedy & Ormrod, 2001). There are two aspects to validity: the external validity and the internal validity. Validity is a measurement characteristic that is concerned with the degree to which a test authenticates what a researcher expects it to authenticate (Cooper & Schindler, 2003). In addition, differences come from the measurement tool's ability to reflect the differences among study participants drawn from the population (Cooper & Schindler, 2003). A study that lacks external validity cannot be projected to other situations (Cook & Campbell, 1979).

The ability that a grouping of measured items has to reflect the hidden variables it intended to measure is termed construct validity (Hair *et al*., 2006). Thus, construct validity is a validity estimate (Cooper & Schindler, 2003). Construct validity is determined by the extent to which a measure confirms various related hypotheses (Zikmund, 2003). As a result, when using construct validity, both the theory and the measuring instrument must be taken into consideration (Cooper & Schindler, 2003).

According to Venter (2002), a measuring instrument is considered to display construct validity if the scale has both convergent and discriminant validity. The extent to which totals on one scale relate with the totals on other scales, which are designed to evaluate the same variable, is referred to as convergent validity (Cooper & Schindler, 2003; Hair *et al*., 2006). In contrast, the extent to which the totals on a scale do not relate with the totals from scales designed to measure different variables is referred to as discriminant validity (Cooper & Schindler, 2003). In addition, discriminant validity is the degree to which a variable is distinct and captures some aspects that other variables do not (Hair *et al*., 2006). Face validity relates to whether the test appears valid to people who might want to use it (Anastasi & Urbina, 1997:35). Similarly Gay and Airasian (2003) point out that face validity denotes to the degree to which a test evaluates what it claims to evaluate.

3.7.5 Data Analysis

Data analysis for this study was be performed using SPSS for Windows. The data analysis of the survey study is separated into two main sections. Before the data analysis, data screening was done on the data as follows: identify missing values and identify any outliers. After the data screening, a descriptive data analysis was conducted to gain a greater understanding of the data and each of the constructs. After that, the research framework formulated in chapter two was assessed based on applicable assessment criteria for SEM. The following subsections describe in more detail the data screening, descriptive data analysis and the research model assessment.

3.7.5.1 Data Screening and Cleaning

Prior to any data analysis, screening of data is necessary (Tabachnick & Fidell, 2001). This section briefly highlights the data screening and cleaning that was conducted in this study. Prior to the data analysis stage, data was examined for errors that might have occurred during data entry. Data were examined for missing data. According to Hair *et al*. (2006), constructs with more than 50 percent missing data should be deleted. The researcher also checked for outliers. Outliers are data values that are unusually higher or lower than other values in the dataset (Tabachnick & Fidell, 2001). Outliers were checked to see if they were likely to influence the results for the model as a whole.

3.7.5.2 Descriptive data analysis

Descriptive statistics provide a description of the data about the study participants based on numerical values. SPSS for Windows software was used for the detailed description of the respondents' personal data, such as gender, age, experience, and educational level. Every construct of the data was analysed using percentages and frequency distribution in order to understand the sample distribution.

3.7.5.3 Research model assessment

SEM was utilised in the present study to test the proposed hypotheses. Structural equation modelling is a statistical technique that utilises a confirmatory approach to the examination of a theory framework bearing on some aspect (Byrne, 2001). SEM tests all relationships in the hypothesised framework at the same time to find the point to which the framework is consistent with the data. Byrne (2001:15) summarised a number of advantages of SEM over other multivariate procedures:

- First, in using SEM the investigator takes a confirmatory approach to data analysis and analyses data for inferential purposes by demanding that the pattern of inter variable relations is specified a priori. In contrast, the descriptive nature of many other multivariate methods makes hypothesis testing difficult.
- Second, traditional multivariate methods are incapable of either assessing or correcting for measurement error; however, SEM analysis can avoid inaccuracies caused by ignoring an error when it exists in the explanatory variables. The structural model allows specification of error term covariances.
- Third, data analysis using SEM allows measurement of the relationship among unobserved and observed variables comprehensively through the analysis of covariance among observable variables. SEM can handle a large number of endogenous variables

(dependent variables) and exogenous variables (independent variables), as well as unobserved variables specified as linear combinations of the observed variables.

- Finally, no widely and easily applied alternatives to SEM exist for modelling multivariate relations or for estimating point and for interval indirect effects (Byrne, 2001:15).

According to Sweeny (2009) despite the clear advantages over other analysis techniques and its ever-increasing popularity, SEM has not escaped criticisms. These are that: SEM is complex and difficult to use (Anderson & Gerbing, 1988); SEM requires large samples (Kline, 2005); and SEM software is not very user friendly as it is more demanding than other multivariate techniques (Hair *et al*., 2006).

Data analysis for the quantitative phase of the study was done using SEM. The statistical tools used for SEM was SPSS Amos. In the table below a comparison is made of the different stages of SEM, as proposed by Hair *et al*. (1998, 2006).

Table 3.10 : Stages in Structural Equation Modelling (Hair *et al*., 1998, 2006)

Stages	**Hair *et al*. (2006)**	**Steps**	**Hair *et al*. (1998)**
1.	Defining individual constructs	1.	Developing a theoretical model
2.	Developing and specifying the measurement model	2.	Constructing a path diagram of causal relationships
3.	Designing a study to produce empirical results	3.	Converting the path diagram into a set of structural equations and measurement models
4.	Assessing the measurement model's validity	4.	Choosing the input matrix type (correlation matrix or covariance matrix) and estimating the proposed model
5.	Specifying the structural model	5.	Assessing the identification of model equations
6.	Assessing structural model validity	6.	Evaluating the results for goodness-of-fit
7.		7.	Making the indicated modifications to the model, if theoretically justified

The following section discusses the steps in SEM as identified by Hair *et al*. (1998):

3.7.5.3.1 Step one

The first step of the SEM process is the development of a theoretical model.

3.7.5.3.2 Step two

The second step of the SEM process is the construction of a path diagram where several constructs are linked by arrows. A straight arrow indicates a direct causal relationship, while a curved line means that a correlation between constructs exists. Hair *et al*. (2006) point out that a path diagram illustrates a dependence relationship between two factors, for example the impact of one factor on another factor. Hair *et al*. (2006) further point out that path diagrams provide a handy way of depicting models in a visual form.

In SEM, constructs are referred to as latent variables which are measured according to their individual indicators, and consist of independent, intervening, and dependent variables (Garson, 2006). If a variable is not predicted or caused by another variable in the model, it is referred to as an exogenous construct. In contrast, if a variable is predicted or caused by any other construct in the model, it is referred to as an endogenous or dependent construct (Hair *et al*., 2006; Hair *et al*., 1998).

3.7.5.3.3 Step three

Once the conceptual model, which is depicted in a path diagram, has been constructed, the next step is that the model will be specified. Specifying the model means that the causal relationships among variables in the hypothesised model are expressed in the form of a series of equations (Hair *et al*., 1998).

In SEM terminology, a conventional model actually consists of two models, the measurement model and the structural model (Hair *et al*., 2006). Specifying the measurement model involves assigning indicator variables to the constructs that they represent. On the other hand, specifying the structural model involves assigning relationships between constructs founded on the proposed theoretical model (Hair *et al*., 2006).

After a theory has been proposed, the SEM model is developed. To begin with, this entails specifying the measurement theory and validating it by means of confirmatory factor analysis. The researcher can then test the structural model once the measurement model is deemed to be valid (Hair *et al*., 2006).

Endogenous Variable	=	Exogenous Variable	+	Endogenous Variable	+	Error
Y_1	=	b_1X_1	+	b_2X_2	+	E_1

Figure 3.1: Structural Equation Example (Hair *et al*., 1998)

The figure above shows that the independent variables X_1 and X_2 have an effect on the dependent variable Y_1, and that provision is made for the measurement and specification error E_1 of magnitude b_1 and b_2 (Venter, 2002). The measurement model specifies the rules of correspondence between measured and latent variables and enables an assessment of construct validity (Hair *et al*., 2006). The measurement model can be represented by a series of regression-like equations, mathematically relating a factor to the measure variables (Hair *et al*., 2006).

Venter (2002) also points out that in the structural model, each hypothesised correlations effect of an exogenous construct on an endogenous construct or an endogenous construct on another endogenous construct is expressed as an equation. For each equation, a structural coefficient (b) is estimated and an error term (E) is included to provide for the sum of the effects of specification and random selection error.

3.7.5.3.4 Step four

In this step, the input matrix type must be chosen, and the proposed model estimated. According to Hair *et al*. (2006), covariance matrices include better information content and therefore provide the researcher with greater flexibility.

3.7.5.3.5 Step five

In step five, the software programme must be assessed to determine if it has produced any insignificant or illogical results while trying to identify the structural model (Hair *et al*., 2006; Hair *et al*., 1998).

3.7.5.3.6 Step six

Goodness-of-fit tests establish the extent to which the structural equation model fits the sample data (Hair *et al*., 1998), or how well the theory fits reality as represented by the data (Hair *et al*., 2006). There are three different types of goodness of fit indices in the SEM (Hair *et al*., 1998) namely:

absolute fit indices, incremental fit indices, and parsimonious fit indices. The absolute fit indices measure the overall fit of the model, which includes chi-square, root mean square error or approximation (RMSEA), and the goodness of fit index (GFI).

The incremental fit indexes are used to compare and contrast the research model with the null model which includes the adjusted goodness of fit (AGFI), normed fit index (NFI), and Bollen's goodness of fit (IFI). Finally, the parsimonious fit indices are comparative measures used when the model can be improved with modified parameters. This includes the parsimony comparative index (Hair *et al*., 2006).

Table 3.11 : Summary of alternative goodness-of-fit indices (Arbuckle, 2003)

Fit Index	**Description**	**Acceptable fit**
1. Measure of absolute fit		
Chi-square	Test of the null hypothesis that the estimated variance-covariance matrix deviated from the sample. Greatly affected by sample size. The larger the sample, the more likely it is that the *p*-value will imply a significant difference between model and data.	Non significant at least *p*–value > 0.05.
Normed Fit Chi-square	Chi-square statistics are only meaningful taking into account the degrees of freedom. Also regarded as a measure of absolute fit and parsimony. Value close to 1 indicates good fit but values less than 1 implies over fit.	Value smaller than 2 and as high as 5 is a reasonable fit.
Standardised Root Mean Square Residuals (SRMR)	Representing a standardised summary of the average covariance residuals. Covariance residuals are the differences between observed and model-implied covariances.	Value < 0.05 good fit; 0.01_0.05 adequate fit.
Root Mean Square Error of Approximation (RMSEA)	Representing how well the fitted model approximates per degree of freedom.	Values 0.05_0.08 is adequate fit.
Goodness-of-Fit (GFI)	Representing a comparison of the square residuals for the degree of freedom.	Value > 0.95 good fit; 0.90_0.95 adequate fit.
2. Incremental fit measures		

Fit Index	Description	Acceptable fit
Adjusted Goodness-of-Fit Index (AGFI)	Goodness-of-Fit adjusted for the degree of freedom. Less often used due to not performing well in some applications. Value can fall outside 0-1 range.	Value > 0.95 good fit; 0.90_0.95 adequate fit.
Bentler-Bonett Normed Fit Index (NFI)	Representing a comparative index between the proposed and more restricted, nested baseline model (null model) not adjusted for degree of freedom, thus the effects of sample size are strong.	Value > 0.95 good fit; 0.90_0.95 adequate fit.
Tucker-Lewis Index (TLI) also known as Bentler-Bonett Non-Normed Fit Index (NNFI)	Comparative index between proposed and null models adjusted for degrees of freedom. Can avoid extreme underestimation and overestimation and robust against sample size. Highly recommended fit index of choice.	Value > 0.95 good fit; 0.90_0.95 adequate fit.
Comparative Fit Index (CFI) identical to Relative Non centrality Index (RNI)	Comparative index between proposed and null models adjusted for degrees of freedom. Interpreted similarly as NFI but may be less affected by sample size. Highly recommended as the index of choice.	Close to 1 very good fit; Value > 0.95 good fit; 0.90_0.95 adequate fit.
Bollen's Incremental Fit Index (IFI)	Comparative index between proposed and null models adjusted for degrees of freedom.	Value > 0.95 good fit; 0.90_0.95 adequate fit.
3. Parsimonious fit measures		
Akaike Information Criterion (AIC)	Comparative index between alternative models.	Value closer to 0 better fit and greater parsimony.
Parsimony Normed Fit Index (PNFI)	This index takes into account both model being evaluated and the baseline model.	Higher value indicates better fit, comparison between alternative models.
Parsimony Comparative Index (PCFI)	This index takes into account both model being evaluated and the baseline model.	Same as above.

SEM researchers have provided numerous comparative fit indexes (Bentler & Bonett, 1980; Bollen, 1986). Given the number of different of fit indices, it is neither practical nor feasible for this project to use every possible model fit test.

3.7.5.3.7 Step seven

In the final step of the SEM analysis, the proposed model must be modified in search of a better fit and an understanding of the outcomes. Hair *et al*. (1998) suggest that during this stage, results should be examined for their correspondence to the proposed theory. Once the model is considered satisfactory, the researcher may wish to identify possible model changes to improve the goodness-of-fit. Model modification could be derived from the examination of the residual of the predicted covariance or correlation matrix.

Standardised residuals with values greater than 2.58 are considered statistically significant at a 0.05 level, which signifies substantial prediction error for a pair of indicators (Byrne, 2001). Another way of determining the fit of a model is the modification index where; a value of 3.84 or greater suggests that a statistically significant reduction in the Chi-square would be achieved when the coefficient is estimated (Hair *et al*., 1998). Hair *et al*. (1998) and Byrne (2001) argued that researchers should not make model changes based only on the modification of indices; some theoretical justification should be available before its implementation.

3.7.6 Potential Source of Bias

Common Method Bias occurs when data from the dependent and independent constructs are collected using the same method such as using the same questionnaire (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The problem arises when an attempt is made to interpret the correlation between the variables. The associations may be attributed to the participants' subjective opinions about the relationship between the variables rather than objective reality (Podsakoff *et al*., 2003). Harman's one factor technique was utilised in this study to test for bias due to common method bias (Podsakoff *et al*., 2003).

3.8 Ethical Considerations

For this study, an application was completed and approved by the Research Office of the University of KwaZulu-Natal to conduct the study. The following research ethical principles were followed in this study in order to conduct the study in an ethical and responsible manner (Gouthier, 2004):

- Respecting the rights and dignity of persons ;
- Caring for others ;
- Concern for others' welfare;
- Integrity ;
- Competence; and
- Scientific, professional and social responsibility

The participants were assured that their identities would not be disclosed to anyone. Therefore in this study the participant details are kept anonymous and no personal data such as names are used. Regarding the results, only summary data in aggregated form is reported and discussed. In addition, the researcher ensured that participation was voluntary and that participants could withdraw at any time should they wish not to participate.

3.9 Summary

This chapter described the research methods that were used to answer the research questions for the study. The research process was conducted in three main phases. In the first research phase, short semi-structured interviews were used to collect data from end users. In the second phase, a Delphi Method was used to obtain consensus from an expert panel on the BI systems success factors and sub factors identified from the literature review and the first phase of the study. In the third research phase, data was collected using a survey.

The quantitative survey provided the main method to validate the proposed model and all the hypotheses and to provide answers to the main research question. The study instrument was developed based on the proposed model discussed in the previous chapter. Before carrying out the main survey a pilot study was carried out to examine whether or not the proposed study model could be effectively used to examine BI success in a South African context.

In the next chapter, the results of the data gathered during the semi-structured interviews, Delphi Method, and the questionnaire survey are presented.

CHAPTER 4 : ANALYSIS

4.1 Introduction

The previous chapter provided an overview of the research methods employed to investigate the factors contributing to the success of BI systems in South Africa. This chapter presents the results of the data analysis. The discussion and interpretation of the results are presented in Chapter 5. Chapter 4 is divided into five sections. Section 4.2 presents the results of the short semi structured interviews with end users. Section 4.3 presents the results for the Delphi Method. Section 4.4 presents the results of the main survey questionnaire study and the last section gives an overall summary of the chapter.

4.2 Qualitative Study

The aim of the short semi-structured interviews was to help in the understanding of BI systems success in South Africa and also to see if the factors converge with the factors from the initial theoretical model developed in the Literature Review phase. The purpose of this section is to present the results of the data analysis from the short semi structured interviews. Data on which qualitative findings are based was collected from three short semi structured interviews that were recorded and later analysed. The transcripts of the interviews are attached in the appendix. The interviews provided insight into the study through exploring the participants perceptions on the various factors identified. The participants were purposively selected from a financial institution operating in South Africa. The researcher served as an interviewer for all the interviews.

4.2.1 Profile of the Interviewees

For ethical reasons interviewees in this study are referred to as Interviewee #1 through to Interviewee #3. Table 4.1 shows the profile of the interviewees. All three participants were male.

