EVALUATION OF KEY VALUE DRIVERS AS A DECISION SUPPORT TOOL FOR STRATEGY IMPLEMENTATION IN BHP BILLITON MANGANESE

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Submitted for the degree of Doctor of Business Administration

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November 2010

ABSTRACT

This study evaluated the use of Key Value Drivers as a decision support tool for strategy implementation in BHP Billiton Manganese. The evaluation methods used in this study were subjective and were based on perception data collected from BHP Billiton Manganese Management. Three data collection methods were used, namely, survey questionnaire, archival search and interviews.

The results obtained indicated that BHP Billiton Manganese managers perceive Key Value Drivers to be an effective decision support tool for strategy implementation, however the current Microsoft Excel model that has evolved over the past decade is perceived to be difficult to maintain with respect to data management and the support that is offered to users in the form of training material and on-line help is limited.

The study indicated that Key Value Drivers as currently used in BHP Billiton Manganese, are an important integrator for a number of business processes such as Planning, Performance Management, Business Improvement and Management Information Systems.

At a practical level, the study provided a method for identification and ranking of Key Value Drivers and a subjective evaluation process that can be used to get user input in design and implementation of management information systems.

At a theoretical level, the study has shown that the relevance of Decision Support Systems and Value Based Management approaches still persists in contemporary managerial decision-making and that there is potential to use modern technologies such as Business Intelligence platforms to support these legacy systems. The empirical findings of this study were in general supportive of what could be expected based on the literature review covering Decision Support Systems, Key Value Drivers, Business Intelligence and Information Systems' Evaluation Approaches.

The Business Intelligence implementation project that is currently underway will benefit from the feedback generated by this study, particularly by ensuring that the two key shortcomings of the current KVD model are addressed.

The study was a cross-sectional study limited to BHP Billiton Manganese. The study can be replicated in other Customer Sector Groups or repeated in BHP Billiton Manganese to create a longitudinal profile.

DEDICATION

This thesis is dedicated to my late father, Rev. Mahlodi Piet Ralephata, whose life was a practical expression of life-long learning.

ACKNOWLEDGEMENT

This research was sustained by the support of many people.

Firstly, I would like to thank my supervisor, Professor Neil Kay for his patience and guidance throughout this research.

Secondly, I would like to thank my former colleagues at BHP Billiton, particularly:

1. The library staff at 6 Hollard Street for their support during the literature review.
2. The BI and PPM project teams for dragging me into the Information Age.
3. Philip Hechter for believing in me even when I doubted myself. Grow old gracefully!
4. All the colleagues from Hotazel, Metalloys, Temco and Gemco who provided feedback and suggestions during the survey

My family has been a constant source of support and encouragement from the first day I embarked on this journey. I would like to thank my dear wife Mashudu and our children; Bojosi, Tshepo, Sebatje and Takalani.

Finally to my God and my Father for the love and grace that is beyond comprehension!

DECLARATION STATEMENT

ACADEMIC REGISTRY
Research Thesis Submission

Name:	Mpoti Abisaai Ralephata		
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Version: *(i.e. First, Resubmission, Final)*	Final	Degree Sought (Award **and** Subject area)	Doctor of Business Administration

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1 INTRODUCTION

1.1 Introduction

The trigger for this study was BHP Billiton Manganese’s decision to implement a Business Intelligence (BI) system designed on the basis of a Key Value Driver (KVD) model. The objective of the BI implementation was to provide the business with a system that would support operational decision-making and consequently lead to improved strategy implementation.

The decision to implement a BI system was taken after a Business Excellence evaluation in September 2006 identified that Information and People Management were the two weakest functional areas in BHP Billiton Manganese.

This study was undertaken in order to evaluate Key Value Drivers as a decision support tool for strategy implementation in BHP Billiton Manganese.

1.2 Research proposition and structure of the thesis

The research proposition is that it is feasible to evaluate KVDs as a decision support tool for strategy implementation by application of appropriate research methods in order to furnish BHP Billiton Manganese management with confirmation that their decision to use KVDs as the basis for BI system implementation was justified.

Management issues, such as “effective decision-making” and “effective strategy implementation” are difficult to measure directly. The paradigm of this study is therefore predominantly phenomenological and relies on perceptions and feedback from BHP Billiton Manganese employees in order to make an evaluation of KVDs as a decision support tool.

A triad of data collection methods, namely, survey questionnaire, semi-structured interviews and archival search was employed in the research. While there is no previous research that covers an identical scope to this research, there is an abundance of literature on evaluation of Decision Support Systems, Strategy Implementation and Value Based Management approaches that can be used as sources for measurement techniques and variables that may be usable in a study of this nature.

This thesis provides a literature review under the chapter headings: Decision Support Systems, Key Value Drivers, Business Intelligence and Evaluation Approaches. In

Chapter 6, the literature review is synthesized and research hypotheses are formulated, followed by research method design in Chapter 7. Results are presented and analysed in Chapter 8. Chapter 9 is the last chapter of the thesis covering conclusions and discussion of the conclusions.

1.3 Scope of study

The scope of this study is limited to BHP Billiton Manganese, which is one of the nine Customer Sector Groups (CSGs) of BHP Billiton. The Manganese Customer Group is comprised of the Hotazel Manganese Mines (South Africa), Groote Eylandt Mining Company(Australia), Metalloys Smelter (South Africa) , Tasmanian Electrometallurgical Company (Australia) and a Corporate Office in Johannesburg (South Africa).

The survey component of the study focussed on employees that have access to the KVD model and are the target user-group for the new BI system. These employees fall within the Managers and Superintendents bands. The interviews focussed on the Top Management category of employees who are responsible for overseeing strategy formulation and implementation. The archival search covered both BHP Billiton Manganese archives and the BHP Billiton Group archives for Group Level Documentation (GLDs).

The intended users of the evaluation feedback from this study are firstly, BHP Billiton Manganese BI system sponsors and Implementation Team. Secondly, the methods used in this study can be replicated in similar studies in other CSGs or Business Units (BUs) throughout the BHP Billiton Group.

1.4 Aims and Objectives of the study

The aim of this research is to examine whether Key Value Drivers are an effective decision support tool for strategy implementation in BHP Billiton Manganese.

The following research objectives were set in order to achieve the above research aim:

1 To examine the effect of use of KVDs on task performance of BHP Billiton managers.
2 To examine the alignment (or good system fit) between the current KVD model and other BHP Billiton Manganese business processes.

3 To examine the extent to which the current Microsoft Excel KVD model is easy to use, i.e. that the system has high usability.

4 To examine whether current KVDs have a significant impact on value creation in BHP Billiton Manganese.

5 To examine whether current KVDs are perceived by BHP Billiton Manganese managers to be controllable.

6 To review the research literature on which the above research objectives were based in the light of the empirical findings of this research in order to ascertain whether the empirical findings support or conflict findings from reviewed literature.

The above research objectives were set based on information obtained during the literature review. A survey questionnaire developed by Adelman and Riedel (1997) was used as the basis for testing hypotheses relating to objectives 1 to 3. Research hypotheses relating to objectives 4 and 5 were tested using a method designed on the basis of a KVD identification process published by L.E.K Consulting (2007).

The research method followed was largely qualitative and the decision-making leading to the conclusions of this study was inductive.

1.5 Background information on BHP Billiton Manganese

The literature review and field-study chapters contain examples and illustrations based on BHP Billiton Manganese processes. The aim of this section is to provide an overview of the BHP Billiton Manganese business in order to create a context for subsequent references to the business that occur throughout the theses.

1.5.1 The Manganese Customer Sector Group

BHP Billiton is a global diversified resources company with its headquarters in Melbourne, Australia. It was formed in 2001 as a result of a merger between BHP Ltd and Billiton plc. The company is divided into nine Customer Sector Groups (CSG's), namely, Aluminium, Base Metals, Coal, Diamonds and Specialty Products, Iron Ore, Manganese (Mn), Petroleum, Stainless Steel Materials and Uranium. The role of the CSGs is to deliver on the BHP Billiton Corporate Strategy. The CSGs are accountable for managing all activities necessary to deliver and grow the CSG's earnings before interest and tax (EBIT). (BHP Billiton, 2008c)

BHP Billiton Manganese is one of the nine Customer Sector Groups that comprises BHP Billiton.

BHP Billiton Manganese CSG operates a number of assets in South Africa and Australia that are jointly owned with Anglo American plc. In South Africa, Samancor Manganese is the statutory entity that owns Hotazel Manganese mines (HMM) and the Metalloys smelter. Samancor Manganese is a joint venture between Anglo American plc (40%) and BHP Billiton LTD (60%) with BHP Billiton having full operational responsibility. In Australia, the Groote Eylandt Mining Company (Gemco) and the Tasmanian Electrometallurgical Company (Temco) are separate statutory entities each owned by Anglo American plc (40%) and BHP Billiton LTD (60%). BHP Billiton has operational responsibility for both Gemco and Temco.

The Manganese industry consists of three categories of industry participants, namely:

1. Ore Producers: The participants in this category are further divided into High Grade (HG) and Low Grade (LG) ore producers. HG ore normally contains more than 35 % Mn and LG ore less that 35% Mn by mass. HG ore producers account for about 65 % of Mn units[1] produced. This is the most profitable segment of the industry with an average profit margin in 2008 of about 45% .
2. Integrated Ore and Alloy Producers: These are industry participants that convert some of their Mn ore production into alloy. BHP Billiton Manganese falls into this industry segment. Integrated Producers accounted for about 30% of the annual alloy production of 10 million tons in 2008.
3. Independent Alloy Producers: these are alloy producers that do not own any Mn ore mines and buy all their ore feedstock on the market. In 2008, independent alloy producers accounted for 70% of the 10 million tons of alloy produced.

The Manganese market consists of two main categories of customers:

1. Customers supplying the steel industry: This group accounts for more than 95 % of the total Mn consumption and consists of independent alloy producers and steel producers.
2. Less that 5% of Mn produced is sold for specialty products in agriculture, dry-cell battery production so on.

[1] One Mn unit (mtu) is equivalent to 10 Kg of 100% Mn, for example, an ore containing 35 % Mn, contains 350 Kg of Mn per ton or 35mtu/ton.

Table 1.1 below summarizes the production volumes of the top four Manganese producers in 2008.

Producer	Ore (million mtu)	Alloy (000 tonnes)	% Integrated[2]
BHP Billiton	283	775	26
Assmang	166	247	14
Eramet	146	722	46
Vale	55	527	90

Table 1.1: Top four Mn ore and alloy producers in 2008 (BHP Billiton, 2009a)

The global demand for Mn is essentially driven by demand for carbon steel and therefore the growth rate in the Mn industry traces that of the steel industry at about 4 % per annum. The markets for ore (in order of decreasing volumes) are China, Japan, South Korea, India, European Union and the America's. Alloy sales are concentrated in North America and the European Union with small volumes going to Asia.

Mn is not traded on an exchange and producers and customers enter into supply contracts at negotiated prices. There is also an active spot market where un-contracted supply is sold. Analysts publish a number of benchmark prices and they serve as a guide of the demand and supply situation in the market.

