Technical capabilities of Business Intelligence systems in South African medium to large organisations

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Abstract

Companies are putting in place systems that might assist in attaining their business goals and vision to improve the running of their business processes. Companies are looking at Business Intelligence (BI) as a means to attain a competitive edge over competitors, predict future trends, improve strategic decision making, facilitate quick and reliable decision making, or make the day-to-day running of business easier.

The study looks at the perspective of middle to top management on the context of BI, with main focus on the technical capabilities of BI within medium to large companies in South Africa. To obtain factors relevant to the South African business context, an online survey was conducted with various sectors of South African industry.

The study is part of research conducted collaboratively by the University of the Western Cape and Neu-Ulm University of Applied Sciences in Germany. It focuses on exploring usage of Business Intelligence Systems (BIS) together with Corporate Performance. Online surveys were conducted that targeted medium to large companies in Germany and South Africa by questioning middle to top management on issues surrounding BIS and Corporate Performance. On this basis online survey approach was taken to ensure required number of participants would be covered and approached. Therefore, the research adopted stratified sample method for the online survey. Stratified sampling enabled the expansion of the research by gathering and collaborating participants responses on the research question and eliminate the possibilities of unreliable sample from large population.

The study outlines that apart from obtaining and implementing a successful BI solution, the need for an organisation to support users of BI systems by providing the applicable skills and

training is of paramount importance to the success of the systems implemented. The study also indicates that the organisation needs to constantly equip users with technical knowledge and support to give them a high level of competency in using and navigating the BI systems.

Keywords

Business Intelligence,

Business Intelligence Systems,

South Africa,

Technical Support,

Technical Knowledge,

Online Questionnaire

Declaration

I declare that ***Technical capabilities of Business Intelligence systems in South African medium to large organisations*** is my own original work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been appropriately indicated and acknowledged as complete references.

Tatenda B Mangwayana

November 2017

Signed

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Abbreviations and acronyms

Acronym	Description
BI	Business Intelligence
BIS	Business Intelligence Systems
CPM	Corporate Performance Management
CRM	Customer Relation Management
CSF	Critical Success Factors
ERP	Enterprise Resource Planning
GDP	Gross Domestic Product
IS	Information Systems
IT	Information Technology
KPI	Key Performance Indicators
OLAP	Online Analytical Processing
PC	Personal Computer
ROI	Return on Investment
SCM	Supply Chain Management

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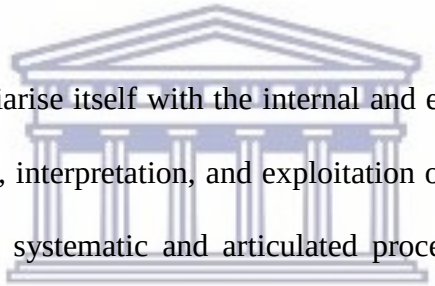
1 Nature and scope of the study

1.1 Background

Top management support, knowledge and dedication in a technical or non-technical system can determine successful system adoption, implementation and appreciation. The positive involvement of a company's top management can result in the company putting in place facilities, structures and infrastructures that attempt to ensure user satisfaction. Companies are putting in place systems that might assist in attaining business goals and achieving their visions for the better running of their business processes.



BI allows a company to familiarise itself with the internal and external environment through systemic acquisition, collation, interpretation, and exploitation of information (AB Sangar & Iahad, 2013). BI can refer to systematic and articulated procedures by which a company acquires, analyses and disseminates information, allowing it to assess future expectations, which in turn enables the company to understand the internal and external environment in which it competes (Ait-yassine, 2012; Amyot, Chen, Weiss, & Forster, 2007a).

The need for the right information, in the right form and at the right time, has seen the growth of BI usage (Oyku, 2010), which through Business Intelligence Systems (BIS) obtained acceptance within companies (Sahay & Ranjan, 2008). Companies are now using BI in an attempt to attain competitive advantage (Hung, Huang, Lin, Chen, & Tarn, 2016) and make better business decisions (Oyku, 2010; Sahay & Ranjan, 2008). Companies are making use of BI on the basis that it can make business processes and decision making easier whilst matching

up to end user requirements of quality service. BI capabilities can lead the success of a company if there is technical knowledge and support to the end users who make use of BIS (Wu, 2010).

BI aims to provide information that is demanded and relevant, yet difficult to adapt to the company's needs. End users – especially employees, being the main users of the system – are typically limited in terms of the expertise needed to run queries or reports, and hence seek assistance from Information Technology (IT) experts (Spahn, Kleb, Grimm, & Scheidl, n.d.). Support and knowledge of technologies are therefore vital, whether via BI tools or systems that can easily interact with users without the need for IT expertise.

This study was part of the research that was conducted in collaboration by the University of the Western Cape and Neu-Ulm University of Applied Sciences in Germany. The research focused on exploring usage of Business Intelligence Systems (BIS) together with Corporate Performance. Online surveys were conducted that target German and South African medium to large companies by questioning middle to top management on issues surrounding BIS and Corporate Performance. The participants didn't need to have an information system background but may be users as well of the BI systems in the respective companies.

This study focuses on South African medium to large companies by investigating the perspective of middle to top management on the technical capabilities of BI that allow the organisation to realise business value of BI. As well as the technical support and knowledge that the organisation have in place to facilitate the successful usage of BI systems. The participants were also considered as end users of the BI system and key decision makers to the introduction or adaptation of BI systems within the respective companies.

1.2 The research problem

Business objectives are used to obtain a competitive advantage, better decision making, and return on investment (ROI) (Jourdan, Rainer, & Marshall, 2008a) from investing in and implementing BI. The introduction and adoption of BI within companies has seen many investments in BIS and benefits of BI have been identified within companies. Firms that initiate and use BI in an effective and efficient way are more likely to obtain a positive return on investment (Sahay & Ranjan, 2008). While the BI market appears vibrant and the importance of BI systems is more widely accepted, organisations have seen end-users either accepting, or rejecting or underutilising BIS (Sharma & Yetton, 2003).

Management also needs to be part of the BI project and have knowledge of the business processes for BI benefits to be fully recognised and advocate for proper usage of BIS (Sahay & Ranjan, 2008). Many companies have developed an interest in BI but there has been growing concern over the success of BI usage (Chuah & Wong, 2012). Research has identified benefits of BIS to a company (Sahay & Ranjan, 2008), but having the BI systems in place does not necessarily imply proper usage of BI systems.

The current trends within the business environment is to obtain effective and efficient knowledge of the market or competitors so as to gain a competitive advantage. While BI is fast becoming a top priority for most companies, BI systems usage remains a big challenge for top management and most of them fear BI failure (Gurjar & Rathore, 2013). Failure of BI usage has been epitomised by issues surrounding technical factors, hence the research will focus on the technical factors that contribute to the success of BI usage.

1.3 Research question and sub-questions

1.3.1 Research question

The main question of the research is thus:

> *"What are the technical capabilities that are inherent in BI systems in South African medium to large organisations?"*

1.3.2 Sub-questions

In light of the main aim, the overall research question can be broken into the following sub-questions:

- What are the reasons South African companies want to use BI?
- How is technical knowledge and support defined within the context of BI acceptance and usage?
- What driving tools are used to enable users to perform BI-related tasks?
- Why is technical knowledge and support important for to users of BI?
- How is the management perspective important in the acceptance and use of BI?

1.4 Research objectives

The research aim is to gather and articulate components that companies consider to be technical knowledge and support that might impact end users to fulfil their job tasks and role requirements. Apart from identifying these components, the research will try to ascertain the role of technical knowledge and support in end users' usage of BI systems, from the perspective

of middle to top management. This is because middle to top management might be considered the most influential parties in the implementation of most systems within a company. Middle to top management are also users of the BI system as they use this for decision making and organisation strategic planning (Hawking, 2011).

The research will assess medium to large companies in South Africa and identify key components that may affect the end users of BI systems. Apart from acknowledging the numerous benefits that BI usage may have on companies, the research aims at advocating for technical knowledge and support as of essence to successful usage of BI. These key components will be derived from reviewing past literature from within and outside South Africa. From an academic perspective, it will bring new insights into how technical capabilities can impact end user tasks and daily operations. The strategic aim is to identify the perspective of middle to top management on the role of technical capabilities that allow end users' usage of BI systems. With this perspective, it will be possible to suggest and comment on the role middle to top management might play in the usage of BI and be able to enhance the body of knowledge. It is therefore imperative that a study into the role of technical knowledge and support in end users' usage of BI systems is conducted and outlined.

1.5 Research methodology

The study intends to identify literature that defines the role of technical knowledge and support with regard to their impact towards BI systems or technology usage and acceptance. The research into prior literature will construct an understanding of how technical knowledge and support is integrated in companies within and outside South Africa. After this has been done,

an empirical quantitative survey will be done to investigate the perspective of middle to top management of medium to large companies within South Africa towards the acceptance and usage of BI. A comparison of the literature and survey will be carried out to identify key elements that might be considered as indicators for effective use of BI.

Quantitative research is vastly outlined and makes use of collection of numerical data that can be counted (Song & Arnott, 2014). A quantitative research data collection method takes a limited range of predetermined responses whereby the experiences and perception of participants can be measured (Warfield, 2005). Given (2008) states that quantitative research refers to the systematic empirical investigation of social phenomena via statistical, mathematical or computational techniques. It also allows for investigating the why, what, and how of BI usage allowing businesses to fulfil their mission and achieve business objectives. Quantitative methodology is thus appropriate for the study.

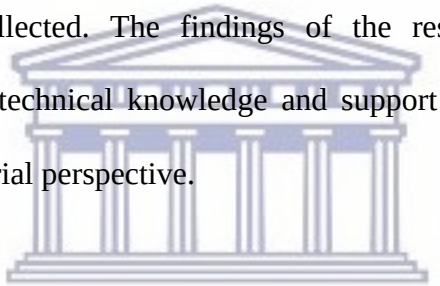
1.6 The scope and limitations of the study

The research will focus on middle to top level management of South African medium to large companies, which will be a limitation as it excludes employees at lower levels and hence does not bring out lower level end users' views. Another limitation is that the study will be based within the South African business context, which will not fully resemble the general view of the global market. The number of targeted participants will be just a fraction of the entire population; hence the sample will not fully reflect the views of the market. A further limitation is that the factors identified that influence success or failure are not the only factors, but for the purpose of the study these are the major factors, hence further study can be done to add more factors. Yet another limitation result from the fact that the survey will be conducted online,

which will exclude companies without internet access, as the survey will require that participants have internet connectivity to respond to the questionnaire.

1.7 Layout of the dissertation

This research is conducted in manner that outlines information regarding acceptance and usage of BI, managerial perspective on the impact technical knowledge and support impact of BI on the daily operations of company, as well as theories relating to technical acceptance. Research methodology, research questions and theoretical framework will follow in the discussion. Data collected will follow with the discussion geared towards supporting and analysing the research questions based on data collected. The findings of the research will bring forth an understanding of the role of technical knowledge and support in employees' usage of BI systems, based on the managerial perspective.



The research is comprised of six chapters outlined as follows:

Chapter one outlines the nature and scope of the study by providing a snapshot of the content used through the study. It provides an introduction that delineates the motivation for conducting the study, followed by the research aims. The background to the study follows and gives an illustration of how the research aims came to be defined, allowing the development of a definition of the research problem and research questions. The chapter concludes by providing assumptions of the study and outlining the chapters to be covered in this research.

Chapter two provides and in-depth exploration into prior literature that relates to the research and subject matter. It will reveal the essence of the research and zoom in to define BI from perspectives of different players within the global market and different industries. The chapter

also contextualises the components of BI that make it what it is today within industries or companies. It concludes by narrowing down to what are considered to be critical success factors of BI and how companies perceive the use of BI systems within modern business.

Chapter three looks at the research design and methodology. This chapter defines and outlines the research methods for the research and the research tools used to collect the data. Data collected is analysed and the analysis approach used for the research is described.

Chapter four presents the data analysis and the findings of the research. This chapter defines the components that the research was aiming to derive at based on the BI capabilities framework.

Chapter five presents conclusions based on the findings of the study, analysis of the data and recommends areas for further study.

1.8 Chapter summary

Chapter one provided an introduction/background to the research, articulating motivation and purpose for pursuing the research. This was followed by the research problem, the research questions and the research objectives to give an understanding of the research. The research methodology was then discussed, followed by the scope and limitations of the research.

The following chapter will provide an in-depth review of literature that relates to the research and subject matter.

2 Literature review

2.1 Introduction

The business environment has become increasingly complex and sophisticated to the extent that companies are constantly looking for ways to gain a competitive edge (Ramakrishnan, Jones, & Sidorova, 2012a) by using various technologies and systems. As the companies look for ways to be better in their respective industries, they also venture into projects that will give return on investment (ROI) and business value (Amyot, Chen, Weiss, & Forster, 2007b). Amyot et al. (2007b) noted that companies are currently exposed to a lot of fast-paced external factors which require them to be proactive in order to sustain the growth. In today's business environment, companies are exposed to a lot of information that they need to process in order to make well informed decisions as quickly as possible (Sacu & Spruit, 2010). These decisions might be strategic, operational or to do with daily operations. Regardless of the nature of decisions to be taken, Business Intelligence (BI) has become an effective and efficient solution if implemented and used correctly.

The introduction of BI has helped companies gain a competitive edge (Imhoff & White, 2011) over competitors, and companies are starting to see the impact of BI usage. It has become difficult for medium to large companies to function without implementing BI systems. BI is a field of IT which brings together the use of different tools such as data warehousing, knowledge discovery from databases, and on-line analytical processing for better decision making. Knowledge of past, present and future events and actions gives a company a competitive edge, and BI provides such knowledge if understood well (Vukšić, Bach, & Popovič, 2013). BI systems are known to be structures that support management's decision making by enabling

analysis of information that companies obtain and gather through various data gathering methods (Ait-yassine, 2012).

Companies obtain their information from both internal and external sources, and this information needs to be analysed and retrieved in the right format within the right time frame. Hence, BI aims to give management a better strategic decision making framework that will enable them to attain the business goals whilst giving employees necessary information to handle the daily operations of the company (Popovic & Jaklic, 2010). In the past the top management and certain departments had the exclusive privilege of accessing BI and utilising its benefits. Nowadays, everyone in the organisation can make use of BI systems for decision making or daily operations (Westerlund & Persson, 2015).

Through correct BI usage, a company may obtain a competitive advantage over its competitors and obtain a better market share (Chen, Storey, & Chiang, 2012). The objective of BI is to make the work of end users easier by providing access to information that they can use effectively and efficiently to draw conclusions and make informed decisions (Wixom, Watson, Reynolds, & Hoffer, 2008). Company management will make use of BI to make informed predication or forecast the future therefore ensuring that the company attain the best results and best strategic decisions.

The quality of the information that BI provides should be delivered at the right time with the right information (Popovič, Turk, & Jaklic, 2010). Despite having implemented Business Intelligence System (BIS), many companies lack the roadmap or the tools to use the enormous amount of information they have in strategic decision making and day-to-day operations (Ranjan, 2008).

This chapter will provide a background to BI usage and a definition of BI from current relevant literature. This will be followed by a discussion of the benefits that BI brings to companies, components of BI that facilitate effective usage of BI, and critical success factors to BI. The chapter will conclude by looking at the user and organisational perspective on BI usage based on the current literature.

2.2 Definition of BI

BI is a process or set of mechanisms that facilitate effective, easy and quick business decision making by providing relevant information obtained from external and internal data (Ponelis & Britz, 2012). Many definitions of BI have been proposed according to the nature or field of study, or the context of the discussion (Ponelis & Britz, 2012). According to Negash (2004), BI systems "combine data gathering, data storage, and knowledge management with analytical tools to present complex and competitive information to planners and decision-makers" (Negash, 2004).

There are numerous BI definitions based on context. Several studies have defined BI according to what is being researched or what they aim to achieve. However, most of the definitions bring out the element that BI is a product and a process. Product, in this context, refers to the information that allows companies to forecast trends of customers, competitors, markets, products, services and technologies with the utmost accuracy (Jourdan, Rainer, & Marshall, 2008b). Process refers to a company's procedures to produce useful information that would assist it to be competitive and survive in the global market (Jourdan et al., 2008b). Table 2.1 shows some of the definitions that are found within literature:

Author(s)	Definition
(Pettersson & Arvidsson, 2012)	BI is a process of gathering and analysing internal and external business information (Pettersson & Arvidsson, 2012).
(Vugt & Jacobsen, n.d.).	BI is an architecture and collection of integrated operations as well as decision support applications and databases that provide the business community easy access to business data (Vugt & Jacobsen, n.d.).
Lonnqvistm and Pirttimaki (2006)	BI is an organised and systematic process by which organisations acquire, analyse, and disseminate information from internal and external information sources significant for their business activities and for decision making (Lönnqvist & Pirttimäki, 2006).
Raisinghani (2004)	BI is a general term for applications, platforms, tools, and technologies that support the process of exploring business data, data relationships, and trends. BI provides executive with timely and accurate information to better understand his or her business and to make more informed, real time business decisions (Raisinghani, 2005).
Williams and Williams (2007)	BI is a set of business information and business analyses within the context of key business processes that lead to decisions and actions (Williams & Williams, 2007). In

	particular, BI means leveraging information assets with key business processes to achieve improved business performance.
Elbashir, Collier & Daven, (2008, p.138)	BI is a set of specialised tools for data analysis, query, and reporting, (such as OLAP and dashboards) that support organisational decision making and potentially enhance the performances of a range of business processes (Elbashir, Collier, & Davern, 2008).
Rouhani (2012)	BI is the process of using information and analysing it in order to support decision making, and using different methods to help organisations forecast the behaviour of competitors, suppliers, customers and environments, in order to survive in the global economy (Rouhani, 2012).
Gurjar & Rathore (2013)	BI is the ability of an organisation to collect, maintain, and organise knowledge. This produces large amounts of information that can help develop new opportunities. Identifying these opportunities and implementing an effective strategy can provide a competitive market advantage and long-term stability (Gurjar & Rathore, 2013).
Okkonen et al.,(2002)	Process of gathering and analysing internal and external business information

Table 2-1: BI definitions

Although these definitions could project what BI is, they speak mainly to software or technology components (Popovič et al., 2010). Popovic et al. (2010) argue that the key influence of BI is to bring an understanding of events within a company and its environment, whilst at the same time, necessary action is taken to achieve the company's goals. To ascertain that the company's goals are achieved, the human factor needs to be considered as no system would function without a human resource (Kapoor & Sherif, 2012a). But at the same time, for the human factor to be factored in, a platform to allow the human interaction must be developed. This might be in the form of resources, training, easy-to-use interfaces, location and access. A study conducted in Finland showed that 75% of participants saw the human factor as contributing greatly to any BI system (Hannula & Pirttimäki, 2003).

Hence, to define BI, it is necessary to include the human factor into the definition (Pellissier & Kruger, 2011), and Popovic (2010) defines BI as "the ability of an enterprise to act effectively through the exploitation of its human and information resources". Other authors have also defined BI: Burnay et al. (2014), for instance, described it as a business management term that was created to explain applications and technologies that assist the business to gather metadata, and provide access to the analysis of data and information that relate to firm, so as to assist decision-makers.

2.3 Evolution of BI

BI has grown in popularity among companies since it its introduction in the1990s (Chen et al., 2012). Prior to this, BI companies made use of information systems like enterprise resource planning (ERP), customer relations management (CRM), supply chain management (SCM) and other e-commerce applications to improve decision making and to remain competitive

(Brockmann, Stieglitz, Kmieciak, & Diederich, 2012). These systems came into existence as companies' requirements evolved, and this resulted in lot of disparate systems that were not able to align with each other even though they may have included similar information. This lead to companies housing large quantities of data about their business but having less access to the information and little knowledge of the relevant industry (Venter & Tustin, 2009).

BI systems saw a growth in demand over the years as companies started to realize the influence of BI usage in strategic decision making and assessing ROI. Prior research has indicated a growing concern about BI usage (Nkuna, 2011), with a focus on the variety of aspects including the ROI that BI can bring to the business, as well as an enhanced competitive advantage and better business value (Eybers, Kroeze, & Strydom, 2013). Despite this, some companies have not maximised the benefits that BI systems can bring, and in these cases BI systems are regarded as failures (Olbrich, Poppelbuß, & Niehaves, 2012) Usage of BI systems has given stakeholders (i.e. management, employees, suppliers and partners) easy access to the information needed to carry out decisions or to perform effectively in their respective roles. Regardless of numerous studies on how to successfully implement a BI, its usage is still low and many implementations are failures (Vukšić et al., 2013).

The emergence of BI systems has allowed users to be less dependent on the IT department with regard to analysing data for decision making, as BI tools have been customised to assist users in using the systems. Regardless of the customisation, the BI systems need to be accepted by the users to ensure that the system is actually used for the intended purpose. Hence, companies invest large amounts of resources to ensure that during the process of development the users are involved or consulted to ensure successful usage of the BI systems (Audzeyeva & Hudson, 2015). User acceptance plays a vital role and is thus a critical success factor; without active

users, BI systems will not see an increase in business value. The more a BI system is in use, the more it brings potential value to the business (Baker & Chasalow, 2015) .

Where companies have a successful implementation of a BI system, these might have been in-house solutions or vendor solutions. Successful implementation is not a necessity for successful usage of the BI systems as there are internal and external factors that need to be considered to ensure correct, effective and efficient use of the system (Hou, 2014; Mcbride, 2014) . These factors include training, access to the systems and hardware, and standards (Amin Sangar & Iahad, 2013).

One study indicated that in the absence of business drivers and alignment of strategic business objectives or aims, BI decision support mechanisms will fail (Mcbride, 2014). In recent years, literature has indicated that the growth of modernisation and globalisation has resulted in new hurdles for companies, as well as future prospects (Sewdass & Toit, 2014). For companies to be able to catch up with all these demands, new ways of conducting business had to be developed. New ways had to bring about acceptance and usage of BI systems by users as this will be vital to the success of recognising BI value.

Acceptance and usage of BI systems is identified to grow with companies allowing further education of all employees, personal development path, workshops and training. Education of employees this involves allowing users to attain knowledge and skills necessary to engage with the respective systems and BI tools. Personal development plan allows for the users to align individual goals with that of the company therefore allowing both the individual and company to effectively attain respective vison and goals. With introduction of new system, applicable

training and workshops to provide insight and context of the system therefore allow users to buy into the new BI system. Buy in results into effective and efficient use of the system.

With constraints on data collection and analysis affecting decision making, companies may have to consider ways to take into account applications like BI systems that are cost effective, flexible, functional and timeous (Kapoor & Sherif, 2012b). If adopted well and backed up by relevant technical knowledge and support, BI systems may give the company a competitive advantage and improve decision making, whilst enabling the end users to carry out tasks in the right manner with less technology constraints or frustrations, hence attaining company's goals.

2.4 Components of BI

2.4.1 On-line analytical processing (OLAP)

Analysis of data and information prior to BI systems involved non IT experts or employees obtaining any data analysis from the IT experts. This made more work for IT experts as they received more requests. At the same time, it caused delays for those that needed to make timely decisions as they had to wait for the IT experts. Even after obtaining the data, it was necessary to export the data to spreadsheet to further analyse the data.