Table 4.1 : Profile of Interviewees

Interviewee No.	Role	Organisation	Year's Experience
1	Non-Management	Financial Services	8
2	Management	Financial Services	10
3	Management	Financial Services	13

4.2.2 Factors

The qualitative findings are presented in accordance with the identified factors that were based on the initial theoretical framework developed in the Literature Review phase of the study. The researcher identified the following six factors during the Literature Review: (1) information quality, (2) system quality, (3) service quality, (4) individual impact, (5) user satisfaction, and (6) user quality.

4.2.2.1 Information Quality

The interviewees gave their opinions regarding the contribution of information quality to the success of BI systems in their organisations. There was a general agreement among interviewees that information quality is a vital factor for BI system success. All interviewees highlighted the importance of information quality. Interviewee #1 pointed out that:

"without good information the BI tool is useless to me. I think the information from the BI system must be up to date and reliable in order to make effective decisions."

Also supporting this view was Interviewee #2 who mentioned that:
"the information is used to help the organisation, if it is not of high quality then its not good for the business. Businesses spend lots of money on BI systems so they can turn the masses of data they have into valuable information. So the information has to be of high quality otherwise we are wasting time and money."

Interviewee #3 also confirmed, "in what I do high quality information is the lifeblood of my department. Without it we would be of no value to the business."
The interview transcripts are attached in the appendix. Table 4.2 summarises the results for this factor, with the factor in the first column, and the result for each interviewee in subsequent columns. Within each factor, the related sub factors are listed.

Table 4.2 : Summary of factors identified by interviewees

	Interviewees				
Factor	Sub factor	I1	I2	I3	Total
Information Quality	Accuracy	√	√	√	3
	Usefulness	×	×	√	1
	Timeliness	√	√	√	3
	Completeness	×	√	√	2

	Interviewees				
Factor	Sub factor	I1	I2	I3	Total
	Relevance	√	√	√	3
	Understandability	×	×	√	1

4.2.2.2 System Quality

The interviewees gave their opinions regarding the contribution of system quality to the success of BI systems in their organisations. Yet again, there was agreement among interviewees that system quality is an essential success factor for BI systems. A number of system quality sub factors were identified by the different interviews. The first of these sub factors were ease of use and ease of learning:

"Well the system must be easy to learn and also must be easy to use. I want to be able to slice and dice with ease, like using excel" Interviewee #1.

Another desirable feature identified by the interviewees was "availability" (Interviewee #1 & Interviewee #2) and a system that is stable and secure (Interviewee #3). One interviewee (Interviewee #1) highlighted the importance of having a responsive system.

Table 4.3 shows the results for this factor.

Table 4.3 : Summary of factors identified by interviewees

	Interviewees				
Factor	Sub factor	I1	I2	I3	Total
System Quality	Availability	√	√	√	3
	Ease of Use	√	√	×	2
	Ease of Learning	√	×	×	1
	Responsiveness	√	×	×	1
	User Friendly	√	×	×	1
	Reliability	×	×	√	1
	Stability	×	×	√	1
	Secure	√	×	√	2

4.2.2.3 Service Quality

The interviewees gave their opinions regarding the contribution of service quality to the success of BI systems in their organisations. Two sub factors were identified by the interviewees namely responsiveness and knowledge. All interviewees identified both sub factors as been important. The general comments were as follows:
When the respondents were asked on their view of the level of service received from the IT team or BI Department. Interviewee #2 pointed out that:
"They are generally well-informed and respond to queries on time. So I am happy with the service I get from them".
Likewise, Interviewee #1 pointed out that:
"Well like I said they solve my problems in time most of the time so I would really say they know what they are doing otherwise they wouldn't know how to solve the problems I have with the cubes".
The cube identified by the interviewee is the BI analytical tool that the interviewee uses.
"I would say they know what they are doing; they are also very reliable and respond to queries quickly. I do get help from them when I need it so to me that's the most important thing" Interviewee #3.

Table 4.4 : Summary of factors identified by interviewees

	Interviewees				
Factor	Sub factor	I1	I2	I3	Total
Service Quality	Responsiveness	√	√	√	3
	Knowledge	√	√	√	3

4.2.2.4 User Satisfaction

Regarding the User satisfaction factor, all interviewees identified the overall satisfaction factor as the most important factor that would enable the users to use a BI system.

"I would say yes overall I am satisfied with the BI system" (Interviewee #3).
Interviewee #3 further points out that:
"Well the BI system does what it's supposed to do so for me I am able to do my work. I cannot speak for the whole organisation but for me based on the requirements of my work I am very satisfied with the BI system".
"I am generally happy with the BI system" (Interviewee #3).

Table 4.5 : Summary of factors identified by interviewees

	Interviewees				
Factor	Sub factor	I1	I2	I3	Total
User Satisfaction	Efficiency	√	×	√	2
	Effectiveness	×	×	√	1
	Overall Satisfaction	√	√	√	3

The second factor that the users identified was efficiency. Two of the three interviewees in this group noted this sub factor.

4.2.2.5 User Quality

The users identified three sub factors of the user quality factor namely Business Skills, Technical Skills, and Analytical Skills. Table 4.6 shows the summary of the identified sub factors.

Table 4.6 : Summary of factors identified by interviewees

	Interviewees				
Factor	Sub factor	I1	I2	I3	Total
User Quality	Business Skills	√	√	√	3
	Technical Skills	×	×	√	1
	Analysis Skills	√	√	√	3

All three interviewees identified business skills sub factor as an important skill for a user.

“I think the firstly the user must understand the business in which he is working, before he can the BI tool effectively” (Interviewee #2).

Similarly, Interviewee #3 points out that “I think as a BI user you really need to understand your area of business to be able to use the BI system effectively”.

4.2.2.6 Individual Impact

Under the Individual impact factor, there were four sub factors identified (individual productivity, decision-making quality, decision making speed and problem identification speed). When asked if the interviewees are getting any benefits from the use of BI systems all users agree that they are getting benefits.

All three interviewees identified individual productivity as a benefit for using BI systems. This is supported by Interviewee #1 who pointed out that :

"besides acting quickly the other benefit is that I can do more in a day than if I did not have the cube". The cube identified by the interviewee is the BI analytical tool that the interviewee uses.

Table 4.7 shows the summary of the identified sub factors.

Table 4.7: Summary of factors identified by interviewees

	Interviewees				
Factor	Sub factor	I1	I2	I3	Total
Individual Impact	Individual Productivity	√	√	√	3
	Decision Making Quality	×	√	√	2
	Problem Identification Speed	√	√	×	2
	Decision Making Speed	√	√	×	2

Likewise, Interviewee #2 pointed out that:

"I am able to be proactive and be more productive. All the information I need is right there in front of me, so I can make high quality decisions quickly".

Similarly, "I think the BI solution helps me to take charge when solving problems" (Interviewee #3).

4.3 Delphi Method

The previous section presented the exploratory study results. The purpose of this section is to present the results of the data analysis from the Delphi Method. In order to verify whether the theoretical framework derived from the Literature Review and semi structured interviews commands support it was decided to submit the theoretical framework to a panel of experts.

4.3.1 The Panel

Participants of the Delphi study were five experts based in South Africa. The participant group consisted of two academics and three industry practitioners. Table 4.12 shows the participants of the Delphi Study.

Table 4.8 : Delphi Participants

Current Position	Industry Sector	Years Experience	Highest Qualification
BI Consultant	Mining	11	Honours
BI Architect	Financial Services	9	Honours
BI Architect	Mining	8	MBA
Academic	Higher Education	7	PhD
Academic	Higher Education	8	PhD

4.3.2 Results of the First Round

The first round of the Delphi study aimed to assess the importance of each factor and sub factor to measure BI systems success. The participants were asked to assess each factor using a four point Likert scale ranging from 4 as "Very Important", 3 as "Important", 2 as "Slightly Important" and 1 as "Unimportant". The results of First Round of the Delphi Study are compiled and presented in Table 4.9.

It is not clear what the level of consensus for statements in a Delphi study should be (Jooste, 2014). Jooste (2014) further points out that it also common to only choose the level of consensus after the first round. According to Keeney *et al*. (2011:822), achieving a certain level of agreement is regarded as the most common measure of consensus. For this Delphi study, the attainment of a certain level of agreement among the panellists is used as a measure to confirm which of the factors and sub factors are important towards the success of BI systems.

A sub factor which received two-thirds level of consensus and a polarity of less than 1.2 among the responses was chosen for this study. The percentage of agreement in this study was calculated by summing the number of responses for the very important and important categories and dividing by the number of respondents and multiplying it by 100. As can be seen in Table 4.9 there are a number of factors with a 100% level of agreement. There are also a number of sub factors with 0 %. The polarity is stated as either strong if the polarity is greater than or equal to 1.5; weak if it is greater than or equal to 1.2 but less than 1.5; or none if it is less than 1.2 (De Loe, 1995).

Table 4.9 : Summary results of Delphi Round one

Factor	Sub Factor	Very Important	Important	Slightly Important	Unimportant	Polarity	Level of Importance
System Quality	Availability	40	60	0	0	0.24	100
	Ease of Use	80	20	0	0	0.16	100
	Ease of Learning	40	60	0	0	0.24	100
	Responsiveness	80	20	0	0	0.16	100
	User Friendly	40	60	0	0	0.24	100
	Reliability	80	20	0	0	0.16	100
	Stability	40	60	0	0	0.24	100
	Secure	40	60	0	0	0.24	100
	Data Accuracy	0	0	60	40	0.24	0
	Data Currency	0	0	40	60	0.24	0
	Database Contents	0	0	80	20	0.16	0
	Access	0	0	60	40	0.24	0
	User Requirements	0	0	60	40	0.24	0
	System Features	0	0	60	40	0.24	0
	System Accuracy	0	0	40	60	0.24	0
	Flexibility	0	0	40	60	0.24	0
	Efficiency	0	0	80	20	0.16	0
	Sophistication	0	0	60	40	0.24	0
	Integration	0	0	40	60	0.24	0

Factor	Sub Factor	Very Important	Important	Slightly Important	Unimportant	Polarity	Level of Importance
	Customisation	0	0	20	80	0.16	0
Information Quality	Accuracy	100	0	0	0	0	100
	Usefulness	40	60	0	0	0.24	100
	Timeliness	80	20	0	0	0.16	100
	Completeness	60	40	0	0	0.24	100
	Relevance	100	0	0	0	0	100
	Understandability	60	40	0	0	0.24	100
	Trustworthy	80	20	0	0	0.16	100
	Importance	0	0	100	0	0	0
	Availability	0	0	100	0	0	0
	Usability	0	0	20	80	0.16	0
	Concisesness	0	0	100	0	0	0
	Uniqueness	0	0	100	0	0	0
User Satisfaction	Efficiency	40	60	0	0	0.24	100
	Effectiveness	40	60	0	0	0.24	100
	Overall Satisfaction	100	0	0	0	0	100
	Enjoyment	0	0	80	20	0.16	0
	Information	0	0	100	0	0	0
	Systems	0	0	80	20	0.16	0
User Quality	Business Skills	80	20	0	0	0.16	100

Factor	Sub Factor	Very Important	Important	Slightly Important	Unimportant	Polarity	Level of Importance
	Technical Skills	40	60	0	0	0.24	100
	Analysis Skills	80	20	0	0	0.16	100
Individual Impact	Job Performance	80	20	0	0	0.16	100
	Individual Productivity	60	40	0	0	0.24	100
	Job Effectiveness	60	40	0	0	0.24	100
	Extent of Analysis in Decision Making	40	40	20	0	0.56	80
	Decision Making Quality	60	0	40	0	0.96	60
	Problem Identification Speed	40	40	20	0	0.56	80
	Decision Making Speed	0	60	40	0	0.24	60
	Learning	0	0	60	40	0.24	0
	Awareness/Recall	0	0	60	40	0.24	0
	Decision Effectiveness	0	0	60	40	0.24	0
Service Quality	Assurance	60	40	0	0	0.24	100
	Empathy	40	60	0	0	0.24	100

Factor	Sub Factor	Very Important	Important	Slightly Important	Unimportant	Polarity	Level of Importance
	Responsiveness	60	40	0	0	0.24	100
	Knowledgeable	20	80	0	0	0.16	100
	Reliability	0	20	60	20	0.4	20
	Tangible	20	20	60	0	0.64	40

A response percentage of 66.7% has been selected as the level of consensus for this research. The results show that consensus has been gained on 30 of the 57 items. According to the Delphi method, the factors, which gain consensus, can either be removed from the next round questionnaire or included, with the advantage of an opportunity to gain a higher level of consensus (Keeney *et al*., 2011).

The advantage of removing the factors is that the next questionnaire is shorter, reducing the risk of attrition (Keeney *et al*., 2011). For this research, the consensus factors were removed. The panel of experts had an option to suggest new factors and sub factors. No new factors were suggested by the panel.

4.3.3 Results of the Second Round

The results of the First Round were used to design the questionnaire for the second round. In this round only the sub factors which have not gained consensus from the first round are included.

Table 4.10 : Summary results of Delphi Round two

Factor	Sub Factor	Very Important	Important	Slightly Important	Unimportant	Polarity	Level of Importance
System Quality	Data Accuracy	0	0	80	20	0.16	0

Factor	Sub Factor	Very Important	Important	Slightly Important	Unimportant	Polarity	Level of Importance
	Data Currency	0	0	40	60	0.24	0
	Database Contents	0	0	80	20	0.16	0
	Access	0	0	80	20	0.16	0
	User Requirements	0	0	0	100	0.00	0
	System Features	0	0	40	60	0.24	0
	System Accuracy	0	0	60	40	0.24	0
	Flexibility	0	0	40	60	0.24	0
	Efficiency	0	0	40	60	0.24	0
	Sophistication	0	0	40	60	0.24	0
	Integration	0	0	80	20	0.16	0
	Customisation	0	0	60	40	0.24	0
Information Quality	Importance	0	0	20	80	0.16	0
	Availability	0	0	20	80	0.16	0
	Usability	0	0	60	40	0.24	0
	Concisesness	0	0	20	80	0.16	0
	Uniqueness	0	0	60	40	0.24	0
User Satisfaction	Enjoyment	0	0	40	60	0.24	0
	Information	0	0	40	60	0.24	0
	Systems	0	0	80	20	0.16	0
Individual Impact	Decision Making Quality	60	40	0	0	0.24	100
	Decision Making Speed	20	80	0	0	0.16	100
	Learning	0	0	40	60	0.24	0
	Awareness/Recall	0	0	40	60	0.24	0
	Decision Effectiveness	0	0	60	40	0.24	0

Factor	Sub Factor	Very Important	Important	Slightly Important	Unimportant	Polarity	Level of Importance
Service Quality	Reliability	0	0	60	40	0.24	0
	Tangible	0	0	60	40	0.24	0

The Delphi study is concluded after two rounds with 32 items out of 57 gaining consensus. The ranking of the importance of the sub factors helps to identify the most important factors and sub factors to BI system success. Thus, these sub factors were added to the framework that is tested in the context of South African BI systems success.

4.4 Quantitative Study

The quantitative section of analysis follows on from the semi structured interviews and Delphi Method from the previous sections. The survey questionnaire approach is the primary research approach for this study. The researcher used this approach to gain an in-depth understanding of factors and sub factors relating to BI systems success in South Africa.

The factors and sub factors for the study are outlined in the previous chapters of this study. The survey questionnaire approach is necessary for this study, as it allows the researcher to empirically explore associations between dependent and independent variables, and thus make assertive conclusions about the relationships between factors of BI systems success in South Africa. This section presents the data analysis of the results of the quantitative study.

4.4.1 Non Response Bias

To check for non-response bias, the respondents were divided into two groups, early and late respondents, with 171 and 40 members respectively. Table 4.11 shows the statistics for the two groups.

Table 4.11 : Group Statistics

	Wave	N	Mean	Std. Deviation	Std. Error Mean
Usersat	First wave	171	4.4873	.48135	.03681
	Second wave	40	4.3500	.68750	.10870
Userqual	First wave	171	4.2378	.45944	.03513
	Second wave	40	3.8917	.70967	.11221
Sysqual	First wave	171	4.2646	.43594	.03334
	Second wave	40	4.2531	.40479	.06400
Indimpact	First wave	171	4.0409	.64309	.04918
	Second wave	40	3.7821	.73557	.11630
Servqual	First wave	171	4.5930	.39281	.03004
	Second wave	40	4.4100	.61760	.09765
Infoqual	First wave	171	4.5322	.33835	.02587
	Second wave	40	4.4583	.32412	.05125

Late respondents were those who returned the questionnaire after a reminder was sent, and early respondents were those who answered and returned the questionnaire before any reminders were sent. The two groups were compared according to responses on user quality, systems quality, user satisfaction, systems quality, service quality, and individual impact. To test the differences between early and late respondents a t-test for equality of means was used. The results are summarised in Table 4.12.