1.5.2 The BHP Manganese Business Units

1 **Hotazel Manganese Mines (HMM):** The Mines are situated in the Northern Cape Province of the Republic of South Africa. HMM comprises of two operations, namely, Mamatwan (open pit) mine and the Wessels underground mine. HMM employs 1500 people.

The Mamatwan operation mines a 20-meter thick body of lower grade manganese ore overlain by 50 meters of Kalahari sand, gravel and calcrete. The mine has an annual run-of-mine ore production capacity of about 2.3 million tons. There is a beneficiation[3] plant comprising of a dense-media separation plant and a million tons per annum sinter plant. The beneficiation plant upgrades the run-of-mine lumpy product from about 38.5 % Manganese to a 48 % Manganese sinter product. Sintering improves both the chemical and physical characteristics of the ore. Chemically, sintering increases the Manganese content (percentage) and removes carbonate compounds that

[2] The extent of integration measured as a percentage mtu sold as alloy from the total saleable product mtu.
[3] Beneficiation refers to the upgrading of a primary ore to a stage where the product(s) can be used in a manufacturing process. (Lurie, 2001:87). In the case of Mn ore can be upgraded or beneficiated by dense-medium separation, sintering and/ or smelting.

create excessive gas when ore is introduced into furnaces. Physically, sinter is both strong and has a high surface area/ mass ratio.

At Wessels, underground mining of hydro-thermally enriched manganese ore of a higher grade is carried out at a depth of about 300 meters. The product grade of ore mined at Wessels can be blended to between 45% and 48 %.

2 **Groote Eylandt Mining Company (Gemco):** Gemco is situated on the island of Groote Eylandt in the Northern Territory of Australia. Groote Eylandt is Aboriginal land that covers an area of approximately 2260 square kilometres, located in the Gulf of Carpentaria in the vast Northern Territory of Australia.

Gemco extracts high-grade manganese ore using open-cut, strip-mining methods. The ore can be sold as lumps or fines with manganese grades variable from 43 % to 46 % manganese. The production capacity at Gemco is about 3.4 million tons per annum.

Gemco employs 650 people.

3 **The Tasmanian Electro Metallurgical Company (Temco)** is a ferroalloy smelter located 50 kilometres north of Launceston at Bell Bay on the coast of Tasmania, Australia.

Temco's four furnaces and sinter plant have an annual production capacity of 230 000 tons of manganese alloys and 350 000 tons of manganese sinter per annum. Alloys that are produced are Silico-manganese (SiMn) and high carbon Ferro-manganese (FeMn).The furnaces can be switched from producing one alloy to the other, depending on market conditions. 425 people are employed at Temco.

4 **The Metalloys Smelter** situated in the town of Mayerton in the province of Gauteng in South Africa. The smelter operates four SiMn , three FeMn furnaces and an Oxygen Basic Converter(OBC).The smelter annual production rate is about 100 000 tons SiMn, 420 000 high carbon FeMn and 70 000 tons medium carbon FeMn (the OBC converts liquid high carbon FeMn to medium carbon FeMn.). Metalloys employs 1250 people.

BHP Billiton Manganese is a mature business with all its operating business units older than 30 years. In addition to the 3825 fulltime employees and contractors that work in the BUs about 35 people are employed at the corporate office in Johannesburg.

The process of strategy development is prescribed by the BHP Billiton in a process generally referred to as CAP[4].The execution of the strategy developed using the CAP process is the accountability of the CSG. Over the years BHP Billiton Manganese BUs have been unable to execute their strategies as planned. The following questions arose amongst the CSG management subsequent to analysis done during a Business Excellence evaluation in 2006:

1. What information is required to implement the Strategy?
2. In what way must this information be made available to the users?

Management decided to implement a Business Intelligence system based on a KVD model, in order to provide the businesses with a tool that will support operational decision-making and consequently lead to improved strategy implementation.

1.6 Synoptic Review of the thesis

This thesis is divided into nine chapters. What follows is a synoptic review of the chapters.

1.6.1 Chapter 1: Introduction

This chapter introduces the study, the research proposition and the synoptic outline of the thesis. The research evaluates Key Value Drivers as a decision support tool for strategy implementation. The scope of the study is limited to the Manganese Customer Sector Group of BHP Billiton. Chapter 1 provides background information on BHP Billiton Manganese in order to create a context for understanding examples and inferences that are drawn from the business throughout the thesis. The aim of the research which is to examine whether Key Value Drivers are an effective decision support tool for strategy implementation in BHP Billiton Manganese is stated together with the five research objectives that were set in order to achieve the research aim.

1.6.2 Chapter 2: Decision Support Systems

Chapter 2 is the first chapter of the literature review and covers the following four broad topics:

[4] Corporation Alignment Planning

The concept of Decision Support System (DSS): the concept of DSS is examined firstly from the perspectives that were used historically to define DSS and secondly from the perspective of contemporary understanding of the decision making process.

Decision Support System Architecture: Two DSS architectural descriptions are examined; the first description by Mallach (2006) emphasising the technological aspects of DSS architecture and the second description by Turban et al (2007) emphasising the functional aspects of DSS architecture.

Decision Support System and Strategy Implementation: this section looks at the BHP Billiton strategy development process (CAP) and analyses it in terms of the decision making approaches that were used in the description of the DSS concept.

Benefits of Decision Support Systems: Money et al (1988) summarized DSS benefits into eight categories based on the literature review they conducted. These categories were; Clerical, Management time utilization, Decision-making, Problem appreciation, Data Utilization, Planning and Control, Decision search and Communication benefits. Mallach (2007) used the following categories of DSS benefits; Personal efficiency, Problem solving, Communication, Training and Organizational Control.

1.6.3 Chapter 3: Key Value Drivers

Chapter 3 is the second chapter of the literature review. This chapter examines Key Value Drivers (KVDs); their definition, practical identification and their use in individual and business performance management.

The chapter starts by discussing the concept of value and the importance of value measurement for both shareholders and managers in the context of the ‘agency problem’. Two competing paradigms used to measure business performance in relation to creation of shareholder value were examined. The two paradigms examined were the Accounting perspective and the Value Based Management perspective to business performance management.

The following criteria for identifying KVDs were discussed: (1) KVDs should have a significant impact on value creation, (2) they should be controllable by management, (3) they should be measurable, (4) they should relate directly to business strategy and (5) they should cover the business comprehensively.

The following approaches to identifying KVDs were discussed: (1) Management Accounting, (2) Functional (e.g. HR, Marketing) and (3) Integrated Performance Frameworks (e.g. balanced scorecard, performance prism).

The chapter concluded by examining the use of KVDs in strategy development and implementation, i.e. the use of KVDs in Planning, Co-ordination, Monitoring, Diagnosis and KVDs as a decision-support tool.

1.6.4 Chapter 4: Business Intelligence

This chapter is the third chapter of the literature review and discusses the concept of Business Intelligence (BI) as a means of ensuring that managers have easy and timely access to accurate information they require to manage the key value drivers of the business. Viewed from the DSS architectural perspectives discussed in chapter 2 BI was examined as a platform for integration of DSS subsystems.

The strategic importance of BI was examined from the context of the BHP Billiton Manganese business. The BI implementation that is underway BHP Billiton Manganese is aimed at improving information access and eliminating reporting problems. A roadmap has been developed to extend BI benefits to advanced use of analytics in decision making in future.

The BHP Billiton Manganese BI implementation roadmap is comprised of two phases, namely, Asset Construction and Value Realisation, based on the BI implementation approach described by Williams and Williams (2007). The design of the BI components is based on the use of KVDs in strategy development and implementation.

1.6.5 Chapter 5: Evaluation Approach

This is the fourth chapter of the literature review and is aimed at reviewing the subject of evaluation and identifying previous approaches that were used in similar contexts as the current research.

Literature on evaluation of DSS, expert systems and general information systems was examined under the following topics: What is to be evaluated? What method is to be used? What is the time-span of the evaluation and what are the expected decisions from the evaluation data.

Evaluation methods for DSS and expert systems can be classified into three broad categories (Adelman, 1992): technical, empirical and subjective evaluations. A subjective evaluation method was selected for use in this research based on a multi-attribute method developed by Adelman and Riedel (1997).

1.6.6 Chapter 6: Synthesis

In chapter 6 the literature on Decision Support Systems (DSS), Key Value Drivers (KVDs), Business Intelligence (BI) and Evaluation Approach is synthesised leading to the development of six research hypotheses.

The six research null hypotheses are:

1. The use of KVDs has a positive effect on the task performance of BHP Billiton managers.
2. The current KVD model is aligned with other BHP Billiton Manganese business processes.
3. The current Microsoft Excel KVD model is easy to use (or has a high degree of usability)
4. The current KVDs have a significant impact on value creation.
5. The current KVDs are controllable by managers.
6. The empirical findings of this research support literature review findings.

The above research hypotheses were subsequently used for the research design and method selection.

1.6.7 Chapter 7: Research Design and Method

The aim of chapter 7 is the development of the research strategy and selection of data-collection methods that would be used to gather data in order to test the research hypotheses developed in chapter 6.

The first stage of designing the research strategy was identifying measurement variables for testing the research hypotheses. The next stage was the selection of data collection methods.

Three data collection methods were selected namely, a survey questionnaire, archival search of business documentation and semi-structured interviews with managers.

The survey questionnaire was distributed electronically (e-mail) and data were collected using the SurveyMonkey subscription service.

Archival data was collected from the BHP Billiton information management system.

Face-to-face interviews were conducted with selected managers at the BHP Billiton corporate offices in Johannesburg.

1.6.8 Chapter 8: Results and Analysis

Survey reports were downloaded from the SurveyMonkey website for analysis.

Basic respondent demographic information was reported. Other data were sorted into categories based on the hypotheses the data was meant to test. The data were then analysed and reported under their relevant hypotheses.

Minitab Statistical software and Microsoft Excel were used for all statistical calculations.

Tests for differences were performed relating to the five hypotheses in order to determine if the respondents perceptions differed based on their organizational roles or the type of business units were the respondents were employed. Both parametric and non-parametric statistical tests were used after tests for Normality revealed that the survey response data relating to hypotheses 1 to 3 were not normally distributed whereas survey response data relating to hypotheses 4 and 5 were normally distributed.

Data obtained from the examination of historical business documents were presented and analysed in order to confirm that the survey results were in agreement with business practice.

Interview data collected during the interviews with top management were coded and presented in a form that is usable for confirming the findings of the survey.

1.6.9 Chapter 9: Conclusions and discussions

Based on the results reported in Chapter 8, findings as summarized below were made:

1. The use of KVDs has a positive effect on the task performance of managers regardless of specific organisational roles (manager or superintendent) or Business Unit (BU) type (Mine, Smelter or Corporate) where managers are employed.
2. BHP Billiton managers perceive the current KVD model to be aligned with other BHP Billiton Manganese business processes.This perception is not dependent on the organizational role of the manager or the type of BU where the manager is employed.
3. The current MS Excel model is easy to use. This perception is also not dependent on the organizational role of the manager or the type of BU where the manager is employed.