BI systems have reduced the reliance on IT experts, and there is no more time wasting as data can be retrieved quickly. On-line analytical processing (OLAP) is one of the components that make up BI systems. OLAP provides users with a brief, multidimensional outline of the business data and assists with reporting, analysis, modelling and planning for development of the company (Muhammad, Ibrahim, Bhatti, & Waqas, 2014). OLAP allows users to work with

tools and techniques that make retrieving information from the data warehouses easier than before with less interference from the IT experts (Venter & Tustin, 2009). Filtering, aggregations, drill-down and pivoting are among the techniques that OLAP can bring to users to allow them to view data multidimensional (Chaudhuri, Dayal, & Narasayya, 2011a).

2.4.2 Monitoring

Companies strive to be almost at par with all of their operations and ensure that they run smoothly. Monitoring components of BI can play a significant role in the successful utilisation of BI systems as it allows for constant and continuous observation of the company's activities (Hawking, 2011). Companies are known to invest in elements that allow for observation of operations; these might be internal operations or external operations. The main objective is to ensure that the company stays on top of its game, gains a competitive edge, has a return on investment and is able to predict future trends.

2.4.3 Dashboards

Dashboards come into play as the ideal BI monitoring tool for companies. Molensky et al. (2010) state that suppliers might not necessarily view dashboards as important but users do (Molensky, Ketter, & Collins, 2010). The dashboards give users three-layer applications comprised of (Eckerson, 2009):

1. Monitoring applications that provide on-time and relevant critical information to the respective user (this might come with graphical representations),

2. An analysis application that allows users to analyse and explore the performance of data within a variety of categories across detailed levels and pinpoint problems or issues, and
3. Management applications to allow communication between managers, executives and staff, providing continuous feedback that will eventually lead to company's vision being kept alive.

2.4.4 Data warehouses

Yadav et al. (2014, p.31) describe data warehouses as "a collection of decision supports technologies, aimed at enabling the knowledge worker (executive, manager and analyst) to make better and faster decisions."

Data warehouses can assist in the most critical decision-making moments as they can be operational tools that house updateable data. The data sources can be operational databases, past data, external data or already functional databases that support the functional operations of the company. The data warehouses can keep data and information that is stored in different formats, i.e. plaintext files, spreadsheets, pictures or multimedia information. According to Venter and Tustin (2009), data warehouses are there to support and provide up-to-standard, on-time, relevant and well-documented data and information to BI analysis tools.

2.4.5 Data marts

Ranjan (2009) states that data marts are: "A collection of subject areas organized for decision support based on the needs of a given department." (Ranjan, 2009). This means that every

department will have its own data mart; for example, a data mart for finance, a data mart for sale, a data mart for marketing and a data mart for human resource (Venter & Tustin, 2009). Each respective department owns and maintains its own data mart hardware and software as each department has its own interpretation of presentation of the data mart. Data marts also possess operational data that can help a company's decision-makers to make well-informed decisions based on past experiences and trends.

2.4.6 Reporting

The reporting function is there to organise the quantitative data to create a report-oriented analysis comprised of graphics, charts, numbers or statistics that outline the business operations or future trends (Baars & Kemper, 2008). Reporting based on prior research can be a frequently-used tool as it is fully automated and there is a lower level of knowledge required. Reporting tools are also mainly used during delivery of reports at most levels (Vukšić et al., 2013).

2.5 Benefits of BI

Since the introduction of information technologies, companies have seen a great deal of benefits from using IT-based solutions. Investment in IT has grown so significant that most companies have made it their mission to have IT-based solutions and systems in the running of their business. Usage of BI systems has also allowed companies to gain benefits from BI (Burnay, Jureta, Linden, & Faulkner, 2014). Hence, in this day and age it is difficult to come across a company that has not adopted BI for its operations (Chaudhuri, Dayal, & Narasayya, 2011b). Companies in different sectors of the industry have embraced BI; for example, the

financial sector uses BI as source for claim analysis and fraud prevention, telecommunication uses BI to facilitate its customer value management, in the health industry BI is considered as outcomes analysis, and in transportation BI is used for management of fleets.

The companies have embraced the impact of using BI and the benefits that might arise from its use. These benefits include:

Staying ahead

This is when a company has a solution that gathers and analyses enormous financial, operational and transactional data, and allows the company's information to be placed in simple, actionable, interactive reports (Stodder, 2013). Using BI systems equips employees and users of the systems with most powerful reporting and analytics, helping them stay ahead of competitors whilst taking advantage of forecasted trends and opportunities (Ramakrishnan, Jones, & Sidorova, 2012b; Van Den Houten, 2012). In today's markets, whoever has access to quality information and is able to analyse it attains the best knowledge and competitive edge (Pellissier & Kruger, 2011; Sahay & Ranjan, 2008). Hence, BI usage can give a company the information it needs to act quickly and effectively whilst staying ahead of competitors.

Prediction of trends

After years of doing data collection, companies find themselves with an enormous amount of data that can be converted into useful information. BI systems can make use of this data to analyse the company's and competitors' behaviour to bring out possible results (Dhar, Jarke, & Laartz, 2014; Nkuna, 2011). This can be taken further by allowing companies to set realistic

goals and ensure these goals are maintained or achieved by placing them against key performance indicators.

Right data for decision-makers

Regardless of positional level, the right data at the right time is essential and BI systems ensure that data is placed on decision maker's lap at the moment of need to allow for informed and well-calculated decisions (Imhoff & White, 2011; Popovič, Hackney, Coelho, & Jaklič, 2012). With BI, companies might eliminate guess work, allowing for exchange of data and information among the different departments within the company.

Dashboards

The most important aspect of a BI system is that it provides a visual representation of data that allows decision-makers to immediately view business metrics to allow for quick, informed decisions (Burnay et al., 2014; Hou, 2012). It gives each user the platform to select the information that is relevant to them by a simple click and drop using the various tools available for exploring data (Molensky et al., 2010).

Reduced resource wastage

The majority of data analysis used to be done using spreadsheets, which meant that data had to be exported to the spreadsheet programs. This data would have redundancies and duplication of entries, and it would take an enormous amount of time to clean it. BI systems eliminate wasted time by reducing data redundancies and duplication of data entries (Khumalo &

Buckley, 2014). Instead of carrying out data cleaning, decision-makers are able to go straight to analysis and can make decisions and advise on critical business decisions (Al-Azmi, 2013).

Improved data management

As data is received from various sources, either internal or external, it is housed in the data warehouse for later retrieval and analysis. Data warehouses store all the data gathered by the company, and this data is of vital importance to the company if it is utilised correctly (Howson, 2014). Most companies to have data warehouses that have valuable data but are not able to make the most of it (Hawking, 2011). A company that implements and makes use of BI systems can benefit from such a data warehouse. Therefore, using BI improves the data management of the company. Great BI systems analyse current and future information needs and describe the vital information.

Improved efficiency

Any system is put in place to allow for better efficiency in the process and operation of a business. IT systems were introduced to facilitate easier operations with regard to data manipulation, decision making, forecasting sales, analysing business trends, maintaining customer relations and profile, and financial analysis. IT was seen as a way to reduce cost whilst maximising profits. BI systems like IT systems have a similar effect on business as they improve efficiency and lead to reduced cost and risk whilst maximising profits. BI analytical tools increase employee productivity and enable them to solve issues effectively (Sahay & Ranjan, 2008).

Knowledge management

Knowing exactly when a product is in demand, when customers are reluctant to purchase, and when new suppliers are needed, or predicting new trends or when production is slow, is the key to success of any business. Knowing the history of all events that occur in the business environment, both internal and external, requires that the information is contained and analysed accordingly. The raw data need to be management to ensure they give the best quality information. Using BI systems allows for knowledge management and allows the company to gain a competitive edge if the information is used correctly. As events occur, a BI system can be useful as it can send out notifications to the relevant users of any new changes or if there is something that needs immediate attention. Decision-makers are able to monitor customer behaviour and use this insight to retain or gain loyalty and maximise profits by recognising opportunities.

Customer satisfaction

Organisations aim to retain and attract more customers, and hence strive to satisfy existing customers. It is therefore important for the company to have correct information about the customer. With BI, a company has a customer knowledge base that it can refer to and can always ensure it has the best solution, product or service for a particular customer (Kim, Lee, & Lee, 2011). BI enables a company to satisfy its customers by retrieving trends of their activity.

Using BI systems can be beneficial as long the companies ensure that there are structures and infrastructures in place for the relevant decision-makers.

2.6 Critical success factors of BI

BI, like any other product, service or system, needs to ensure its own sustainability and bring value to the business. For BI systems to be successful, the critical success factors (CSF) need to be considered, otherwise all the efforts to gain success and profit from the system might be in vain. Research has shown that critical success factors allow companies to look into factors that they need to address to improve on new BI systems or when implementing a BI system (Dawson & Belle, 2013).

For the South African context, through the study that was conducted, the CSF were categorised as: committed management support champion, business vision, user involvement and data quality (Dawson & Belle, 2013). These CSF are comparable to the known factors in recent studies from European countries.

2.7 Companies' perspectives on BI

Hawking (2010) mention that Gartner carried out a survey of over 1 500 Chief Information Officers, which focused on understanding how companies put a value on BI system compared to other systems. The study noted that BI was considered as a priority for companies. Usage of BI systems carries different notation for each individual company; hence, there are varying degrees of success (Hawking & Sellitto, 2010). In light of this, some companies see BI as a failure, as they fail to realize the benefits afforded by BI systems. A Cutter Consortium Report based on a study of 142 companies indicated that 41% of the participants experienced a failure with a BI project, and 15% believed that BI implementation was a success (Hawking, 2011).

Other researches indicated that 60% of BI projects failed because of poor planning, poor management and undelivered business requirements, and BI projects that were unsuccessful delivered failed due to poor quality. Despite the growth in awareness of BI and the great benefits associated with implementing and using BI systems, companies have been faced with great losses and low return on BI investment.

BI can bring about major changes within a company only if implemented successfully. Acme Manufacturing, a global food packaging and processing company, implemented a BI solution after experiencing a lot of challenges (Hawking & Sellitto, 2010). The challenges resulted from the following issues: the ERP system they had initially implemented was not as successful as the company had hoped, increased pressure on its pricing, legacy systems support for new markets, increased competition and issues around the implications of Y2K on legacy systems. These issues lead the company to look for better and improved solutions; hence, a BI team was formed to give a solution which was later called the Business Warehouse Project (Hawking & Sellitto, 2010). The BI project resulted in a standardised mechanism, a user-accepted system, better reporting systems and an increase in production performance.

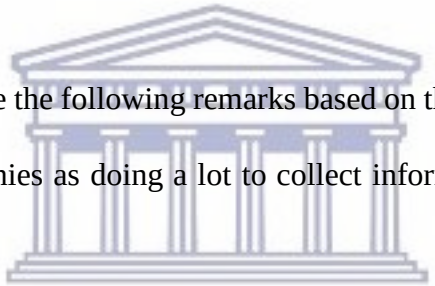
2.8 User perspectives on BI

For any system to be effective and efficient it needs to be accepted and actually used by the user, otherwise it would merely be an implemented system without any impact. Hence, the user needs to be involved in the implementation of most systems. User input is considered vital during the stages of implementation, as this allows the user to feel like part of the decision to implement that system. This will increase the likelihood that the user will accept and actually use the system. When a user believes that using a certain system will improve his or her

productivity, while simultaneously making the task easier, he or she is more likely to use the system (Chang, Hsu, & Shiau, 2013).

2.9 Usage of BI systems

A case study on South African companies done by Venter and Tustin (2009) focused on understanding how users of BI view BI systems (Venter & Tustin, 2009). The researchers asked the participants questions around the application of BI in the organisation. These questions where around BI overall quality, BI collection, BI analysis, BI dissemination, BI responsiveness, and BI and decision-makers.



Venter and Tustin (2009) made the following remarks based on the information they received:

- Users view the companies as doing a lot to collect information that is relevant to the specific user.
- 66.7 % of the participants felt there were more informal ways of gathering information and fewer formal ways like doing a formal market study.
- Users indicated that information sharing between departments is vital and hence departments were actually sharing information, holding quarterly meetings to do so.
- Although there was sharing of information internally, participants indicated that there was less sharing of knowledge with external business partners, minimising the knowledge of the global market.
- Users were impartially convinced about the role of IT in supporting BI and less convinced that during designing of IT infrastructure, the BI objectives were not addressed.

- 75% of the participants acknowledge that the BI team actually knew the information needs of the users.

2.10 Users' views on BI techniques and technology

The key elements of any system are its availability, its user friendliness, and having the necessary technology and techniques to support its use. Table 2.2, derived from the study by Venter and Tustin (2009) on BI usage in South African companies, gives an overview of participants' views regarding the technology and techniques that support BI.

Tools and technologies	Up to 150 employes %	151–350 employes %	351–1 000 employes %	>1 000 employes %
Competitive intelligence	75.4	73.2	69.8	81.6
Market research	62.3	80.5	69.8	91.8
Intranet	73.9	87.8	90.5	95.9
Data warehousing	58	63.4	74.6	83.7
Enterprise resource planning systems	37.7	68.3	61.9	77.6
A knowledge management function	50.7	61	68.3	67.3
A business intelligence function	65.2	61	68.3	71.4
A customer relationship management (CRM) system	62.3	73.2	69.8	73.5
Online analytical processing (OLAP)	34.8	41.5	38.1	57.1
Data query software (e.g. SQL)	43.5	61	52.4	65.3
Data mining tools (e.g. SAS)	30.4	39	33.3	34.7
Planning support software	66.7	70.7	66.7	65.3
Executive information systems (EIS – e.g. performance dashboards)	49.3	48.8	50.8	63.3

Table 2-2: Tools and technology usage by organisation size (Venter & Tustin, 2009)

Based on table 2.2, Venter and Tustin (2009) had the following observations:

- Companies with 350 to 1 000 employees use key intelligent gathering techniques like competitive intelligence and market research.

- Given the current prominence of knowledge management, investment in establishing a knowledge management function remains comparatively low.
- Overall investment in data-mining techniques is low across all companies.
- Competitive intelligence across all companies is considered a driving force and therefore, the percentages are within the higher margins.
- Market research is used more within companies with large employee base, this may be due to company being able to dedicate this section to respective employees who will only focus on market research. Companies with fewer employers have lesser percentage as individual employees may be focusing on more than one aspect of the company. Therefore, more need to focus on market research is needed within small companies and BI systems may assist in this regard.
- Companies with fewer employees based on Table 2.2 have adopted the use of BI tools and technologies but not to the same extend as larger companies.

2.11 Technical knowledge and support

Users of BI systems may or may not have the technical expertise and skills to effectively and efficiently make use of the systems. Organisations that implement BI systems occasionally provide the users with training and supporting documentation that outlines steps to follow when using the BI systems. Technical knowledge and support are comprised of two components – technical knowledge and technical support – though the two complement each other.

Technical knowledge is regarded as enhancing employees' performance as it guides on-the-job behaviour and indirectly impacts employee skills (Kell, Motowidlo, Martin, Stotts, & Moreno, 2014). Technical knowledge has been identified to provide users with a basis upon which they

can improve in their work roles, as it makes them aware of the system's capabilities. Technical support refers to providing the users with the relevant service to improve their access to the system in question. Overall, technical knowledge and support is regarded as an important element, and organisation are therefore eager to ensure that employees are aware of the services available to them.

2.12 BI Technical Capabilities Framework

Based on the literature review given above, a BI Technical Capabilities Framework can be formulated to encapsulate the components that support the main research question. Technical capabilities in this research are also regarded and referenced as the technological knowledge and support. Table 3 outlines the key components outlined above.

Component	**Elements**
Meta-model	- Meta-model standardisation - Meta-model terminology
Master Data	- Traceability on master data - Versioning of master data - Compatibility of BI tools - Uniformity
BI Usage	- Use of BI data analysis - Use of BI forecasting - Use of BI scenario modelling - Use of BI statistical modelling - Use of BI communication and data distribution - Use of BI presentation and visualisation - Use of mobility - Use of notes and descriptive comments
Satisfaction Level	- Satisfaction level – data analysis - Satisfaction level – forecasting function - Satisfaction level – scenario modelling function - Satisfaction level – statistical analysis function - Satisfaction level – communication and data distribution function - Satisfaction level – presentation and visualisation function

	- Satisfaction level – mobility function - Satisfaction level – entering notes and descriptive comments - User Satisfaction
Workflow Exception Reports	- Automated operational workflow exception reporting - Automated strategic workflow exception reporting
Data Process	- Completeness of data - Timeliness of data - Relevance of data - Consistency of data - Frequentness of data - Integrity of data
BI Context	- BI architecture standardisation - BI solutions usage - BI roles and responsibilities - BI development and IT regulation - BI regulatory requirements - User permissions
BI Documentation	- BI architecture documentation - Defined process models - Defined design methods - Defined documentation standards - BI documentation

Table 2-3: BI Technical Capabilities Framework

The BI technical capabilities framework shall be the bases onto which the research will be based and will allow for the analysis of the data and make sound conclusion.

2.13 Chapter summary

Chapter 2 introduced the concept of BI and BI systems by providing the background of BI and defining BI from the perspective of various authors in the BI industry. Based on prior literature, BI has no predefined or set definition, as illustrated in table 2.1. The chapter indicated components of BI systems that are considered useful to organisations. Critical success factors of BI were also illustrated to provide a deeper understanding of BI systems. Technical knowledge and support were defined in relation to BI system usage by providing the meanings of the terms as applicable to the study. The prior literature leads the study into the next chapter, chapter 3, by providing a background to the research design and methodology.

3 Research design and methodology

3.1 Introduction

Conducting research in any area of study requires mechanisms, techniques and assumptions to govern the path the research is to follow. Mechanisms, techniques and assumptions provide a framework onto which a researcher can map the how's, what's, where's and why's of the research. Research can be defined as well organised study of information related to a specific area or topic. To establish a structured research, a methodology is required to serve as a template according to which the research will be conducted (Rajasekar, Philominathan, & Chinnathambi, 2006).

This chapter will outline the research design and research methodology used in this research to answering the how's, what's, where's and why's applicable to it. The chapter will also address the sampling technique used in the research: online questionnaire, and procedure and data analysis technique. The chapter will also focus on the ethical considerations and challenges faced in conducting the research.

3.2 Research methodology

Like most academic fields of study, Information Systems (IS) is not limited to one research methodology; research can be carried out based on numerous research methodologies. Research methodology is defined as gathering, retrieving, organising and analysing data to convert it into useful and useable information for the researcher to draw up a conclusion or recommendation (Rajasekar et al., 2006).

There are numerous research methodologies, but for the purpose of this research, quantitative research was used. To understand quantitative research, a comparison of quantitative and qualitative methodologies is useful.

3.2.1 Qualitative vs quantitative research methodology

Strauss and Corbin (1990) defined qualitative research methodology as "any kind of research method that produces findings not arrived at by means of statistical procedures or other means of quantification". Qualitative research methodologies looks at the real world and allows events to happen naturally (Golafshani, 2003) whilst the researcher is observing. Unlike qualitative research methodology, quantitative research focuses on the study of natural phenomena (Myers, 1997) and generalisation (Polit & Beck, 2010). Methods or techniques that can be used within quantitative methods include experiments conducted in the laboratory, surveys, and mathematical models.

Quantitative research methodology is ideal for instances where deductive approaches and/or theories can be used to justify variables or defined research questions (Boreego, Douglas, & Amelink, 2009). The quantitative method allows data collection to be managed via survey, and the data to be statistically analysed, allowing the researcher to make generalisations or inferences (Boreego et al., 2009).

3.2.2 Quantitative research methodology

Based on the objectives of quantitative research methodology, the method allows for survey, questionnaires and statistical computation. It was therefore ideal for this research as it was compatible with the desired goals. The method allowed for data collection to be conducted via online questionnaires. After being randomly selected, participants received an email asking them to participate. More discussion on selection criteria follows.

Qualitative methodology requires the researcher to be personally involved in the research process – for instance, visiting participants to conduct face-to-face interviews. Quantitative methodology, on the other hand, allows the researcher to reach participants in multiple geographical areas simultaneously. This was ideal for this research as it spanned across different industries and countries, and it allowed researchers partaking in the combined study to use the same data from a central source. The large sample size of the research made and the fact that the questionnaire was based on numerical response made the use of the quantitative method ideal.

The purpose of this research is to understand organisations' involvement in supporting employees with regard to technical knowledge and technology support in the usage of BI systems. To understand the organisation's role, the ideal participants were the middle to top management, as these are the decision-makers of organisations.

3.3 Research paradigm

Researchers have different approaches, known as research paradigms. Research paradigms guide how a researcher will carry out the research. The term paradigm may be defined as “a loose collection of logically related assumptions, concepts, or propositions that orient thinking and research” (Bogdan & Biklen, 1998).

In information systems research there are positivist, interpretivist and critical paradigms that a researcher can use to guide the research. The paradigm will assist the researcher in understanding the underlining assumptions of the research.

3.3.1 Comparison of research paradigms

The critical research paradigm is concerned with the human interaction and is associated with the rebuking of norms of society and arguing against diversity issues or assumptions. However, critical research allows the researcher to be critical of issues that are being researched and/or makes the researcher to go into depth on social and ethical issues (Myers & Klein, 1999). The critical paradigm removes itself from the norm and poses the questions that oppose the standard views of the positivist and interpretive paradigms. Due to its critical position, it might lack the basis to reach any sort of agreement or conclusion.

The interpretive research paradigm, unlike the positivist, argues that people or individuals interpret their environments in ways that are modelled by the particular cultures in which they live (Johnson & Onwuegbuzie, 2004) and/or cultural assumptions (Mackenzie & Knipe, 2006). Interpretive research involves focus groups, interviews, research diaries and case studies

(Elliott & Lukeš, 2008). Qualitative data collection and analysis are usually used in interpretive research (Mackenzie & Knipe, 2006).

The positivist research paradigm can be regarded as scientific method or science research (Mackenzie & Knipe, 2006) and came about with Augusta Comte in 19th century (Lather, 2006), with a focus on how things are rather than how they should be. Positivism has the ideology that a scientific methodology can be applied to gain understanding, and hence supports research phenomena.

3.3.2 Positivism as the research paradigm

The positivist research paradigm has been known to allow for (Mackenzie & Knipe, 2006):

- the use of experimental method and forms of statistical analysis to engage in measurement of research phenomena,
- relying on quantitative data, and
- seeking of casual and statistical relationships among variables.

Research based on positivism is believed to be transparent and objective, facilitating the replication of studies that use it. Replication can be necessary to allow testing of knowledge produced and checking that there was no bias or distortion on the part of the researcher (Johnson & Onwuegbuzie, 2004). Johnson and Onwuegbuzie (2004) also indicate that, according to this school of thought, educational researchers should eliminate bias, remain emotionally separated and not get involved with the objects of the study.

This research is based on quantitative data and analysis; hence, the positivist research paradigm is suitable as it allows the researcher to utilise tools like questionnaires. Furthermore, the researcher is not physically and emotionally involved with the participants, and less researcher involvement means that the research can be retested by other researchers.

3.4 Research design

The research design is a logical approach, which serves as a link between the research question and the research process. It can also be described as the overall plan for connecting the conceptual research problems to the pertinent empirical research. Research design can be the basis on which a researcher is able to determine research method, data collection and data analysis. There are a number of research designs known to information systems. This section describes three research designs and explains the choice of one of these for this research.