Table 4.12 : Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Usersat	Equal variances assumed	7.997	.005	1.487	209	.139	.13733
	Equal variances not assumed			1.197	48.311	.237	.13733
Userqual	Equal variances assumed	20.412	.000	3.824	209	.000	.34615
	Equal variances not assumed			2.944	46.919	.005	.34615

Sysqual	Equal variances assumed	.466	.496	.152	209	.879	.01149
	Equal variances not assumed			.159	61.986	.874	.01149
Indimpact	Equal variances assumed	1.898	.170	2.228	209	.027	.25879
	Equal variances not assumed			2.049	53.798	.045	.25879
Servqual	Equal variances assumed	16.132	.000	2.349	209	.020	.18298
	Equal variances not assumed			1.791	46.634	.080	.18298
Infoqual	Equal variances assumed	.707	.401	1.252	209	.212	.07383
	Equal variances not assumed			1.286	60.515	.203	.07383

There was no statistically significant difference between the early respondents and the late respondents for service quality, system quality, information quality and user satisfaction.

However according to Table 4.12 above, user quality and individual impact seems to be the factors affected by the non-response bias for they both report a significant difference of mean. Despite this significant difference both respondents and non-respondents still fall under strongly agree and agree which implies that the difference is statistical, but in terms of opinion, the answers are homogenous.

4.4.2 Common Methods Bias

Since the independent and the dependent variables were measured from the same questionnaire, there was a potential for common methods bias. To test for common methods bias Harman's single factor test was used. The Harman 1 factor test was conducted to determine if the first principal component explains less than 50% of the total variance.

Table 4.13 : Harman1 Factor Test Results

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.700	17.814	17.814	5.700	17.814	17.814
2	4.581	14.315	32.129			
3	2.635	8.235	40.364			
4	2.439	7.621	47.984			
5	1.721	5.378	53.362			
6	1.654	5.167	58.529			
7	1.299	4.059	62.589			
8	1.028	3.211	65.800			
9	.843	2.634	68.434			
10	.788	2.463	70.897			
11	.782	2.442	73.339			
12	.731	2.285	75.625			
13	.687	2.148	77.773			
14	.663	2.073	79.846			
15	.645	2.016	81.862			
16	.583	1.823	83.685			
17	.540	1.688	85.373			
18	.506	1.580	86.953			
19	.478	1.494	88.447			
20	.442	1.381	89.829			
21	.429	1.342	91.170			
22	.400	1.251	92.421			
23	.360	1.125	93.546			
24	.340	1.062	94.608			
25	.321	1.003	95.611			
26	.307	.958	96.569			
27	.296	.925	97.495			
28	.250	.780	98.274			
29	.233	.727	99.002			
30	.159	.498	99.499			
31	.101	.316	99.816			
32	.059	.184	100.000			

Table 4.13 indicates that only 17.814 % of the total variance is explained when the first factor is extracted. In other words, a significant amount of variance is explained by the factors which were not extracted. This suggests that common methods bias is not an issue in this study.

4.4.3 Reliability and Validity of Constructs

SPSS version 21 was used to test the reliability of the measuring instrument in order to determine accuracy and consistency of results. The construct's Cronbach's Alpha were determined together with Cronbach's alpha when an item is deleted. This enabled the researcher to determine which items would increase Cronbach's alpha, if the item is deleted from the construct. Cronbach's alpha coefficient can range from zero to one. The closer Cronbach's alpha Coefficient is to 1, the higher the internal consistency and the more reliable the scale (Hair *et al.,* 2006).

Table 4.14 : Cronbach's Alpha coefficient (Hair *et al*., 2006)

Alpha Coefficient Range	Strength of Association
< 0.6	Poor
0.6 to < 0.7	Moderate
0.7 to < 0.8	Good (acceptable)
0.8 to < 0.9	Very good (acceptable)
> 0.9	Excellent (acceptable)

In this study, Cronbach's alpha coefficient was calculated for the questionnaire for measures of the six factors namely user satisfaction, information quality, user quality, services quality, user satisfaction and individual impact. A series of tables below shows each factor Cronbach alpha and items that constitute that factor.

4.4.3.1 User Satisfaction

Table 4.15 shows a good Cronbach alpha of 0.735 (Hair *et al*., 2006) for the user satisfaction construct. If we delete any one of the items, the Cronbach's Alpha will drop. Therefore it was decided to retain all items.

Table 4.15 : Reliability statistics for User Satisfaction

User satisfaction		0.735
	Scale Mean if Item Deleted	Cronbach's Alpha if Item Deleted
us1	9.05	.685
us2	8.93	.570
us3	8.79	.674

4.4.3.2 Information Quality

Next, is Table 4.16, which is showing a Cronbach alpha of 0.702 for information quality. This is also a good Cronbach alpha result (Hair *et al*., 2006). Again, none of the items would improve reliability for information quality construct, if deleted.

Table 4.16 : Reliability statistics for Information Quality

Information Quality		0.702
	Scale Mean if Item Deleted	Cronbach's Alpha if Item Deleted
infq1	22.62	.684
infq2	22.58	.633
Infq3	22.49	.639
infq4	22.79	.695
Infq5	22.62	.689
infq6	22.71	.692
Infq7	22.58	.633
infq8	22.36	.622
infq9	22.49	.639
Infq10	22.49	.639

4.4.3.3 User Quality

Table 4.17 shows a good Cronbach alpha of 0.733 (Hair *et al*., 2006) for the user quality construct. If we delete any one of the items, the Cronbach's Alpha will drop. Therefore it was decided to retain all items.

Table 4.17 : Reliability statistics for User Quality

User satisfaction		0.733
	Scale Mean if Item Deleted	Cronbach's Alpha if Item Deleted
uq1	8.31	.644
uq2	8.39	.635
uq3	8.33	.658

4.4.3.4 System Quality

Table 4.18 gives reliability statistics for the system quality construct. The Cronbach alpha is 0.780, which also indicates good reliability (Hair *et al*., 2006). The indication is that system reliability (sysq6) item would improve reliability of the construct, if deleted.

Table 4.18 : Reliability statistics for System Quality

System Quality		0.780
	Scale Mean if Item Deleted	Cronbach's Alpha if Item Deleted
sysq1	29.92	.764
sysq2	29.81	.750
sysq3	29.86	.743
sysq4	29.82	.755
sysq5	29.85	.762
sysq6	29.79	.787
sysq7	29.82	.754
sysq8	29.83	.731

4.4.3.5 Individual Impact

Individual Impact is shown in Table 4.19. The Cronbach alpha is 0.885, which indicates a very good reliability (Hair *et al*., 2006). The statistics indicate that no item would improve reliability if deleted. Thus it is was decided to retain all items.

Table 4.19 : Reliability statistics for Individual Impact

Individual Impact		0.885
	Scale Mean if Item Deleted	Cronbach's Alpha if Item Deleted
ii1	23.89	.866
ii2	24.04	.872
ii3	23.96	.869
ii4	23.97	.872
ii5	23.92	.867
ii6	23.93	.872
ii7	23.94	.864

4.4.3.6 Service Quality

Service Quality construct is shown in

Table 4.20, and indicates that item assurance (servq1) would improve reliability if deleted. The Cronbach alpha is 0.834, which indicates a very good reliability (Hair *et al*., 2006) but deleting the assurance item would increase the Cronbach Alpha to 0.868.

Table 4.20 : Reliability statistics for Service Quality

Service Quality		0.834
	Scale Mean if Item Deleted	Cronbach's Alpha if Item Deleted
servq1	18.36	.868
servq2	18.34	.782
servq3	18.22	.774
servq4	18.16	.783
servq5	18.09	.781

A measuring instrument's scores are considered valid if the instrument measures what it purports to measure (Hair *et al*., 2006). Items included in the current study have been validated in a number of earlier studies as discussed in Chapter 2. According to Fatma & Gulhayat (2012), convergent validity shows that a set of sub factors represent one and the same underlying factor, which can be demonstrated through their uni-dimensionality. According to Fornell & Larcker (1981), the convergent validity is satisfactory when the factors have an AVE greater than or equal to 0.5.

Table 4.21 : AVE for each construct

Construct	**AVE**
System Quality	0.59
Information Quality	0.60
User Satisfaction	0.55
User Quality	0.57
Individual Impact	0.53
Service Quality	0.40

As the Table 4.21 shows, AVE ranging from 0.40 to 0.60 and this range is above the suggested threshold of 0.50 for five constructs except service quality.

The reliability and validity statistics provided in this section gives the researcher confidence to proceed with the rest of the statistical analysis. In the next sections of this chapter, the researcher describes the profile of respondents, descriptive statistics of constructs, and performs further statistical analyses in in order to answer the research questions posed in Chapter 1 of this study.

4.4.4 Normality of Data

The answers to survey questions were analysed in order to find out if they are normally distributed. The distribution of the data was validated by examining skewness and kurtosis. The following table shows the mean, standard deviation, skewness and kurtosis values of the data collected.

Table 4.22 : Assessment of Normality

Construct	Items	Skewness	Kurtosis
System Quality	8	-.951	-.148
Information Quality	10	-.675	-.246
User Satisfaction	3	-.767	-.154
User Quality	3	-.155	.006
Individual Impact	6	-.754	-.550
Service Quality	5	-1.110	.688

According to Hair *et al*. (2007), the normal distribution has an acceptable range of skewness value from -1 to 1, and a Kurtosis value from -1.5 to 1.5. The skewness and kurtosis values above indicate that the data collected follow a fairly normal distribution. This is based on the rule of thumb that these values should lie between ±1 (Hair *et al*., 1998).

4.4.5 Profile of Respondents

The researcher used data description as a tool to explore and point out trends and significant traits that help present a picture of BI. SPSS was used to produce frequencies and graphic presentation of the data. The following sections will present the results of the analysis of the respondents' profile, organised by age, gender, years in current position, industry sector, job level and educational level.

4.4.5.1 Age

The age group profile of the respondents are detailed in Table 4.23.

Table 4.23 : Respondents by Age

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	21-30	12	5.7	5.7	5.7
	31-40	112	53.1	53.1	58.8

	Frequency	Per cent	Valid Per cent	Cumulative Per cent
41-50	73	34.6	34.6	93.4
51-60	14	6.6	6.6	100.0
Total	211	100.0	100.0	

Results above show that the majority (53.1%) of respondents were aged between 31-40 years.

4.4.5.2 Gender

Table 4.24 shows that out of 211 responses received, 121 were from male respondents and 90 were female respondents.

Table 4.24 : Respondents by Gender

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Male	121	57.3	57.3	57.3
	Female	90	42.7	42.7	100.0
	Total	211	100.0	100.0	

4.4.5.3 Years in Current Position

Table 4.25 illustrates the respondents years of experience in current position. More than 50% of the respondents have been in their organisations for more than 6 years, with 31.8% of respondents having worked for between 1 to 5 years**.**

Table 4.25 : Respondents by Years in Current Position

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 years	67	31.8	31.8	31.8
	6-10 years	104	49.3	49.3	81.0
	>10 years	40	19.0	19.0	100.0
	Total	211	100.0	100.0	

4.4.5.4 Industry Sector

Table 4.26 shows the respondents by industry sector.

Table 4.26 : Respondents by Industry Sector

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Telecommunications	75	35.5	35.5	35.5
	Financial Services	72	34.1	34.1	69.7
	Manufacturing	26	12.3	12.3	82.0
	Retail	23	10.9	10.9	92.9
	Media, Entertainment and Leisure	15	7.1	7.1	100.0
	Total	211	100.0	100.0	

4.4.5.5 Job Level

Table 4.27 indicates that the majority of the respondents are Operational Staff, accounting for approximately 76.8% of the total responses.

Table 4.27 : Respondents by Job Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Top Management	10	4.7	4.7	4.7
	Middle Management	39	18.5	18.5	23.2
	Operational Staff	162	76.8	76.8	100.0
	Total	211	100.0	100.0	

4.4.5.6 Education Level

Respondents were asked about their highest level of education attained. Most of the study participants reported highest level of education as a Bachelor's degree (49.3%) followed by a Diploma (37.9%).

Table 4.28 : Respondents by Education Level

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Matric	8	3.8	3.8	3.8
	Diploma	80	37.9	37.9	41.7
	Bachelor’s Degree	104	49.3	49.3	91.0
	Master’s Degree	19	9.0	9.0	100.0
	Total	211	100.0	100.0	

4.4.6 Descriptive Statistics of Construct Items

This section provides details relating to how the survey questions were answered by each of the respondents. Respondents were asked to evaluate their level of agreement on a five point Likert scale where 1 indicated “strongly disagree”; 2 indicated “disagree”; 3 stood for “neutral”; 4 was for “agree”; and 5 indicated “strongly agree”. Items in each of the six constructs have been grouped together and detailed responses are provided in the next section. This gives an overall impression of the respondents' attitudes towards items in the different constructs.

4.4.6.1 Information Quality

The information quality construct consisted of ten items. As pointed out above the respondents were asked to indicate their perceptions of the quality of information from the BI systems in their organisations. A five point Likert scale ranging from strongly disagree (scale 1) to strongly agree (scale 5) was used to measure this construct. The results of the respondents’ ratings for each item of this construct are reported in Figure 4.1. The item “The Business Intelligence system is very helpful and makes me more productive” had a mean score 4.75. This result suggests that the study participants perceive BI systems as been helpful in their work. On the other hand, the item “The Business Intelligence System provides up-to-date information” had a mean value of 4.32 and was rated the lowest by the study participants.

	iq1	iq2	iq3	iq4	iq5	iq6	iq7	iq8	iq9	iq10
strongly agree	50	56	51	35	27	41	52	76	65	44
agree	49	42	45	63	56	58	47	23	32	56
neutral	1	0	4	3	17	0	0	0	3	0
disagree	0	1	0	0	0	0	0	0	0	0
strongly disagree	0	0	0	0	0	0	0	0	0	0

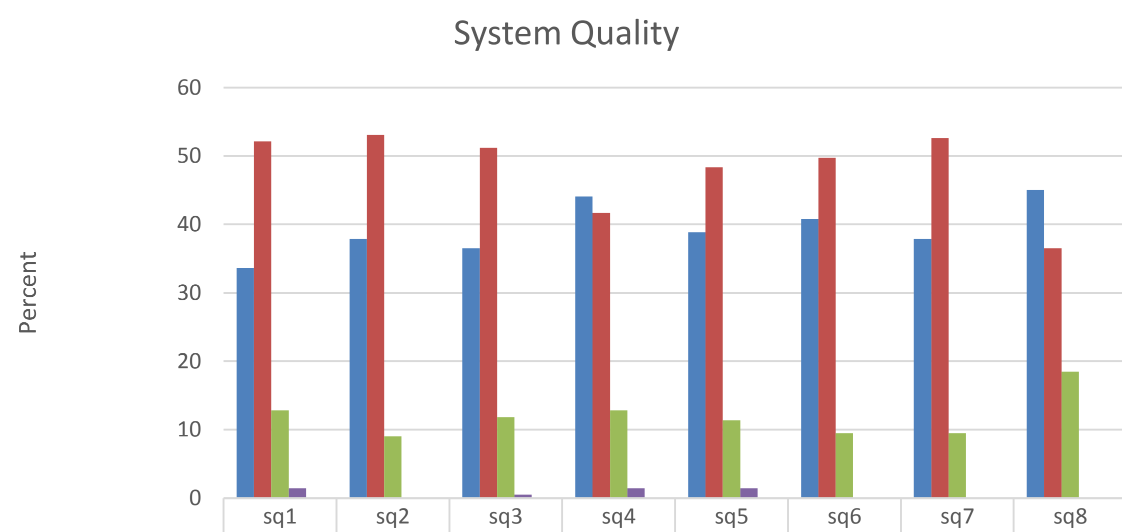
Figure 4.1: Respondent's Ratings of Information Quality of BI systems

This result suggests that the respondents view up to date information as important factor for a BI system. Although the information might be accurate, if the users do not get up to date information this might influence the decision of using or not using the BI system. If the end user perceives the information from the BI system to be useful and is able to assist in performing daily tasks they will continue to use the system.

The understandability[sic] sub factor was rated above the mean score by the study participants. This suggests that the study participants perceive the information from the BI systems as easy to interpret and easy to understand. If the end users are unable to interpret and understand the information, they will not find the BI system useful. However, overall, the results show that the study participants rated all items of the information quality construct above the mean score.