4. The current KVDs are perceived to have varying degrees of impact on value creation.
5. The current KVDs are controllable to varying degrees.
6. The findings were found to be broadly consistent with what could be expected from the literature review. In particular, there is strong alignment between the published benefits of DSS and the perceived value of the evaluated KVD model.

In discussing the results, it was acknowledged that the findings might not be generalized to all businesses or even to other BHP Billiton Customer Sector Groups; however, the study makes two main practical contributions; firstly, it provides a method for identification and selection of Key Value drivers that can be replicated by other businesses. Secondly, the subjective evaluation process followed can be used to complement technical evaluation processes for other Information Systems projects, thus bridging the gap between technical experts and business users.

The validity of the research was enhanced firstly by triangulation using the three data collection methods and secondly by the use of the Multi-Attribute Utility Assessment questionnaire as the basis of survey questionnaire design. The MAUA questionnaire has been tested and validated previously as reported in literature. (Riedel and Adelman, 1997).

The overall conclusion of the research is that KVDs are an effective decision support tool for strategy implementation. The research also provided current BI sponsors and implementers with feedback regarding the usability deficiencies of the current KVD model. This feedback can be used to design further enhancements to the BI system that is being implemented.

1.7 Chapter Summary

Chapter 1 introduced the thesis by firstly outlining the research aim and objectives, secondly by giving background information on the business where the research takes place and finally by giving a synoptic review of the thesis leading to the main conclusion of the study.

The aim of the study was to examine whether KVDs are an effective decision support tool for strategy implementation in BHP Billiton Manganese. Six research hypotheses were developed from literature. These hypotheses were examined using three data collection methods, namely, survey questionnaire, archival search and interviews.

The main conclusion of the study was that KVDs are an effective decision support tool for strategy implementation in BHP Billiton Manganese. Furthermore, the study highlighted that the usability of the current Excel KVD model can be improved by provision of more user support (training and on-line help facilities) and better data management technology. The Business Intelligence implementation that is currently underway should ensure that these improvement opportunities are realized.

The empirical findings that support the main conclusion of this study were examined in the light of the reviewed literature covering Decision Support Systems, Key Value Drivers, Business Intelligence and Evaluation Approaches. The findings were found to be generally supportive of what could be expected based on the reviewed literature.

The main practical significance of the study for BHP Billiton is that the research methodology used in the study can be replicated by other Customer Sector Groups to identify KVDs and to integrate business processes based on KVDs. The study also provides a method for assessing the relevance of Information System technologies to business requirements. The subjective evaluation method used in this study can be used to complement existing project evaluation methods for Information Systems that are predominantly technical in orientation.

2 DECISION SUPPORT SYSTEMS

2.1 Introduction

This chapter together with chapters 3 and 4 examine literature regarding decision-support systems, key value drivers and business intelligence. The objective of this literature review is to set the context in which an evaluation of key value drivers as a decision support tool in strategy implementation in BHP Billiton Manganese can take place. Chapter 5 focuses on evaluation techniques for decision support systems and information systems in general.

The literature on decision –support systems (DSS) is firstly, reviewed from a historical perspective, in order to understand the concept and evolution of DSS. Secondly, DSS are examined from the context of decision-making and strategy implementation with examples from current BHP Billiton Manganese business processes.

2.2 The Concept of Decision Support System

The topic of Decision Support Systems has been dealt with extensively in the literature over a period of almost 40 years. The reason that interest in DSS persists to this day, is that the underlying issue that a DSS tries to address will always be with us. A DSS is aimed at addressing the following questions:

1. What information do managers require to make decision?
2. How can managers be supported in the process of decision-making?
3. How can the quality of decision-making be improved?

In the context of strategy implementation, the quality of the decisions will be positively correlated to the extent to which the strategic objectives of the company are achieved.

In order to develop an approach for evaluating KVDs as a tool for decision support in strategy implementation in BHP Billiton Manganese it is desirable to review literature on DSS in general to understand how decision support systems have evolved and also how advances in information technology have impacted the evolution and usefulness of DSS.

2.2.1 What is a Decision Support System?

As the name Decision Support System suggests, a DSS is a system that supports managers in decision-making. The DSS itself does not make the decision and therefore does not replace the decision maker.

Gorry and Scott Morton (1971:61), drawing on earlier work by amongst others, Simon and Anthony (Shim et al, 2002), proposed the original concept of DSS.

Gorry and Scott-Morton (1971) defined DSS as information Systems that support managers in dealing with semi-structured and unstructured problems. Gorry and Scott-Morton (1971) referred to these systems as "management decision systems." The two points to note in Gorry and Scott Morton's definition of DSS is firstly, the notion of "support" and secondly, that the problems are "unstructured".

The notion of "support" reinforces the fact that DSS systems are not meant to replace the decision maker but to support him/her. As Ginzberg and Stohr (1982:3) pointed out, "these (DSS) systems were meant to be an adjunct to the decision maker, to extend his capabilities but not to replace his judgment." This means that most automatic control systems, for example, a thermostat that automatically maintain the temperature in a room at a specified point, will not be considered as a DSS. Courtney (2001) argued that, it is possible to design a computer to deal with a structured problem without the intervention of a user, but it is when the judgment of the decision maker is brought to bear on the unstructured part of the problem that we have a human-machine system, and only then, can we talk of decision "support".

As far as the concept of "structure" in decision situations is concerned, Gorry and Scott Morton (1971:59) relied on the work of Simon (1965) and his description of three classes of decision situations: structured, semi-structured and unstructured. (See Table 2.1 below)

Gorry and Scott Morton (1971:62) suggested a framework that mapped potential computer support for management activities on two dimensions: The first dimension was Anthony's (1965) three levels of managerial activity: Operational control, management control and strategic planning. The second dimension was derived from the work of Simon (1965) and contains three classes of decision situations: structured, semi-structured and unstructured. Table 2.1 below gives examples of the Gorry and Scott Morton (1971) decision types (Courtney, 2001)

	Strategic Planning	Management Control	Operational Control
Unstructured	E-commerce	Career paths	Grievances
Semi-structured	Forecasting	Budgeting	Assignments
Structured	Dividends	Purchasing	Billing

Table 2. 1: Examples of Gorry and Scott-Morton decision types (Courtney 2001:18)

The early attempts to define a DSS focused on the use of DSS rather than the make-up or technology of the DSS. As computer technology, evolved later definitions incorporated more and more technical aspects, for example, Shim et al (2002) defined a DSS as a *computer system* that dealt with a problem where at least some stage of the problem was semi-structured or unstructured.

A common problem with both earlier and later definitions of DSS was how to quantify the concept of 'Problem Structuredness'. Some authors such as Moore and Chang (1980) argued that “problem structuredness cannot be defined in absolute terms; hence they dismiss it as a meaningful concept for defining DSS”. On the other hand other authors such as Sprague (1980:12) took the view that “the concept of “structure” in decision making is heavily dependent on the cognitive style and approach to problem solving of the decision maker” What matters therefore is whether the decision maker requires support for decision making in line with his/her experience with the problem.

Konsynski et al (1992:1) attributed the prosperity of DSS from inception in the 1970s through the 1980s to two key trends, firstly, the growing belief then that “existing information systems, despite their success in automating operating tasks in organizations, had failed to assist management in many higher level tasks.” Secondly, continuous improvement in both hardware and software made it possible to give managers increased computing power.

As computer-technology developed starting in the1970s through to the present, the number of possibilities on how decision makers could be supported in decision-making increased, as did the different perspectives that were adopted in defining DSS. Some authors preferred definitions premised on the type of decision or problem to be solved, others emphasized the architecture of the DSS and so on.

What follows below is a brief examination of some of the definitions that were advanced over the period.

In the early 1980s, Sprague (1980:6) defined a DSS as “a class of information system that draws on the transaction processing systems and interacts with other parts of the overall information system to support the decision-making activities of managers and other knowledge workers in the organization.” He went on to list the characteristics of DSS systems as observed by a number of researchers such as Alter, Keen and others at the time. These included:

a. They (DSS) tend to be aimed at the less well-structured, under-specified problems that upper managers typically face.
b. They attempt to combine the use of models or analytical techniques with traditional data access and retrieval functions.
c. They specifically focus on features which make them easy to use by non-computer people in an interactive mode.
d. They emphasize flexibility and adaptability to accommodate changes in the environment and the decision making approach of the user.

Sprague’s (1980:6) definition is an enhancement of earlier definitions such the one advanced by Gory and Scott Morton (1971) in that it starts-off with the legacy idea that DSS supports decision making in less structured problem environments. The definition goes on to explore the constituents of the systems, namely, models and analytical techniques that were becoming increasingly prevalent as computing power increased, and lastly Sprague introduced the idea of “user friendliness”.

Sprague’s definition is also presented in the context of *information systems.* This is evidence of the increasing role that information management technology was assuming.

Ginzberg and Stohr (1982:8) defined a DSS as: “a computer-based information system used to support decision making activities in situations where it is not possible or desirable to have an automated system perform the entire decision process”. This was an explicit characterization of a DSS as a computer based information system, which was an important distinction from other forms of decision support systems that could be based on mechanical, hydraulic or electrical systems.

In the early 1990s Eom and Lee (1990), drawing on publications on DSS applications over a period of almost two decades (1971-1988) described a DSS as a computer-based interactive system that could be characterized as follows:

a. Supports decision makers rather that replace them
b. Utilizes data and models
c. Solves problems with varying degrees of structure
d. Focuses on the effectiveness rather than the efficiency of decision process

Eom and Lee (1990) introduced the concepts of effectiveness and efficiency as part of the DSS definition. This adds the dimension of value derived from the use of a DSS. The value of the DSS therefore is not derived primarily from the enhancement of the processing speed of the manager as he makes a decision, but mainly from the system's applicability to decisions that matter in terms of value creation.

The work of Eom and other researchers of the time such as Sprague(1980) expended a substantial amount of effort on trying to define unambiguously what DSS was and on articulating what the defining characteristics of a DSS were. How a DSS was different and distinguishable from other information systems such as Electronic Data Processing (EDP) and Management Information Systems (MIS). Ginzberg and Stohr (1982:3) stated then, that "There is at present little consensus about what qualifies a system as a DSS."

As a system, any DSS can therefore be studied by applying generic system characteristics. A system can be characterized as having three key components, namely,

1. *Inputs* , coming from the external environment into the system
2. *Transformation mechanism*, changing inputs into outputs within the system
3. *Outputs* , released from the system to the external environment

An examination of the above definitions of DSS reveals different levels of emphasis on the different components that make up the DSS.

Earlier definitions tended to focus on the inputs. How structured is the data? What type of decision is to be made? What area of management did the problem address?

The evolution of more powerful computers increased the transformation capacity of DSSs and the interest shifted to the models and analytical techniques that became available to be used in the DSS. This increase in processing capability also increased the quantity of data and data sources that could now form part of the DSS. The increase in processing capability also had disadvantages, it became important to focus on the quality and relevance of the outputs that were coming out of the systems, and hence the idea of effectiveness started gaining ascendancy over efficiency or speed.