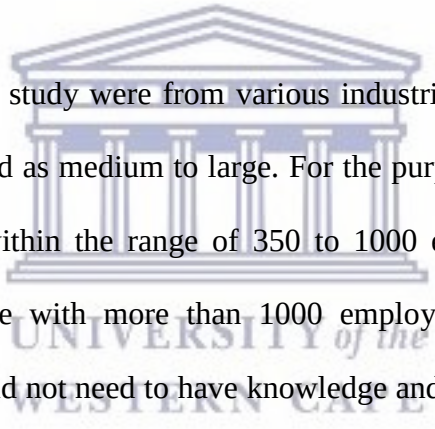
3.4.1 Comparison of research designs

Explanatory study is sometimes regarded as analytical study with the aim of identifying causal links between factors that relate to relevant research being conducted (Wei-Yuan, 2002). Exploratory research, on the other hand, is mainly considered for research that aims to address issues with high levels of unknowns and unfamiliarity about the subject, and when the problem is not very well understood (Isik, 2009). Descriptive study is aimed at documenting aspects of the research as they occur naturally (Polit & Beck, 2010).

3.4.2 Descriptive study as research Design

For the purpose of this study, descriptive study was adopted. The main aim of descriptive research is to provide an accurate and valid representation of the factors or variables that are relevant to the research question. It describes what might already be available and this might help to uncover new meanings and facts about the area of research. One of the instruments ideals for descriptive study is questionnaires, which made descriptive study ideal for this research.

3.5 Sampling



The target participants for the study were from various industries in South Africa and from organisations that are classified as medium to large. For the purpose of this study companies with number of employees within the range of 350 to 1000 employees were regarded as medium companies and those with more than 1000 employees were regarded as large companies. The participants did not need to have knowledge and technical background of BI, though understanding the history of BI would allow the participant to give more detailed responses to the questions. The survey focused on issues that pertained to BI usage in the organisation and infrastructure within the organisation that supports the use of BI systems.

The research participants were selected from the list of companies on the South African Stock Exchange based on a stratified random sample. Stratified random sampling is a technique which attempts to restrict the possible samples to those which are “less extreme” by ensuring that all parts of the population are represented in the sample in order to increase the efficiency (that is to decrease the error in the estimation). Stratified sampling enabled the expansion of

the research by gathering and collaborating participants responses on the research question and eliminate the possibilities of unreliable sample from large population. Random selection helps to ensure that the participants represent the population of interest and hence reduces bias towards a particular industry (Işık, Jones, & Sidorova, 2013). The participants were from the middle to top executive of each organisation, as these were the focus participants for the study. The participants received emails containing the link to the survey as well as consent forms regarding the study and its purpose.

The South African Stock Exchange, allowed for a total of 3 661 contacts to be extracted and contacted via email. Out of the total contacted, 513 individuals were unreachable as emails bounced back. From the remainder, at least 800 individuals received follow-up telephone calls and emails. A combined total of approximately 1 500 individuals were contacted via the initial request email and follow-up telephone calls or emails. After follow-ups and initial responses, a total of 68 responded and participated in the study. Based on the responses obtained from the 68 participants, the confidence interval of at least 6.0 resulted in a confidence level of at least 95%, which is termed acceptable for this study (Bartlett, Kotrlik, & Higgins, 2001) even though the responses were low numerically.

3.6 Data collection

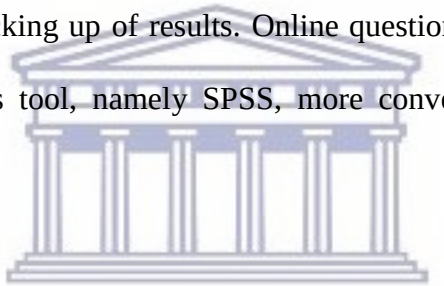
3.6.1 The need for data collection

The research was part of a broader research project which had a great number of questions that delved into a variety of relevant matters pertaining to BI. The questionnaire was designed to capture responses that could be used by every researcher in either the individual studies or the

combined research paper. Therefore, an online questionnaire was able to give all researchers, regardless of geographical location, sufficient responses for their respective studies.

3.6.2 Method of data collection

Having a broad sample of participants required a technique that would enable participants to be reached quickly and give participants a convenient engagement tool. Online questionnaires were ideal as they would allow the researcher to be able to note the progress of the participants to send electronic notifications to participants to remind them of questionnaire. Misplacing of hard copies by both participants and the researcher was eliminated by having the questionnaire online, and this facilitated backing up of results. Online questionnaires made the transfer of data collected to the analysis tool, namely SPSS, more convenient, reducing time spent capturing hard-copy data.



3.6.3 Online questionnaire as method of survey

An online survey in the form of a questionnaire was adopted as a means of collecting information as this further strengthened the study (Carton & Wellman, 1999). Using online questionnaires/surveys allowed for minimal investment in developing and administering the questionnaire, as well as making it easier to formulate generalisations (Glasow, 2005). The online questionnaire was designed and complied by respective researchers based on a consensus between the University of the Western Cape and Hochschule Neu-Ulm University of Applied Sciences.

The study is part of collaborative that was agreed upon and partnered by Neu-Ulm University of Applied Sciences in Germany and the University of the Western Cape. The project was initiated and launched to run concurrently within organisations in South Africa and Germany with comprehensive surveys investigating the usage of BI Systems and Corporate Performance Management. Therefore, consensus for an online questionnaire allowed the research to reach a large number of participants and reduced the time constraint of having to have one-on-one interviews.

The participants were drawn from the list of companies on the South African Stock Exchange and on German business groups; samples of random participants were taken to participate in the research and the participants were contacted via email.

3.6.4 Online questionnaire construction

As the research span across nations and comprised of wider audience that was targeted as participants the selected instrument of online questionnaire was identified as valid and effective instrument. Therefore, the research to cover major aspects of the project the questionnaire was construct to cover broader spectrum of usage of BI system and Corporate Performance Management. The questionnaire had to be construct to allow all researchers to be able to pull out data that will drill down on the respective focus areas. In support to this the online questionnaire was structured in two categories:

a. Corporate Performance Management (CPM) Questionnaire

This part of the questionnaire looked at the CPM defined as "*a methodology to optimize the execution of business strategy that consists of a set of integrated, closed-loop management and*

analytic processes, supported by technology, that address financial as well as operational activities or data. It is an enabler for business in defining strategic goals, and then measuring and managing performance against those strategic goals." The "*core financial and operational processes of CPM include planning, consolidation and reporting, modelling, analysis, and monitoring of key performance indicators (KPIs) linked to organizational strategy*" (BPM Standards Group, 2005). This would begin with the participant being asked to give responses to questions regarded as general. These questions would focus on issues such as annual turnover, company history, industry type, job title, management structure and the legal form of the company.

The questions in the next section were based on the current status of the organisation; this included KPIs, business strategy, business vison and CPM relations, among other aspects. Lastly, this category looked at the validation summary, where participants would give responses based on the value they considered the organisation to have and that they expected it to have after given period.

b. BI Questionnaire

In this category, the questionnaire looked at BI. Like the CPM category, it began by asking the participants to give responses to general questions. These questions would focus on issues such as annual turnover, company history, industry type, job title, management structure and the legal form of the company.

Within the current status section, the participant was asked to give responses based on the following choices: totally disagree / mostly disagree / sometimes disagree / sometimes agree / totally agree/ statement not relevant / I do not know. The questions focused on issues regarding:

- Metamodels in BI databases regarding standardisation
- Standardisation terminology
- BI tools with regard to CPM
- BI features for data analysis
- BI predictive forecasting
- Strategic management towards BI
- Among other relevant BI issues

For the purpose of this research BI section of the questionnaire was the input to the research and these was used to bring about the main research question together with the sub question.

3.7 Data analysis

The online questionnaire consists of questions which had a rating mechanism based on a Likert Scale. Participants rated responses according to the given scale.

A few questions were open-ended, allowing participants to explain certain aspects, and some questions were based on company background information. For the analysis of the data, SPSS was chosen as this tool allows for factor analysis, among others, and support of descriptive statistics analysis of the data.

3.8 Ethical considerations

As per the University of the Western Cape requirement, the researchers obtained ethical clearance to conduct the research before conducting the research, therefore the research is governed by the ethical considerations required by the institute. The participants of the research where given consent forms outlining the research topic and purpose, and defining the terms used and the expected results. The consent forms also indicated that the participants' personal information would only be used for the intended purpose (i.e. the research) and would be kept confidential; hence, the names of individuals and companies will not appear in any part of the research and results of the study will be shared only in an aggregated way.

3.9 Challenges faced / limitations

The BI scope was limited to participant perspective of internal data and not competitors' data, as any questions around the competitors' data were part of the research. This research was based within the South African business context, which might have not fully reflected the general view of the global market. The number of participants was just a fraction of the entire population; hence the participants could not fully represent the views of all the industries. The research was conducted via an online questionnaire, which might have excluded those companies without internet usage or restricted access to external links.

3.10 Conclusion

This chapter outlines the research methodology and research design that the research used to expand on the research phenomena. It also articulated the data collection technique and data analysis used for the research, namely the quantitative approach. The quantitative approach

was deemed appropriate because the researcher collected data via online questionnaires that were distributed to participants across various industries and in different geographical locations.

To sum up the chapter, table 4.1, gives an overview of the research methodology and research design that the research used.

Research outline	**Research approach**
Research methodology	Quantitative research
Research paradigm	Positivist
Research design	Descriptive research
Data collection	Online questionnaire
Data analysis	SPSS – factor analysis
Ethical consideration	Detailed consent form

Table 3-1: Summary

4 Data analysis and findings

4.1 Introduction

Chapter 3 outlined the research design and research methodology used for this research to facilitate answering of the how's, what's, where's and why's of this research. This chapter will present the analysis of data retrieved from the online questionnaires and discuss the findings in relation to the quantitative approach.

The chapter will look at the descriptive statistics to comprehend information about the participants that took part in the research. To facilitate an easy and fast statistical analysis, Tableau 10.2 was used to give a more visual and graphical representation of data. Descriptive statistics will help in describing and summarising the data in a meaningful way and give a more in-depth analysis of the data to allow for conclusion and recommendations.

As indicated in previous chapters, the study was a combined project of two institutes, namely the University of the Western Cape and Hochschule Neu-Ulm University of Applied Sciences; therefore, a combined 232 respondents were obtained. Of the 232 respondents, 113 came from a BI perspective. Sixty-eight respondents were from South Africa, and for the purpose of this research, only South African respondents were considered.

This chapter will be presented in two parts. The first part will focus on descriptive statistics, and secondly the chapter will expand on the online questionnaire by focusing on the individual BI questions.

4.2 Descriptive statistics

Descriptive statistics are characterised as the basic feature of outlining raw data into a presentable format to show what is going on or what the data shows in a visual presentation. However, descriptive statistics may not allow the researcher to reach conclusions that go beyond the data presented.

4.2.1 Company background

The figure below (Figure 5.1) outlines the responses which highlight the background of the respondents and organisations.

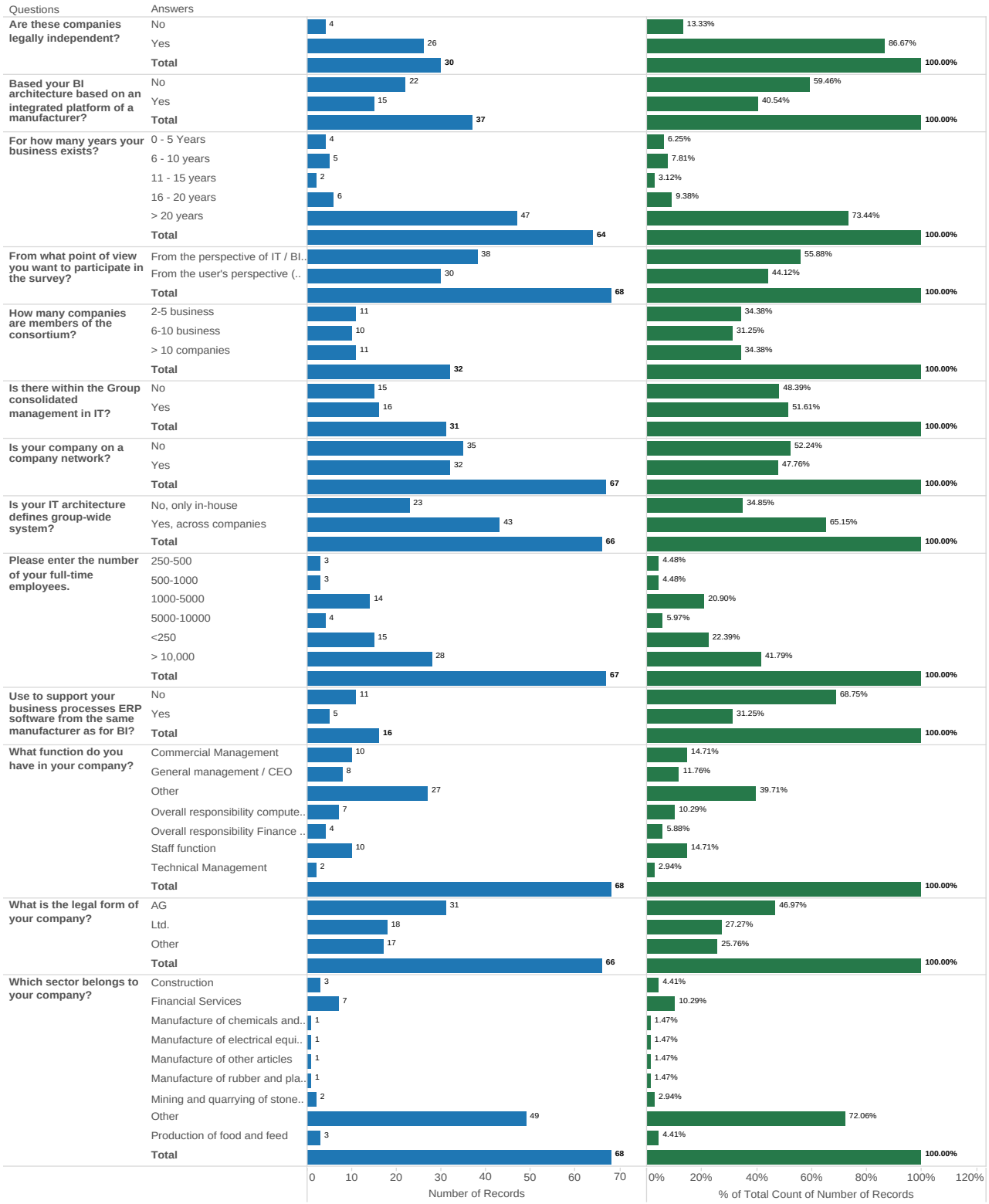


Figure 5-1: Company background

Legal independence: The results indicate that 86.67% of the companies that the participants are from are legally independent companies. This may mean they are not in a group of companies.

BI architecture: 59.46% of the participants indicated that in their companies the BI architecture in place is based on the manufacturer or provider BI architectural design. 40.54% indicated that the companies have their own BI architectural design.

Company age: 73.44% of the participants stated that their company has been in existence for more than 20 years, with 6.5% indicating that their company has been in existence for between 0 and 5 years. These indications illustrate the necessity for access to BI usage within the companies as most have been in existence for more than 20 years.

Viewpoint of participants: The research was focused on middle to top management of various South African industries. 55.88% of the participants had an IT background, which may indicate that the participants were aware or had knowledge of BI from an IT technical perspective. The other 44.12% of the participants were users of BI, giving them an insight to how BI is used within the respective companies.

Number of companies in consortium: 47.76% of the South African participants indicated that their respective companies are part of a consortium. Being a part of a consortium would suggest that the decision to make use of BI within the companies is centralised. This is an indication that there is support from top management.

IT architecture defines group-wide system: 65.15% of the participants from South Africa stated that there is wide variety of off-the-shelf systems that make up the IT architecture. This shows that the companies make use of variety of BI system for the running of the company. In-house systems were shown to be also in use by 34.85% of the participants. The in-house systems make up the IT architecture.

Number of full-time employees: The research focused on medium to large organisations. 41.79% of the participants indicated that their companies had more than 10 000 employees, 20.9% indicated 1 000 – 5 000 employees, 5.97% indicating 5 000 – 10 000 employees, and 22.39% indicated less than 250 employees. This shows that the participants were from medium to large organisations.

Function within the firm: Middle to top management participants were the target sample for the research. 39.71% classified themselves as *"other"*, which may not necessary indicate that they are non-middle to top management, as the survey was given to participants who were identified to be from middle to top management. 14.71% indicated that they were commercial management and 11.76% that they were general management/CEO. These participant groups are the core decision-makers of the companies.

Legal form of company: AG is a German abbreviation for a corporation limited by share ownership. 46.97% of the respondents indicated that their companies were AG, which shows that these companies are within the medium to large organisations. 27.7% respondents indicated that their companies were Ltd. and 25.76% respondents indicated "other".

Company sector: In South Africa, the main sectors that contribute to the Gross Domestic Product (GDP) and are considered the backbone of economic growth are communication, mining, financial services, retail, manufacturing, tourism and agriculture. 72.06% respondents indicated “other” as the sector of their companies, which indicates the respondents were not from production of food and feed, construction, financial services, and manufacturing. This might mean they are from retail, communication, wholesale and retail, tourism or agriculture.

4.2.2 BI products

The respondents were asked to indicate which BI products are used within their companies. Figure 5.2 outlines the response that were obtained, and from the responses one can see which BI products are mainly used.

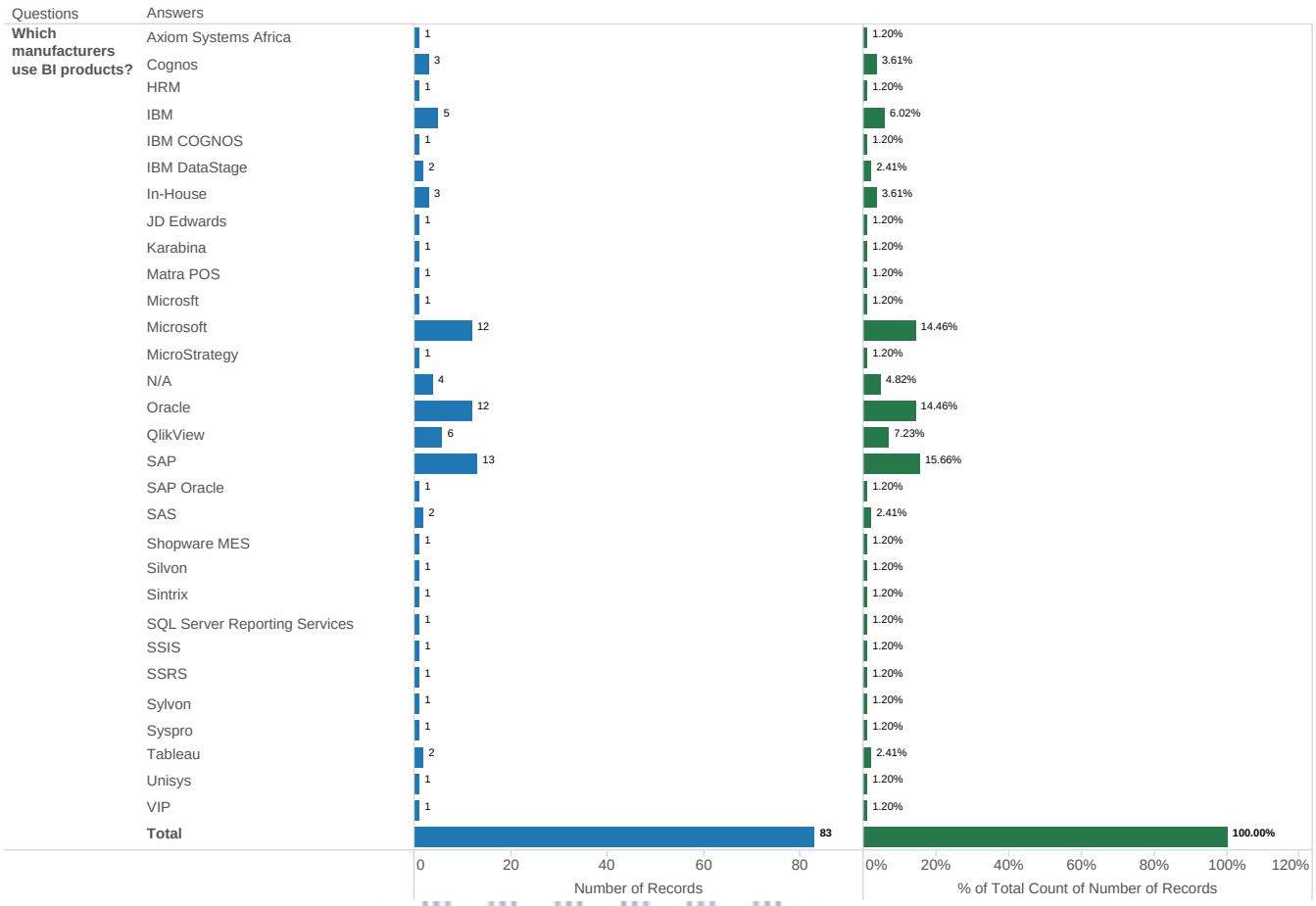


Figure 5-2: BI products

There are numerous BI products. From the research, the majority of the respondents indicate Microsoft, Oracle and SAP products as the BI products used within their companies. SAP, Oracle and Microsoft had the highest indication of 15.66%, 14.46% and 14.46% respectively. In the ICT industry, SAP, Oracle and Microsoft are regarded as the top customisation and open-shelf BI products. IBM also had a high instance of use at 3.61%.

4.2.3 BI expenditure

Participants gave responses to questions relating to their company's expenditure on BI. The BI expenditure questions focused on the following elements:

- Development of detailed reporting
- Hardware
- Management dashboards
- Software

Figure 5.3 below shows the responses to BI expenditure questions.