4.4.6.2 System Quality

System Quality construct was measured by eight items. Figure 4.2 reports the respondents' ratings of measured items of the system quality construct. Results show that all items relating to system quality were positively rated by the respondents and the entire items' mean score was greater than the neutral point (3). The item “The Business Intelligence System is safe” had a mean score 4.31 and was the highest rated item by the study participants. This result suggests that the end users perceive BI systems as been secure. The lowest rated item for the system quality construct is “The Business Intelligence System is easy to use”. Although this item was rated low (4.18) this score is above the mean score and might indicate that most end users perceive BI systems as been easy to use. This is supported by Turban *et al.* (2008) who pointed out that BI systems are easy to use. The survey reported a mean rate of 4.28 out of 5 for the "ease of learning" item. This result may suggest that the study participants find it is easy to learn the BI system. This result is also supported by the interviewees who had pointed out that during the training the users had learned even the most difficult functionalities of the BI system.



	sq1	sq2	sq3	sq4	sq5	sq6	sq7	sq8
strongly agree	34	38	36	44	39	41	38	45
agree	52	53	51	42	48	50	53	36
neutral	13	9	12	13	11	9	9	18
disagree	1	0	0	1	1	0	0	0
strongly disagree	0	0	0	0	0	0	0	0

Figure 4.2: Respondent’s Ratings of System Quality of BI systems

The study participants also scored the “responsiveness” above the mean score. This might suggest that the respondents have not lost confidence in their BI systems caused by bad or slow responses. If the BI system is slow the end users will be unsatisfied with the system (DeLone & McLean, 1992). Overall, the results show that the study participants rated all items of the system quality construct above the mean score. This may suggest that the study participants were overall satisfied with the system aspects of their BI systems.

4.4.6.3 Service Quality

Service Quality construct was measured by five-items. Figure 4.3 presents the respondents' ratings of the measured items of this construct.

	servq1	servq2	servq3	servq4	servq5
strongly agree	44	53	64	65	74
agree	56	40	29	32	24
neutral	0	7	6	2	0
disagree	0	0	1	0	1
strongly disagree	0	0	0	0	0

Figure 4.3: Respondent's Ratings of Service Quality of BI systems

The highest mean rating of 4.71 was for item 'The Business Intelligence System support team provides a prompt service to users' while the lowest mean rating was 4.43 for item 'The Business Intelligence support team provides service as promised'. In accordance with the model of DeLone and McLean (2003), the result suggests that the service quality received by the study participants is vital to the success of a BI system. This result is also supported by the interviews with the end users in phase 1 of this study. However only two of the five items were identified by the interviewees namely "knowledgeable" and "responsiveness".

4.4.6.4 User Quality

Three-items were used to measure this construct on a Likert scale ranging from one to five points. Figure 4.4 presents the respondents' ratings of the measured items of this construct.

	uq1	uq2	uq3
strongly agree	32	30	31
agree	58	53	57
neutral	9	16	12
disagree	1	1	0
strongly disagree	0	0	0

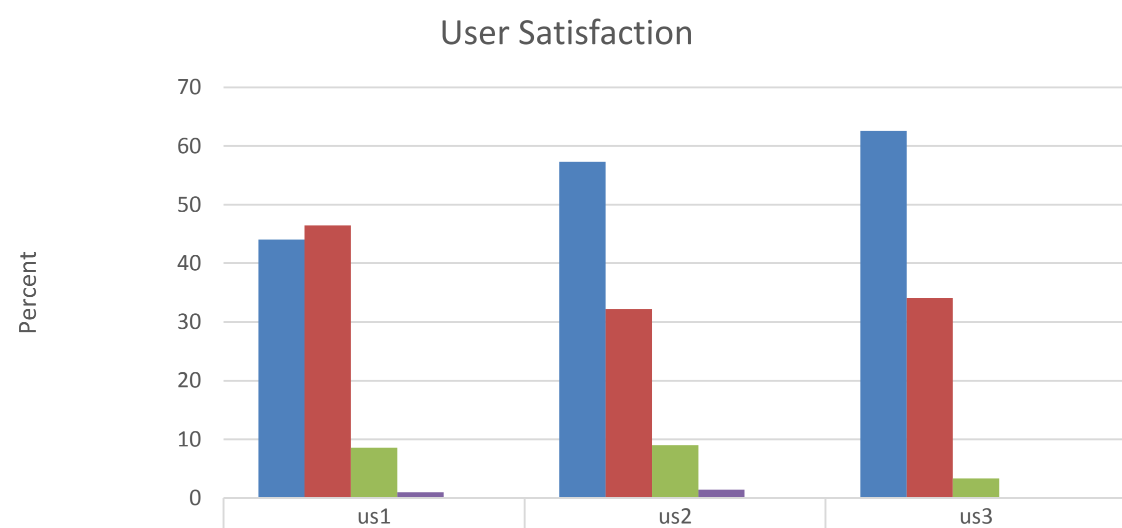
Figure 4.4: Respondent's Ratings of User Quality of BI systems

The low mean rating observed was 4.13 for item "Business Intelligence System users should have technical skills of how to use the system in their organisation" and the highest mean rating of 4.20 was reported for "Business Intelligence System users should be knowledgeable in their business or working environment".

This result is also supported by the interviews with the end users in phase 1 of this study, were the interviewees identified that Business Skills, Technical Skills and Analytical skills are important skills for a BI system end user. In accordance with the model of Almabhou *et al*. (2012), the result also suggests that skilled users are crucial to the success of a BI system.

4.4.6.5 User Satisfaction

Three items were used to measure this construct. Figure 4.5 presents the respondents' ratings of the measured items of the user satisfaction construct. The respondents reported levels of satisfaction concerning their usage of BI systems on a 5-point scale ranging from 1 referring to "strongly disagree" to 5 referring to "strongly agree".



	us1	us2	us3
strongly agree	44	57	63
agree	46	32	34
neutral	9	9	3
disagree	1	1	0
strongly disagree	0	0	0

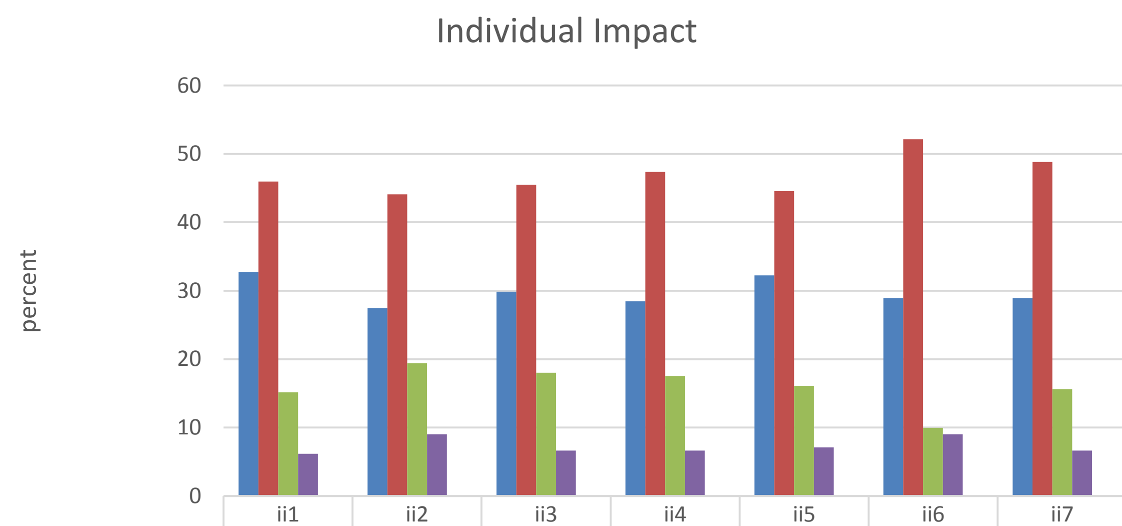
Figure 4.5: Respondent's Ratings of User Satisfaction of BI systems

The highest mean rating of 4.59 was found for item "Overall, I am satisfied with the Business Intelligence System" while the lowest mean rating was 4.34 for "I am satisfied with the Business Intelligence System efficiency" item. User satisfaction measures as an overview how much the end users are satisfied by the BI system and if they like it or not.

The overall user satisfaction is above the mean score, this might suggest that most study participants were satisfied with their BI system. When users have a high degree of overall satisfaction with a system they will continue to interact with the system and continue to use the system (DeLone & McLean, 1992). When users are not satisfied with the system they will not be committed to using the system and an unused system may lead to the system being seen as a failure.

4.4.6.6 Individual Impact

The individual impact construct consisted of seven items. The respondents were asked to indicate their perceptions of the benefits of using BI systems in their organisations. A five point Likert scale ranging from strongly disagree (scale 1) to strongly agree (scale 5) were used to measure this construct. The results of the respondents' ratings for each item of this construct are reported in Figure 4.6.



	ii1	ii2	ii3	ii4	ii5	ii6	ii7
strongly agree	33	27	30	28	32	29	29
agree	46	44	45	47	45	52	49
neutral	15	19	18	18	16	10	16
disagree	6	9	7	7	7	9	7
strongly disagree	0	0	0	0	0	0	0

Figure 4.6: Respondent's Ratings of Individual Impact of BI systems

The low mean rating observed was 3.90 for item "Using the Business Intelligence System in my job increases my productivity" and the highest mean rating of 4.05 was reported for "Using the Business Intelligence System improves my job performance". This result is in accordance with the model of DeLone and McLean (1992), the use of the BI system affects positively the individual impact. Most of the respondents reported that BI system has overall enhanced different parts of their decision making process (DeLone & McLean, 1992). This result is also supported by the interviews with the end users in phase 1 of this study, were all the interviewees reported that the BI system improved their individual productivity.

4.4.7 Assessment of Measurement model

Confirmatory Factor Analysis was performed on the measurement model comprising six factors, which were: system quality; information quality; service quality; user quality; individual impact and user satisfaction. Figure 4.7 depicts the measurement model.

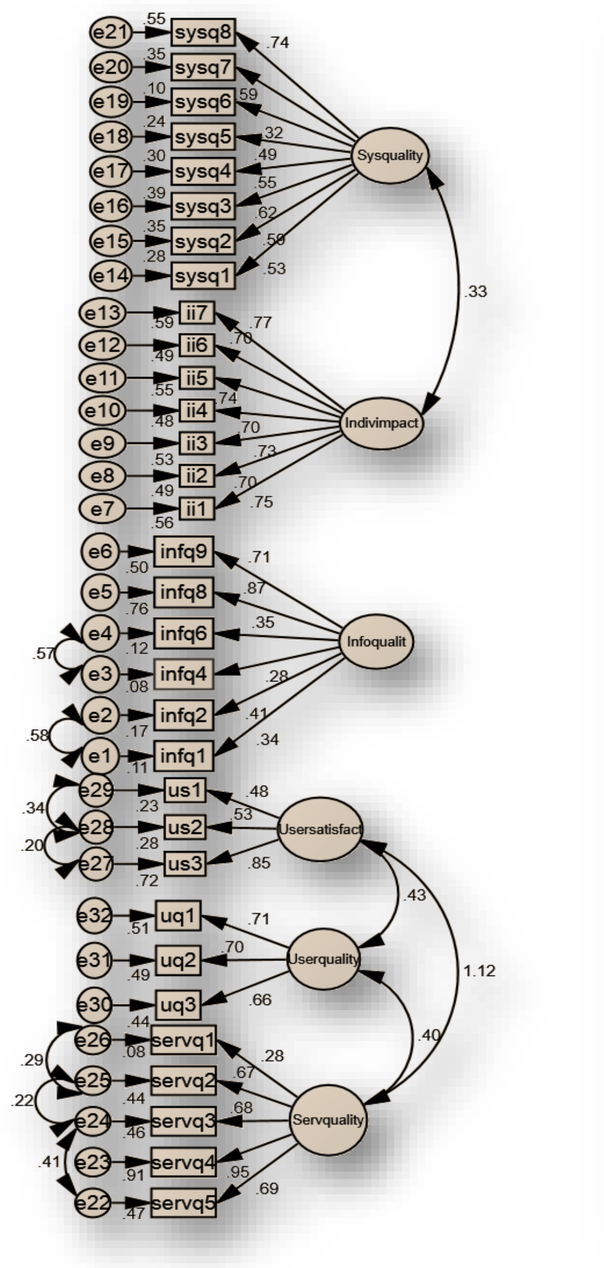


Figure 4.7: Initial Measurement Model

The Chi-square (911.332) of the measurement model above is significant (p =.000) at 453 degrees of freedom. The correlations appearing on the model are the only ones significant at .05. All the non-significant correlations were deleted from the model. Although CMIN/DF falls in the recommended range (2.012 < 5), the following indices GFI (.807), AGFI (.776), TLI (.829), and CFI (.844) are below the threshold, which is .90. In addition, RMSEA= .069 (supposed to be less than .05) and PCLOSE = .000 (supposed to be above .05). The model does not have a good fit; further modifications need to be actioned to reach the model fit. This poor fit is cause by two variables overlapping with each other. The variables user satisfaction and service quality are over correlated (r=1.12), meaning they are measuring the same thing. Deleting one of them may improve the model fit. The improved model is shown in Figure 4.8.

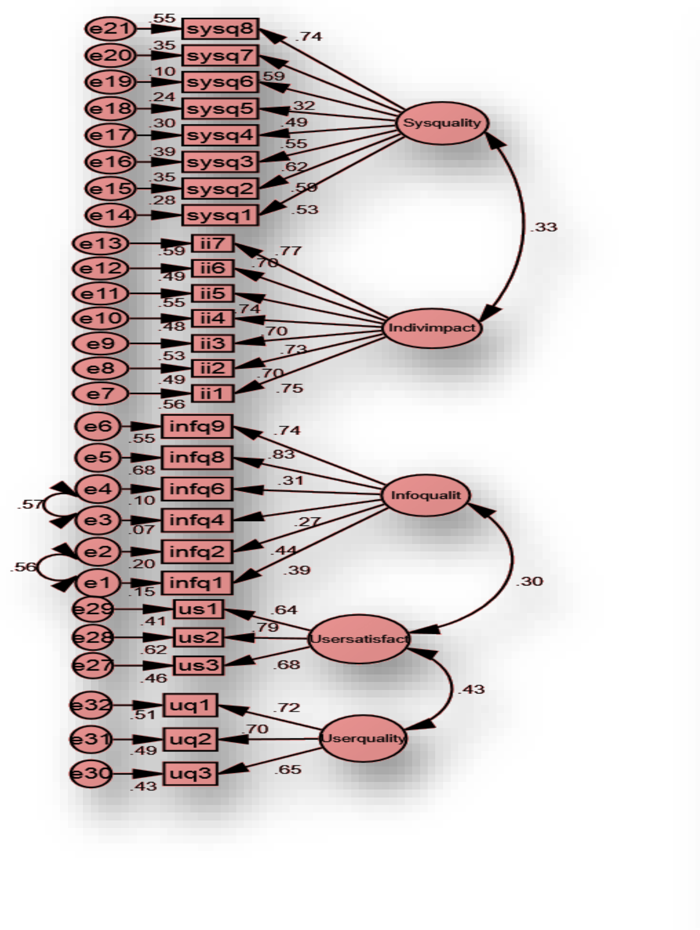


Figure 4.8: Final Measurement Model

In the final measurement model, service quality is removed due to its overlap with user satisfaction in the initial measurement model. The Chi-square (400.322) of the final measurement model has a p =.001 at 319 degrees of freedom. All the correlations appearing on model are significant at .05.

The following indices CMIN/DF falls within the recommended range (1.255< 5) GFI is acceptable (.877), AGFI is acceptable (.854), TLI is good (.948), and CFI is good (.953), RMSEA is good for it is less than .05 (.035) and PCLOSE is also good (.994) because it is above .05. Given that more than four indices are good, it can be concluded that the Final Measurement Model has a good fit. Therefore the structural model is be developed and tested based on this model.

4.4.8 Structural Model Evaluation and Hypotheses Testing

The test of the structural model includes an estimation of the path coefficients as well as coefficients of determination. Path coefficients indicate the strengths of the relationships between the dependent and independent variables whereas coefficients of determination values represent the amount of variance explained by the independent variable. SPSS Amos was used to calculate the coefficients of determination values for dependant constructs of the model as well as path coefficients between independent constructs. The standardised regression weights are shown in Table 4.29.

Table 4.29 : Standardised Regression Weights

			Estimate (Beta values)	P value
User_satisfaction	<---	User_quality	.30	***
User_satisfaction	<---	System_quality	.06	.374
User_satisfaction	<---	Information_quality	.24	***
Individual_impact	<---	User_quality	.02	.779
Individual_impact	<---	System_quality	.27	***
Individual_impact	<---	Information_quality	.01	.902
Individual_impact	<---	User_satisfaction	.05	.487

Although only three paths are significant, all the relationships on the structural model are positive; meaning that when the dependent variable increases by a standard deviation, its impact on the dependent variable also increases by a beta value proportion of the standard deviation of the dependent variable. The standard deviations are shown in Table 4.30.