The three components of the system need a communication process to ensure that the data can be exchanged amongst them. The advent of the world-wide-web increased the capability of linking smaller systems into much bigger and more complex systems. The web has also significantly enhanced user access to different DSS systems.

Power (2003) suggested a DSS classification scheme for DSS that is aligned with the evolution of DSS over time:

a. Decision sciences dominated DSS
b. Model-driven DSS
c. Data-driven DSS
d. Web enabled DSS

According to Power (2003), a technology shift occurred in the early 1990s because of the work of Bill Inmon and Ralph Kimball who actively promoted DSS using relational database technologies. Model-driven DSS, which had been dominant prior to the 1990s, was relegated largely to the domain of operations research while data warehousing took centre stage in Management Information systems.

Power's observation is important in the context of this research because it implies that current studies of DSS will invariably extend to data warehousing technologies and business intelligence approaches.

2.2.2 Decision Making Process

Understanding the decision making process is important because in order to design a DSS it is necessary to understand the decision that the DSS is meant to support. If we do not have full understanding of what is to be decided, it would be difficult to develop an effective DSS to support people making that decision.

Decision-making can be defined as the process by which managers respond to opportunities and threats by analysing options and making determinations about specific organizational goals and courses of action. (Jones and George, 2003:219)

According to Daft (2006, 443), Organizational decision-making is formally defined as the process of identifying and solving problems.

Effective decision-making is one of the important elements of management that is required in order to ensure business success. Decision-making has been studied in different fields. In philosophy, decision-making is concerned with the role of ethics, values and logic. In psychology, it is concerned with the behaviour of individual decision-makers. In sociology it is concerned with the behaviour of groups in decision –making. In economics, decision-making forms part of the rational utility theory[5] and in operations research decision-making is seen in terms of well-structured choice problems. (Kivijärvi, 1987:23)

What is a decision?

Mallach (2000: 37) defines a decision as a reasoned choice among alternatives. We make decisions regularly in our daily lives, most of the time without pausing to formally reflect on the process we are following. Decisions are normally made in the context of a broader problem-solving situation. A problem exists when there is a gap between the current state or reality and the desired state. The process of closing this gap is problem solving.

Conceptually decision-making starts with a decision statement, followed by generation of alternatives and then the selection of the best alternative based on some criteria.

A decision statement is a statement of what is to be decided or what is the 'gap' to be closed between current reality and the desired state. This is a very important step in the decision making process because if the decision statement is not accurate the resultant decision will not close the gap or contribute to solving the problem. In the case of DSS development, we may end up with an efficient system for supporting an irrelevant decision. Frequently more than one person participate in the decision making process and a clear and accurate decision statement will ensure that team members try to decide on the same thing.

[5] Rational utility theory: Given accurate information, the decision-maker will arrive at a logical conclusion about the decision most likely to produce the desired result.(Dearlove,1998:18)

Alternatives can be defined as the possible decisions we can make. There will always be at least one alternative available to each decision-making situation, the so-called “do nothing” alternative. On the other extreme, there may be thousands of possible choices available to the decision maker and the decision maker will require some tools or techniques to narrow down the choices to a manageable level.

Decision-making criteria are what we want to optimise in a decision. Sometimes we have conflicting criteria and in those cases, trade-offs might have to be made.

A decision is an outcome of the decision making process. The decision making process is itself a series of decisions. Simon (1965:43) recognized this potential “infinite regress”[6] when defining the four phases of decision –making .He stated that “each phase in making a particular decision, is itself a complex decision-making process” (Simon, 1965:43).

Decision Making in Strategy Implementation

What are the types of decisions that managers make in implementing strategy?

Mallach (2000:42) following on Gorry and Scott Morton’s (1971) framework defines nine types of decisions that managers make. He arrives at these nine types by arranging decision types in a 3×3 matrix. On one axis the decisions are arranged in terms of their nature following on Simon’s (1965) earlier concept of programmed versus un-programmed decisions, these categories are: structured, semi-structured and un-structured. On the other axis the decisions are arranged in terms of their scope following on Anthony’s levels, namely, Operational, Tactical and Strategic. Based Mallach (2000:42-44) we can define each of the categories as follows:

- A **structured decision** is one for which a well-defined decision-making process exists. This means that all the three decision phases, intelligence, design and choice can be specified exactly. This kind of decisions can be programmed into a computer to execute without human intervention or the decision-making procedure can be left to a relatively unskilled clerical type of person to execute. In terms of our earlier definitions of DSS, a computer that would make this kind of decision would not be a DSS but rather a decision-making system.

[6] “infinite regress” in this context results from the fact that a decision-making process is made up of decisions and therefore each decision can always be broken up into an infinite chain of preceding decisions. The regress potential creates ambiguity as to whether decision-making is a process or a single action or choice.

- An **Unstructured decision** is one for which all three decision phases are unstructured. In this instance, not even one aspect of any of the three phases can be specified. This would be because it may be the first time that such a decision has to be made and there is therefore no experience to draw from. The computer can still be used to support the decision maker, but the decision maker has to decide what process to follow.
- A **Semi-structured decision** has some structured aspects but the decision cannot be completely structured. Most organizational decisions would be of this type, i.e. the decision –maker is in a position to specify some aspects of one or more decision phases.
- A **Strategic decision** is one, which will affect the entire organization or a major part of it, for a long period. Senior and top management would in general make these decisions.
- A **tactical decision** is one that will affect how a part of the organization does business for a limited time into the future. Tactical decisions are also called management control decisions and are generally made by middle managers within the context of earlier strategic decisions.
- An **operational decision** is one that affects a particular activity currently taking place in the organization. Operational decisions will have little or no impact on the future. If there were an impact, the decision would be made within a specified controlling policy.

Table 2.2 below is a 3×3 grid of the nine decision types from Mallach (2000:42) with examples from BHP Billiton Manganese.

	Operational	**Tactical**	**Strategic**
Structured	Is the furnace safe to start-up?	How should we start the furnaces each month?	What furnaces should we install?
Semi-structured	How should we transport ladles today?	What product should we make in Furnace A this month?	In which markets should we sell our products?
Un-structured	Which route should the ore trucks follow today?	Who should be awarded the ore transport contract for next year?	How do we minimize our alloy cost of production?

Table 2. 2: Examples of decision types in a Manganese Smelter (Mallach, 2000:42)

It is important to characterize decisions as above because decisions of the same type have common characteristics. From a DSS development point of view a DSS developed for a specific decision may be usable in other decisions of the same type.

The Process of Making Decisions

In the preceding section, we have named, described and classified different types of decisions that are made in organizations, and we have used specific examples from BHP Billiton Manganese to illustrate the different decision types. However, naming, describing and classification do not explain the process of how decisions are made. What then is the process of decision-making?

In organizations, decisions can be made by individual managers acting on their own or by teams of managers acting together.

Decision-making by managers acting as individuals

Simon (1965:40) described management decision-making as being comprised of four principal phases, namely; intelligence, design, choice and review phase.

In the first phase, which is the intelligence phase, the decision-maker searches the environment for conditions calling for a decision. The condition calling for a decision can vary from a crisis on one extreme to an opportunity on the other extreme.

The second phase or the design phase, is comprised of activities aimed at inventing, developing and analysing possible causes of action.

The third phase or the choice phase is concerned with selecting the cause of action from those available.

The fourth phase, called review phase assesses past decisions to verify that the decisions made resulted in the intended results.

Simon's decision-making process description is based on the assumption that the individual decision –maker acts (or seeks to act) rationally, that is, given accurate information, the decision-maker will arrive at a logical conclusion about the decision most likely to produce the desired result (Dearlove, 1998:18). Daft (2006:446) described the rational approach to decision making as being made up of eight steps. Table 2.3 below summarizes Daft's (2006) rational approach to decision-making:

Step	Outcome
1. Monitor the decision environment	Identification of deviation from planned or acceptable behaviour
2. Define the decision problem	Essential details of the problem; where, when, who was involved, who was affected and how current activities are influenced
3. Specify decision objective	What performance outcomes should the decision achieve?
4. Diagnose the problem	Analysis of data to identify the root-cause of the problem
5. Develop alternative solutions	An understanding of options available to achieve the desired outcome
6. Evaluate alternatives	Assessment of the merits of each available choice and the likelihood of implementing the choice successfully
7. Choose the best alternative	Selection of a single alternative that has the highest likelihood of success
8. Implement the chosen alternative	Mobilization and deployment of resources required to ensure that the decision is carried out

Table 2. 3: Rational Approach to Decision-Making adapted from Daft (2006:466-7)

The rational approach to decision-making is a useful tool that enables decision makers to make decisions in a systematic and logical manner. The drawback of the approach is that, in the real world there is often uncertainty, complexity, rapid change and a limit on the time available to decision makers to go through the process in detail. In most instances, decision-makers resort to intuition and experience to deal with decisions situations that are ill defined or to make decisions when there are time constraints. The limitations of the rational approach are in part a consequence of the underlying assumptions of the model. According to Robbins (2001:133), the rational decision-making model is based on the following assumptions:

1. Problem clarity: The problem is clear and unambiguous.
2. Known options: It is assumed the decision maker can identify all available options and understands the consequence of selecting each of the options.
3. Clear preferences: the criteria and alternatives can be ranked and weighted to reflect their importance.

4. Constant preferences: the specific decision criteria are constant the weights assigned to them remain stable over time.
5. No time and cost constraint: the decision maker can obtain full information required because there are no time and cost constraints
6. Maximum payoff: the decision maker will choose the alternative that yields the highest perceived value.

Simon and March coined the term ‘bounded rationality’ to describe the situation in which the number of alternatives a manager must identify is so great and the amount of information so vast that it is difficult for the manager to even come close to evaluating it all before making a decision.(Jones and George,2003:222)

The bounded rationality perspective attempts to explain how managers make decision in the following situations:

1. Where there is uncertainty or insufficient information.
2. Where there is rapid change and a large number of concurrent decisions need to be made.
3. Where the time available for analysis is limited and the problems to be resolved are ill defined.

The bounded rationality approach is often associated with intuitive decision-making, i.e. “experience and judgment rather than sequential logic or explicit reasoning are used to make decisions.”(Daft, 2006:451). Intuitive decision-making can be institutionalised in organizations by development of generally accepted rules-of –thumb or heuristics that managers use repeatedly to make decisions under seemingly similar conditions. The use of heuristics may however lead to systematic errors that may result in managers making bad decisions. (Jones and George, 2006)

Going back to Robbins’ (2001) list of assumptions underpinning rational decision-making listed above, bounded rationality applies specifically to a situation where assumption 2 does not hold; i.e. not all options available to the decision-maker are known.

Decision-making in organizations

In most organizations, decision-making is seldom carried out by individuals acting in isolation, but by teams made up of two or more individuals. The criteria for selecting alternatives are also based on what is preferable for the organization or team.

Decision-making processes for organizations are subjected to even more variables from within and without the organization, as each of the decision making process requires consensus of the team members involved. As Simon (1965:43) noted “each phase in making a particular decision is itself a complex decision-making process”

According to Daft (2006:453), research into decision-making processes in organizations has identified four primary types of decision-making processes, namely, the management science approach, the Carnegie Model, the incremental decision process model and the garbage can model.