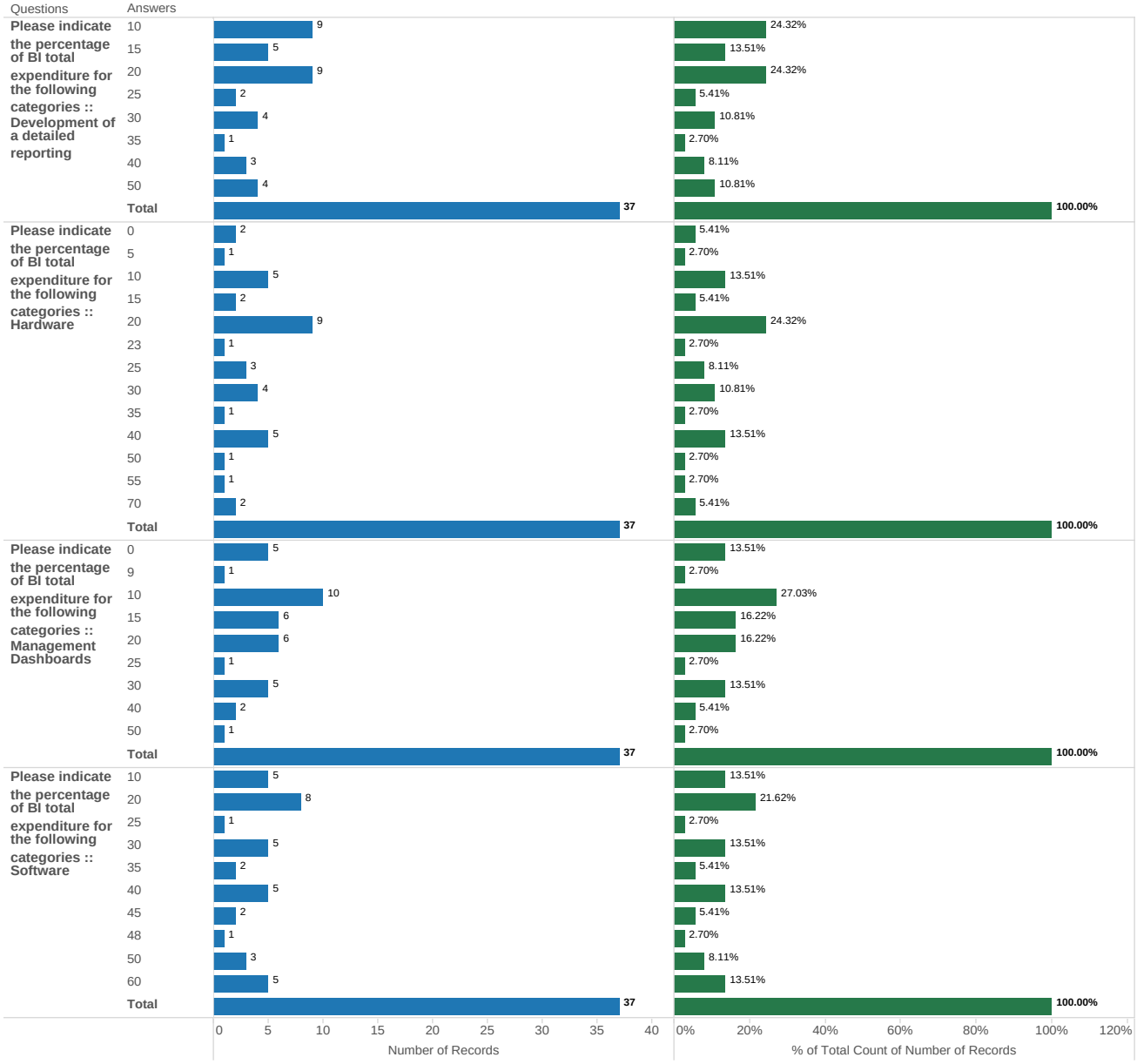
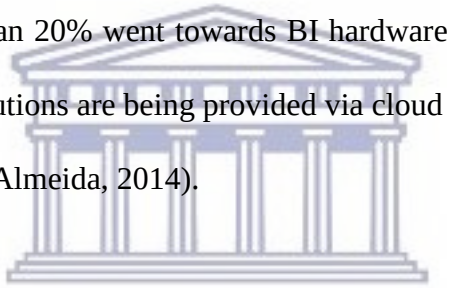


Figure 5-3: BI expenditure

Responses based on following categories:

Development of detailed reporting: 10.81% of the participants indicated that 50% of their company's expenditure was geared towards obtaining or developing the reporting capabilities of a BI system. The majority of the participants indicated that 10% to 30% was used to drive development of detailed reporting. This may suggest that the reporting aspect of BI was being utilised with the companies.

Hardware: The majority of participants (90%) indicated that 10% – 49% of BI expenditure went towards obtaining hardware that enabled the use of BI. Among these participants, the majority indicated that less than 20% went towards BI hardware expenditure. This might be because the majority of BI solutions are being provided via cloud computing or as software as a service (SAAS) (Ricardo & Almeida, 2014).



Management dashboards: Section 2.4 showed the dashboard facility to be the most important aspect of a BI system, as it provides a visual representation of data that allows relevant decision-makers to immediately view business metrics to allow for quick, informed decision-making (Burnay et al., 2014; Hou, 2012). Based on the feedback from participants, 74% indicated that 10% to 30% of the expenditure is used towards the management of dashboards, which shows significant usefulness of dashboards.

Software: A high percentage of participants (13.51%) indicated that 60% of the expenditure goes towards BI software. A greater number of participants indicated that 20% – 40% of expenditure goes towards BI software.

4.2.4 Five-year expenditure

Participants were asked to indicate the total expenditure their companies incurred during the last five years on BI. Figure 5.4 illustrates their responses.

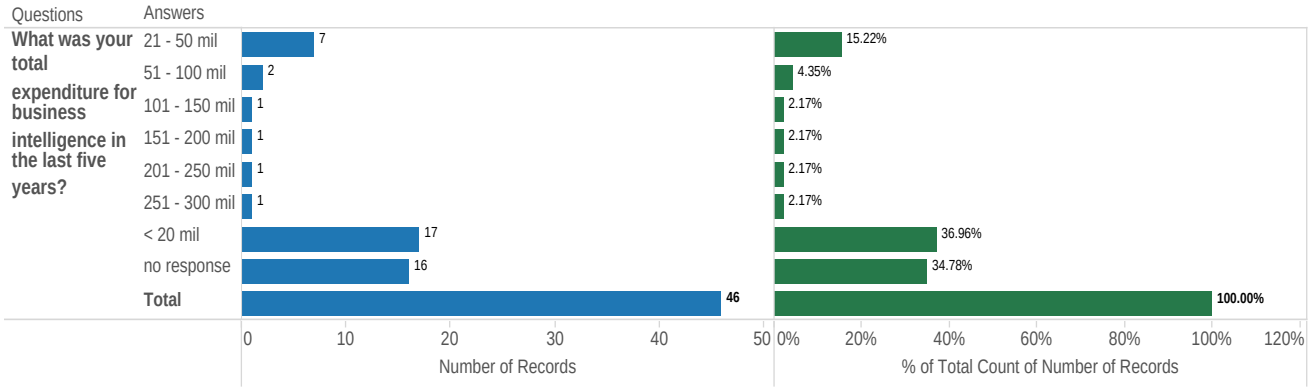


Figure 5-4: Five-year expenditure

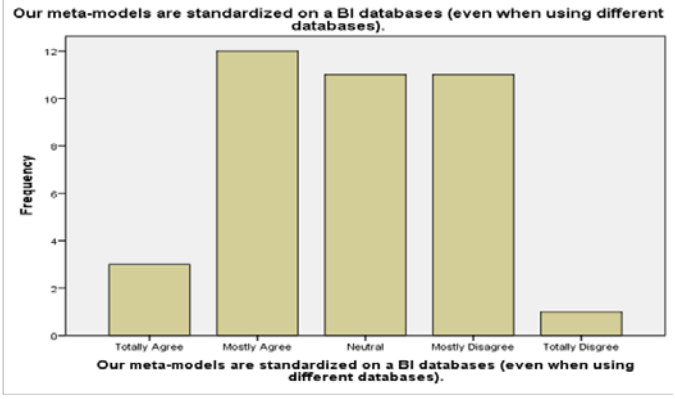
Of the 37 participants who responded to questions regarding BI expenditure (section 5.2.3), 45.95% indicated that it was less than R20 million with the rest indicating over R21 million. The highest number of participants indicated R21 – 50 million. 13.03% of participants indicated that their expenditure was more than R50 million. This might be an indication that use of BI within companies is significantly increasing, and research of the same nature, if done after another five years, might show that these figures have increased significantly.

4.3 BI information-related questions

Participants were presented with questions that where based on a Likert Scale ranging from “Totally Agree” to “Totally Disagree”. This research focused on responses addressing BI usage, BI documentation, BI processes, BI requirements, BI architecture and user satisfaction which form part of and outlined with the BI Technical Capabilities framework describe in section 2.

4.3.1 Meta-model standardisation

Figure 5-5 and table 5-1 show the analysis of meta-model standardisation of BI.



	Frequency	Percent	Valid Percent	Cumulative Percent
Totally Agree	3	7.9	7.9	7.9
Mostly Agree	12	31.6	31.6	39.5
Neutral	11	28.9	28.9	68.4
Mostly Disagree	11	28.9	28.9	97.4
Totally Disagree	1	2.6	2.6	100.0
Total	38	100.0	100.0	

Figure 5-5: Meta-model standardisation

Most participants (31.6%) indicated "Most Agree" in answer to the question of meta-model standardisation, with "Neutral" and "Mostly Disagree" both obtaining 28.9% of the responses. The high percentage on "Mostly Agree" is an indication that employees do experience and make use of meta-model standards. Table 5-1 shows the skewness, kurtosis and mean based on the response distribution.

N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.868	1.0180	-.048	.383	-.830	.750

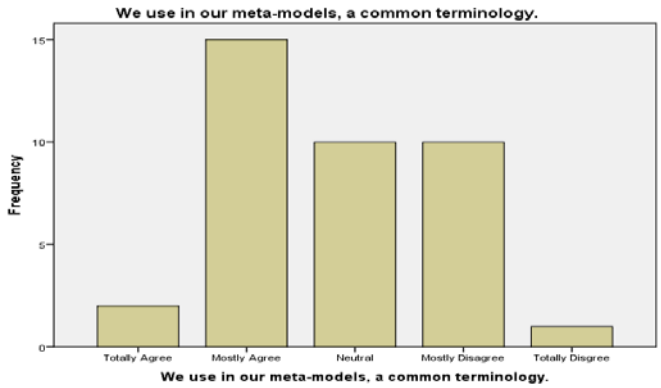
Table 4-1: Meta-model standardisation

Negative skewness (-.048) suggests that the distribution of responses was slightly more to the negative, as most responses were "Mostly Disagree" and "Neutral". This also indicates that the data distribution is close to symmetric (normal distribution). Kurtosis of -0.830 represents a

flatter peak, which shows uniformly spread responses. Responses may indicate that meta-data has not been embraced within organisations and therefore BI systems are not yet taking centre stage. This is further supported by the negative mean of 2.868.

4.3.2 Meta-model terminology

Figure 5-6 and table 5-2 show the analysis of meta-model terminology.



	Frequency	Percent	Valid Percent	Cumulative Percent
Totally Agree	2	5.3	5.3	5.3
Mostly Agree	15	39.5	39.5	44.7
Neutral	10	26.3	26.3	71.1
Mostly Disagree	10	26.3	26.3	97.4
Totally Disagree	1	2.6	2.6	100.0
Total	38	100.0	100.0	

Figure 5-6: Meta-model terminology

Most participants (39.5%) indicated “Mostly Agree” in answer to the question of meta-model terminology, with “Neutral” and “Mostly Disagree” both obtaining 26.3% of the responses. The high percentage on “Mostly Agree” is an indication that employees do experience and make use of meta-model terminology.

N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.816	.9824	.210	.383	-.843	.750

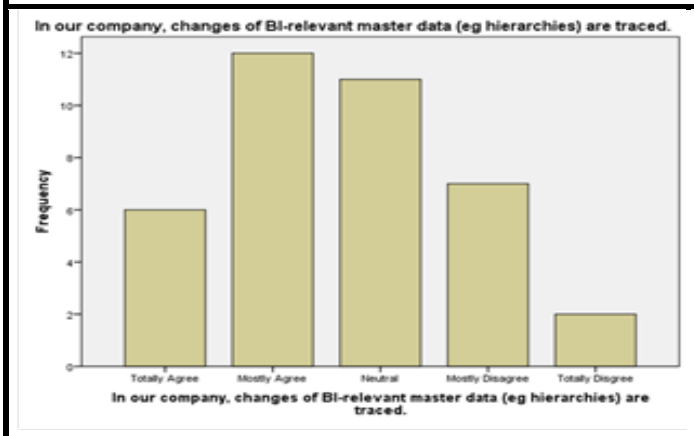
Table 4-2: Meta-model terminology

A mean of 2.816 and skewness of slightly positive 0.210 indicate that combined “Neutral” and “Mostly Disagree” had a slightly higher percentage of responses compared to “Mostly Agree”.

Therefore, the data distribution was close to normal symmetrical and with a flatter curve as indicated by -0.842 kurtosis, showing slightly equal distribution of responses. This shows that organisations provide the necessary technical knowledge and support to users of BI systems.

4.3.3 Traceability on master data

Figure 5-7 and table 5-3 show the analysis of traceability to changes in BI master data.



		Frequency	Percent	Valid Percent	Cumulative Percent
In our company, changes of BI-relevant master data (eg hierarchies) are traced.	Totally Agree	6	15.8	15.8	15.8
	Mostly Agree	12	31.6	31.6	47.4
	Neutral	11	28.9	28.9	76.3
	Mostly Disagree	7	18.4	18.4	94.7
	Totally Disagree	2	5.3	5.3	100.0
	Total	38	100.0	100.0	

Figure 5-7: Traceability on master data

Most of the participants indicated "Mostly Agree" (31.6%) and "Totally Agree" (15.8%), while fewer indicated "Mostly Disagree" (18.4%) and "Totally Disagree" (5.8%), suggesting participants observed an element of traceability within master data. A combination of positive total percentage (47.4%) suggests that the majority of the participants agreed on the traceability element as part of master data.

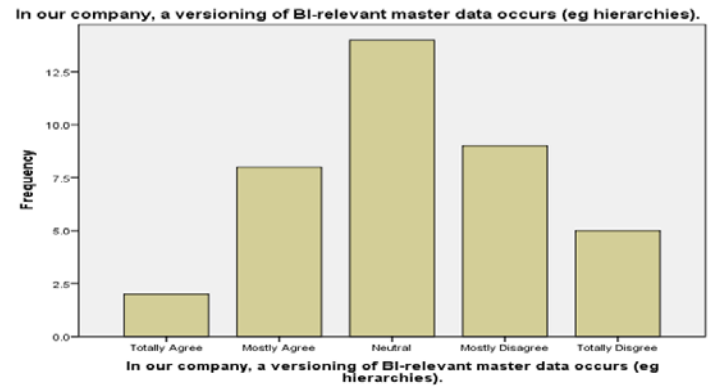
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.658	1.1217	.249	.383	-.637	.750

Table 4-3: Traceability on master data

Table 5-3 indicates a mean of 2.658, which is slightly towards the positive due to “Neutral” (28.9%) responses. This is supported by the skewness of 0.249 and kurtosis of -0.637. This indicates that there is close to normal data distribution. This shows that organisations provide the necessary technical knowledge and support to users of BI systems.

4.3.4 Versioning of master data

Figure 5-8 and table 5-4 show the analysis of the versioning element within master data.



		Frequency	Percent	Valid Percent	Cumulative Percent
In our company, a versioning of BI-relevant master data occurs (eg hierarchies).	Totally Agree	2	5.3	5.3	5.3
	Mostly Agree	8	21.1	21.1	26.3
	Neutral	14	36.8	36.8	63.2
	Mostly Disagree	9	23.7	23.7	86.8
	Totally Disagree	5	13.2	13.2	100.0
	Total	38	100.0	100.0	

Figure 5-8: Versioning of master data

A large number of responses were observed on “Totally Disagree” (13.2%) and “Mostly Disagree” (23.7%), which points to the fact that participants did not recognise versioning in master data. This suggests that, in organisations, master data versioning is not highly considered. Table 5-4 shows a mean of 3.184, which is more towards the negative side and conforms to the disagreeing responses shown in figure 5-8.

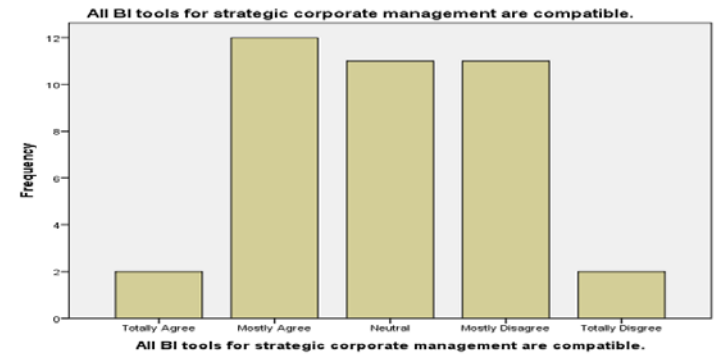
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	3.184	1.0869	.013	.383	-.535	.750

Table 4-4: Versioning of master data

Skewness of positive 0.013 was obtained showing that the data distribution was near normal symmetrical, indicating equal distribution of responses. Therefore, the element of versioning in master data is not recognised within the organisations.

4.3.5 Compatibility of BI tools

Figure 5-9 and table 5-5 show the analysis of compatibility of BI tools.



		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally Agree	2	5.3	5.3	5.3
	Mostly Agree	12	31.6	31.6	36.8
	Neutral	11	28.9	28.9	65.8
	Mostly Disagree	11	28.9	28.9	94.7
	Totally Disagree	2	5.3	5.3	100.0
	Total	38	100.0	100.0	

Figure 5-9: Compatibility of BI tools

Most participants (31.6%) indicated "Mostly Agree" in answer to the question regarding compatibility of BI tools. 5.3% indicated "Totally Agree", 28.9% indicated "Mostly Disagree" and 5.3% indicated "Totally Disagree", suggesting that participants agreed that strategic corporate management is compatible with BI.

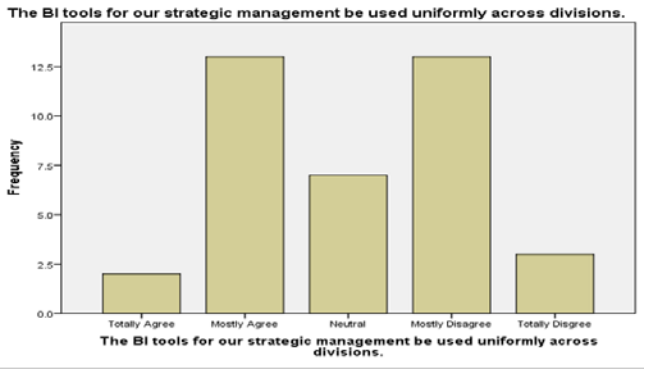
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.974	1.0263	.055	.383	-.765	.750

Table 4-5: Compatibility of BI Tools

A combined positive total percentage (36.9%) suggests that the majority agreed that strategic corporate management is compatible with BI.

4.3.6 Uniformity

Figure 5-10 and table 5-6 show the analysis of uniformity of BI tools.



		Frequency	Percent	Valid Percent	Cumulative Percent
The BI tools for our strategic management be used uniformly across divisions.	Totally Agree	2	5.3	5.3	5.3
	Mostly Agree	13	34.2	34.2	39.5
	Neutral	7	18.4	18.4	57.9
	Mostly Disagree	13	34.2	34.2	92.1
	Totally Disagree	3	7.9	7.9	100.0
	Total	38	100.0	100.0	

Figure 5-10: Uniformity

The responses showed equal distribution of responses between “Mostly Agree” and “Mostly Disagree”, with both answers receiving 34.2%. This shows that the participants were divided in their views on uniformity of BI tools. A close to negative response was obtained when consideration is given to “Totally Agree” and “Totally Disagree”, which had 5.3% and 7.9% respectively.

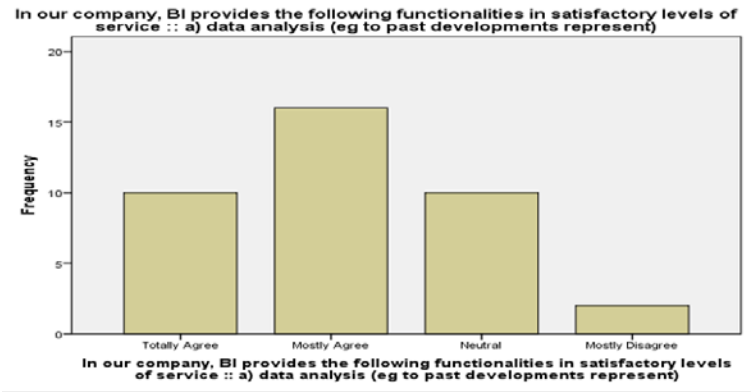
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	3.053	1.1137	.015	.383	-1.088	.750

Table 4-6: Uniformity

Table 5-6 represents a mean of 3.053, which indicates a slight negative move towards "Disagree". A positive skewness (0.015) indicates that the data was close to normal symmetric, showing data distribution was almost equal. This shows that organisations provide the necessary technical knowledge and support to users of BI systems.

4.3.7 Satisfaction level – data analysis

Figure 5-11 and table 5-7 show the analysis of BI data analysis functionality.



		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally Agree	10	26.3	26.3	26.3
	Mostly Agree	16	42.1	42.1	68.4
	Neutral	10	26.3	26.3	94.7
	Mostly Disagree	2	5.3	5.3	100.0
	Total	38	100.0	100.0	

Figure 5-11: Data analysis functionality

The majority of participants (42.1%) "Mostly Agree" that BI data analysis functionality was at a satisfactory level, with 26.3% indicating "Totally Agree". A positive skewness of 0.321 (table 5-7) indicates that most responses were positive, and this is also shown by the mean of 2.105. Participants acknowledge that, within their organisations, BI data analysis functionality has a high satisfaction level and this may be regarded as enhancing employees' daily operations.

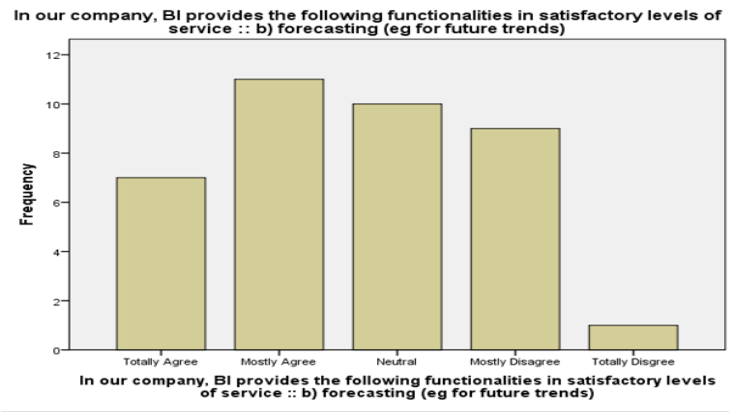
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.105	.8634	.321	.383	-.564	.750

Table 4-7: Data analysis functionality

Table 5-7 represents a mean of 2.105, which indicates a positive move towards agreement. A positive skewness (0.321) indicates that the data was close to normal symmetric, showing data distribution was almost equal. This shows that organisations provide the necessary technical knowledge and support to users of BI systems.

4.3.8 Satisfaction level – forecasting function

Figure 5-12 and table 5-8 show the analysis of forecasting function of BI.



		Frequency	Percent	Valid Percent	Cumulative Percent
In our company, BI provides the following functionalities in satisfactory levels of service :: b) forecasting (eg for future trends)	Totally Agree	7	18.4	18.4	18.4
	Mostly Agree	11	28.9	28.9	47.4
	Neutral	10	26.3	26.3	73.7
	Mostly Disagree	9	23.7	23.7	97.4
	Totally Disagree	1	2.6	2.6	100.0
	Total	38	100.0	100.0	

Figure 5-12: Forecasting function

Figure 5-12 illustrates that 47.3% of participants gave positive responses, thus agreeing that BI provides forecasting functionality, compared to a combined 26.3% of participants who disagreed. 26.3% of the participants took a neutral stand, which may indicate uncertainty towards forecasting functionality of BI among organisations.