Table 4.30 : Descriptive Statistics of the Constructs

Construct	Std. Deviation
User_satisfaction	.528
User_quality	.532
System_quality	.429
Individual_impact	.668
Service_quality	.448
Information_quality	.336
Valid N (listwise)	211

For example, if user quality increases by one standard deviation, which is .532, its impact on, user satisfaction will also increase by .158 (which is 30% the standard deviation of user satisfaction. If user quality decreases by .532, its impact on user satisfaction will also decrease by .158. The result of structural analysis of the model is shown in Figure 4.9.

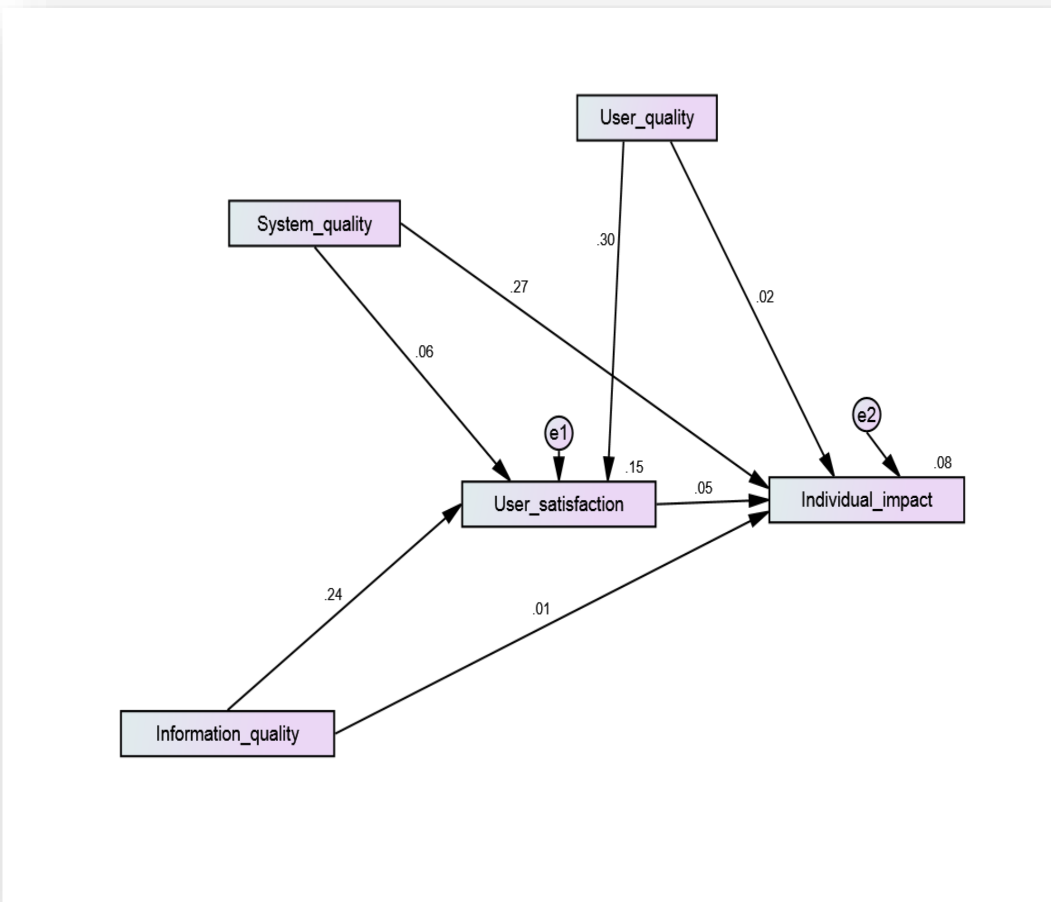


Figure 4.9: Structural Model

The Chi-square (2.464) of the structural model has a p =.982 at 9 degrees of freedom, CMIN/DF is good (.511 < 5), GFI is very good (.994), AGFI is very good (.978), TLI is very good (1), and CFI is also very good (1), RMSEA is very good (.000) for it is less than .05 and PCLOSE is also good (.998) because it is above .05. Given that all the indices are good, it can be concluded that the final structural Model has a good fit. However, some paths appearing in the structural model are not significant.

After achieving a satisfactory model, the final process involved testing the causal relationships between the constructs. This was carried out by examining the path coefficients estimates, standard errors and t-values. Table 4.31 shows the summary of the hypotheses testing.

Table 4.31 : Summary of the Hypotheses Testing

Null Hypotheses	**Result**
H_{10}: Information quality is not related to user satisfaction in a BI system.	Rejected
H_{20}: System quality is not related to user satisfaction in a BI system.	Not Rejected
H_{30}: Service quality is not related to user satisfaction in a BI system.	Not Tested
H_{40}: User quality is not related to user satisfaction in a BI system.	Rejected
H_{50}: User Satisfaction is not related to individual impact in a BI system.	Not Rejected
H_{60}: Information quality is not related to individual impact in a BI system.	Not Rejected
H_{70}: System Quality is not related to individual Impact in a BI system.	Rejected
H_{80}: Service quality is not related to individual impact in a BI system.	Not Tested
H_{90}: User Quality is not related to individual impact in a BI system.	Not Rejected

4.4.8.1 Hypothesis 1

Hypothesis 1 explored the relationship between information quality and user satisfaction. Table 4.29 indicates that the regression estimate of the path from information quality to user satisfaction is 0.2 with a p-value of 0.001. The result suggests that when the information quality is high, end users are more likely to be satisfied with the BI system. The regression estimate also indicates that the null hypothesis can be rejected. Therefore, the alternative hypothesis stands.

4.4.8.2 Hypothesis 2

As shown in Table 4.29, the estimate of the path from system quality to user satisfaction is 0.06 and a p-value of 0.374 suggesting that this path is statistically insignificant. The results demonstrated a lack of support for hypothesis H2, which was proposed in the model (presented in Chapter two). The regression estimate indicates that the null hypothesis can not be rejected.

4.4.8.3 Hypothesis 3

Hypothesis 3 was intended to test the association between service quality and user satisfaction in a BI system:

H_{30}: Service quality is not related to user satisfaction in a BI system.

H_{3A}: Service quality is related to user satisfaction in a BI system.

However, Hypothesis 3 could not be tested because service quality items were dropped from the model as they were deemed not to be valid items of service quality.

4.4.8.4 Hypothesis 4

The influence of user quality on user satisfaction of a BI system in South Africa is examined by hypotheses four. The validated model indicates that the estimate of the regression coefficient from user quality to user satisfaction is 0.3 with a p-value of 0.051. There is a positive relationship between user satisfaction and user quality. As user quality increases, user satisfaction increases. Therefore, the null hypothesis can be rejected. User quality is related to user satisfaction in a BI system.

4.4.8.5 Hypothesis 5

Hypothesis 5 examined the association between user satisfaction and individual impact in a BI system. The structural model indicates that the estimate of the regression coefficient from user satisfaction to individual impact is 0.05 with a p-value of 0.487. There is no significant relationship between individual impact and user satisfaction. Therefore, the null hypothesis cannot be rejected. User satisfaction is not related to individual impact in a BI system.

4.4.8.6 Hypothesis 6

The influence of information quality on individual impact of BI systems in South Africa is examined by hypotheses six. The structural model indicates that the estimate of the regression coefficient from information quality to individual impact is 0.01 with a p-value of 0.902. There is no significant relationship between information quality and individual impact. Therefore, the null hypothesis cannot be rejected.

4.4.8.7 Hypothesis 7

Hypothesis 7 examined the relationship between system quality and individual impact in a BI system. Figure 5.8 indicates that the estimate of the regression coefficient from system quality to individual impact is 0.27 with a p-value of 0.000. There is a positive relationship between system quality and individual impact. As system quality increases, so does the individual impact. Therefore, the null hypothesis can be rejected.

4.4.8.8 Hypothesis 8

Hypothesis 8 was intended to test the association between service quality and individual impact in a BI system:

H_{80}: Service quality is not related to individual impact in a BI system.

H_{8A}: Service quality is related to individual impact in a BI system.

However, Hypothesis 8 could not be tested because service quality items were excluded from the model as they were deemed not to be valid items of service quality.

4.4.8.9 Hypothesis 9

The influence of user quality on individual impact of BI systems in South Africa is examined by hypotheses nine. The structural model indicates that the estimate of the regression coefficient from user quality to individual impact is 0.02 with a p-value of 0.779.There is no significant relationship between user quality and individual impact. Therefore, the null hypothesis cannot be rejected.

4.4.9 Further Data Analysis

To further, explore the difference between the different job role types the study sample was divided into three models according to the job role. The focus was on the variations in the structural model because the measurement model had already been validated.

The job role groups were group 1 was the Top Management with 10 respondents, group 2 was the Middle Management with 39 respondents and group 3 was the Operational Staff with 162 respondents. The analysis was only done on group 3 and group 2 data. The data for the Top Management was insufficient for the analysis. In this section, the analysis of the groups is presented.

Figure 4.10 shows the structural model results for the middle management group.

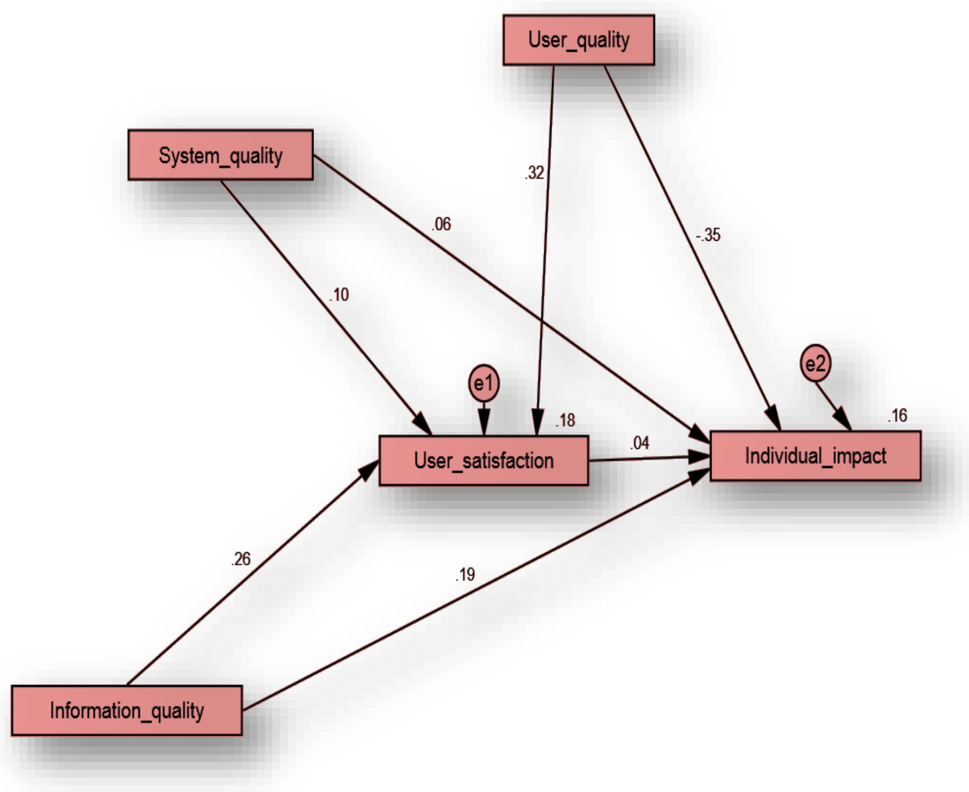


Figure 4.10: Structural Model for Middle Management

Table 4.32 shows the standardised regression weights for the middle management structural model.

Table 4.32 : Standardised Regression Weights

			Estimate (Beta values)	P value
User_satisfaction	<---	User_quality	.32	.028
User_satisfaction	<---	System_quality	.10	.476
User_satisfaction	<---	Information_quality	.26	.073
Individual_impact	<---	User_quality	-.35	.023
Individual_impact	<---	System_quality	.06	.680
Individual_impact	<---	Information_quality	.19	.206
Individual_impact	<---	User_satisfaction	.04	.789

According to Table 4.32, only two paths are significant for the middle management group. There is a positive relationship between user quality and user satisfaction, meaning that when user quality increases by one standard deviation which is .532, its impact on user satisfaction will also increase by .168 (which is 32% the standard deviation of user satisfaction. If user quality decreases by .532, its impact on user satisfaction will also decrease by .168).

There is a negative relationship between user quality and individual impact; meaning that when user quality increases by one standard deviation, which is .532, its impact on individual impact decreases by .233 (which is 35% the standard deviation of individual impact. If user quality increases by .532, its impact on individual impact will, decrease by .233). User quality is the only significant predictor of the model for middle management group. Figure 4.11 shows the structural model for the operational staff.

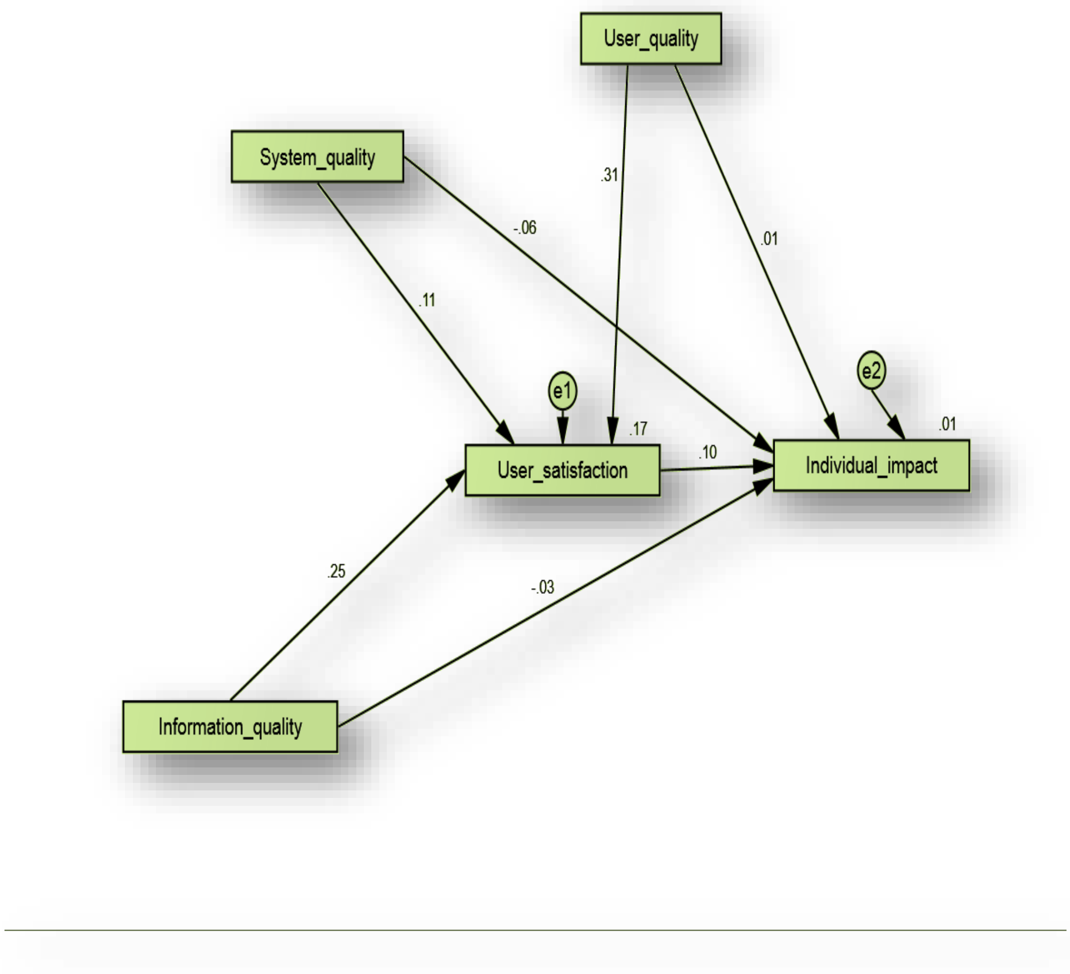


Figure 4.11: Structural Model for Operational Staff

Table 4.33 shows the standardised regression weights for the operational staff structural model.

Table 4.33 : Standardised Regression Weights

			Estimate (Beta values)	P value
User_satisfaction	<---	User_quality	.31	***
User_satisfaction	<---	System_quality	.11	.135
User_satisfaction	<---	Information_quality	.25	***
Individual_impact	<---	User_quality	.01	.909
Individual_impact	<---	System_quality	.06	.463
Individual_impact	<---	Information_quality	.03	.678
Individual_impact	<---	User_satisfaction	.10	.238

Although only two paths are significant, all the relationships on the structural model are positive; meaning that when user quality increases by one standard deviation, which is .532, its impact on user satisfaction, will also increase by .163 (which is 31% the standard deviation of user satisfaction). If user quality decreases by .532, its impact on user satisfaction will also decrease by .163.