Management Science Approach:

The management science approach can be traced as far back as 1911 to a paper originally prepared for presentation to the American Society of Mechanical Engineers by Frederick W Taylor (Taylor, 1988: iv). Taylor’s science was born out of the desire to ensure that each man was doing his job as efficiently as possible. In Taylor’s own words, “the most prominent single element in modern scientific management is the task idea.”(Taylor, 1988:17).Taylor examined worker’s individual tasks in order to determine the exact times required to execute each task. By planning each worker’s task and measuring, each worker’s output Taylor was able to demonstrate that his scientific approach resulted in significant productivity gains at Midvale Steel Works.

It was during World War II that scientific management was entrenched as a fact or data driven approach to decision making. According to Daft (2006:453), scientific management is analogous to the rational approach to decision making by individual managers.

Scientific management formed the basis of other management approaches that became very popular amongst contemporary managers, for example, the Total Quality Management approach, Six Sigma and 20 Keys. Scientific management and the other approaches aligned to it as indicated above are “reductionist” in nature, i.e. they are based on the belief that if a problem can be reduced to its basic components and each component understood, then it would be possible to comprehend and to solve the problem as whole.

Availability of powerful computing technology has enabled modern managers to model and solve problems that have a large number of variables. The risk of making poor decisions still persists because management science depends on the availability of accurate data and where mathematical models are used, these models might not adequately quantify the problem under consideration.

The Carnegie Model

The Carnegie Model derives its name from the Carnegie-Mellon University. Most of the people whose work contributed to the formulation of the model were associated with the Carnegie-Mellon University. Foremost amongst these contributors are Richard Cyert, James March and Herbert Simon. The work of these men helped formulate the bounded rationality approach to individual decision-making and their insights into organizational decision-making helped formulate the Carnegie Model. (Daft, 2006:456)

Cyert and March (1963:4-26) were concerned with how the firm makes economic decisions. They made detailed observations of the processes and procedures by which firms make decisions and based on these observations formulated their behavioural theory of the firm. One of their key observations was that many stakeholders make decisions in organizations; these stakeholders include managers, workers, suppliers, customers and so on. The existence of multiple stakeholders result in goal misalignment, divergent expectations, inconsistent criteria for making choices amongst alternatives and gaps between chosen alternatives and implemented alternatives.(Mahoney,2005:34).

The central theme of the Carnegie Model is that organizational decisions are taken by coalitions of stakeholders. According to Daft (2006, 456) coalition is an alliance among several stakeholders who agree on organizational goals and problem priorities.

The process of coalition formation has several implications for organizational decision behaviour (Mahoney, 2005:36):

I. Multiple, changing, acceptable-level goals: The criterion is that the alternative selected meets the demands of the coalition.
II. Satisficing: The first satisfactory alternative evoked is accepted or decisions are made to 'satisfice' rather than to optimise problem solutions.

III. Uncertainty avoidance: The organization seeks to avoid uncertainty by following standard operating procedures and a policy of reacting to feedback rather than try to forecast the future.

IV. Problemistic Search :This means that the search that is stimulated by a problem is directed to finding the solution to that problem, therefore managers look around in the immediate environment to find a solution that quickly resolves the problem.

V. Organizational Learnings: organizations similar to individuals exhibit adaptive behaviour over time and develop an organizational memory that can be invoked when similar decision situations as those already experienced arise.

In practical Strategy implementation, it is important that there is agreement on problem identification and that once a solution is selected; there is commitment to implement the solution. The Carnegie model would therefore be useful in getting alignment amongst the different stakeholders.

Incremental Decision Process Model

The Carnegie model highlighted the role that coalitions play in the organizational decision-making process. The Incremental Decision Process Model focuses on the structured sequence of activities undertaken from the discovery of a problem to its solution. This model resulted from an empirical study of 25 decisions in organizations undertaken by Henry Mintzberg and his colleagues at McGill University (Mintzberg et al, 1976).

Mintzberg and his team set out to investigate how organizations go about making ‘unstructured’ strategic decisions. Their study was motivated by the realization that although there was a body of normative literature on techniques for strategic decision-making, the published techniques seemed “unable to deal with the complexity found at strategic level, about which little was known” (Mintzberg et al, 1976:246). Based on their empirical research Mintzberg and his team proposed a basic framework that described unstructured, strategic decision process. In their paper titled “The structure of ‘unstructured’ Decision Processes” published in 1976, Mintzberg et al defined a decision as “a specific commitment to action” and a decision processes as “a set of actions and dynamic factors that begins with the identification of a stimulus for action and ends with specific commitment to action.”(Mintzberg et al, 1976:246)

Fig 2.1 below is a representation of the Incremental Decision Process Model depicting the three major phases and the three sets of supporting routines.

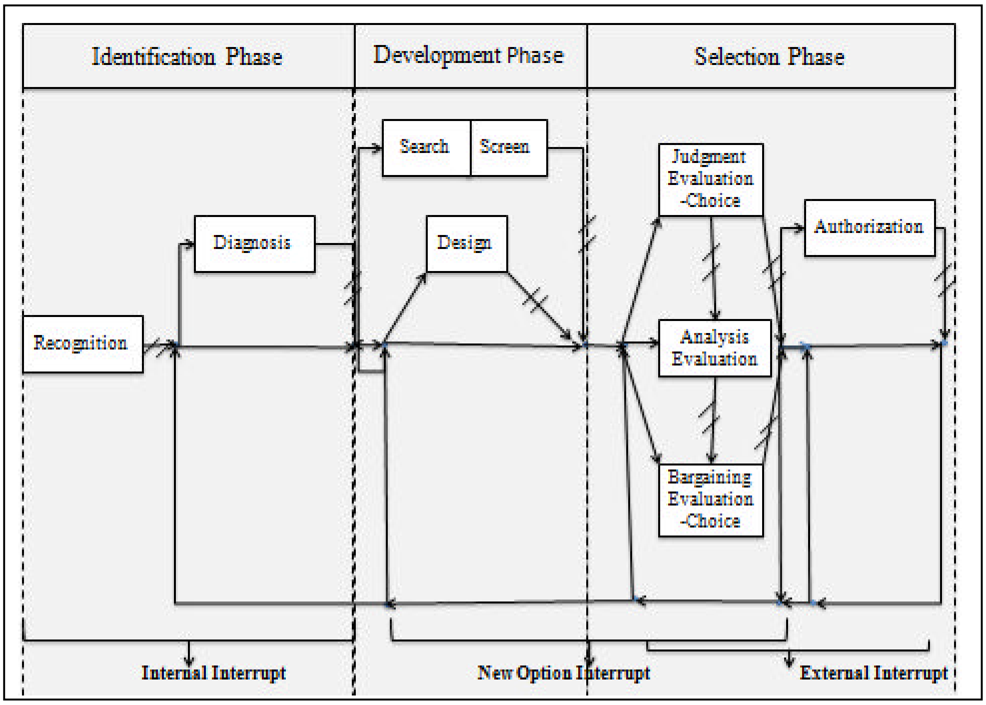


Fig 2. 1: Incremental Decision Process Model (Mintzberg et al, 1976:266)

Mintzberg et al identified six groups of dynamic factors that are responsible for introducing interferences, feedback loops and other factors that prevent the strategic decision –making process from proceeding in a steady undisturbed progression from one routine to another. These dynamic factors are (Mintzberg et al, 1976:263):

1. Interrupts, which are caused by environmental factors.
2. Scheduling delays.
3. Timing delays and Speedups, which are affected by the person making the decision.
4. Feedback delays.
5. Comprehension cycles.
6. Failure recycles, which are largely inherent in the decision process itself.

The Incremental Decision Making model highlights that decision-making is a dynamic process that takes place over an extended period. A decision may therefore require a number of cycles or iterations before being finalized.

The Garbage Can Model

In 1972, Michael Cohen, James March and Johan Olsen published a paper in the Administrative Science Quarterly titled “A Garbage Can Model of Organizational Choice”. The Garbage Can Model deals with decision situations that are different from those dealt with by the Carnegie and the Incremental Decision Process Models. The Carnegie and the Incremental Decision Process models deal with how a single decision is made in an organization. The Garbage Can Model addresses the question of how organizations make multiple decisions in an environment of high uncertainty (Daft, 2006:463).

Cohen et al (1972:1) introduced the idea of organizations that can be viewed as “organized anarchies”. These organizations are characterized by:

I. Problematic Preferences: The organization operates based on a variety of inconsistent and ill-defined preferences. Goals, problems, alternatives and solutions are ill defined.
II. Unclear technology: The organization continues to survive and produce despite the fact that members do not understand its own processes. Cause-and-effect relationships within the organization are difficult to identify. Operation is by trial and error and learning from the accidents of past experience.
III. Fluid Participation (or turnover): Participation to a given decision will be fluid and limited either due to high turnover of participants or due to limited and random assignment of participants to specific problem or decision situations.

The Garbage Can Model attempts to model decision-making in “organized anarchies”. The model proposes that a decision is an outcome or interpretation of several relatively independent streams in an organization. Four such streams are, Problems, Solutions, Participants and Choice opportunities. These streams enter and leave the organization (Garbage Can), while in the Can they are subjected to processing in terms of some model assumptions. Based on their organizational decision-making view, Cohen et al(1972:2) asserted that an organization is a “collection of choices looking for problems, issues and feelings looking for decision situations in which they might be aired, solutions looking for issues to which they might be the answer and decision-makers looking for work.”

The Garbage Can model highlighted that most decisions in organizations are taken simultaneously under situations of extreme uncertainty and not one decision at a time as the Carnegie and Incremental Decision Process model seem to suggest.

Daft's Contingency Decision-making Framework:

Daft (2006:467) suggested a "contingency decision-making framework" that attempted to draw on all the different decision-making approaches that were described above.

Daft's framework starts by recognizing that each decision is made within some organizational context. In order to select an appropriate decision making approach we need to consider both the decision problem and the organizational setting. The decision problem can be characterized by:

1. The extent of consensus on what the problem is.
2. Technical knowledge about the means to solve the problem.

Fig 2.2 below is an illustration of Daft's framework.