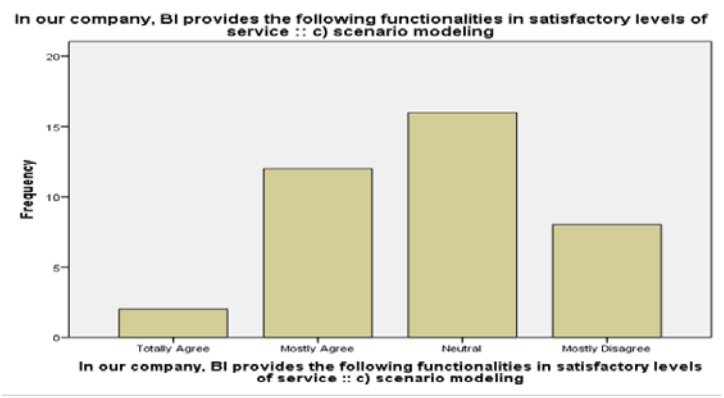
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.632	1.1252	.074	.383	-.987	.750

Table 4-8: Forecasting function

A positive skewness of 0.074 shows that the data distribution was near normal symmetrical, indicating equal distribution of responses. Table 5-8 represents a mean of 2.632, which also indicates a slight negative move towards “Disagree”. The positive skewness indicates that the data were close to normal symmetric, showing data distribution was almost equal. This shows that organisations provide the necessary technical knowledge and support to users of BI systems.

4.3.9 Satisfaction levels – scenario modelling function

Figure 5-13 and table 5-9 show the analysis of satisfaction levels towards the BI scenario modelling function.



	Frequency	Percent	Valid Percent	Cumulative Percent
Totally Agree	2	5.3	5.3	5.3
Mostly Agree	12	31.6	31.6	36.8
Neutral	16	42.1	42.1	78.9
Mostly Disagree	8	21.1	21.1	100.0
Total	38	100.0	100.0	

Figure 5-13: Scenario modelling function

Figure 5-13 shows that most respondents indicated “Neutral” (42.1%), with “Mostly Agree” at 31.6% and “Mostly Disagree” at 21.1%. Therefore, based on table 5-9, a negative skewness (-0.144) represent the number of participants that did not consider scenario modelling to be of influence.

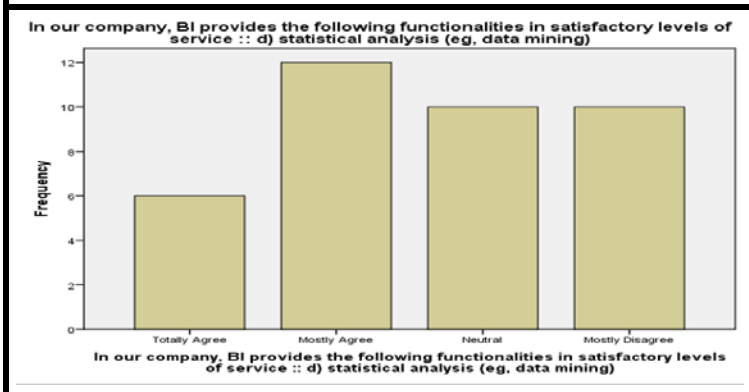
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.789	.8433	-.144	.383	-.596	.750

Table 4-9: Scenario modelling function

A mean of 2.789 and negative skewness of 0.144 represent a negativity to the use of BI scenario modelling function by users. The fact that "Neutral" responses have a higher percentage than other responses may show that technical knowledge and support with regard to BI scenario modelling might be lacking.

4.3.10 Satisfaction level – statistical analysis function

Figure 5-14 and table 5-10 show the analysis of statistical analysis function of BI.



		Frequency	Percent	Valid Percent	Cumulative Percent
In our company, BI provides the following functionalities in satisfactory levels of service :: d) statistical analysis (eg, data mining)	Totally Agree	6	15.8	15.8	15.8
	Mostly Agree	12	31.6	31.6	47.4
	Neutral	10	26.3	26.3	73.7
	Mostly Disagree	10	26.3	26.3	100.0
	Total	38	100.0	100.0	

Figure 5-14: Statistical analysis

A response of "Mostly Agree" at 31.6%, "Totally Agree" at 15.8% and "Mostly Disagree" at 26.3% was obtained from the respondents, showing that the majority of respondents found statistical analysis to be at a satisfactory level. A response of 26.3% "Neutral" balanced the responses, hence a negative skewness of 0.073 (table 5-10) was attained. This represents a close to normal symmetric towards data distribution.

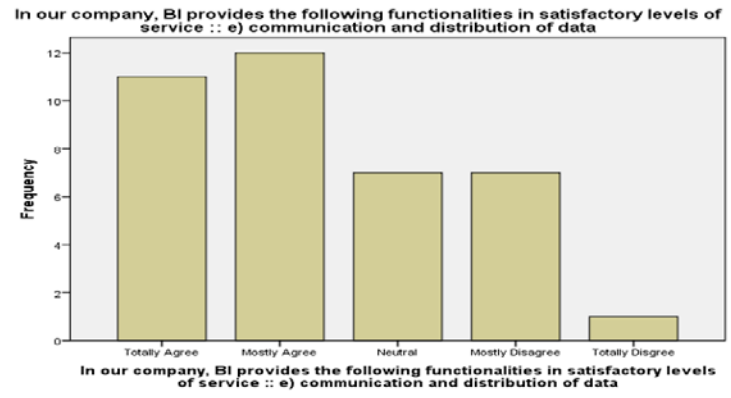
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.632	1.0506	-.073	.383	-1.181	.750

Table 4-10: Statistical analysis

A kurtosis of -1.181 represents a close to flatter curve, which shows that participants' opinion on statistical analysis is not fully positive. This indicates that more knowledge of BI tools needs to be introduced in organisations to obtain a fully used BI system.

4.3.11 Satisfaction level – communication and data distribution function

Figure 5-15 and table 5-11 show the analysis of communication and data distribution function of BI.



		Frequency	Percent	Valid Percent	Cumulative Percent
In our company, BI provides the following functionalities in satisfactory levels of service :: e) communication and distribution of data	Totally Agree	11	28.9	28.9	28.9
	Mostly Agree	12	31.6	31.6	60.5
	Neutral	7	18.4	18.4	78.9
	Mostly Disagree	7	18.4	18.4	97.4
	Totally Disagree	1	2.6	2.6	100.0
	Total	38	100.0	100.0	

Figure 5-15: Communication and data distribution function

Figure 5-15 shows a positive response to the question of communication and data distribution function of BI. Combined, 60.5% of the respondents indicated that they either "Mostly Agree" (31.6%) or "Totally Agree" (28.9%), which shows that the majority of respondents considered communication and data distribution functionality to be of great importance by indicating it holds a high level of satisfaction. This shows that employees have technical knowledge of BI

as indicated by their agreeing that it provides communication and data distribution functionality.

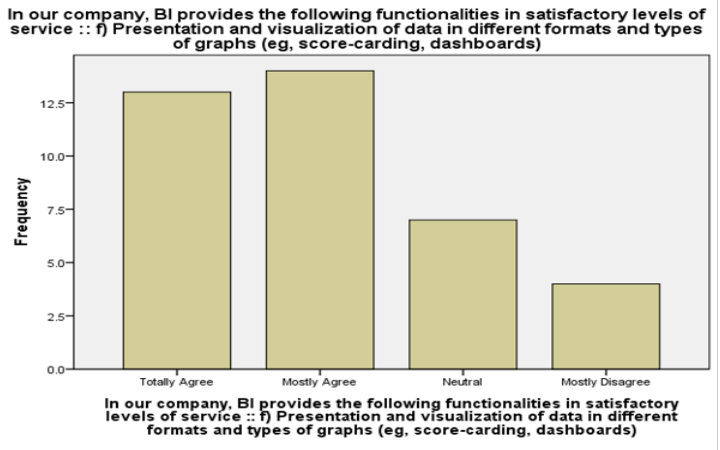
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.342	1.1689	.457	.383	-.876	.750

Table 4-11: Communication and data distribution function

Positive skewness of 0.457 further indicates that the majority of responses had a high level of satisfaction regarding BI communication and data distribution functionality. Skewness of 0.457 indicates close to normal symmetric. This again shows that technical knowledge of BI function currently exists in organisations.

4.3.12 Satisfaction level – presentation and visualisation function

The below figure 5-16 and table 5-12 show the analysis of BI presentation and visualisation function.



		Frequency	Percent	Valid Percent	Cumulative Percent
In our company, BI provides the following functionalities in satisfactory levels of service :: f) Presentation and visualization of data in different formats and types of graphs (eg, score-carding, dashboards)	Totally Agree	13	34.2	34.2	34.2
	Mostly Agree	14	36.8	36.8	71.1
	Neutral	7	18.4	18.4	89.5
	Mostly Disagree	4	10.5	10.5	100.0
	Total	38	100.0	100.0	

Figure 5-16: Presentation and visualisation function

Combined, 71% of participants indicated that they either “Totally Agree” (34.2%) or “Mostly Agree” (36.8%) that there is a satisfactory level of BI presentation and visualisation functionality. “Mostly Disagree” accounted for 10.5%. “Neutral” responses (18.4%) can be excluded as they may have resulted from uncertainty among participants.

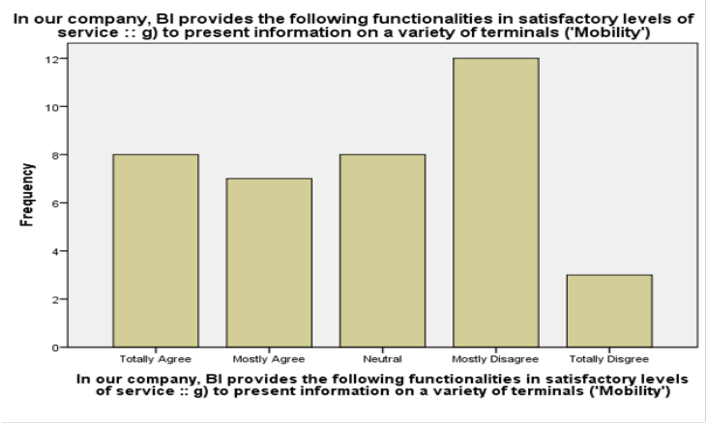
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.053	.9850	.607	.383	-.587	.750

Table 4-12: Presentation and visualisation function

A positive skewness of 0.607 was observed, together with kurtosis of -0.587, which shows that data was close to normal and responses were more to the positive side. This shows that employees had a high level of satisfaction regarding BI presentation and visualisation functionality.

4.3.13 Satisfaction level – mobility function

Figure 5-17 and table 5-13 show the analysis of BI mobility function.



		Frequency	Percent	Valid Percent	Cumulative Percent
In our company, BI provides the following functionalities in satisfactory levels of service :: g) to present information on a variety of terminals ('Mobility')	Totally Agree	8	21.1	21.1	21.1
	Mostly Agree	7	18.4	18.4	39.5
	Neutral	8	21.1	21.1	60.5
	Mostly Disagree	12	31.6	31.6	92.1
	Totally Disagree	3	7.9	7.9	100.0
	Total	38	100.0	100.0	

Figure 5-17: Mobility function

Figure 5-17 shows that an equal distribution of responses was obtained, with “Agree” and “Disagree” responses each totalling 39.5%. “Neutral” responses (21.1%) can be excluded as they may have resulted from uncertainty among participants.

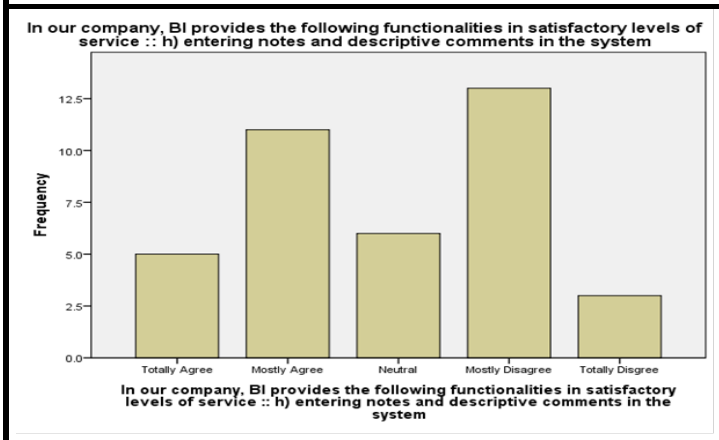
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.868	1.2980	-.134	.383	-1.209	.750

Table 4-13: Mobility function

Table 5-13 shows a mean of 2.868 and skewness of -0.134, indicating a slight lean towards negativity, which could have resulted from a higher instance of “Mostly Disagree” responses (31.6%), showing that mobility functionality has not yet been fully embraced. This could also be an indication that there is less technical knowledge within the organisation.

4.3.14 Satisfaction level – entering notes and descriptive comments

Figure 5-18 and table 5-14 show the analysis of entering notes and descriptive comments.



	Frequency	Percent	Valid Percent	Cumulative Percent
Totally Agree	5	13.2	13.2	13.2
Mostly Agree	11	28.9	28.9	42.1
Neutral	6	15.8	15.8	57.9
Mostly Disagree	13	34.2	34.2	92.1
Totally Disagree	3	7.9	7.9	100.0
Total	38	100.0	100.0	

Figure 5-18: Entering notes and descriptive comments

Figure 5-18 also shows an equal distribution of responses between “Agree” and “Disagree”, each totalling a combined 42.1%. “Neutral” responses (15.8%) can be excluded as they may have resulted from uncertainty among participants.

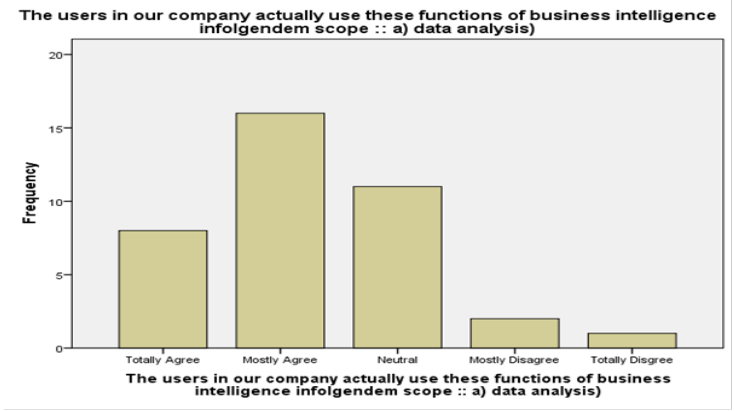
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.947	1.2291	-.079	.383	-1.170	.750

Table 4-14: Entering notes and descriptive comments

Table 5-14 shows a mean of 2.947 and skewness of -0.079, indicating a slight lean towards negativity, which could have resulted from a higher instance of “Mostly Disagree” responses (34.2%), showing that entering notes and descriptive comments functionality has not yet been embraced. This could also be an indication that there is less technical knowledge within the organisation.

4.3.15 Use of BI data analysis

The Figure 5-19 and Table 5-15 show the analysis of use of data analysis by employees.



		Frequency	Percent	Valid Percent	Cumulative Percent
The users in our company actually use these functions of business intelligence infolgendem scope :: a) data analysis)	Totally Agree	8	21.1	21.1	21.1
	Mostly Agree	16	42.1	42.1	63.2
	Neutral	11	28.9	28.9	92.1
	Mostly Disagree	2	5.3	5.3	97.4
	Totally Disagree	1	2.6	2.6	100.0
	Total	38	100.0	100.0	

Figure 5-19: Use of data analysis

The majority of participants indicated “Mostly Agree” (42.1%), showing that most employees make use of BI data analysis when carrying out their roles. A minority indicated “Mostly Disagree” (5.3%), which also supports the notion that employees do make use of the BI data analysis function.

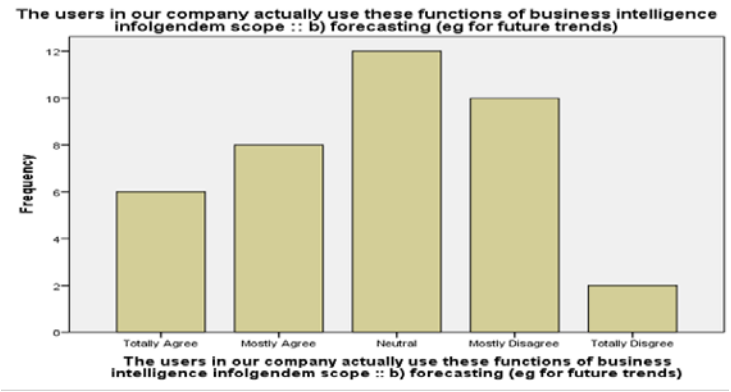
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.263	.9497	.632	.383	.570	.750

Table 4-15: Use of data analysis

Table 5-15 shows a positive skewness of 0.632 and a mean of 2.263, which further indicates that most respondents agreed that employees in their organisations do make use of BI data analysis functionality. The positive responses indicate that organisations do provide technical knowledge and support to the employees, hence a positive indication towards use of BI data analysis.

4.3.16 Use of BI forecasting

Figure 5-20 and table 5-16 show the analysis of use of forecasting by employees.



		Frequency	Percent	Valid Percent	Cumulative Percent
The users in our company actually use these functions of business intelligence infolgendem scope :: b) forecasting (eg for future trends)	Totally Agree	6	15.8	15.8	15.8
	Mostly Agree	8	21.1	21.1	36.8
	Neutral	12	31.6	31.6	68.4
	Mostly Disagree	10	26.3	26.3	94.7
	Totally Disagree	2	5.3	5.3	100.0
	Total	38	100.0	100.0	

Figure 5-20: Use of BI forecasting

Figure 5-19 shows that the majority of participants felt "Neutral" (31.6%), neither agreeing nor disagreeing that users make use of BI forecasting. Though based on a combined percentage, a comparison between "Agree" (36.9%) and "Disagree" (31.6%) indicates a slight positive response.

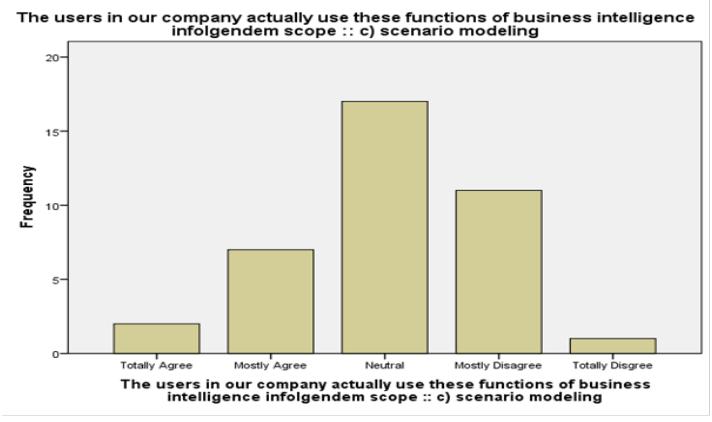
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.842	1.1514	-.124	.383	-.828	.750

Table 4-16: Use of BI forecasting

A mean of 2.842 and negative skewness of 0.124 represent a lean towards negativity regarding the use of BI forecasting functionality by users. The fact that "Neutral" responses have the highest percentage may indicate that technical knowledge and support with regard to BI forecasting functionality is lacking.

4.3.17 Use of BI scenario modelling

Figure 5-21 and table 5-17 represent the analysis of use of scenario modelling by employees.



	Frequency	Percent	Valid Percent	Cumulative Percent
Totally Agree	2	5.3	5.3	5.3
Mostly Agree	7	18.4	18.4	23.7
Neutral	17	44.7	44.7	68.4
Mostly Disagree	11	28.9	28.9	97.4
Totally Disagree	1	2.6	2.6	100.0
Total	38	100.0	100.0	

Figure 5-21: Use of BI scenario modelling

The majority of participants indicated “Neutral” (44.7%), indicating that the participants neither agreed nor disagreed that users make use of BI scenario modelling. Though based on a combined percentage, a comparison of “Agree” (23.7%) and “Disagree” (31.5%) indicates a negative response.

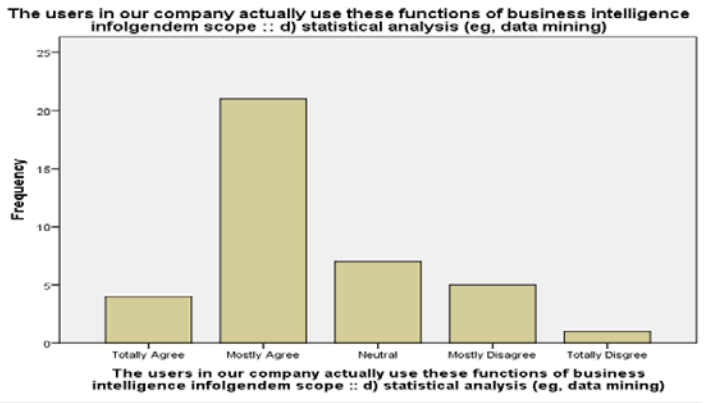
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	3.053	.8989	-.343	.383	.020	.750

Table 4-17: Use of BI scenario modelling

“Mostly Disagree” (28.9%) shows the second highest percentage, indicating that respondents felt BI scenario modelling is not adequately used within their organisations. A mean of 3.053 and negative skewness of 0.343 further support the analysis. This shows a lack of technical knowledge and support in use of BI scenario modelling.

4.3.18 Use of BI statistical analysis

Figure 5-22 and table 5-18 show the analysis of use of data analysis by employees.



		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally Agree	4	10.5	10.5	10.5
	Mostly Agree	21	55.3	55.3	65.8
	Neutral	7	18.4	18.4	84.2
	Mostly Disagree	5	13.2	13.2	97.4
	Totally Disagree	1	2.6	2.6	100.0
	Total	38	100.0	100.0	

Figure 5-22: Use of BI statistical analysis

The respondents "Mostly Agree" (55.3%) that users do make use of BI statistical analysis functionality. A low number indicated "Mostly Disagree" (13.2%), which also supports this assessment.

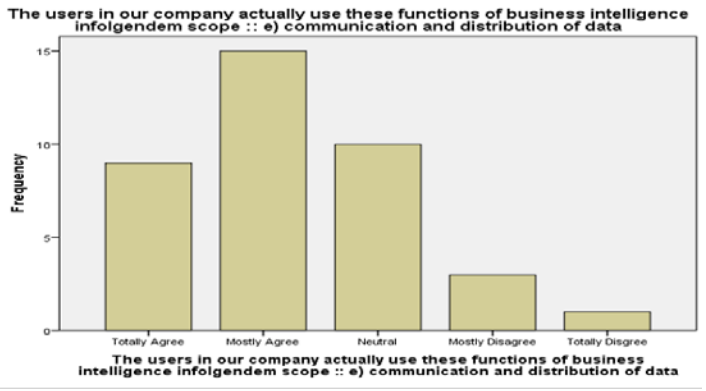
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.421	.9482	.842	.383	.401	.750

Table 4-18: Use of BI statistical analysis

Table 5-18 shows a positive skewness of 0.842 and a mean of 2.421, which further indicates that most respondents agreed that employees in their organisations do make use of BI statistical analysis functionality. The positive responses indicate that organisations do provide technical knowledge and support to the employees, hence a positive indication towards use of BI statistical analysis.

4.3.19 Use of BI communication and data distribution

Figure 5-23 and table 5-19 show the analysis of use of communication and data distribution.