4.5 Summary

This chapter has presented the results of the study. The study first presented the results of the short semi structured interviews with the end users. This was followed by the results for the Delphi Method. The last section presented the results of the main survey questionnaire study. The proposed theoretical model of BI systems success for South African companies was empirically tested by means of SEM.

The next chapter of this study interprets and discusses the results from the study to provide answers to this study's research question and hypotheses; and establishes and discusses the relationship between the key findings of this study and the relevant literature.

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CHAPTER 5 : DISCUSSION

5.1 Introduction

The previous chapter validated the proposed model of BI systems success. This chapter provides a discussion and interpretation of the results, correlating it with the research question to be answered. This chapter is organised as follows: the first section discusses the findings of the main model validation; the second section compares the middle management and operational staff structural model results; the third section gives a brief summary of the uniqueness of the study, the fourth section discusses the implications of the study; and the last section gives an overall summary of the chapter.

5.2 What are the factors that contribute to the success of BI systems in South Africa?

The purpose of this research study was to determine the post implementation factors that contribute to the success of BI systems success in South Africa. The figure below shows the significant paths validated in the previous chapter. H5 is included in the model for completeness.

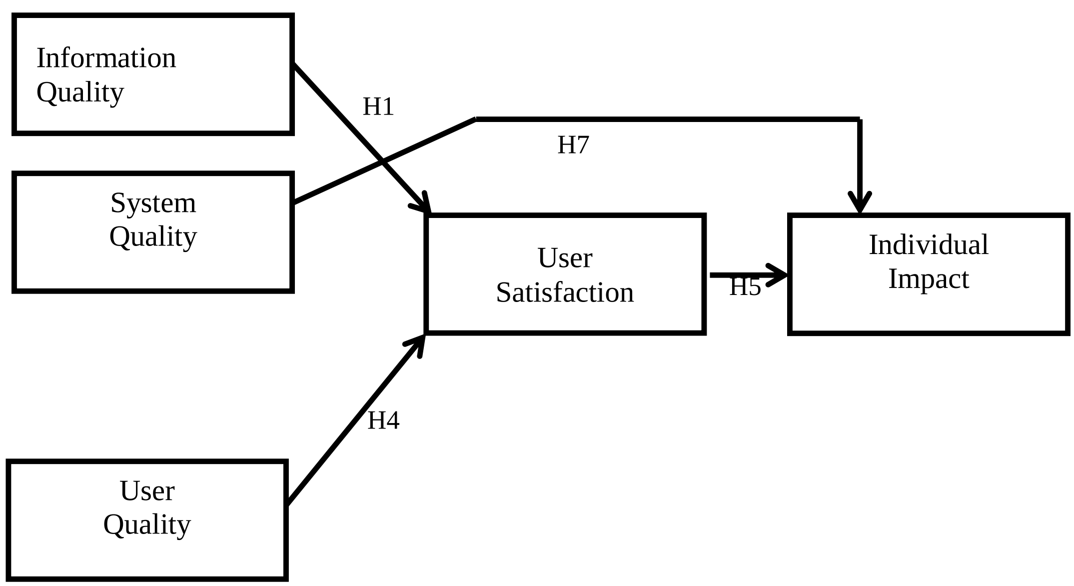

Figure 5.1: BI systems success validated model

In this study information quality was defined as the desirable characteristics of the information produced by the BI system (Petter *et al*., 2008; Hwang & Xu, 2008). Based on prior literature seven items were selected to measure information quality namely; accuracy, usefulness, timeliness, completeness, relevance, understandability[sic] and trustworthiness. The relationship between information quality and user satisfaction of a BI system in South Africa was examined by hypothesis one. This hypothesis was drawn from the updated DeLone and McLean (2003) model (as described in chapter 2). The results of the structural model show that there is a positive relationship between information quality and user satisfaction (β = .24, p =.000).

The results of this study are consistent with the results of prior studies (DeLone & McLean, 2003; Holsapple & Lee-Post, 2006; Lin, 2007; Chiu *et al*., 2007; Halawi *et al*., 2007; Leclercq, 2007; Kulkarni *et al*., 2006; Wu & Wang, 2006; Almutairi & Subramanian, 2005; Hunton & Flowers, 1997). The results also support the findings of Wixom and Todd (2005), which found that when users believe that the quality of the information provided by the BI system is favourable, they are more likely to be satisfied with it. Therefore, this study further provides support for the theory that the higher the quality of the information of the BI system the more satisfied the users will be with the BI system.

The results suggests that BI system end users are more likely to be satisfied with the BI system if the information quality is high. This finding maybe valuable and might have important implications for other companies in the developing world intending to adopt a BI system. This finding was also supported in the interviews, where all three respondents indicated information quality is a vital factor in the success of BI systems.

Organisations wishing to adopt BI systems could focus on the quality of the information in order to improve user satisfaction levels. Good information quality improves the way information is provided thereby enabling a better decision-making environment. In order to achieve high levels of information quality, BI systems need to develop and promote strategies that emphasise accuracy, completeness, currency, relevant, format, and integrity of information.

The relationship between information quality and individual impact was tested by hypothesis six. The structural model showed that the relationship between information quality and individual impact is not statistically significant (β = .01, p =.902). This finding is inconsistent with previous studies where information quality is reported to have a positive significant influence on individual impact (Santos, Takaoka & Souza, 2010). This result suggests that end users do not view information quality as affecting their job performance.

However, this study is not alone in providing evidence of a non-significant relationship between quality information and individual impact. In a study by Rudra and Yeo (2000) it was found that information quality does not directly influence IS success. Rudra and Yeo (2000) found mixed reactions to information quality by end users using DWH among large companies in Australia. In the study by Rudra and Yeo (2000) the majority of the end users were unsure of the quality of information produced by the systems and therefore did not consider it important.

In this study, system quality refers to the desirable characteristics of the BI system (Petter *et al*., 2008). The items used in this study to measure system quality were: ease of use, user friendliness, responsiveness, learnability, stability, security, and reliability and availability. Hypothesis 2 was used to find out if there is a relationship or not between system quality and user satisfaction.

H_{20}: System quality is not related to user satisfaction in a BI system.

H_{2A}: System quality is related to user satisfaction in a BI system.

The results show there is a no significant relationship between user satisfaction and system quality ($\beta = .06$, $p = .374$). This result suggests that the end users' perception of the quality of the system is not significantly related to the BI system's satisfaction levels. The results of this study do not agree with the findings of many previous studies, which suggested that system quality and user satisfaction have a strong positive relationship (DeLone & McLean, 2003; Holsapple & Lee-Post, 2006; Lin, 2007; Halawi *et al*.,2007; Kulkarni *et al*., 2006; Wu & Wang, 2006; Almutairi & Subramanian, 2005). Nevertheless, the results are consistent with the results of Wang and Liao (2008), who found an insignificant relation between system quality and user satisfaction in the banking sector in Taiwan.

The lack of statistical support for the system quality and user satisfaction could also be attributed to the difference in applications. The different types of applications investigated and the different contexts can explain differences among the results of this study and previous studies. Thus, while the present study examined BI systems in South Africa, the DeLone and McLean (2003) examined e-commerce in developed economies.

Hypothesis 7 was used to explore the relationship between system quality and individual impact. The result shows that system quality has a positive influence on individual impact ($\beta = .27$, $p = .000$). This finding is consistent with previous studies where systems quality is reported to have a positive influence on individual impact (Bharati & Chaudhury, 2006; Wixom & Todd, 2005).

This finding could be explained by the fact that the use of an easy to use, user friendly and responsive BI system could facilitate the improvement of the quality of information. Furthermore, higher levels of BI system quality may help provide easy-to-understand information outputs and timely reports, and the changed information needs can be met easily. Additionally, a poor BI system could place the business at a competitive disadvantage because of its inability to provide quality information, specifically in terms of accuracy and content.

User satisfaction was defined in the previous chapters as the perception of the end user towards the BI system in relation to what the end user expected upon first use of the BI system (Seddon, 1997). The items that were used to investigate user satisfaction were: efficiency, effectiveness and overall satisfaction. Hypothesis 5 investigated the relationship between user satisfaction and individual impact namely;

H_{50}: User satisfaction is not related to individual impact in a BI system.

H_{5A}: User satisfaction is related to individual impact in a BI system.

The results show that there is no significant relationship between individual impact and user satisfaction (β = .05, p =.487). Therefore, the null hypothesis cannot be rejected. According to Petter *et al*. (2008), there is a strong support for association between user satisfaction and individual impact. Prior studies have found user satisfaction to be positively related to: a user's job performance (Yoon & Guimaraes, 1995; Torkzadeh & Doll, 1999) increase in productivity and effectiveness (Rai *et al*., 2002; Halawi *et al*., 2007), improved decision making (Vlahos & Ferratt, 1995; Vlahos *et al*., 2004), enhanced job satisfaction (Ang & Soh, 1997).

The findings for this study are therefore inconsistent with the research studies of Yoon and Guimaraes (1995); Ang and Soh (1997). However, this research is not alone in providing evidence of a non-significant relationship between user satisfaction and individual impact. For example, Yuthas and Young (1998) found that user satisfaction was only weakly associated with decision-making performance. The result suggests that the satisfaction levels of end users has no impact on their job performance. End users within an organisation may have expectations about the BI system. If these expectations are unrealistic and cannot be met, this may cause user disappointment and dissatisfaction with the system.

User quality measures the impact of the end users' capabilities on the BI system success. The items that were used to investigate user quality were: technical skills, business skills and analysis skills. The influence of user quality on individual impact of BI systems in South Africa is examined by hypotheses nine, namely;

H_{90}: User quality is not related to individual impact in a BI system.

H_{9A}: User quality is related to individual impact in a BI system.

The results of the hypothesis test found there was no significant relationship between user quality and individual impact (β = .02, p =.779). This finding suggests that the level of the user's skills in analysing the data provided by the BI system are not very important for the success of the BI system. The results of this study do not agree with the findings of other previous studies (Wixom & Watson, 2001; Hwang *et al*., 2004). The reason of this finding could be that, the BI end users that possess the required skills such as technical, business, and analytical skills take for granted the importance of their skills in the better management of data and hence do not see these skills as impacting on their daily work tasks.

Hypothesis four examined the relationship between user quality and user satisfaction of a BI system namely:

H_{40}: User quality is not related to user satisfaction in a BI system.

H_{4A}: User quality is related to user satisfaction in a BI system.

The results of the study show that there is a positive relationship between user quality and user satisfaction (β = .30, p =.000). As the user quality levels increase, the user satisfaction levels of the BI system increases. This result is consistent with the study of Wixom and Watson (2001) which found that high levels of user skills is positively related to DWH success. A study by Hwang *et al*. (2004) also found similar results when investigating the project team skills and DWH adoption. The result of the study suggests that as the levels of user skills increase so does the user satisfaction with the BI system.

The reason for this finding could be that, highly skilled BI end users do not have unrealistic expectations of their BI systems and hence are more easily to be satisfied by the BI systems. Furthermore, knowledgeable BI end users are more likely to comprehend the business requirements and have the resolve to make action-based decisions which result in the improvement of the business.

5.3 Employment Groups

The previous chapter presented the results of this research, which included all end users surveyed in this study. This section discusses the two employment cohorts namely Middle Management and Operational Staff which were analysed to determine if there were any differences between the two groups.

Firstly, the findings of this study revealed two BI systems success structural models for Middle Management and Operational Staff. The Top Management group sample did not meet the minimum threshold for analysis. The research proposed several BI systems success constructs and their inter relationships. However, the data analysis revealed that the existence of these success construct differed slightly between the two job roles. Table 5.1 compares between the two job role models in terms of the relationships between success factors.

Table 5.1 : Comparison of Structural Models

			Middle Management	Operational Staff
User_satisfaction	<---	User_quality	√	√
User_satisfaction	<---	System_quality	×	×
User_satisfaction	<---	Information_quality	×	√
Individual_impact	<---	User_quality	√	×
Individual_impact	<---	System_quality	×	×
Individual_impact	<---	Information_quality	×	×
Individual_impact	<---	User_satisfaction	×	×

Table 5.1 displays only two significant paths in both job roles. In both Operational Staff and Middle Management, there is a positive relationship between user quality and user satisfaction in a BI system. The result might suggest that both groups view user quality as an important success factor. The other significant path among Middle Management Staff is the association between user quality and individual impact (β = -.35, p =.023). However, this relationship is negative meaning that if user quality levels increase then individual impact decreases. If the individual impact of the BI system increases then user quality decreases. The second significant path for the Operational Staff is that of information quality and user satisfaction (β = .25, p =.000). This is a positive association, as the quality of information increases the levels of user satisfaction increases.

5.4 Originality of Study

The study is original in the following ways:

Firstly, the study used an adapted model of the DeLone and McLean (2003) model as the underlying model for the present study. DeLone and McLean (2003) suggested that researchers should adapt the research model to suit specific contexts (Dinter & Schieder, 2011). In this study the DeLone and McLean (2003) model was adapted by removing the use construct and adding a user quality construct.

Secondly, to the best of the researcher's knowledge, there is no prior studies that were conducted to determine the post implementation success of BI systems in South Africa. This study uses the adapted DeLone and McLean (2003) to asses post implementation success of BI systems in a South African context.

5.5 Implications

This study might have important implications for researchers and practitioners in South Africa and in other developing countries. On one hand, the study model extends the DeLone and McLean success model to account for the factors and sub factors of a BI system's success in South Africa organisations. The results therefore contribute to the research on BI systems as well as to the research on the DeLone and McLean model and IS success in general.

Furthermore, the results could be of value to the business community involved in developing and implementing BI systems. Given the significant expenditures associated with the implementation of BI systems (Gonsalves, 2008), the identification of BI system success factors might help choose an appropriate BI strategy that could be undertaken to improve the chances of success and continuous use of such expensive systems.

5.6 Summary

This chapter has discussed and interpreted the results of the study. The next chapter is the final chapter of this study and it contains the overall summary of the study, contribution of the research to knowledge, limitations of the study, as well as management guidelines. It concludes with recommendations for future study.

CHAPTER 6 : CONCLUSION

6.1 Introduction

Chapter 5 discussed the results of the research. The aim of this chapter is to bring to a conclusion this study on the success of BI systems in South Africa. The chapter is divided into eight sections. Section 6.1 provides a brief introduction of the chapter. Section 6.2 provides an overall summary of the study. Next, section 6.3 provides a summary of the principal research question. The contributions of the study are discussed in section 6.4. Limitations of the study are detailed in section 6.5. Management Guidelines are provided in section 6.6. Section 6.7 suggests directions for future research study. The last section provides the final concluding remarks of the study.

6.2 Overall Summary of the Study

An examination of the literature provided evidence of a gap in the literature on factors influencing the success of BI systems in South Africa. The problem that the study sought to address is the absence of formal management guidelines for managers and practitioners in South African organisations regarding how to assess post implementation BI systems success.

The study proposed a theoretical model based on the updated DeLone and McLean (2003) model. The factors and items of the initial research model were formulated from the literature review. Thereafter the initial research model was validated and enhanced by a qualitative study. The qualitative study involved three semi-structured interviews with BI systems end users in South Africa. A panel of experts was used to further refine the model.

The combination of factors and sub factors from the literature, interviews, and the Delphi method resulted in the formulation of a final research model that consisted of the following factors: system quality; information quality; service quality; user satisfaction; user quality; and individual impact. A questionnaire to assess BI systems success was developed based on the theoretical research model. The questionnaire utilised a 5 point-Likert-scale ranging from strongly agree to strongly disagree.

The initial research questionnaire was pre-tested by five conveniently selected professionals. The layout and contents of the questionnaire were slightly revised according to the feedback obtained. The main survey was then administered to randomly selected end users of BI systems in companies in South Africa. There were 211 valid responses. The majority of the respondents of the study were male (57.3%) and 42.7% female. In addition, most of the respondents of the study were aged between 31 to 40 years old. In terms of length of service, most of the respondents have been in their current positions for more than 5 years (68%).

SPSS-Amos was used as the path analysis software. The analysis followed a sequential assessment, starting with the measurement model and then using the structural model. The results of the hypotheses were mixed. Three suggested relationships were found to be statistically significant, two relationships were not tested while the other four were not supported.

The following relationships were supported: Information quality is positively related to user satisfaction in a BI system, system quality is positively related to individual impact in a BI system and user quality is positively related to user satisfaction in a BI system.

The following section highlights the contribution of each chapter to the study:

Chapter 1 introduced the overall background of the study. Chapter 1 also outlined the aim and research objectives of the study. Chapter 1 also explained the research design used to reach the aim and the objectives of the study. Chapter 1 also provided a justification of the study.

Chapter 2 presented an examination of the related literature in order to provide a theoretical background for the study. The chapter began by defining BI. There are various definitions of BI in the literature. The following definition of BI was chosen for use in the present study. BI is the use of technologies, applications, and processes to gather, store and analyse data to enhance decision-making (Wixom & Watson, 2010).