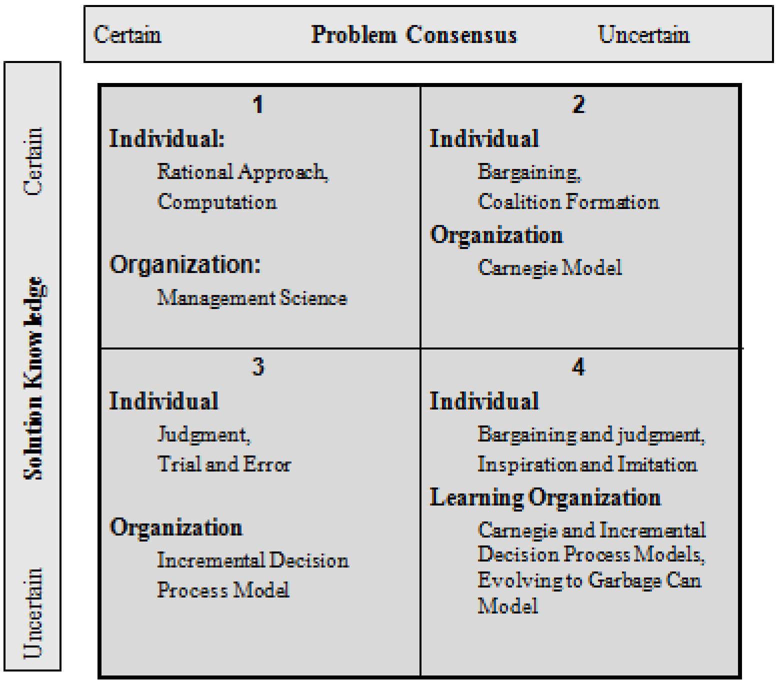


Fig 2. 2: Contingency Decision-Making Model (Daft, 2006:469)

In earlier definitions of DSS, the recurring theme was that DSS are required to support managers in dealing with problems where some aspect of the problem situation is unstructured. Considering Fig 2.2 above, it would be reasonable to assume that problems falling into quadrants 2, 3 and 4 would all be suitable candidates for DSS application. Problems in quadrant 1 would be ideally be dealt with using expert systems.[7]

Table 2.2 above gave examples of decision types as applied to a BHP Billiton Ferromanganese Smelter. Combining examples of decision types in table 2.2 and Daft's framework in fig 2.2, we can determine what decision making approach would be effective and ascertain if a DSS could potentially be used. Table 2.4 below maps the decision- making approaches from Daft's Contingency Decision making model onto the Manganese examples of decision types previously listed in table 2.2 above.

	Operational	Tactical	Strategic
Structured	Is the furnace safe to start-up? *Rational Approach/ Management Science*	How should we start the furnace each month? *Judgment/ IDPM*	What furnaces should we install? *IDPM / Garbage Can*
Semi-structured	How should we transport ladles today? *Judgment /IDPM*	What Product should we make in Furnace X this month? *Judgment / IDPM*	In which markets should we sell our products? Judgment / IDPM / *Garbage Can*
Un-structured	Which route should the ore truck follow today? *Judgment / IDPM*	Who should be awarded the ore-transport contract for next year? *Judgment / IDPM / Garbage Can*	How do we minimize our alloy cost of production? *Judgment / IDPM / Garbage Can*

Table 2. 4:Decision-making approaches for a sample of Mn business decision types (Author's interpretation of Mallach, 2000:42 and Daft, 2006:469)

All semi-structured and unstructured decision types can be supported by a DSS. It can be argued that the structured-operational decisions need an expert system rather than a DSS. This can be achieved for example, by installation of safety interlocks to ensure that the furnace should not be operated unless all safety conditions are met.

[7] An expert system is typically an interactive computer program designed to emulate the problem –solving process of one or more experts in a particular problem domain. The typical user of an expert system is not the expert but more inexperienced personnel. (Adelman L.1992. Evaluating Decision Support and Expert Systems, Wiley-Interscience, NY.) p 2

In the next section (section 2.3), we look at DSS architecture in order to understand how different DSS components are linked together in order to deliver the required performance from the DSS.

2.3 Decision Support System Architecture

It is unlikely that one would find a stand-alone DSS in a modern enterprise. The DSS systems are more likely to be found embedded in the bigger enterprise information systems. What then is typical DSS architecture and why is it important to answer this question?

Understanding DSS architecture is important for the following reasons:

1. The need to develop technical specifications for building DSS.
2. The need to understand the functionality of the DSS from a User's perspective.
3. The need to ensure that a particular DSS performs as intended.

In the context of this research, the DSS architecture is of interest because we would like to evaluate the effectiveness of a KVD-model based DSS as a tool for supporting strategy implementation.

Mallach (2000:166) listed elements of a DSS system that will ensure that the DSS can support an organization across a wide spectrum of potential DSS usage. The following are typical elements of DSS architecture:

1. Database: These could be dedicated or shared data repositories that are managed to ensure accuracy, currency and security of data.
2. Models: This could be calculation routines, financial packages or any other models that support the DSS.
3. Users: The people who use the system. It is important to understand the job levels, location and literacy in order to ensure effective DSS usage.
4. Software tools for users: To enable Users to access the database and the models in order to manipulate the data and produce reports.
5. Software tools for administrators: To enable the administrators to maintain databases, models and other components of the system.
6. Hardware and Operating System: To host the databases and the models. It is necessary to ensure that the hardware is compatible with other non-DSS requirements that may be part of the enterprise information system.

7. Networking and communication capability through which platforms are interconnected.
8. An architecture blueprint that supports the organizations policies for example, decentralization vs. centralization or preferred hardware and software suppliers.

Turban et al (2007:92) grouped the elements that constitute a DSS into four subsystems, namely:

1. **The Data Management Subsystem**: consisting mainly of the database and the database management system (software).
2. **The Model Management System:** The Model management system is a software package that includes financial, statistical, management science, geosciences and other models that provides the system's analytical capability. In the case of BHP Billiton Manganese, the KVD model will form part of this system.
3. **The User Interface System**: The user together with the workstation through which the DSS is accessed is part of this subsystem.
4. **The Knowledge-based Management system:** This is the system that provides intelligence to augment the user's own intelligence. The system provides access to a variety of artificial intelligence tools and assists directly in the decision making process.

The DSS architectural descriptions of Mallach (2006) and Turban et al (2007) appear similar at first glance, but they are different in that they represent the technical (or information technology) perspective and the functional (or business) perspective of what constitutes a DSS respectively.

As stated above the interest in the DSS architecture is for the purpose of evaluating a specific DSS (KVD) as a strategy implementation tool. Considering the typical architectures discussed above a number of possibilities present themselves for conducting an evaluation of a DSS system:

1. Evaluation of the performance of the elements and/or the subsystems. The performance of each element can be measured to determine how efficiently the elements perform in relation to their design requirement. The results of such an evaluation will give an indication of the efficiency of the DSS.

2. Evaluation of the effectiveness of the entire system. The purpose of the DSS is to support users in decision-making; we can therefore evaluate the system to determine to which extent the above elements and the connections amongst them enable managers to make better decisions.
3. Adelman (1992: 18) suggested an evaluation approach based on looking at three interfaces in the DSS architecture:
    a. System-User interface: the issue here is the extent to which the system characteristics hinder or promote its usability.
    b. User-organization interface: the issue here is to what extent the DSS facilitates the decision making process of the organization.
    c. Organization-external environment interface: the issue here is whether the DSS improves the organization's decision-making and thus its performance.

2.4 Decision Support System and Strategy Implementation

The primary aim of the research is to evaluate KVD as a decision support tool for strategy implementation in BHP Billiton Manganese. It is therefore necessary to examine the current approach to strategy implementation in BHP Billiton Manganese in order to understand the context in which the intended evaluation of KVDs as a tool for strategy implementation is to take place.

The Corporate Alignment Planning Standard (CAP Standard) governs Strategy formulation and implementation in all BHP Billiton businesses. Fig 2.3 below is a diagrammatic representation of the CAP process.

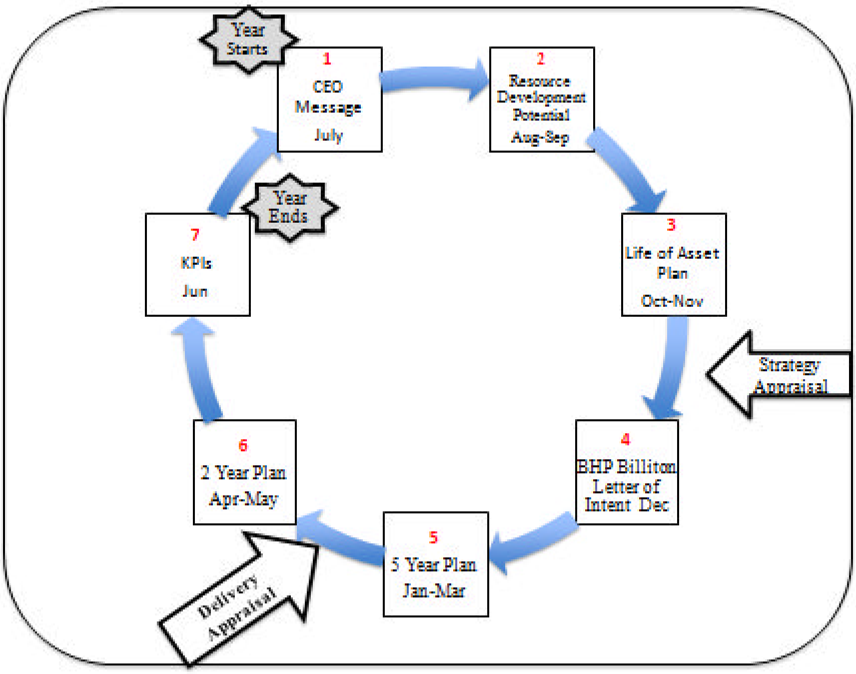


Fig 2. 3: The BHP Billiton CAP Process (BHP Billiton, 2008c)

Fig 2.3 depicts the CAP process as a 7- step sequential process starting in July and ending in June of the following year. The above illustration of the CAP process is a simplification in two important respects:

1. The seven steps are not totally separate and do not necessarily follow a strict sequence. There are time-overlaps between steps and some steps are iterative in nature and are constantly being updated as new information comes to light.
2. The life of assets plans (LOA) span the projected life of a business and are not limited to 12 months. Similarly, 5 year and 2-year plans are not constrained by the annual cycle.

For purposes of simplifying the discussion below, we will treat the seven steps as separate and sequential

Step 1: <u>The Group Chief Executive's Message (CEO Message)</u>

The CAP process kicks-off at the beginning of the financial year in July with the issuance of the Group Chief Executive's Message. The CEO Message is the directional message from the CEO to BHP Billiton that initiates the planning cycle. The message is intended to communicate the following information:

1. The strategic priorities of the BHP Billiton group that should be incorporated in all levels of the business.

2. CEO's view on critical planning considerations, including, BHP Billiton group strategy, global scenarios, knowledge from prior CAP business appraisals and key risks identified from the enterprise wide risk assessment process (EWRM).

Step 2: Resource Development Potential (RDP)

The aim of the RDP sub-process in CAP is to involve some employees in determining alternatives for resource and business development to maximize the value of the asset where they work. A specially selected team of participants with a range of cross-functional skills and experience conducts the RDP sub-process. The sub-process has the following steps:

I. Preparation of inputs including, size/inventory of resource, analysis of present state of the asset, market and macro-economic assumptions, exploration targets strategic framework and scenarios.
II. Problem framing: this takes place in a facilitated workshop to ensure consensus on the RDP objective, scope of the exercise and area of business under consideration.
III. Assessment of options using basic models and simulation tools.
IV. Selection of options and reporting

The options selected should be classified into one of the following eight categories:

i. Additions to the study pipeline: these options are referred for further study to refine and differentiate between related and similar options. Analysis that is more rigorous is applied in the study phase.
ii. Options for preservation: these options are preserved to be invoked under changed strategic scenarios, price environments or other business conditions.
iii. Changes to mode of operation: proposed changes to current mode of operation based on potential to increase NPV, strategic fit or reduction of risk.
iv. Recommendation for brown field exploration to alter the resource base.
v. Recommendation for research and development, for example to develop new technology or product.
vi. Recommendation for business development, for example, in order to execute a merger, acquisition or disposal.

vii. Recommendation for safe design based on the risk assessment.