		Frequency	Percent	Valid Percent	Cumulative Percent
The users in our company actually use these functions of business intelligence infolgendem scope :: e) communication and distribution of data	Totally Agree	9	23.7	23.7	23.7
	Mostly Agree	15	39.5	39.5	63.2
	Neutral	10	26.3	26.3	89.5
	Mostly Disagree	3	7.9	7.9	97.4
	Totally Disagree	1	2.6	2.6	100.0
	Total	38	100.0	100.0	

Figure 5-23: Use of BI communication and data distribution

The majority of respondents indicated “Mostly Agree” (39.5%), indicating that most employees make use of BI communication and data distribution functionality when carrying out their roles. A low number indicated “Mostly Disagree” (7.9%), which also supports this assessment.

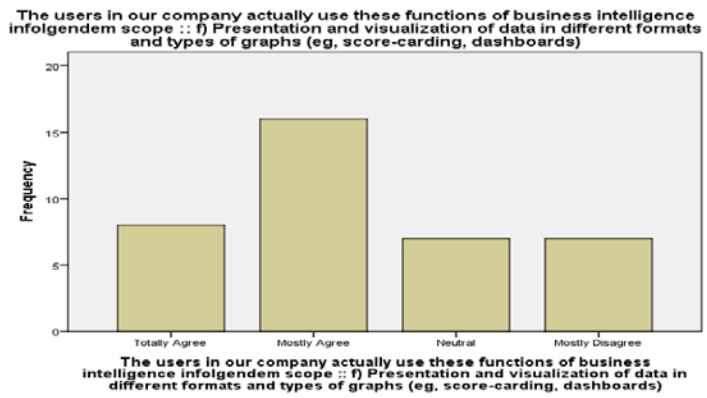
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.263	1.0050	.613	.383	.148	.750

Table 4-19: Use of BI Communication and Data distribution

A combined response of “Agree” (63.2%), with “Neutral” (26.3%) and “Disagree” (10.5%) results in a mean of 2.263 and positive skewness of 0.613. This shows that BI communication and data distribution functionality use is adequately used within organisations, hence indicating that within organisations there is technical knowledge and support for the use of BI communication and data distribution functionality.

4.3.20 Use of BI presentation and visualisation

Figure 5-24 and table 5-20 show the analysis of use of BI presentation and visualisation.



		Frequency	Percent	Valid Percent	Cumulative Percent
The users in our company actually use these functions of business intelligence infolgendem scope :: f) Presentation and visualization of data in different formats and types of graphs (eg, score-carding, dashboards)	Totally Agree	8	21.1	21.1	21.1
	Mostly Agree	16	42.1	42.1	63.2
	Neutral	7	18.4	18.4	81.6
	Mostly Disagree	7	18.4	18.4	100.0
	Total	38	100.0	100.0	

Figure 5-24: Use of BI presentation and visualisation

The respondents "Mostly Agree" (42.1%) that users in their company make use of BI presentation and visualisation functionality when carrying out their roles. The second highest response was "Totally Agree" (21.1%), with "Neutral" and "Mostly Disagree" both showing an 18.4% response. This indicates that organisations are making use of some form of visual aid to analyse data.

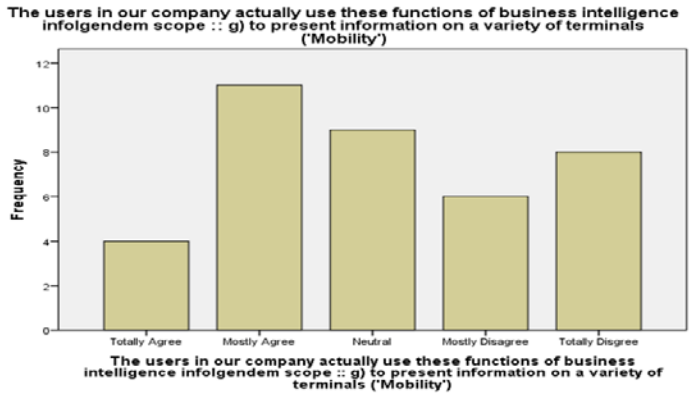
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.342	1.0208	.373	.383	-.906	.750

Table 4-20: Use of BI presentation and visualisation

Table 5-20 shows a mean of 2.342 and positive skewness of 0.373, which indicates a positive response to the question of BI presentation and visualisation functionality use among users within the organisation. This shows that organisations provide the necessary technical knowledge and support to users of BI presentation and visualisation functionality.

4.3.21 Use of BI mobility

Figure 5-19 and table 5-15 show the analysis of use of BI mobility by employees.



		Frequency	Percent	Valid Percent	Cumulative Percent
The users in our company actually use these functions of business intelligence infolgendem scope :: g) to present information on a variety of terminals ('Mobility')	Totally Agree	4	10.5	10.5	10.5
	Mostly Agree	11	28.9	28.9	39.5
	Neutral	9	23.7	23.7	63.2
	Mostly Disagree	6	15.8	15.8	78.9
	Totally Disagree	8	21.1	21.1	100.0
	Total	38	100.0	100.0	

Figure 5-25: Use of BI mobility

Figure 5-25 shows that most participants “Mostly Agree” (28.9%), followed by “Neutral” (23.7%) and then “Totally Disagree” (21.1%). The response distribution was somewhat equal, indicating that organisations are making use of BI tools and are incorporating the mobility functionality of the BI tools.

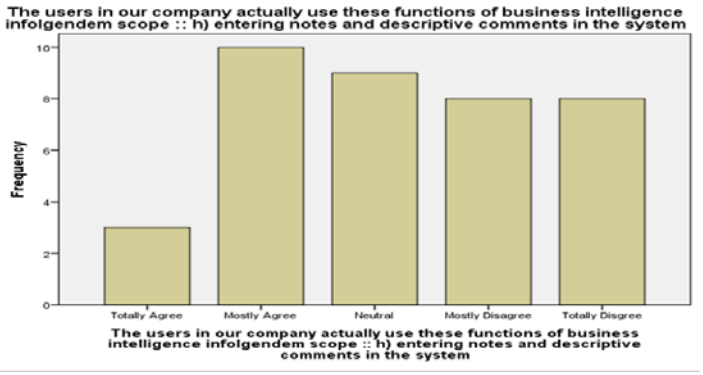
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	3.079	1.3230	.143	.383	-1.154	.750

Table 4-21: Use of BI mobility

Table 5-21 shows a mean of 3.079 and positive skewness of 0.143, which indicates that the organisations had slightly positive impact in the use of BI mobility functionality. A negative kurtosis of 1.154 shows that the data distribution was almost equal across the responses. This indicates that technical knowledge and support for the use of BI mobility is somewhat available within the organisation but more support is needed.

4.3.22 Use of BI notes and descriptive comments

Figure 5-26 and table 5-22 shows analysis of use of BI notes and descriptive comments.



		Frequency	Percent	Valid Percent	Cumulative Percent
The users in our company actually use these functions of business intelligence infolgendem scope :: h) entering notes and descriptive comments in the system	Totally Agree	3	7.9	7.9	7.9
	Mostly Agree	10	26.3	26.3	34.2
	Neutral	9	23.7	23.7	57.9
	Mostly Disagree	8	21.1	21.1	78.9
	Totally Disagree	8	21.1	21.1	100.0
	Total	38	100.0	100.0	

Figure 5-26: Use of BI notes and descriptive comments

Figure 5-26 shows that that the majority of participants indicated “Mostly Agree” (26.3%), followed by “Neutral” (23.7%). “Totally Disagree” and “Mostly Agree” both received 21.1%, indicating that the responses were somewhat equally distributed.

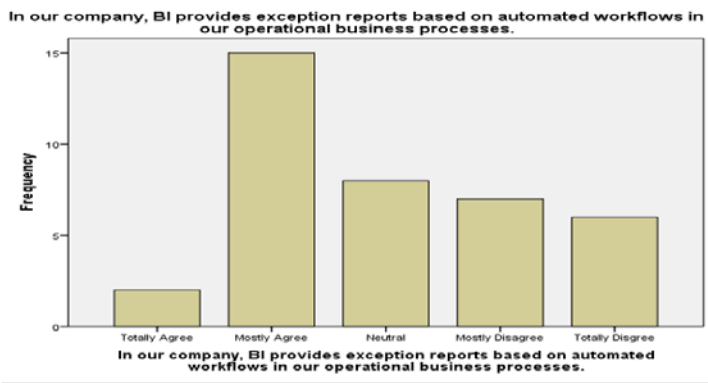
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	3.211	1.2768	-.006	.383	-1.127	.750

Table 4-22: Use of BI notes and descriptive comments

Table 5-22 shows a mean of 3.211 and negative skewness of 0.006, which represents a slight negative impact of the use of BI notes and descriptive comments functionality. A negative kurtosis of 1.127 indicates a relatively flat distribution of responses regarding notes and descriptive comments. This an indication that the availability of technical knowledge and support for the use of BI notes and descriptive comments is not adequate within the organisations.

4.3.23 Automated operational workflow exception reporting

Figure 5-19 and table 5-15 show the analysis of automated operational workflow exception reporting.



		Frequency	Percent	Valid Percent	Cumulative Percent
In our company, BI provides exception reports based on automated workflows in our operational business processes.	Totally Agree	2	5.3	5.3	5.3
	Mostly Agree	15	39.5	39.5	44.7
	Neutral	8	21.1	21.1	65.8
	Mostly Disagree	7	18.4	18.4	84.2
	Totally Disagree	6	15.8	15.8	100.0
	Total	38	100.0	100.0	

Figure 5-27: Automated workflow exception reporting

The majority of respondents “Mostly Agree” (39.5%) that BI provides automated operational workflow exception reporting functionality, while 34.2% disagreed.

N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	3.000	1.2081	.388	.383	-1.021	.750

Table 4-23: Automated workflow exception reporting

Table 5-23 above shows a mean of 3 and positive skewness of 0.388. A kurtosis of -1.021 was obtained, which represents a flatter peak and shows uniformly spread responses. This shows that organisations have limited technical knowledge and support geared towards automated workflow exception reporting provided by BI.

4.3.24 Automated strategic workflow exception reporting

Figure 5-28 and table 5-24 show the analysis of automated strategic workflow exception reporting.

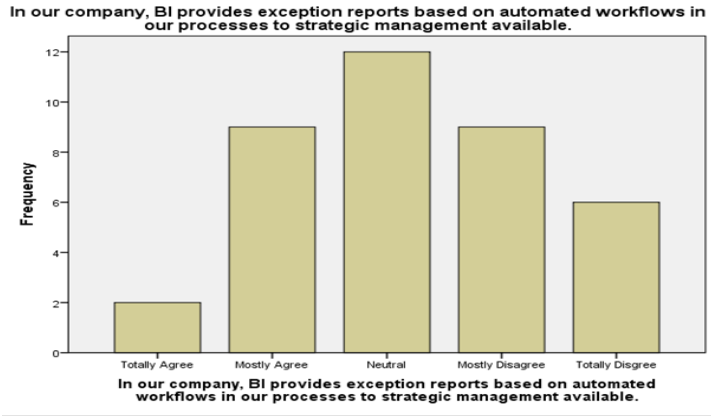
		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally Agree	2	5.3	5.3	5.3
	Mostly Agree	9	23.7	23.7	28.9
	Neutral	12	31.6	31.6	60.5
	Mostly Disagree	9	23.7	23.7	84.2
	Totally Disagree	6	15.8	15.8	100.0
	Total	38	100.0	100.0	

Figure 5-28: Automated strategic workflow exception reporting

Most respondents had a “Neutral” (31.6%) view, neither agreeing nor disagreeing that BI provides automated strategic workflow exception reporting.

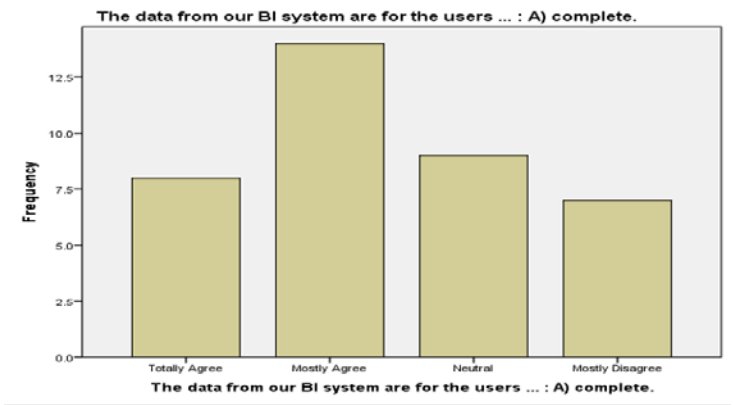
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	3.211	1.1427	.022	.383	-.796	.750

Table 4-24: Automated strategic workflow exception reporting

Figure 5-28 shows a “Mostly Agree” and “Mostly Disagree” response of 23.7%, representing a closely equal distribution of responses. A mean of 3.211 and a positive skewness of 0.022 is shown in table 5.24. The skewness represents a close to symmetric data distribution. This indicates that as many respondents consider automated strategic workflow exception reporting to be a useful function as do not. This shows that more organisational support needs to be introduced to enhance technical knowledge across the organisation.

4.3.25 Completeness of data

Figure 5-29 and table 5-25 show the analysis of completeness of data within BI.



		Frequency	Percent	Valid Percent	Cumulative Percent
The data from our BI system are for the users ... : A) complete.	Totally Agree	8	21.1	21.1	21.1
	Mostly Agree	14	36.8	36.8	57.9
	Neutral	9	23.7	23.7	81.6
	Mostly Disagree	7	18.4	18.4	100.0
	Total	38	100.0	100.0	

Figure 5-29: Completeness of data

Figure 5-29 shows that most participants “Mostly Agree” (36.8%) that data provided by BI systems is complete. A further 21.1% “Totally Agree”, while 18.4% “Mostly Disagree” (18.4%).

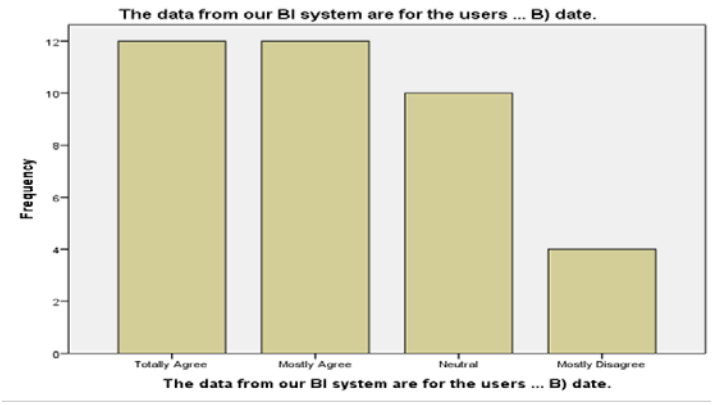
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.395	1.0277	.220	.383	-1.028	.750

Table 4-25: Completeness of data

A positive skewness of 0.220 is shown in table 5-25, further indicating the positive stance of respondents. Therefore, technical knowledge and support can be considered to exist within the organisations.

4.3.26 Timeliness of data

Figure 5-19 and table 5-15 show the analysis of timeliness of data within BI.



		Frequency	Percent	Valid Percent	Cumulative Percent
The data from our BI system are for the users ... B) date.	Totally Agree	12	31.6	31.6	31.6
	Mostly Agree	12	31.6	31.6	63.2
	Neutral	10	26.3	26.3	89.5
	Mostly Disagree	4	10.5	10.5	100.0
	Total	38	100.0	100.0	

Figure 5-30: Timeliness of data

Figure 5-30 shows that most participants “Mostly Agree” or “Totally Agree” (both 36.8%) that data provided by BI systems is timely. 26.3% of respondents are “Neutral” and 18.4% “Mostly Disagree”.

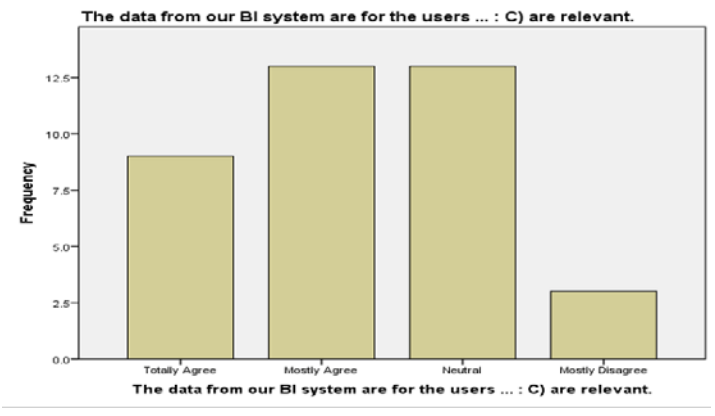
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.158	1.0007	.350	.383	-.956	.750

Table 4-26: Timeliness of data

A positive skewness of 0.350 is shown in table 5-26, further indicating the positive stance of respondents. Therefore, technical knowledge and support can be considered to exist within the organisations.

4.3.27 Relevance of data

Figure 5-31 and table 5-27 show the analysis of relevance of data within BI.



	Frequency	Percent	Valid Percent	Cumulative Percent
Totally Agree	9	23.7	23.7	23.7
Mostly Agree	13	34.2	34.2	57.9
Neutral	13	34.2	34.2	92.1
Mostly Disagree	3	7.9	7.9	100.0
Total	38	100.0	100.0	

Figure 5-31: Relevance of data

Figure 5-31 shows that most participants “Mostly Agree” (34.2%) that data provided by BI systems is relevant. A further 23.7% “Totally Agree”, while 7.9% “Mostly Disagree” (7.9%).

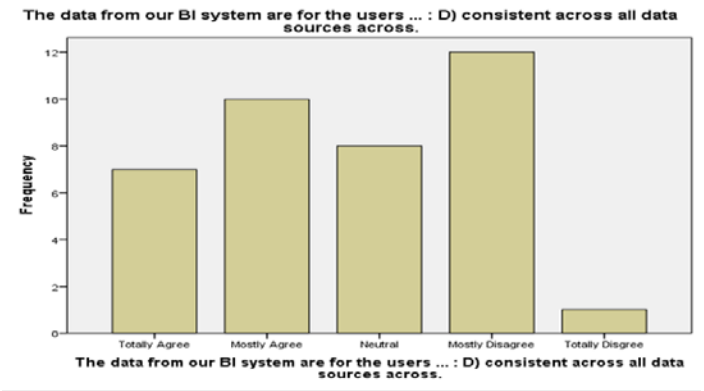
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.263	.9208	.093	.383	-.866	.750

Table 4-27: Relevance of data

A positive skewness of 0.093 further indicates the positive stance of respondents. Therefore, technical knowledge and support can be considered to exist within the organisation.

4.3.28 Consistency of data

Figure 5-32 and table 5-28 show the analysis of consistency of data within BI.



		Frequency	Percent	Valid Percent	Cumulative Percent
The data from our BI system are for the users ... : D) consistent across all data sources across.	Totally Agree	7	18.4	18.4	18.4
	Mostly Agree	10	26.3	26.3	44.7
	Neutral	8	21.1	21.1	65.8
	Mostly Disagree	12	31.6	31.6	97.4
	Totally Disagree	1	2.6	2.6	100.0
	Total	38	100.0	100.0	

Figure 5-32: Consistency of data

Figure 5-32 shows that most participants “Mostly Disagree” (31.6%) that data provided by BI systems is consistent. 26.3% “Mostly Agree” (26.3%), 18.4% “Totally Agree” and 2.6% “Mostly Disagree”.

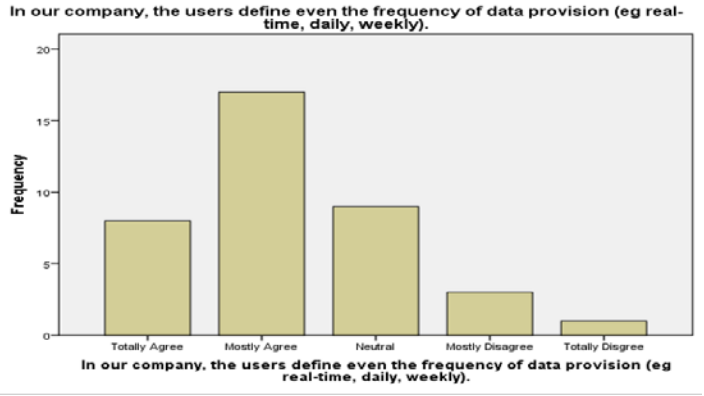
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.737	1.1783	-.083	.383	-1.223	.750

Table 4-28: Consistency of data

A negative skewness of 0.083 and a mean of 2.737 shown in table 5-28 indicate a slight negative stance of respondents. Therefore, technical knowledge and support can be considered to be lacking within the organisation.

4.3.29 Frequentness of data

Figure 5-33 and table 5-29 show the analysis of frequentness of data within BI.



		Frequency	Percent	Valid Percent	Cumulative Percent
In our company, the users define even the frequency of data provision (eg real-time, daily, weekly).	Totally Agree	8	21.1	21.1	21.1
	Mostly Agree	17	44.7	44.7	65.8
	Neutral	9	23.7	23.7	89.5
	Mostly Disagree	3	7.9	7.9	97.4
	Totally Disagree	1	2.6	2.6	100.0
	Total	38	100.0	100.0	

Figure 5-33: Frequentness of data

Figure 5-33 shows that most participants indicated “Mostly Agree” (44.7%), indicating that they agree that data provided by BI systems is frequent. A further 21.1% “Totally Agree” while 18.4% “Mostly Disagree”.

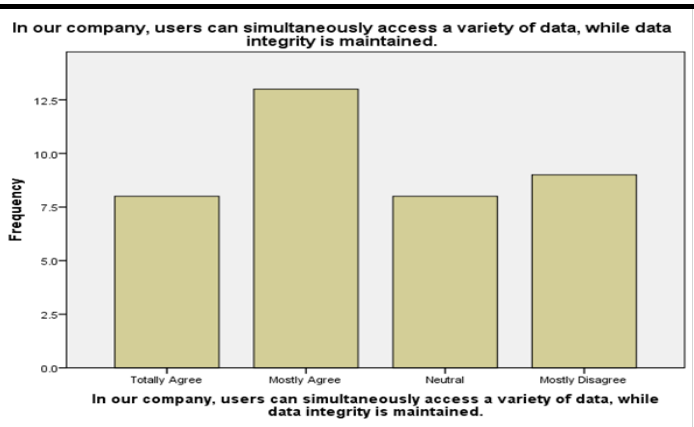
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.263	.9777	.714	.383	.446	.750

Table 4-29: Frequentness of data

A mean of 2.263 and positive skewness of 0.714 is shown in table 5-29, further indicating the positive stance of respondents. Therefore, technical knowledge and support can be considered to exist within the organisation.

4.3.30 Integrity of data

Figure 5-34 and table 5-30 represents the analysis of integrity of data within BI.



	Frequency	Percent	Valid Percent	Cumulative Percent
Totally Agree	8	21.1	21.1	21.1
Mostly Agree	13	34.2	34.2	55.3
Neutral	8	21.1	21.1	76.3
Mostly Disagree	9	23.7	23.7	100.0
Total	38	100.0	100.0	

Figure 5-34: Integrity of data

Figure 5-34 shows that most participants "Mostly Agree" (34.2%) that BI systems provide data based on integrity. A further 21.1% "Totally Agree" while 23.7% "Mostly Disagree".