Drawing from different sources the chapter also presented an examination of key characteristics of a typical BI System. Chapter 2 also provided an overview of the international and South African BI industry. Chapter 2 also compared how a typical BI system differs from a transactional IS. Chapter 2 proposed a BI systems success theoretic framework. The proposed research model was adapted from the updated DeLone and McLean (2003), as well as from a semi structured interviews with BI systems end users. The purpose of these interviews with end users was to determine if the theoretical model would be supported by the views of local BI systems end users.

The theoretical model was then presented to a panel of expert informants for further validation. The study identified six BI systems success factors namely: system quality, information quality, service quality, system usage, user satisfaction and individual impact. Nine statistical relationships between the independent variables and the dependent variables were hypothesised.

Chapter 3 described the research design and methodology that was used to answer the research question for the study. The research paradigm, research approach, research design; data collection; the development of the instruments; reliability and validity of the instrument; and the data analysis used to test the research hypotheses were discussed.

Chapter 4 presented the results of the research. The results were presented in three main sections. First, the results of the short semi structured interviews are presented, followed by the results of Delphi method. Finally, the results of the main quantitative study are presented.

Chapter 5 discussed the results of the main quantitative study.

Chapter 6 is the final chapter of the study. This chapter presents an overview of the study, highlights the key findings, summarises how the research question was answered, presents the contribution of the research to the existing body of knowledge, discusses the limitations of the study, and identifies opportunities for further study.

6.3 Re-visiting the Research Question

This section reviews how the sub-questions were answered. The answers to these sub-questions contributed to achieving the broader study objective, which was to address the main research question:

What are the factors that contribute to the success of BI systems in South Africa?

To answer the main research question, the following four sub-research questions were identified and investigated:

- What existing IS success theoretical frameworks can be used in the context of BI systems?
- What are the factors influencing the success of BI systems as perceived by BI end-users in South African organisations?

- What are the factors influencing the success of BI systems as perceived by BI experts in South Africa?
- To what extent does the hypothesised BI system success model fit into the identified factors?

Answers to the four sub-questions yielded the answer to the main research question. A summary of the answers for these sub-questions is presented below:

6.3.1 Sub-question 1

What existing information systems success theoretical frameworks can be used in the context of BI systems?

This sub question was intended to assist in the understanding of existing IS success theories.

To answer this sub-question, a detailed literature review was conducted on BI and IS success and presented in Chapter 2. It was found that while there are many sources on the success of IS systems in general, no empirical research on BI systems success in a developing country context had been undertaken (see Appendix J). Chapter 2 discussed the existing IS success models present in the literature and examined the usefulness that these models offer to the research question posed in Chapter 1. The Updated DeLone and McLean (2003) IS Success model appeared as one of the most comprehensive models supported with numerous empirical study applications. Thus the Updated DeLone and McLean (2003) IS Success model was chosen as the underlying model for the present study. The Updated DeLone and McLean (2003) model is made up of six constructs namely:

- systems quality;
- information quality;
- service quality;
- system usage;
- user satisfaction; and
- net benefits.

6.3.2 Sub-Question 2

What are the factors influencing the success of BI systems as perceived by BI end-users in South African organisations?

To answer sub question two, semi-structured interviews with three end users were conducted. The results of this phase were discussed in Chapter four. The interviews provided direction as to what variables and items were important for organisations in South Africa. Furthermore, the purpose of this question was to: identify any additional BI specific success factors not highlighted through the literature review. The initial model (identified in sub-question 1) was modified, based on the results from the interviews.

6.3.3 Sub-Question 3

What are the factors influencing the success of BI systems as perceived by BI experts in South Africa? In order to verify, whether the theoretical model derived from the literature review and the small-scale exploratory study phase, commands support the theoretical model was presented to a panel of experts. As a result of the feedback obtained from the expert panel changes were made to the theoretical model.

6.3.4 Sub Question 4

To what extent does the hypothesised BI system success model fit into the identified factors?
To answer this sub-question, the hypothesised model, developed from the previous sub questions, was empirically tested. The hypothesised model of BI systems success was made up of six factors namely:

- information quality;
- system quality;
- service quality;
- user satisfaction;
- user quality; and
- individual impact.

Nine hypotheses were posited. SEM was employed in testing the hypotheses. Figure 6.1 shows the structural model results showing both significant and non-significant paths.

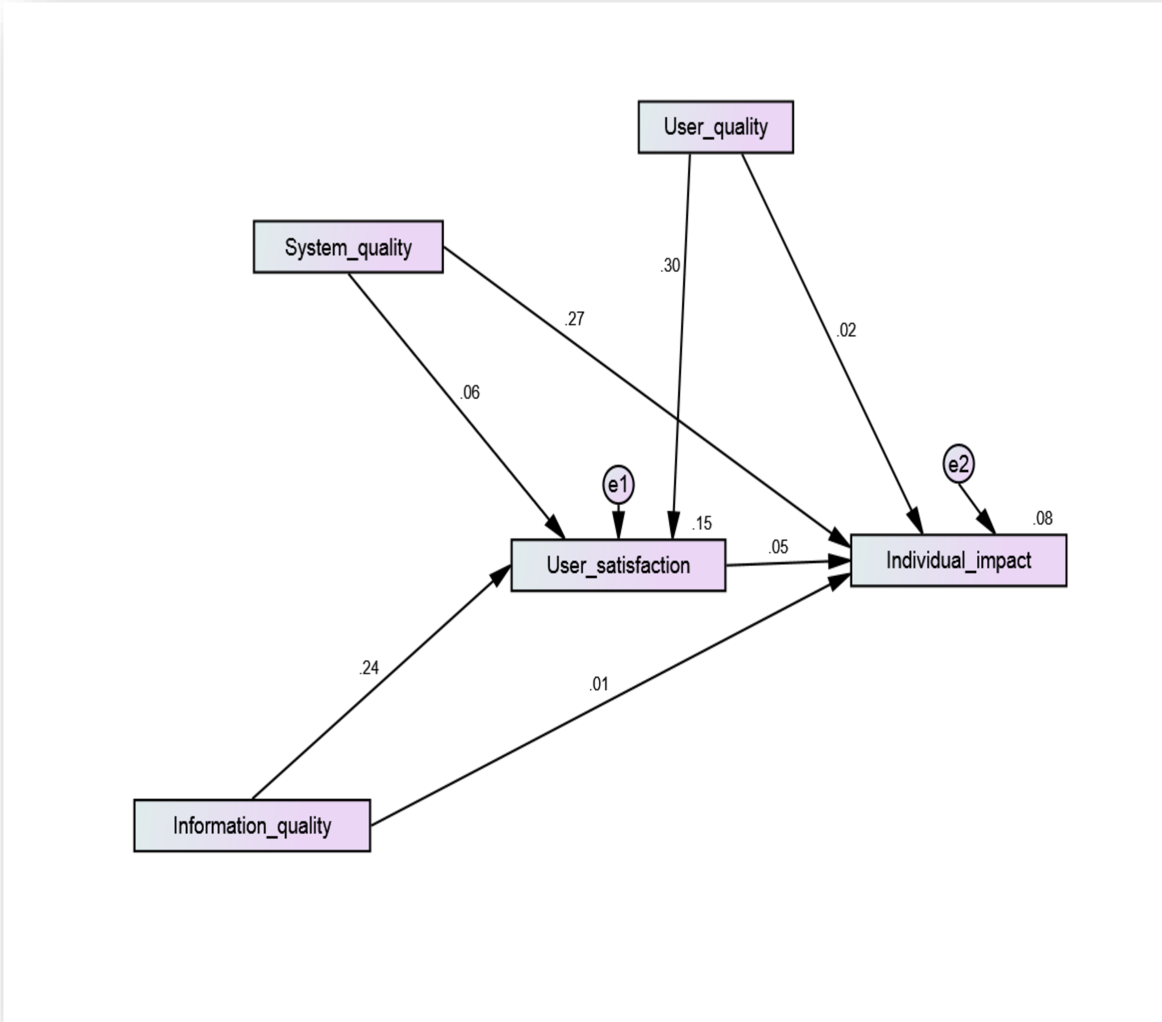

Figure 6.1: BI system success Structural Model

6.3.4.1 Reflection on the findings regarding information quality

The results of the study presented and discussed in chapter 5 show that information quality has no significant relationship with individual impact in a BI system. This result suggests that higher quality information will not significantly affect the individual impact of a BI system. However, the results of this study presented and discussed in Chapter 5 show that information quality has a positive influence on user satisfaction in a BI system. This result suggests that the higher the information quality, the more users are likely to be satisfied with the BI system. This result is supported by previous researches such as Hunton and Flowers (1997) who found a positive relationship between information quality and user satisfaction in an accounting information system context. Rai *et al*., (2002) also found that information quality strongly and positively impact on user satisfaction in an IS environment.

6.3.4.2 Reflection on the findings regarding system quality

According to the findings presented and discussed in Chapter 5, the results of the study show that system quality does not influence user satisfaction in a BI system. The results of the test on the effect of system quality on individual impact found that system quality is positively related to individual impact in a BI system. As the quality of the system increases, the individual impact levels increases.

6.3.4.3 Reflection on the findings regarding user quality

The following three items measured the user quality construct: business skills, technical skills and analytical skills. The empirical results of the study indicate that there is no significant relationship between user quality and individual impact in a BI system. This finding suggested that the user capabilities do not significantly influence individual impact of the BI system. The results of the study indicate that user quality influences user satisfaction positively.

6.3.4.4 Reflection on the findings regarding user satisfaction

The empirical results of the study indicate that user satisfaction does not significantly influence individual impact. These results are inconsistent with the IS success model by DeLone and McLean (2003) which suggested that user satisfaction is positively related to net benefits in an ecommerce IS.

6.3.4.5 Reflection on the findings regarding employment groups

This study also assessed BI Success from multiple stakeholder perspectives. Using the classification of employment groups into top management, middle management and operational staff, the data analysis reveals that each stakeholder group tends to be better informed about, and more influenced by particular BI Success factors.

There are two paths that are significant for the middle management group. There is a positive relationship between user quality and user satisfaction, meaning that when user quality increases the user satisfaction increases. There is a negative relationship between user quality and individual impact; meaning that when user quality increases its influence on individual impact decreases.

There are also two paths that are significant for the operational staff group. There is a positive relationship between user quality and user satisfaction, meaning that when user quality increases the user satisfaction also increases. There is a positive relationship between information quality and user satisfaction; meaning that when information quality increases its impact on user satisfaction increases.

6.4 Contribution of the Research to Knowledge

The study is the only one identified by the researcher that formulates and empirically tests a BI systems success model based on the DeLone and McLean (2003) IS success model in a South African context (appendix A). The contributions are discussed below and divided into contributions to theory and contributions to practise.

6.4.1 Contribution to Theory

The study contributed to a theoretical improvement of the existing level of knowledge in the current literature on BI systems success. This was attained by empirically testing the research model among end users of BI systems in South Africa. Firstly, although success factors for BI have been researched, the majority of studies in this area tend to focus on BI implementation success factors in developed countries (Joshi & Curtis, 1999; Wixom & Watson, 2001; Chenoweth *et al*., 2006; Hwang & Xu, 2008; Hawking & Sellitto, 2010).

The researcher found no prior research that had studied factors influencing the post implementation success of BI systems in a South African context (see Appendix I). Developing countries experience different challenges to developed countries, it is therefore important to identify factors that influence IS success in developing countries (Murugan, *et al*., 2000).

By using the DeLone and McLean (2003) model as its foundation, this research adds to the area of IS success by supporting the DeLone and McLean (2003) model and by refining it to be more suited to BI systems success, specifically in the context of South Africa. Some of the factors identified through this research as important to BI success corroborate previous literature.

Principally, information quality was found to be positively related to user satisfaction in a BI system. This finding is in agreement with previous BI literature (DeLone & McLean, 2003; Holsapple & Lee-Post, 2006). User satisfaction was also found to be related to user quality in a BI system. This study has added support to the relationship between system quality being closely linked to individual impact in a BI system (DeLone & McLean, 2003; Holsapple & Lee-Post, 2006).

Contrary to much of the IS literature (Leonard & Sensiper, 1998; Nonaka & Takeuchi, 1995), this research has found that system quality has no significant relationship to user satisfaction. This is an important contribution as it indicates that the theory of increased system quality levels leading to increased user satisfaction is not necessarily realised in practise.

The different types of applications investigated and the different contexts can explain differences among the findings of this study and previous research. Thus, while the present study examined BI systems in South Africa, the DeLone and McLean (2003) examined e-commerce in more developed economies. Even though, the DeLone and McLean (2003) model is intended to be valid for all IS in general DeLone and McLean (2003) recommended that researchers should adapt the research model for specific domains to better address their characteristics (Dinter & Schieder, 2011) . In this study, the success constructs where adapted to suit the BI context.

6.4.2 Contribution to Practise

The model of BI system success formulated and tested in this study may be of interest to organisations wishing to adopt or that have adopted BI systems. There are two groups of people who could possibly be directly advantaged by this study. First are the BI practitioners and managers who work directly with the BI systems. The second group comprises of those in the BI vendor industry.

First, from a practical point of view, this study may help organisations in South Africa and other developing countries uncover areas that are important for the implementation of a BI strategy. Therefore, the main practical implication of this research for BI practitioners and managers is that they could become more aware of what factors influence the success of the BI systems they develop.

With these factors in mind, the BI practitioners are then able to incorporate into their development such factors as system ease of use, system ease of learning, system stability and security. This research enables the various people in the BI vendor industry to understand the pitfalls of BI adoption and the reasons why adoption can be problematic, taking a more proactive approach when new solutions are been developed.

The proposed model provides Managers with a fresh perspective for dealing with BI systems success by proposing that the information quality perceived by users is one of the pointers of using such systems. Management can then focus those areas to try to ensure the success of a BI project.

Furthermore, the success factors identified in this study can potentially be used as a checklist for practitioners in the implementing of a BI project. Business organisations wanting to adopt BI could benefit in that they could be better prepared to identify the key success factors of BI thereby minimising the adoption risks associated with BI projects.

Secondly, academic institutions may benefit from the knowledge of BI success factors. South African universities could develop professional short courses targeted at IT knowledge workers and CIOs that focus on BI success in developing countries. It is the hope of this researcher that data from this study can offer better information on IS Management practises.

Thirdly, this study sought to identify success factors of BI systems in South Africa. The study findings were thus of significance by providing the empirical evidence of various factors influencing BI success.

Finally, the study promises to benefit companies who have implemented BI systems, by providing them with a means to benchmark their implementations and to identify areas upon which to concentrate their optimisation initiatives.

6.5 Limitations of the Study

There are some limitations to this study. The limitations are as follows:

First, the study utilised self-reported questionnaires, the study participants were asked to answer the survey questions based on the perception of the BI system in their organisations. Self-reporting bias may lead respondents to over-report those factors that seem to be more acceptable.

Another limitation was that the independent and the dependent variables were measured from the same questionnaire, which has a potential for common methods bias. Harmon's one factor technique was utilised in this study to test for bias due to common method bias (Podsakoff *et al*., 2003).

The third limitation was that the empirical and theoretical literature on the subject of BI success has emanated predominantly from the developed economies. The absence of relevant local literature was a limitation in the sense that the present findings could not be discussed in context.

6.6 Management Guidelines

The present study has developed a set of management guidelines that may help organisations in successfully managing and implementing BI systems. These guidelines have been developed from the research models, as well as from the data analysis of the data collected in the study. In order to aid future success of BI systems the following seven practical management guidelines are proposed:

- Invest in training end users of BI systems not only in the use of the BI system, but also in understanding how their work fits into the whole business.
- Include the end users from the start in the development of any BI systems, this includes including the users in the selection of a BI tool so that all users embrace the BI tool.
- Focus on solving technical system challenges by choosing BI tools that are easy to use, user friendly and provide flexibility to the end users by integrating with other applications.
- Manage service quality levels - to ensure the continuity of the BI service and maintain the availability of information at an acceptable level.
- Information Quality management – formally manage the information quality to ensure the reliability of the data and information used in the organisation. This can be done by developing a data governance framework
- Based on the different needs of middle management and operational staff, organisations must aim to develop and manage BI systems that meet the different needs of the different user groups in mind.
- Manage end user expectations in order to guard against unrealistic expectations of the BI system.

The above-mentioned guidelines include some of the possible aspects that could have an effect on the success of BI systems. Addressing and applying the proposed guidelines may assist with the successful implementation and management of BI systems in South Africa.