Step 3: Life of Asset Plan (LoA)

The objective of the LoA is to use the options identified in the RDP sub-process to make decisions on how to exploit these options in order to maximize asset value. The LoA sub-process is used to generate long-term plans of actions for maximizing asset value at acceptable levels of risks. Organizationally the LoA process is used to build alignment and commitment of management towards sustainable delivery of the identified outcomes from the asset.

The process steps for LoA are similar to those of the RDP; the difference is that the economic assumptions, analysis and simulations used in the LoA are more refined and rigorous.

Step 4: The BHP Billiton Letter of Intent (LoI)

The LoI is a directional message to the whole BHP Billiton group that is issued by the Group Management Committee (GMC) in order to facilitate the link between directional and delivery planning, i.e. the link between strategy development and implementation. The LoI communicates the GMC's short to medium term performance expectations for the group.

Step 5: 5 Year Plan (5YP)

The 5YP is a report that contains the mandated minimum contents, which are the output of a rigorous planning process based on the results of the RDP and LoA processes. The prescribed chapters for the 5YP are:

1. Executive Summary: Identification of key issues within the 5-YP for use as discussion points during the business appraisal process.
2. The business strategy: Documentation of the vision and strategic imperatives for the business unit. This should demonstrate alignment with the CSG.
3. Actions : A roadmap of initiatives to be undertaken in the next 5 years plus a detailed plan of actions for the next one-year including performance measures and who is accountable for their delivery.
4. Outcomes: 5-year physical and financial outcomes. The financial outcomes to be presented as income statement, balance sheet, cash flow statement and a schedule

of capital requirements.

5. Contingency Plans: Contingency plans to manage variations from assumptions based on the results of scenario planning and risk assessment.

Step 6: 2-Year Budget (2-YP)

This is a detailed plan of the first two years of the 5-year plan. The 2-YP's budgets and forecast numbers are to be used for performance monitoring. Included projects have at least gone through an initiation phase and high-level project plans have been developed. The Key Performance Indicators (KPI) for continuing operations, projects and initiatives are included in the 2 year plans.

Step 7: Key Performance Indicators (KPI)

These are KPIs for the next year. They are generally represented as a business scorecard that can be cascaded down into team and individual scorecards. They are used as part of variable pay or bonus system.

Business Appraisal: Each planning unit, i.e. a CSG or Business unit/Asset is subjected to at least two appraisal sessions per year.

The financial year starts in July and the first appraisal takes place between October and December months. The focus of this appraisal is on the Life of Asset Planning and strategy development of the business. It deals with directional issues or the question: are we doing the right things?

The second appraisal takes place between March and May and this appraisal session focuses on the 2YP and Strategy implementation. The key question in this session is: Are we doing things right?

Participants in the appraisal sessions are managers of the business under review together with managers of the next level entity for reporting purposes; for example, the CSG executive committee of BHP Manganese will appraise all the Manganese business units.

CAP Process Decision-making approaches:

From the preceding description of the CAP process, it is possible to make some observations regarding the decision-making approaches that are used throughout the process. The observations are going to be made using the Contingency Decision-Making Model (Daft, 2006) as illustrated in fig 2.2 above.

1. **CEO Message:** The CEO has a formal mandate from the board of directors that sets out his/her performance expectations. The mandate represents the board's consensus on how the BHP Billiton group is to maximize value for shareholders. However, the knowledge of what exactly needs to be done to deliver on the mandate of the CEO is less certain. In terms of the Contingency model, this would place the decision –making required to compile the CEO's message in quadrant 3(bottom-left). The CEO as an individual is trying to make decisions under conditions of certain problem consensus and uncertain solution knowledge, the most likely decision making approaches to be used are **judgment and trial and error**. The period over which trial and error occurs could be several years long.
2. **Resource Development Plan:** This is a team or organizational activity and from the description above the outputs of the RDP includes a problem statement reached by consensus in a facilitated problem framing workshop and a range of options to maximize the value of the assets. Considering the Contingency Decision-Making framework, we can say that the problem consensus is uncertain (initially) and that the solution knowledge is also uncertain, therefore decision making is taking place predominantly in quadrant 4 and the approaches that are likely to be used are; the **Carnegie model** in the problem framing workshop and the **Incremental Process model and Garbage Can models** in the identification, analysis and selection of options.
3. **Life of Asset Plan:** The problem consensus is now certain after the problem-framing workshop conducted as part of the RDP process, but the viability and implications of the proposed options from the RDP process are still not fully understood and need further refinement. The solution knowledge is therefore uncertain. This will place the decision-making in quadrant 3 of the Contingency Decision-Making Framework. The LoI being a team process implies that the most likely decision-making model to be used will be the **Incremental decision Process Model**.
4. **The Letter of Intent:** The Group Management Committee as a team issues the LoI. The GMC having acquitted themselves with the different LoIs for businesses

under their responsibility, collaborate to agree on the problem consensus and on the broad delivery approach. The development of the LoI therefore takes place under uncertain problem consensus and knowledge solution and the decision-making approaches that will be used are the **Carnegie Model** to agree on the problem statement and the **Incremental Decision Process and the Garbage Can models** to design the delivery approach. Decision-making takes place largely in quadrant 4 of the framework.

5. **5-Year Plan:** The LoI gives direction and reduces uncertainty with regards to both problem consensus and solution knowledge. The development of the 5-year plans will take place most in quadrant 1 of the framework and decision-making will largely be through **Management Science.**
6. **2-Year budgets**: In this instance both the problem consensus and the solution knowledge are more certain after the analysis and planning in the LoI and 5-year planning stages. Actions can now be assigned to individuals and deadlines agreed upon. Individuals will tend to use **Rational Approach** and the organization will be using mostly **Management Science Approach.**
7. Key Performance Indicators (KPI): Similar to 2-year budget above. Decision-making takes place mostly in quadrant 1 where the problem consensus and the solution knowledge are certain and individuals use the **Rational Approach** to decision –making whereas teams use the **Management Science** approach.

Fig 2.4 below superimposes the CAP process on the Contingency Decision-Making Framework.

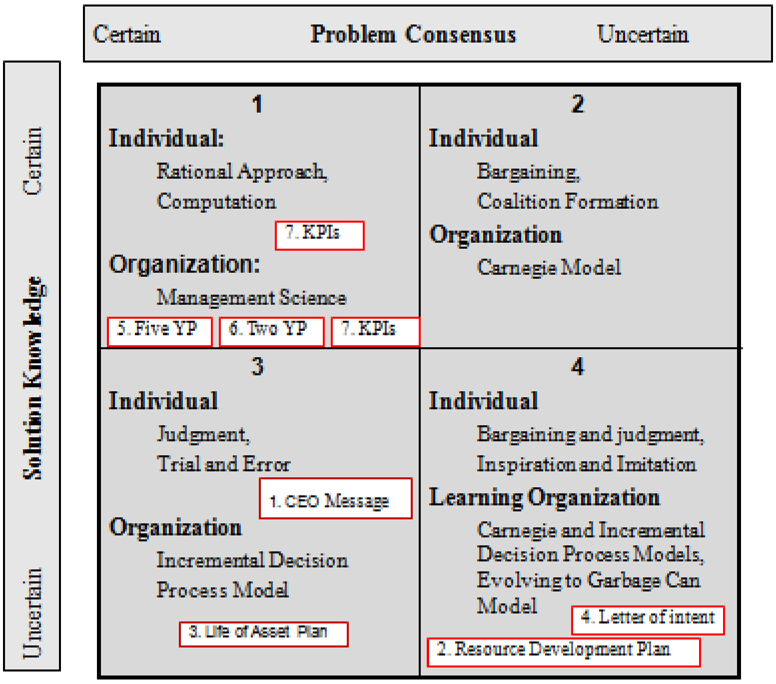


Fig 2. 4: CAP Decision-making approaches (Daft, 2006:469 and BHP Billiton, 2008c)

CAP Strategy Implementation Approach

Business Unit Strategy

The CAP prescribes the procedures for performing the Resource Development Potential, The Life of Asset Plan and the 5 Year Plan[8]. The 2-year budget and the KPI setting process are managed collaboratively by relevant Group Functions, for example, the Finance Group Function will publish schedules and templates for the budgeting process and the Human Resources Group Function will publish and manage schedules for KPI setting and performance reviews.

The Delivery Appraisal process is aimed at ensuring that the Business Units have a systematic plan for implementing the strategies that were ratified during the Strategy Appraisal process that takes place in the first half of the financial year.

[8] PRO.013: Resource Development Potential Procedure, PRO.012: Life of Asset Procedure and PRO.021: Five Year Plan Procedure. All these procedures are contained in the BHP Billiton Operating Model.

The CAP process gives the Business Units much latitude in terms of details of tools or approaches for strategy implementation. In the case of the Manganese CSG, the process of strategy implementation can be summarized as follows:

The CSG President issues a Letter of Intent for the Manganese CSG to supplement and expand on the LoI issued by the Group Management Committee. In this letter, the President will give direction in terms of what initiatives and projects ought to receive priority in the ensuing performance period.

Initiatives are managed under the umbrella of the Manganese Improvement Method (MIP) under the leadership of a Corporate Practice Leader. The MIP uses different tools and systems, such as 5S, Six Sigma and so on to execute these initiatives. The final choice of the tools is often left to the Business Unit Management. Projects are executed on the Manganese Project and Portfolio Management System[9].

The ongoing operational performance is managed and reported through a system of Management and Financial Reporting. The Management Reports include a set of Key Value Driver reports .The CSG Executive Committee and the Management Committee of each Business Unit review the operational reports monthly.

The use of Key Value Driver trees is one of the common features found in all Manganese Business Units. The KVD trees are used mainly in the following way:

1. By CSG and BU Management as a BU Performance review tool
2. By operational (sectional) teams to identify improvement opportunities and to track improvement initiatives.
3. As part of people performance management to provide guidance in setting individual performance measures.
4. As a benchmarking tool to identify measures that should be included in benchmarking studies.