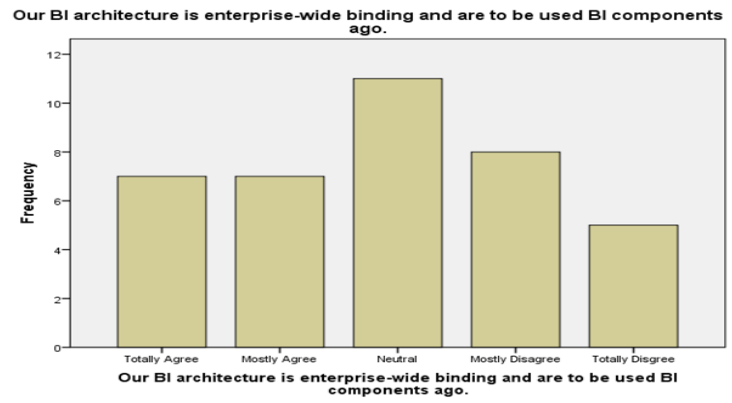
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.474	1.0840	.138	.383	-1.237	.750

Table 4-30: Integrity of data

A mean of 2.474 and positive skewness of 0.138 is shown in table 5-30, further indicating the positive stance of respondents. Therefore, technical knowledge and support can be considered to exist within the organisation.

4.3.31 BI architecture standardisation

Figure 5-35 and table 5-31 show the analysis of BI architecture standardisation.



	Frequency	Percent	Valid Percent	Cumulative Percent
Totally Agree	7	18.4	18.4	18.4
Mostly Agree	7	18.4	18.4	36.8
Neutral	11	28.9	28.9	65.8
Mostly Disagree	8	21.1	21.1	86.8
Totally Disagree	5	13.2	13.2	100.0
Total	38	100.0	100.0	

Figure 5-35: BI architecture standardisation

Figure 5-35 shows that most respondents were “Neutral” (31.6%), neither agreeing nor disagreeing that data provided by BI systems is consistent. 26.3% “Mostly Agree”, 18.4% “Totally Agree” and 2.6% “Mostly Disagree”.

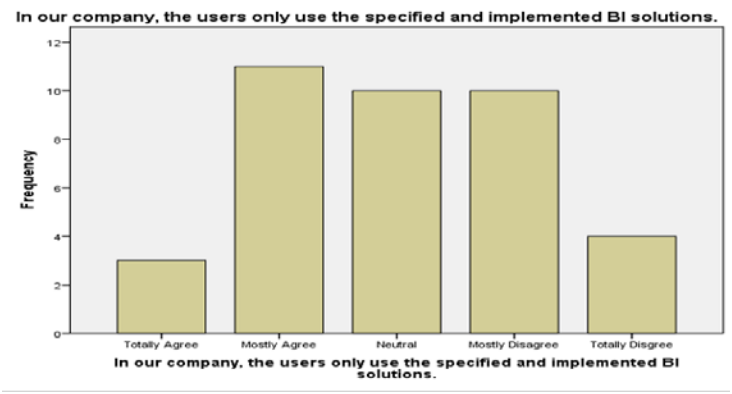
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.921	1.3024	-.002	.383	-.999	.750

Table 4-31: BI architecture standardisation

A negative skewness of 0.002 and a mean of 2.921 shown in table 5-28 indicate a slight negative stance of respondents. Therefore, technical knowledge and support can be considered to be lacking within the organisation.

4.3.32 BI solutions usage

Figure 5-36 and table 5-32 show the analysis of BI solutions usage within the organisations.



		Frequency	Percent	Valid Percent	Cumulative Percent
In our company, the users only use the specified and implemented BI solutions.	Totally Agree	3	7.9	7.9	7.9
	Mostly Agree	11	28.9	28.9	36.8
	Neutral	10	26.3	26.3	63.2
	Mostly Disagree	10	26.3	26.3	89.5
	Totally Disagree	4	10.5	10.5	100.0
	Total	38	100.0	100.0	

Figure 5-36: BI solutions usage

Figure 5-36 shows that most participants "Mostly Agree" (28.9%) that users make use of specified BI solutions. A further 7.9% "Totally Agree" while 26.3% "Mostly Disagree".

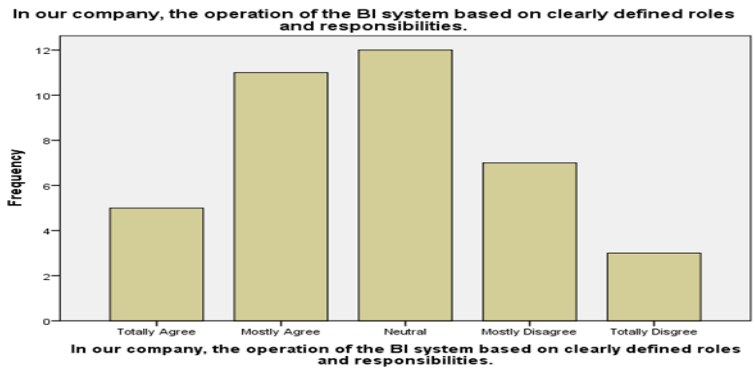
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	3.026	1.1505	.059	.383	-.856	.750

Table 4-32: BI solutions usage

The total combination of responses that agreed to the fact that users make use of specified BI solutions (36.8%) equals the total combination of those that disagreed (36.8%). Table 5-32 describes this with a mean of 3.026, skewness of 0.059 and kurtosis of -0.856, which indicates close to normal distribution of data and a close to flatter peak, that shows uniformly spread responses. Therefore, technical knowledge and support can be considered to exist within the organisation, though more awareness is needed.

4.3.33 BI roles and responsibilities

Figure 5-37 and table 5-33 show the analysis of BI roles and responsibilities.



		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally Agree	5	13.2	13.2	13.2
	Mostly Agree	11	28.9	28.9	42.1
	Neutral	12	31.6	31.6	73.7
	Mostly Disagree	7	18.4	18.4	92.1
	Totally Disagree	3	7.9	7.9	100.0
	Total	38	100.0	100.0	

Figure 5-37: BI roles and responsibilities

Figure 5-37 shows that most respondents were "Neutral" (31.6%), neither agreeing nor disagreeing that organisations have clearly defined BI roles and responsibilities. 28.9% "Mostly Agree", 13.2% "Totally Agree" and 18.4% "Mostly Disagree".

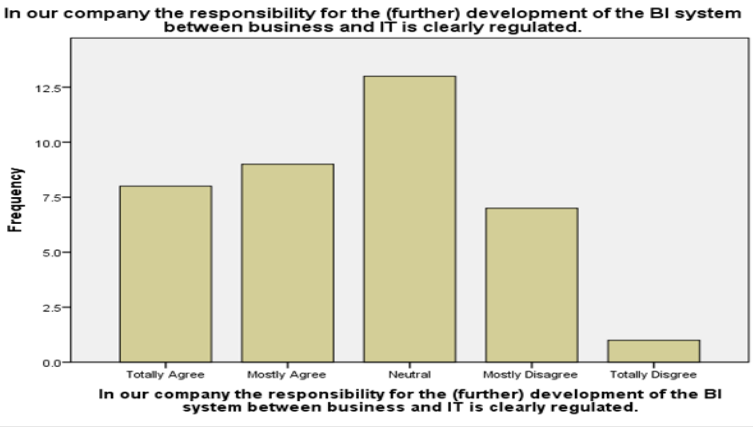
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.789	1.1427	.208	.383	-.608	.750

Table 4-33: BI roles and responsibilities

The total combination of responses that agreed that users make use of specified BI solutions (42.1%) is greater than the total combination of those that disagreed (26.3%). Table 5-33 indicates a mean of 2.789, skewness of 0.208 and kurtosis of -0.608, which indicates positive response and agreement that organisations has clearly defined BI roles and responsibilities. Therefore, technical knowledge and support can be considered to exist within the organisation.

4.3.34 BI development and IT regulation

Figure 5-38 and table 5-34 show the analysis of BI development and IT regulation.



		Frequency	Percent	Valid Percent	Cumulative Percent
Totally Agree	8	21.1	21.1	21.1
Mostly Agree	9	23.7	23.7	44.7
Neutral	13	34.2	34.2	78.9
Mostly Disagree	7	18.4	18.4	97.4
Totally Disagree	1	2.6	2.6	100.0
Total	38	100.0	100.0	

Figure 5-38: BI development and IT regulation

Figure 5-38 shows that most participants were “Neutral” (34.2%), neither agreeing nor disagreeing that the responsibility for the development of the BI system between business and IT is clearly regulated. 23.7% “Mostly Agree”, 13.2% “Totally Agree” and 18.4% “Mostly Disagree”.

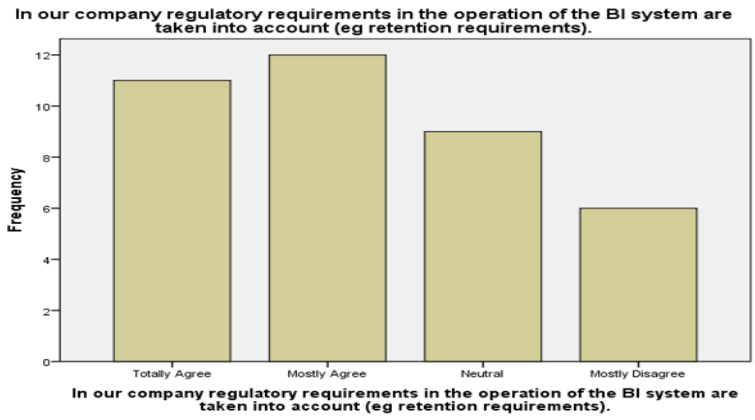
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.579	1.1060	.042	.383	-.837	.750

Table 4-34: BI development and IT regulation

The total combination of responses that agreed that the responsibility for the development of the BI system between business and IT is clearly regulated (44.8%) is greater than the total combination of those that disagreed (26.3%). Table 5-34 indicates a mean of 2.579, skewness of 0.208 and kurtosis of -0.837, which indicates positive response and agreement that the responsibility for the development of the BI system between business and IT is clearly regulated. Therefore, technical knowledge and support can be considered to exist within the organisation.

4.3.35 BI regulatory requirements

Figure 5-39 and table 5-35 show the analysis of BI regulatory requirements.



		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally Agree	11	28.9	28.9	28.9
	Mostly Agree	12	31.6	31.6	60.5
	Neutral	9	23.7	23.7	84.2
	Mostly Disagree	6	15.8	15.8	100.0
	Total	38	100.0	100.0	

Figure 5-39: BI regulatory requirements

Figure 5-39 shows that most participants "Mostly Agree" (31.6%) that the organisation takes into account regulatory requirements in the operations of BI systems. A further 28.9% "Totally Agree" while 15.8% "Mostly Disagree".

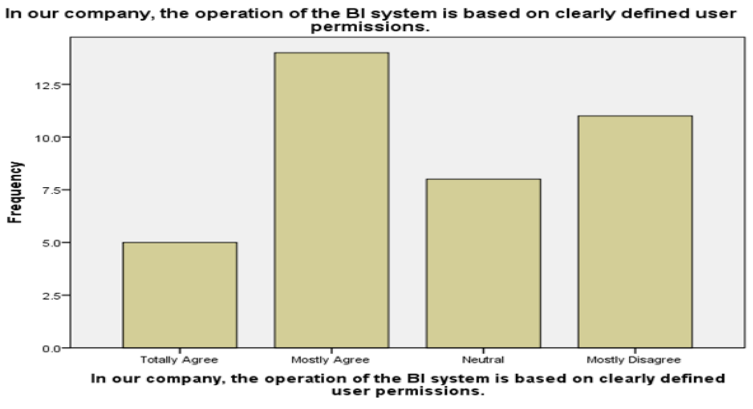
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.263	1.0574	.305	.383	-1.090	.750

Table 4-35: BI regulatory requirements

The total combination of responses that the organisation takes into account regulatory requirements in the operations of BI systems (60.5%) is greater than the total combination of those that disagreed (15.8%). Table 5-35 indicates a mean of 2.263, skewness of 0.305 and kurtosis of -1.090, which indicates positive responses and agreement that the organisation takes into account regulatory requirements in the operations of BI systems. Therefore, technical knowledge and support can be considered to exist within the organisation.

4.3.36 User permissions

Figure 5-19 and table 5-15 show the analysis of user permissions.



		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally Agree	5	13.2	13.2	13.2
	Mostly Agree	14	36.8	36.8	50.0
	Neutral	8	21.1	21.1	71.1
	Mostly Disagree	11	28.9	28.9	100.0
	Total	38	100.0	100.0	

Figure 5-40: User permissions

Figure 5-40 shows that most participants "Mostly Agree" (36.8%) that operation of BI systems is based on clearly defined user permissions. A further 28.9% "Totally Agree" while 15.8% "Mostly Disagree".

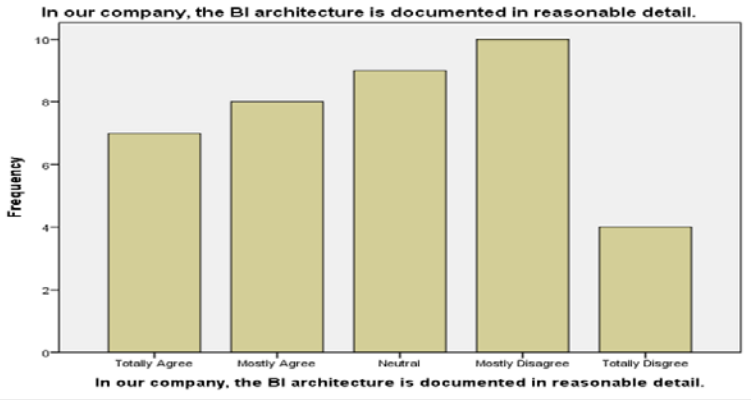
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.658	1.0469	.004	.383	-1.243	.750

Table 4-36: User permissions

The total combination of responses that operation of BI systems is based on clearly defined user permissions (50%) is greater than the total combination of those that disagreed (28.9%). Table 5-36 indicates a mean of 2.658, skewness of 0.004 and kurtosis of -1.243, which indicates a positive response and agreement that operation of BI systems is based on clearly defined user permissions. Therefore, technical knowledge and support can be considered to exist within the organisations.

4.3.37 BI architecture documentation

Figure 5-41 and table 5-37 show the analysis of BI architecture documentation.



		Frequency	Percent	Valid Percent	Cumulative Percent
In our company, the BI architecture is documented in reasonable detail.	Totally Agree	7	18.4	18.4	18.4
	Mostly Agree	8	21.1	21.1	39.5
	Neutral	9	23.7	23.7	63.2
	Mostly Disagree	10	26.3	26.3	89.5
	Totally Disagree	4	10.5	10.5	100.0
	Total	38	100.0	100.0	

Figure 5-41: BI architecture documentation

Figure 5-41 shows that most participants "Mostly Disagree" (26.3%) that their organisation's BI architecture is well documented. 21.1% "Mostly Agree" and 18.4% "Totally Agree".

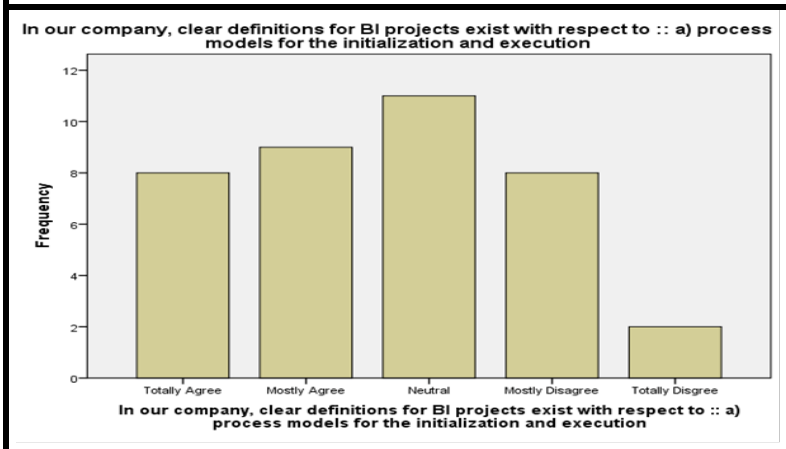
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.895	1.2901	-.033	.383	-1.092	.750

Table 4-37: BI architecture documentation

A negative skewness of 0.033 and a mean of 2.895 shown in table 5-37 indicate a slight negative stance of respondents. Therefore, technical knowledge and support can be considered to be lacking within the organisation.

4.3.38 Defined process models

Figure 5-42 and table 5-38 show the analysis of defined process models.



		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally Agree	8	21.1	21.1	21.1
	Mostly Agree	9	23.7	23.7	44.7
	Neutral	11	28.9	28.9	73.7
	Mostly Disagree	8	21.1	21.1	94.7
	Totally Disagree	2	5.3	5.3	100.0
	Total	38	100.0	100.0	

Figure 5-42: Defined process models

Figure 5-42 shows that most participants are "Neutral" (28.9%), neither agreeing nor disagreeing that BI projects exist with respect to defined process models. 23.7% "Mostly Agree" and 21.1% "Totally Agree" while 21.1% "Mostly Disagree".

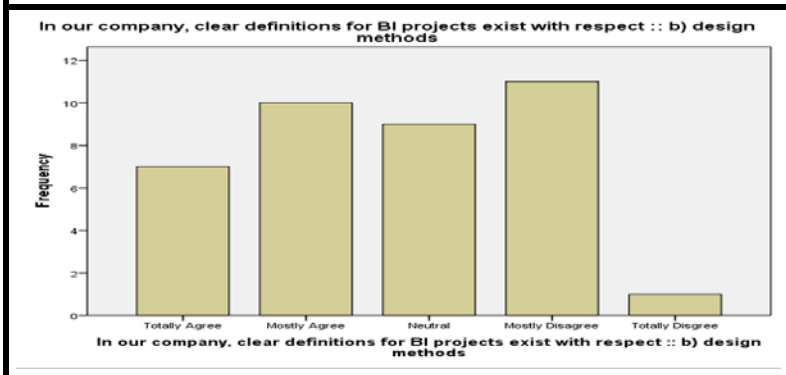
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.658	1.1918	.109	.383	-.921	.750

Table 4-38: Defined process models

The total combination of responses that agreed that BI projects exist with respect to defined process models (44.7%) is greater than the total combination of those that disagree (26.4%). Table 5-38 indicates a mean of 2.658, skewness of 0.109 and kurtosis of -0.921, which indicates a positive response and agreement that BI projects exist with respect to defined process models. Therefore, organisations do provide technical knowledge and support to the BI systems users.

4.3.39 Defined design methods

Figure 5-19 and table 5-15 show the analysis of defined design methods.



		Frequency	Percent	Valid Percent	Cumulative Percent
Totally Agree		7	18.4	18.4	18.4
Mostly Agree		10	26.3	26.3	44.7
Neutral		9	23.7	23.7	68.4
Mostly Disagree		11	28.9	28.9	97.4
Totally Disagree		1	2.6	2.6	100.0
Total		38	100.0	100.0	

Figure 5-43: Defined design methods

Figure 5-43 shows that most participants "Mostly Disagree" (28.9%) that a clear definition for BI projects exists with respect to design methods. 26.3% "Mostly Agree" and 18.4% "Totally Agree".

N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.711	1.1603	-.051	.383	-1.148	.750

Table 4-39: Defined design methods

The total combination of responses that agreed that a clear definition for BI projects exists with respect to design methods (44.7%) is greater than the total combination of those that disagree (31.5%). Table 5-39 indicates a mean of 2.711, skewness of -0.051 and kurtosis of -1.148, which indicates negative responses and disagreement that a clear definition for BI projects exists with respect to design methods. Therefore, lack of clear definitions could contribute to organisations not providing clear technical knowledge and support to users of BI systems.

4.3.40 Defined documentation standards

Figure 5-44 and table 5-40 show the analysis of defined documentation standards.

		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally Agree	8	21.1	21.1	21.1
	Mostly Agree	8	21.1	21.1	42.1
	Neutral	13	34.2	34.2	76.3
	Mostly Disagree	7	18.4	18.4	94.7
	Totally Disagree	2	5.3	5.3	100.0
	Total	38	100.0	100.0	

Figure 5-44: Defined documentation standards

Figure 5-42 shows that most participants are "Neutral" (28.9%), neither agreeing nor disagreeing that BI projects exist with respect to defined documentation standards. 21.1% "Mostly Agree" and 21.1% "Totally Agree" while 18.4% "Mostly Disagree".

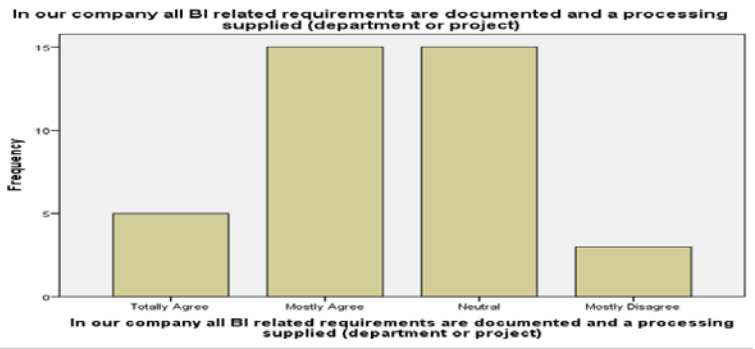
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.658	1.1689	.079	.383	-.790	.750

Table 4-40: Defined documentation standards

The total combination of responses that agreed that BI projects exist with respect to defined documentation standards (42.1%) is greater than the total combination of those that disagree (23.7%). Table 5-40 indicate the mean of 2.658, skewness of 0.079 and kurtosis of -0.790, which indicates positive responses and agreement that BI projects exist with respect to defined documentation standards. Therefore, organisations provide technical knowledge and support to the users of BI systems.

4.3.41 BI documentation

Figure 5-45 and table 5-41 show the analysis of BI documentation.



	Frequency	Percent	Valid Percent	Cumulative Percent
Totally Agree	5	13.2	13.2	13.2
Mostly Agree	15	39.5	39.5	52.6
Neutral	15	39.5	39.5	92.1
Mostly Disagree	3	7.9	7.9	100.0
Total	38	100.0	100.0	

Figure 5-45: BI documentation

Figure 5-45 shows that most participants are “Neutral” (39.5%) or “Mostly Agree” (39.5%) that BI-related requirements are documented. A further 13.2% “Totally Agree” while 7.9% “Mostly Disagree”.

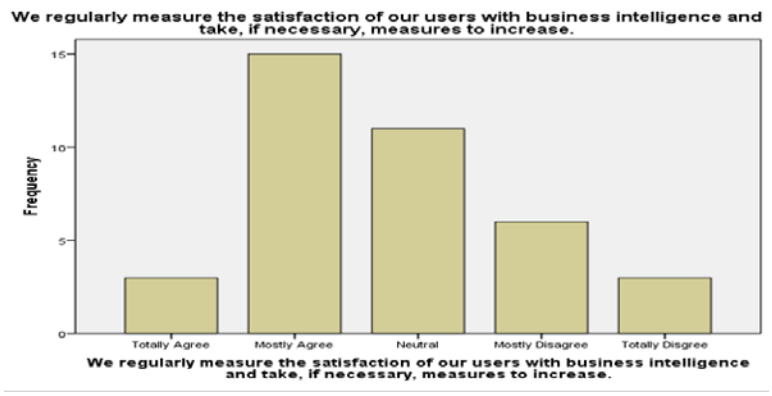
N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	4.0	2.421	.8263	-.038	.383	-.451	.750

Table 4-41: BI documentation

A slight negative skewness of 0.038 shown in table 5-27 indicates a slight negative stance of respondents. This shows that there is a need for organisation to push for more BI documentation that will promote technical knowledge assist the users.