6.7 Recommendations for Future Study

Despite the limitations briefly discussed in section 6.5, the present study developed a model that might provide valuable insight into the study of BI systems success in South African organisations. The limitations acknowledged therefore provide some suggestions for further research. The recommendations for future study are discussed in this section. The suggested recommendations are as follows:

First, the proposed model validated in this study incorporated only part of the updated DeLone and McLean (2003) model. Further research could consider incorporating and validating other aspects of the updated DeLone and McLean (2003) model such as the feedback loop between net benefits and user satisfaction.

Secondly, a research study focussing on a specific industry could be very helpful in facilitating a clearer understanding of success factors in specific industries.

Thirdly developing an instrument that captures the dependent and independent variables separately to eliminate the possibility of common methods bias.

Finally, increasing the number of interviewees could help to enhance and validate the final model developed and also provide a balanced view of different end users in different industries. This can also facilitate a broader list of success factors, possibly not identified by this study.

6.8 Concluding Remarks

This last chapter of the study has summarised the study, discussed the main contributions of this study to theory and practice, summarised the limitations of the study, provided some managerial guidelines; and suggested directions for future study. The results of this study enrich current IS literature on the topic of IS success, by specifically looking at the success of BI systems in a South African context. The study measured the responses of BI end users in organisations in South Africa on their perceptions of BI systems. These results were then used to gauge what factors lead users to perceiving a BI system as being successful.

Despite the limitations of the study identified in section 6.5, this study has made important contributions to the literature. Firstly, it modified the DeLone and McLean (2003) model to assess the success of BI systems in a South African context which is a developing economy. Secondly, it aided in evaluating end user interest and factors influencing acceptance of BI systems in South Africa. Further research could extrapolate from the current research and confirm whether or not this conceptual model provides similar results in different organisations and contexts.

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Appendix A: Main Study Questionnaire

* Required
Section A: Background Information
1. Age *

- <21
- 21-30
- 31-40
- 41-50
- 51-60
- >60

2. Gender *

- Male
- Female

3. Race *

- Black
- Indian
- Coloured
- White
- Other:

4. What is your Highest Level of Education? *

- < Matric
- Matric
- Diploma
- Bachelor's Degree
- Master's Degree
- Doctoral Degree

5. How would you describe your role? *

- Top Management
- Middle Management
- Operational Staff
- Other:

6. How long have you held your current position? *

- <1 year
- 1-5 years

- 6-10 years
- >10 years

7. What industry sector does your organisation operate in? *

- Telecoms
- Financial Services
- Mining
- Other

Information Quality (the desirable characteristics of the Business Intelligence System outputs)

8. The information I get from the Business Intelligence System is easy to understand *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

9. The Business Intelligence System provides accurate information. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

10. The Business Intelligence System provides complete information. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

11. The Business Intelligence System provides up-to-date information. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

12. The Business Intelligence System provides information that is exactly what I need. *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

13. The Business Intelligence System provides trustworthy information. *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

14. The Business Intelligence System provides information that is easy to understand. *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

15. The Business Intelligence System is very helpful and makes me more productive. *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

16. I am satisfied that Business Intelligence System meets my information processing needs. *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

17. The information from the Business Intelligence system is relevant to my needs *

Strongly disagree

Disagree

Neutral

- Agree
- Strongly agree

User Satisfaction

18. I am satisfied with the Business Intelligence System efficiency. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

19. I am satisfied with the Business Intelligence System effectiveness. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

20. Overall, I am satisfied with the Business Intelligence System. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

User Quality

21. Business Intelligence System users should be knowledgeable in their business or working environment. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

22. Business Intelligence System users should have technical skills of how to use the system in their organisation. *

- Strongly disagree
- Disagree
- Neutral

Agree

Strongly agree

23. Business Intelligence System users should have an ability to analyse data from the system in their organisation. *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

System Quality (the desirable characteristics of the Business Intelligence System)

24. The Business Intelligence System is easy to use *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

25. The Business Intelligence System is user friendly *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

26. The Business Intelligence System returns my requests quickly and in a timely manner. *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

27. The Business Intelligence System is easy to learn. *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

28. The Business Intelligence System is consistent. *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

29. The Business Intelligence System issafe. *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

30. The Business Intelligence System is dependable (does what is expected) *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

31. The Business Intelligence System is always available for use when I need to use it *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

Individual Impact (the extent to which the Business Intelligence System is contributing to the success of the individual)

32. Using the Business Intelligence System improves my job performance. *

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

33. Using the Business Intelligence System in my job increases my productivity. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

34. The Business Intelligence System enhances my effectiveness in my job *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

35. Using the Business Intelligence System helps me to spend more time analysing the data before making a decision *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

36. Using the Business Intelligence System in my job improves my decision-making quality. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

37. Using the Business Intelligence System helps me to identify potential problems faster. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

38. Using the Business Intelligence System helps me to shorten the time frame for making decisions. *

- Strongly disagree

- Disagree
- Neutral
- Agree
- Strongly agree

Service Quality (the quality of the support that users receive from the Information System department and Information Technology support personnel)

39. The Business Intelligence support team provides service as promised. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

40. The Business Intelligence System support team performs service right the first time. *

- (selected) Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

41. The Business Intelligence System support team keeps users informed about when service will be performed. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

42. The Business Intelligence System support team has a willingness to help users. *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

43. The Business Intelligence System support team provides a prompt service to users. *

- Strongly disagree
- Disagree

- Neutral
- Agree
- Strongly agree

Appendix B: Invitation Letter for the Survey

UNIVERSITY OF KWAZULU-NATAL
School of Management and IT Governance

PhD Research

Researcher: Taurayi Mudzana (0714113122)

Supervisor: Prof MS Maharaj (031-260 8023)

Research Office: Ms P Ximba 031-260 3587

Dear Respondent,

I, Taurayi Mudzana, am a Phd student in the School of Management and IT Governance, at the University of KwaZulu-Natal. You are invited to participate in a research project entitled: *Business Intelligence Information Systems Success: A South African Study*.

The aim of this study is to identify the factors contributing to the success of Business Intelligence Systems in South African Organisations. Through your participation I hope to understand what the success factors of Business Intelligence systems in South Africa are. The results of this survey are intended to contribute to the understanding of information systems Success in developing countries in general and South Africa in particular.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this research project. Confidentiality and anonymity of records identifying you as a participant will be maintained by the School of Management and IT Governance, UKZN.

If you have any questions or concerns about participating in this study, please contact me or my supervisor at the numbers listed above.

It should take you about 10 minutes/s to complete the questionnaire. I hope you will take the time to complete the questionnaire.

Sincerely

Investigator's signature Date :

Appendix C: Consent Form

UNIVERSITY OF KWAZULU-NATAL
School of Management and IT Governance

PhD Research

Researcher: Taurayi Mudzana (0714113122)

Supervisor: Prof MS Maharaj (031-260 8023)

Research Office: Ms P Ximba 031-2603587

CONSENT

I____(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

____________________ ____________________

Signature of Participant Date

Appendix D: Interview Guide

UNIVERSITY OF KWAZULU-NATAL
SCHOOL OF MANAGEMENT, IT AND GOVRNANCE
PhD Research Project

Researcher: Mr. Taurayi Mudzana, Tel: 071-4113122
Supervisor: Prof. Manoj Maharaj,Tel: 031-2608023
Research Office: Ms P. Ximba, Tel: 031-2603587

Title: Business Intelligence Information Systems Success: a South African study.

Section A: Information about respondent

Designation:
Organisation:
Sex:
Highest Education Qualification:
Date of the interview:
Years Experience:

Section B:

#	Question
1	Please tell me what you understand by the term Business Intelligence?
2	What are some of the benefits you are deriving from using Business Intelligence Systems?
	What do you think are the main Information Quality sub-factors that affect the use of Business Intelligence Systems in your organisation?
3	What do you think are the main System Quality sub-factors that affect the use of Business Intelligence Systems in your organisation?
4	What do you think are the main Service Quality sub-factors that affect the use of Business Intelligence Systems in your organisation?
5	Are there any other factors and sub-factors that you think affect the use of Business Intelligence Systems?

Thank you for participating.

Appendix E: English Language Editing

Heather Cousins

language editing & proofreading

hcousins78@gmail.com

076 472 4542

Date: **10 August 2015**

Dear Sir or Madam

RE: DECLARATION BY LANGUAGE PRACTITIONER

I, ***Heather Cousins,*** certify that I have checked the language and grammatical structure of the treatise document prepared by ***Taurayi Mudzana.***

Where possible I have made changes directly to the text and in other instances, have suggested changes. It remains the responsibility of the student to accept or reject such suggestions.

Regards,

Heather Cousins

Appendix F: Nexus Data

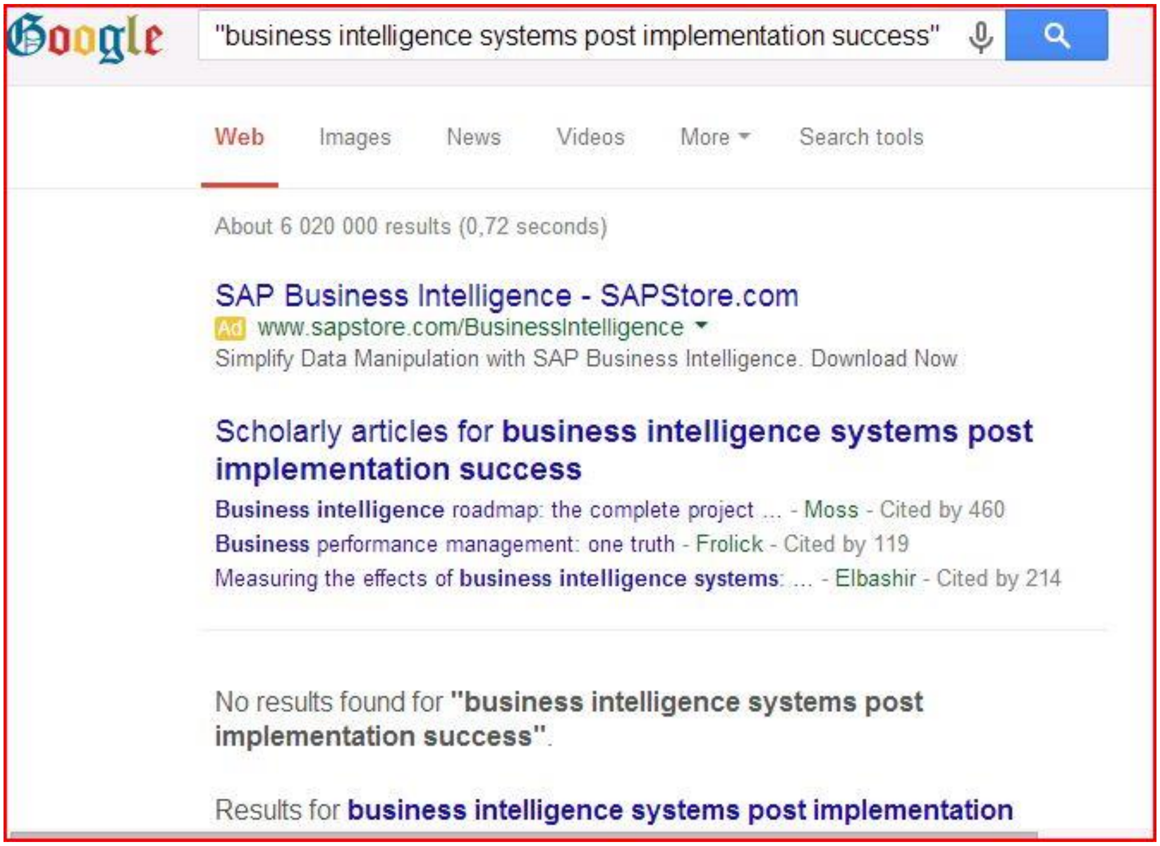
Author	Year	Title	Status
Crossland MJ	2010	How business intelligence is adding business value	Completed
Denham L-A	2009	The strategic use of business intelligence systems	Completed
Pillay N	2007	Application of business intelligence in demand management to improve delivery timeframes and increase customer satisfaction	Completed
Conradie PJ	2005	An industrial engineering perspective of business intelligence	Completed
Ackerman M	2004	Processes for unlocking auctionable business intelligence in SA banking institutions	Completed
Zagey S	1999	The role of business intelligence software and data warehousing in developing multidimensional managers and transforming users into knowledge users	Completed
Harmse SSA	2011	Business intelligence/data warehousing	Current
Hartley MK	2011	An analysis of the use of business intelligence for improved public service delivery	Current
Clavier RP	2010	A service-dominant logic approach to business intelligence	Current
Maponya E	2010	Feasibility study into the implementation of business	Current

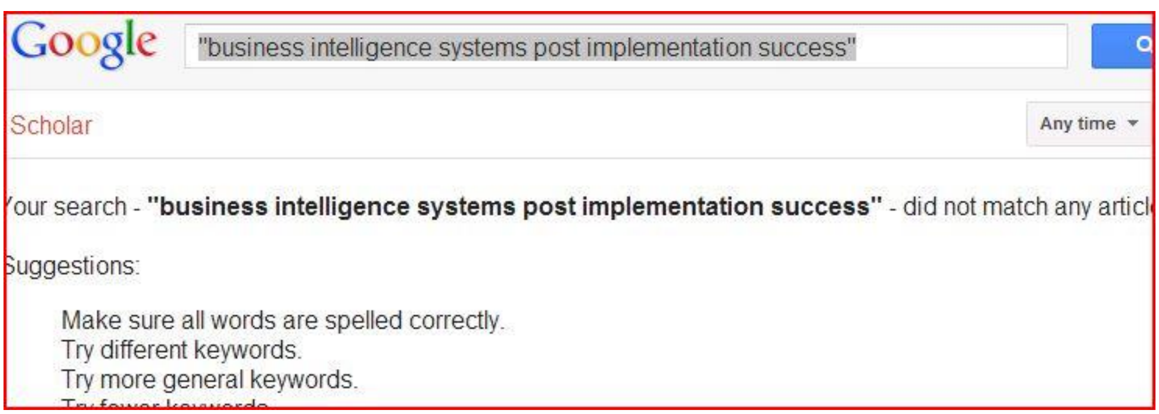
		intelligence within the Auditor-General of South Africa	
Kruger JP	2008	The development of a theoretical model for strategic intelligence for use within the South African business environment	Current
Prior IW	2007	Investigating business intelligence communication through action research methods	Current
Labuschagne LDV	2005	Sustainable business intelligence capability within an outsourced ICT environment	Current
Pretorius P	2003	A strategic focus on competitive intelligence in a business environment	Current

Year (If Status is Completed the Year is Year of Completion else if status is current then Year is Start Date)

Appendix G: Snapshots

Examples of search engine results from Google and Google Scholar





Appendix H: Invitation Letter to Participate in a Delphi Study

Dear [expert name]

My name is Taurayi Mudzana, I am registered for a PhD in the College of Law and Management Studies at the University of KwaZulu-Natal under the supervision of Prof Manoj Maharaj (email: maharajms@ukzn.ac.za)

The area of my research is on Business Intelligence Systems success in South Africa.
I will be using a Delphi approach and I am in the process of compiling a panel of experts in the field to participate in the process.

It would be greatly appreciate if you would consent to participating in the study.

If you have any questions please do not hesitate to contact my supervisor or me.

Kind Regards,

Taurayi Mudzana
Phd Student
College of Law and Management studies
University of KwaZulu-Natal
email: 211559325@ukzn.ac.za
Cell : +27 714113122

Appendix I: Statistical Analysis

Empower your research project

Research & Training

Statistical Analysis Declaration

TO WHOM IT MAY CONCERN

This is to certify that I (Nkwei Emile- consultant at Osmoz Consulting) have conducted the statistical analysis for the dissertation:

BUSINESS INTELLIGENCE INFORMATION SYSTEMS SUCCESS: A SOUTH AFRICAN STUDY

Candidate: Mudzana T

Tel. +27110716993; Mob.078 780 3795; 0745642967/ 33, 7th avenue Florida, Johannesburg, South-Africa
Website: www.osmozconsulting.com

Appendix J: Ethical Clearance Letter

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

4 July 2013

Mr Taurayi Mudzana 211359324
School of Management, IT and Governance
Westville Campus

Protocol reference number: HSS/0551/013D
Project title: Business Intelligence Information Systems Success: A South African Study.

Dear Mr Mudzana

Expedited Approval

I wish to inform you that your application has been granted Full Approval.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. Please note: Research data should be securely stored in the school/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

....
Dr S Singh (Deputy Chair)

/pm

cc Supervisor: Professor MS Maharaj
cc Academic Leader Research: Professor B McArthur
cc Post Graduate Administrator: Ms Angela Pearce

Humanities & Social Sciences Research Ethics Committee
Professor Urmila Bob (Chair) and Dr Shenuka Singh (Deputy Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Telephone: +27 (0)31 260 3587/8350/4557 **Facsimile:** +27 (0)31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

Founding Campuses: Edgewood, Howard College, Medical School, Pietermaritzburg, Westville

INSPIRING GREATNESS