4.3.42 User satisfaction

Figure 5-46 and table 5-42 shows the analysis of use of data analysis by employees.



		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally Agree	3	7.9	7.9	7.9
	Mostly Agree	15	39.5	39.5	47.4
	Neutral	11	28.9	28.9	76.3
	Mostly Disagree	6	15.8	15.8	92.1
	Totally Disagree	3	7.9	7.9	100.0
	Total	38	100.0	100.0	

Figure 5-46: User satisfaction

Figure 5-46 shows that most participants "Mostly Agree" (39.5%) that their organisations measure user satisfaction derived from using BI systems. A further 7.9% "Totally Agree" while 15.8% "Mostly Disagree".

N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
38	1.0	5.0	2.763	1.0764	.502	.383	-.341	.750

Table 4-42: User satisfaction

The total combination of responses that agreed that their organisations measure user satisfaction derived from using BI systems (47.4%) is greater than the total combination of those that disagreed (23.7%). Table 5-42 indicates a mean of 2.763, skewness of 0.502 and kurtosis of -0.341, which indicates positive response and agreement that organisations measure user satisfaction derived from using BI systems. This indicates that organisations provide technical knowledge and support to the users of BI systems.

4.4 Summary of BI information questions

The results obtained in section 4.3 above sum up to present outcomes in the form of positive or negative leanings.

Question	Description	Outcome
1	Meta-model standardisation	Negative
2	Meta-model terminology	Positive
3	Traceability on master data	Positive
4	Versioning of master data	Positive
5	Compatibility of BI tools	Positive
6	Uniformity	Positive
7	Satisfaction level – data analysis	Positive
8	Satisfaction level – forecasting function	Positive
9	Satisfaction level – scenario modelling function	Negative
10	Satisfaction level – statistical analysis function	Positive
11	Satisfaction level – communication and data distribution function	Positive
12	Satisfaction level – presentation and visualisation function	Positive
13	Satisfaction level – mobility function	Positive
14	Satisfaction level – entering notes and descriptive comments	Negative
15	Use of BI data analysis	Positive
16	Use of BI forecasting	Negative
17	Use of BI scenario modelling	Negative
18	Use of BI statistical modelling	Positive
19	Use of BI communication and data distribution	Positive
20	Use of BI presentation and visualisation	Positive
21	Use of mobility	Positive

22	Use of notes and descriptive comments	Negative
23	Automated operational workflow exception reporting	Positive
24	Automated strategic workflow exception reporting	Positive
25	Completeness of data	Positive
26	Timeliness of data	Positive
27	Relevance of data	Positive
28	Consistency of data	Negative
29	Frequentness of data	Positive
30	Integrity of data	Positive
31	BI architecture standardisation	Negative
32	BI solutions usage	Positive
33	BI roles and responsibilities	Positive
34	BI development and IT regulation	Positive
35	BI regulatory requirements	Positive
36	User permissions	Positive
37	BI architecture documentation	Negative
38	Defined process models	Positive
39	Defined design methods	Negative
40	Defined documentation standards	Positive
41	BI documentation	Negative
42	User satisfaction	Positive

Table 4-43: Summary of BI information questions

Based on the responses received, the overall outcome showed a negative stance regarding meta-model standardisation. Respondents could not identify meta-model standardisation as they had little or no information and training in this regard. Therefore, there is a need for organisations

to provide information sessions to users to allow them to identify and understand meta-model standardisation. A positive input from the organisation would result in a more positive response towards meta-model standards.

The question regarding scenario modelling functionality obtained negative responses regarding user satisfaction. Scenario modelling functionality enables users to view alternative possibilities and compare each possibility, making it vital for users. This functionality is thus critical, and organisations need to provide training to allow for technical knowledge to be acquired by users. This also serves as an indication of the organisation's support in assisting users to understand the role and tools of BI systems.

The functionality within BI systems to enter notes and descriptive comments also received negative responses with regard to satisfaction. There could be number of reasons for this: the users might not be willing to make use of the functionality as it might be time-consuming to document solutions or problems; users might not see value in the functionality; and the functionality might be unknown to the users. Therefore, a deeper review might be required to ascertain the reason for the negative response. For now, organisations must provide training and outline the importance of the functionality. This will facilitate capturing of individual knowledge that can be disseminated throughout the organisation.

Other issues identified include the lack of usage of BI forecasting, BI scenario modelling, and notes and descriptive comments. Lack of use of these BI tools could be a result of the tools not falling within the users' prescribed roles and responsibilities. There might also be lack of necessary information and skill set to make use of the tools. Therefore, there is a need for training to provide an overview of the tools and their importance. By providing the necessary

skills and knowledge, organisations provide the technical knowledge and support necessary for usage of BI tools.

Other issues identified revolve around BI architecture standardisation and documentation. These could result from insufficient knowledge and information being passed down from those involved in the implementation of the BI systems. Therefore, users might not be aware of the BI architecture standards, and this is contributed by lack of BI architectural documentation. There is a need for information to be distributed to all users and possibly for training to be provided to give an overview of the BI architecture. By providing the necessary information and documentation, organisations provide technical knowledge and support.

Another issue identified revolves around a lack of knowledge about defined design methods. This could be the result of insufficient knowledge and information being passed down from those involved in the implementation and design of the BI systems. Therefore, users might not be aware of the defined design methods. There is a need for information to be distributed to all users and possibly for training to be provided to give an overview of the BI design methods. By providing the necessary information and documentation, organisations provide technical knowledge and support.

Based on the analysis of responses, key aspects were highlighted that impact the distribution of technical knowledge and support regarding BI usage within organisations. The key aspects identified are: facilitating conditions, social influence, information accessibility, and information quality. These key aspects were in place in instances where positive responses were obtained.

5 Conclusions and recommendations

5.1 Introduction

This chapter summarises the approach and methodology taken in conducting the research, and findings obtained based on literature review and the findings from conducting the online survey. The BI Technical Capabilities Framework was formulated based on the literature review and became the basis of the research. Based on the framework and the data analysis this chapter will also highlight the strengths, weaknesses and limitations of the research, and will also make recommendations for further studies and draw a final conclusion.

5.2 Summary

The main research question is:

> *"What are the technical capabilities that are inherent in BI systems in South African medium to large organisations?"*

The overall research question was broken into the following sub-questions:

- What are the reasons South African companies want to use BI?
- How is technical knowledge and support defined within the context of BI acceptance and usage?
- What driving tools are used to enable users to perform BI-related tasks?
- Why is technical knowledge and support important for to users of BI?
- How is the management perspective important in the acceptance and use of BI?

Based on the main question and the sub-questions, both literature review and respondents showed that BI systems provided organisations with a competitive advantage against their competitors, provided they were implemented successfully, and with focus on technical capabilities. BI systems assist employees in carrying out their day-to-day activities by providing the means to analyse data and/or make informed decisions. BI systems, used together with current organisational systems or integrated into the current technical framework, result in organisations being able to maximise the value of already attained data and information.

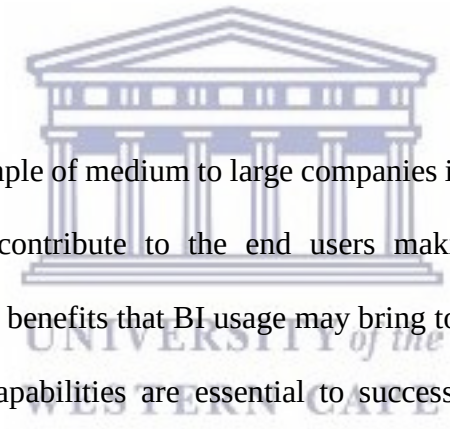
The literature reviews also indicated that lack of BI systems might result in medium to large organisations missing out on important aspects of the industry. Therefore, there was a move from basic databases to the use of information systems like enterprise resource planning (ERP), customer relations management (CRM), supply chain management (SCM) and other e-commerce applications to improve decision-making and remain competitive (Brockmann et al., 2012). The introduction of more information systems that have capability to expand an organisation growth and competitiveness has impacted the way organisation conduct day to day activities. Therefore, supporting the use of BI systems as these bring about more sophisticated, effective, efficient and user-friendly BI systems came into existence. This relates to sub-question one.

The introduction of new systems saw organisations introducing more frequent user training for all employees, from top management right down to the bottom. This relates to sub-question two. Awareness and initiatives by management to having employees other than IT experts attain formal training lead to more BI systems becoming useful within organisations (sub-question three). Through the awareness and training, users of the BI systems found them easy

to use and navigate and were able to use BI systems to carry out their day-to-day activities as well as make important and well-informed decisions.

With regard to sub-question five, respondents indicated that management participation was recognised and that effort was made to ensure use of BI systems. Participants came from middle to top management, based on the responses BI usage and solution indicated that the management was involved in the ensuring of usage by making use of the BI system. The management involvement during solution scope was also indicated through the responses attained when participants respondent to BI solutions question.

5.3 Study significance



The study was based on a sample of medium to large companies in South Africa and identified key components that may contribute to the end users making use of BI. Apart from acknowledging the numerous benefits that BI usage may bring to companies, the study aimed to advocate that technical capabilities are essential to successful usage of BI. These key components where derived from past literature within and outside South Africa. The key components allow for further study into introducing BI systems into small and start-up business.

From an academic perspective, it brings new views into how technical knowledge and support can impact end user tasks and daily operations. The study also identified the role of middle to top management perspective in the impact of technical knowledge and support on end users of BI systems.

5.4 Strengths

The emergence of BI systems has allowed users to be less dependent on the IT department with regard to analysing data for decision making, as BI tools have been customised to assist users in using the systems. BI systems have reduced the reliance on IT experts, and there is no more time wasting as data can be retrieved quickly.

The BI technical capabilities framework illustrated larger positive response by the participants. The participants alluded to the fact that BI provided more benefits to organisation therefore resembling that focus on technical capabilities does provide vital importance to BI system and its users. BI systems are known to provide relevant data that can be integrated into reports, visual analysis, performance management and effective decision making. Therefore, allowing for capabilities that facilitate and allow for data to be manipulated to provide value to business is great need for the organisation.

5.5 Weaknesses

The research projected significant participants though this might have improved the number or the number of participants would have been high with separation of the questionnaire into a more streamlined questionnaire. Given the time constraints that might influence middle to top management into dedicating time to the research, an expanded focus that might have included the general employees might have given large sample to the research.

5.6 Recommendations for further study

The study main participants where from middle to top management, which excluded the general employees. For more insight, further studies can be geared towards the general

employees. General employees make use of most of the components of BI systems on a daily basis and may provide an up-close view of the systems' benefits. Studies may also be conducted to compare the influence of technical knowledge and support on BI usage within large organisations as opposed to small ones, and to what extend BI systems are being integrated into daily operations, against the background of the necessary training and awareness already being in place.

The study mainly focused on South Africa, even though it was part of a collaborative study by a German and a South African institution. The same study could be carrying out with a focus on Germany, and both findings could be compared to discern any similarities or differences.

5.7 Conclusion

The research questions in this study were designed to ascertain the role that organisations play, from technology perspective, in the successful use of BI systems. Apart from ensuring that the best BI solution is obtained and the right BI system is in place, more and deeper questions had to be answered. The questions revolved around how effective and efficient the BI systems being used are and how well-equipped or knowledgeable those using the systems are. To do this, it was necessary to gain an understanding of the organisation's involvement in ascertaining the depth of users' knowledge and look at the organisation's involvement in providing a platform for users to learn and be equipped.

The study examined the aspects of technical knowledge and support for end users of BI. Therefore, the study illustrated that, apart from obtaining a successful BI solution and implementing a BI system successfully, it is of paramount importance to the success of

implemented BI systems that organisations support users of BI systems by providing the applicable skills and training. The study also indicated that organisations need to constantly equip users with technical knowledge and support to give them a high level of competency in using and navigating the BI systems.

This chapter detailed the analysis of the research questions, pointing out the elements that participants considered to be important. The results obtained were analysed by breaking them into sections, starting with a statistical descriptive analysis, followed by responses learning analysis, summary analysis of questions and factor analysis.

The questions were categorised into concepts that conformed to the BI capabilities framework. This enabled the researcher to ascertain the main objective of the research: to identify organisation involvement in contributing towards the role of technical knowledge and support in the use of BI systems.

The factors identified through the study conformed to the BI capabilities framework and therefore alluded to the sub-questions that organisations perceive technical knowledge and support as being of value to the role that BI systems play within organisations. The organisations consider providing supporting structures that enhance BI understanding as vital, as this was shown to improve performance efficiency and social influence.

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Appendix

Appendix A: Cover Letter

Project Title: The impact of technical knowledge and support on the usage of Business Intelligence Systems in South Africa.

What is this study about?

My name is Tatenda B Mangwayana, a student at the University of the Western Cape pursuing a Master's degree in Information Management in the Information Systems Department. I am conducting a study on *"How do medium to large companies in South Africa manage the availability of technical knowledge and support for end users of BI systems?"* This study forms part of a combined study conducted by The University of Western Cape in South Africa and the Neu-Ulm University of Applied Sciences in Germany. The overall aim of this study project is to analyse whether and how far BI could enhance the success of business organisations related to the planning, monitoring and control of strategic and operational business activities.

However, my part of the study will contribute to the overall study as it will tie with main objective of the study. Your personal details shall remain strictly confidential and anonymous, and the study does not intend to harm you in any way.

I thank you in advance for your participation.

What will I be asked to do if I agree to participate?

If you agree to participate in this study, section A will comprise of general questions that relate to your organisation which might include selecting a relevant response from ones provided and filling in own response. Section B will follow with questions around the current status of the organisation and this questions will be based on Likert scale thus a scale of Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know. The questionnaire will take about 20 – 30 minutes and allows for you to save and be able to return at a later stage to complete the questions.

Would my participation in this study be kept confidential?

The online survey is anonymous and no filling of personal details or company names is asked to be included. On completion and submission of the responses no email or personal details is kept. If need be on your side, require the results of the study to be shared may provide an email address of your choice at the end of the survey.

What are the risks of this study?

There are no known risks associated with participating in this study.

What are the benefits of this study?

This study is not designed to help you personally, but the results may assist organisations to evaluate the level of their own Business Intelligent (BI) systems, on the basis of which they could define a customised BI-Strategy. The study will also allow the organisation to measure the value the BI systems are bringing to the organisation and its employees hence advocating for better understanding the use of the systems.

Do I have to be in this study and may I stop participating at any time?

Participation in this study is completely and entirely voluntary. You may choose not to take part at all. If you decide to participate in this study, you may stop participating at any time.

Is any assistance available if I am negatively affected by participating in this study?

This study will not expose you to any harm as a result of your participation.

What if I have questions?

If you have any questions feel free to contact Tatenda B Mangwayana, the student, at University of the Western Cape. My phone number is +27 71 151 3388 and my e-mail address is 2901645@myuwc.ac.za. May also contact my supervisor Dr Adheesh Budree at Information Department, University of Western Cape. His telephone number is +27 21959 3249.

Should you have any questions regarding this study and your rights as a study participant or if you wish to report any problems you have experienced related to the study, please contact:

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Appendix B: Consent Form

Letter of Consent for Online Survey

Project Title: The impact of technical knowledge and support on the usage of Business Intelligence Systems in South Africa

Student: Tatenda B Mangwayana

Please may you read the below and consent:

1. I confirm that I have read and understood the information sheet explaining the above study project and I have had the opportunity to ask any questions about the project.
2. I understand that my participation in this study is voluntary. I am free not to participate and have the right to withdraw from the study at any time, without having to explain myself. I am aware that this interview might result in study which may be published, but my name may be/ not be used.
3. I understand my response will be kept strictly confidential. I gave permission for members of the study team to have access to my anonymized responses. I understand that the information derived from this study is confidential and treated as such.
4. I agree that the data collected from me to be used in the future study.
5. I agree to take part in the above study project.

Date:

If you have any questions about the study itself, please my supervisor Dr Adheesh Budree at Information Department, University of Western Cape. His telephone number is +27 21959 3249. his email address is: abudree@uwc.ac.za

By pressing “CONTINUE” means you agree with the terms and conditions stated on consent form, otherwise click “EXIT” if not agreeing.

EXIT CONTINUE

Appendix C: Survey

General questions

1. Total annual turnover	< 250 Mio ZAR 250 - 500 Mio ZAR 501 - 1.250 Mio ZAR 1.251 - 2.500 Mio ZAR 2.501 - 5.000 Mio ZAR > 5.000 Mio ZAR
2. Sales turnover of the last 3 years	- declining (< -2%) - continuous (-2% - +2%) - increasing (> +2%) - No answer
3. Earnings performance of the last 3 years	- declining (< -2%) - continuous (-2% - +2%) - increasing (> +2%) - No answer
4. Employee fulltime equivalence	< 250 251 - 500 501 - 1.000 1.001 - 5.000 5.001 - 10.000 > 10.000
5. Years of trading period	0 to 5 / 6 to 10 / 11 to 15 / 16 to 20 / 20 +
6. Industry type	- *Mining and quarrying industries* - Manufacturing of food and forage - Manufacturing of wearing apparel - Manufacturing of leather, leather-related products and shoes - Manufacturing of printing products - Manufacturing of chemical products - Manufacturing of pharmaceutical products - Manufacturing of rubber products and plastic products - Metal production and processing - Manufacturing of metal products - Manufacturing of electrical equipment - Mechanic engineering - Manufacturing of furniture - Manufacturing of miscellaneous products - Energy supply - Construction industry - Miscellaneous
7. Job title of the respondent	- Managing director/CEO, - Business director, - Technical director, - Finance & Accountancy/CFO, - CIO, - Staff function, - Miscellaneous
8. Legal form of the company	- private limited company - public limited company - Miscellaneous
9. Does your company belong to a company group?	yes/no If “no”, please go forward with question 13 If “yes”, go forward with question 10
10. How many companies belong to this alliance?	Open question

11. Are the companies of the alliance independent legal entities?	yes/no
12. Do you have a uniform management of IT?	yes/no
13. Is the IT architecture determined company-internal or cross-company?	- Company-internal - Cross-company
14. Is your BI architecture based on an integrated platform of a **single** provider?	yes/no If "no", please go forward with question 16 If "yes", go forward with question 15
15. Do you use ERP software and BI systems of the same provider?	yes / no
16. Which BI system**s** does your company use? (name of providers)	- - - - -
17. How much did your company spent on BI over the last five years?	In ZAR
18. Please indicate the percentage spent on BI in the following categories:	Software Hardware Detailed report development Management and strategic dashboards

Please evaluate the following statements for your company with regard to your **current status.**	
1. In our organisation the meta-models in all BI databases are **standardised** (even if there are a variety of database formats.)	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
2. In our organisation the meta-models use the same **standardised terminology**.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
3. In our organisation the BI-Tools used for corporate performance management processes are **interoperable**.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
4. In our organisation the BI-Tools used for corporate performance management processes are the same **for each functional area**.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
5. In our organisation data changes of BI relevant master data (e.g. hierarchies) can be traced	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
6. In our organisation versioning control of BI relevant master data (e.g. hierarchies) is practiced.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know

7. In our organisation BI provides a sufficient feature set for **data analysis** (e.g. to show past trends).	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
8. This feature set for **data analysis** (if available) is used by our users.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
9. In our organisation BI provides a sufficient feature set for **predictive forecasting** (e.g. to show future trends).	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
10. This feature set for **predictive forecasting** (if available) is used by our users.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
11. In our organisation BI provides a sufficient feature set for **scenario modelling**.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
12. This feature set for **scenario modelling** (if available) is used by our users.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
13. In our organisation BI provides a sufficient feature set for **statistical analysis** (e.g. data mining).	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
14. This feature set for **statistical analysis** (if available) is used by our users.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
15. In our organisations BI provides a sufficient feature set to **share** and **disseminate** data.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
16. This feature set to **share** and **disseminate** data (if available) is used by our users.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
17. In our organisation BI provides a sufficient feature set to **present and visualize data in different formats and graphics** (e.g. score-carding and dash-boarding).	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
18. This feature set to **present and** visualize data in different **formats and graphics** (if available) is used by our users.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
19. In our organisation BI provides a sufficient feature set to present data/information on **several devices** („mobility“).	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know

20. This feature set to set to present data/information on **several devices** („mobility“) is used by our users.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
21. In our organisation BI provides a sufficient feature set for the users to add describing **comments / notes** to the system. 22. In our organisation we use BI **comments / notes**.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
23. In our organisation BI provides a sufficient feature set for alerts linked to the automated workflow data in our **operational business processes.** 24. In our organisation BI provides a sufficient feature set for alerts linked to the automated workflow data in our **strategic business processes.**	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
25. In our organisation BI components supply **complete** data according to the needs of the users.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
26. In our organisation BI components supply **current** data according to the needs of the users.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
27. In our organisation the **frequency** of data supply is determined by the user (e.g. real-time, daily, weekly…)	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
28. In our organisation BI components supply **relevant data** according to the needs of the users.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
29. In our organisation we have **consistent** data across the databases 30. In our organisation users have **simultaneous** access to data while maintaining data integrity.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know

31. In our organisation the BI-Architecture which defines the existing BI components is **binding** throughout the whole enterprise.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
32. In our organisation users use **only** the implemented BI-solutions.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
33. In our organisation the operation of the BI system is based on clearly defined roles and responsibilities.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
34. In our organisation the enhancement of the BI system is based on clearly defined roles and responsibilities between our functional and IT departments.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
35. In our organisation we consider regulatory requirements by operating our BI system (if available), e.g. legal obligations to keep data.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
36. In our organisation the operation of the BI system is in compliance with clearly defined user rights.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
37. In our organisation the BI architecture is described in an appropriately detailed document.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
38. In our organisation there are clearly defined procedure models for planning and implementing BI projects.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
39. In our organisation there are clearly defined design methods for BI projects.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know

40. In our organisation there are clearly defined documentation standards for BI projects.	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
41. In our organisation all new requirements of BI are documented and evaluated by functional departments or project team	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
42. In our organisation we take action to increase user BI satisfaction based on regular measurement	Totally agree / mostly agree / partially agree/disagree / mostly disagree / totally disagree/ statement not relevant/I do not know
Summary Validation:	
43. Please choose which of the following attributes are suitable to generate the greatest business value of BI in your company: a) Operationalisation of business strategy b) Alignment of business units towards corporate and business objectives c) Linkage between strategic and operational planning d) Feedback loop to control the attainment of objectives and deduction of measures if objectives are missed e) Integration through common data and aligned management methods f) Supply the management with current data g) Ensure robust and non-arbitrarily data supply process for the management h) Supply the management with relevant, complete and consistent data i) Transparent and communicated corporate performance processes j) Enterprise-wide standards and tools for corporate performance management k) Compliance with external legal regulations	Expected value in 3-5 years: Low value / marginal value / average value, rather high value / high value / statement not relevant / I do not know

If you would like to be informed about the results of the survey, please fill in your email address below. _____