The above discussion examined strategy implementation in BHP Billiton Manganese from a perspective that looked at the steps or procedures that constitute the strategy implementation process. The emphasis of the discussion was more on the content rather than the (behavioural) process that constitutes strategy implementation practice. Bourgeois and Brodwin (1984) proposed five models that can be used to describe strategy

[9] PPM is a product of Hewlett-Packard Corporation configured to support the Manganese Business Processes.

implementation from a process point of view. The models proposed by Bourgeois and Brodwin can be summarized as follows:

1. Commander Model: In this model, the CEO and/or a select group of top managers are the "rational actors": receiving information, making strategic choices and then communicating the chosen course of action to the rest the organization for implementation. This approach does not consider the implementation problem explicitly and its success is generally limited to companies operating in stable environments where the required actions for strategy implementation do not require significant organizational change.
2. The Change Model: This model is an extension of the commander model in the sense that the CEO and/or top management not only select the course of action but they consider the implementation problem, i.e. how do we implement the strategy we have developed. The implementation approach, for example, may take the form of a new organization structure, personnel changes, new information systems and behavioural and culture change initiatives. The Change Model might be of limited use in environments that are in a state of rapid change due to the loss of strategic flexibility that might result from implementation of systems to support a specific strategy.
3. The Collaborative Model: The Collaborative Model extends decision-making in strategy formation to the key managers and functional experts. Group dynamics and brainstorming techniques are used to facilitate agreement on the organization's strategic direction. The involvement of the key stakeholders in decision-making is aimed at creating a sense of commitment that will enhance the chances of success in strategy implementation. The risk with this approach is that what is politically optimal is not necessarily economically or technically optimal.
4. The Cultural Model: The Cultural Model seeks to extend the participative elements of the Collaborative Model to the lower levels in the organization in order to get the whole organization committed to the goals and strategy. Extensive use is made of cultural symbols such as company songs, creeds and vision statements to promote singleness of purpose and unity in action.
5. The Crescive Model: In this model strategy development and implementation comes upwards from the coalface rather than downward from the top. The role of the CEO is to articulate the corporate objective or purpose in a way that sets the decision premises. The CEO has to perform a balancing act between setting too

wide a scope to the extent that the firm loses focus and setting too narrow a scope to the extent that innovation is stifled.

Returning to the CAP process, the Group CEO's message at the beginning of the strategy cycle serves the purpose of setting the decision premises as envisaged in the Crescive Model. The CSG are responsible to make sure that the rest of the CAP process is followed in their business units. The RDP, LoA and 5YP sub-processes are more aligned to the Collaborative Model approach. In the Manganese CSG the 2 Year budget process and the setting of KPIs is more aligned with the Change Model. The CSG and BU management teams in one forum agree at the objectives and each BU team has to implement the required systems to ensure delivery. As Bourgeois and Brodwin (1984) pointed out in their paper, the strategy implementation approaches described above are not "mutually exclusive forms, but probably modal, in the sense that any firm will probably engage in a variety of the models, but with different emphasis."(Bourgeois and Brodwin, 1984:260).

The CAP process exists within the broader BHP Billiton Operating Model. In terms of the Operating Model, the BHP Billiton board and top executive management set strategy for the Group. The strategy is communicated down throughout the Group. CSGs and BUs are expected to develop their strategies within the boundaries set by the Group. The development and communication of the Operating Model with its emphasis on clear delegation of responsibility and accountability is an attempt to deal with the 'implementation problem'. In terms of Bourgeois and Brodwin's (1984) models, the BHP Billiton Group's overall strategy implementation process would predominantly be the 'Change Model'.

2.5 Benefits of Decision Support Systems

Having considered decision-making processes in BHP Billiton and specifically how the CAP process can be understood in terms of the Daft (2006:469) Contingency Decision-Making Model, we now examine the benefits that a DSS system would bring to the decision-making process.

Turban et al (2007:20) described DSS as being a "content-free expression" (i.e. is a term that means different things to different people). The truth of this assertion is evident in section 2.2 above, when we examined the attempts of various authors to define what DSS is. It is therefore not surprising that there is a large variety of views on what the benefits of DSS are and how they ought to be quantified.

The simplest view of DSS benefits is the one that evaluates a DSS in terms of single-outcome measures, such as decreased cost, improved profit and so on (Gupta et al,2006:3). While this approach might have been adequate in the past when the majority of DSSs were constructed to solve a specific problem, in today's world its usefulness is limited because most DSS form part of an integrated information system.

Another view of DSS benefits could be in terms of process measures, for example, organizational learning, processing-speed and so on. In general, DSS can be said to be beneficial in increasing the effectiveness and efficiency of decision-making. Turban et al (2007:755) define effectiveness as: "The degree of goal attainment. Doing the right things", and efficiency as: "The ratio of output to input. Doing things right." Most if not all of DSS' benefits discussed in literature involve improving either the effectiveness or efficiency of decision-making.

In 1988, Money et al (1988:224) published a value-based DSS evaluation methodology that sought to:

a. Emphasize value rather than cost
b. Focus on intangible benefits, and
c. Is applicable to a single investment proposal.

In conducting the literature review for the above study Money et al (1988:226) identified categories of perceived DSS benefits as published in the literature up to then (1988).

Table 2.5 below summarises the benefits of DSS as reported by Money et al (1988:226) from the literature survey they conducted.

	Literature Source	Benefit of DSS
1	Wagner, Keen, Smith, Parker and Thierauf	**Clerical Benefit** (time and labour saving, smoother administration)
2	Alavi, Wagner, Thierauf and Keen	**Management time utilization benefit** (more efficient time usage)
3	Thierauf, Parker, Keen, Wagner, Smith and Alavi	**Decision-making benefit** (better decisions, possible to cope with more complex decisions)
4	Alavi, Wagner, Radford, Parker and Keen	**Problem Appreciation Benefit** (improved understanding of problems, learning value, management skills leverage and increased decision confidence)
5	Alavi, Keen, Thierauf, Parker, Radford, Smith and Wagner	**Data Utilization Benefit** (improved timeliness, greater accuracy access and availability of data)
6	Parker, Keen and Thierauf	**Planning and Control Benefit** (improvement)
7	Alavi, Smith, Wagner, Parker, Thierauf and Keen	**Decision search Benefit** (increased depth and scope of alternatives exploration)
8	Radford, Smith and Keen	**Communications Benefit** (promotes contact between management levels)

Table 2. 5: Perceived DSS benefits from literature (Money et al, 1988:226)

The benefits of DSS as summarized in Table 2.5 can be classified in terms of whether they enhance decision –making effectiveness or efficiency, for example, clerical benefits are efficiency enhancers whereas decision-making benefits are effectiveness enhancers.

Mallach (2000:18) pointed out that DSS benefits are not necessarily mutually exclusive, i.e. one factor can enhance both efficiency and effectiveness simultaneously.

Mallach (2000:18-23) classifies DSS benefits into the following five categories:

1. Improving Personal Efficiency: This is the ability of DSS to enable employees to make decisions faster with less chance of error. This corresponds to the clerical benefits in Table 2.5 above.
2. Improving Problem Solving: Mallach (2000:19) distinguished three ways in which a DSS can improve problem solving, namely:
    a. Solving a problem faster –improving speed of processing information for decision-making or increasing the quantity of decisions made.
    b. Solving the problem better - improving the quality of decisions made.
    c. Increased consistency of decisions – this is ensuring that decision-makers use the same assumptions and formulas in reaching their decisions.
3. Facilitating communications: DSS promotes communication between management levels by providing a common basis for decision-making, including standardization of concepts, mechanics and vocabulary.
4. Promotes learning and training: most DSS provides the users with reasons for making particular recommendations or in the case of user error, they recommend possible solutions.
5. Increase Organizational Control: DSS can be used to ensure that individual decisions conform to organizational norms, guidelines or requirements

Referring to the Contingency Decision-Making model Fig 2.4 above we can infer what categories of DSS benefits will be emphasized under different decision making conditions applicable to the CAP process:

1. Problem consensus certain: Solution knowledge certain (quadrant 1): The decision-making approaches for individuals are rational and/ or computation and for organizations the management science approach will dominate. The DSS benefits will relate mostly to processing speed (efficiency) of the information that is available.
2. Problem consensus certain: Solution knowledge uncertain (quadrant 3): The decision-making approaches for individuals are judgment and trial and error and for organizations, the approach is the incremental Decision Process Model. The important benefits of DSS under these conditions are those that enable gathering

and organization of information into usable intelligence for decision-making, providing users with common vocabulary and model.

3. Both problem consensus and solution knowledge uncertain (quadrant 4): under these conditions both the efficiency and effectiveness enhancement capabilities of the DSS are required, i.e. the ability to gather information, identify relevant information and enable speedy processing of the information.
4. Problem consensus uncertain-solution knowledge certain (Quadrant 2): The decision-making approaches for individuals are bargaining and coalition formation and the decision-making approach for organizations is the Carnegie Model. The DSS requirements are similar to those in point 2 (quadrant 3) above. The important issue is information gathering, forming common concepts and developing models that will enable problem definition.

All the CAP processes occur within quadrants 1, 3 and 4 in Fig 2.4 above and DSS can be utilized to improve any these processes as discussed above. The use of DSS will, however, emphasize different DSS capability depending on the CAP sub-process or step under consideration. The one factor that is common under all decision-making contexts, as listed in quadrants 1, 3 and 4 of Fig 2.4, is the central role of a model or models to enable processing efficiency (quadrant1) or to enable concept formation and problem definition (quadrants 3 and 4). The KVD model that has been developed in BHP Billiton Manganese is presumed to fulfil this role and this research is meant to test this presumption.

2.6 Chapter Summary

DSS are systems that support but do not replace decision-makers. DSS utilize data and models to produce output that the decision-makers use in making decisions. As computing technology advanced over the years DSS have also advanced from problem-specific desktop applications to web based applications that can accommodate multiple problem types.

Decisions made in organizations can be at operational, tactical and strategic levels. In each of these levels, the decisions can be structured, semi-structured and un-structured. DSS are used in dealing with un-structured decision situations.

Individuals make decisions using either a rational approach or an intuitive approach. The rational approach is often a data based approach based on applying some logical rules, whereas the intuitive approach is often based on experience and judgment (Daft, 2006:451).

In organizations a number a decision-making approaches, such as : The Management Science Approach, The Carnegie Model, The Incremental Decision Process Model and The Garbage Can Model have been proposed as best representation of the decision-making process. Daft (2006) constructed a contingency decision-making framework based on the extent of the problem consensus and the technical knowledge about the problem solution.

The CAP process that is used for Strategy formation in BHP Billiton was examined in the context of the different decision-making approaches and Daft's contingency decision-making framework in order to characterize the different steps that take place during the CAP process.

Decision-making is a critical part of strategy implementation. The five strategy implementation models as described by Bourgeois and Brodwin (1984) were examined. These approaches are: The Commander Model, The Change Model, The Collaborative Model, The Cultural Model and the Crescive Model.

Lastly, some DSS benefits as found in literature were reviewed and different kinds of benefits that would be emphasized under different CAP decision-making processes were suggested.

The next chapter will examine Key Value Drivers: how they are defined, identified and used in business processes.

3 KEY VALUE DRIVERS

3.1 Introduction

In the previous chapter, we reviewed the history of decision support systems, examined decision making, and decision support within the context of BHP Billiton Manganese. It also became apparent that central to any DSS or decision –making approach there are models that encapsulate the decision –making rules and logic and provide concepts that are used in problem definition and solution. In BHP Billiton Manganese, the KVD model plays this pivotal role. In this chapter, we examine KVDs: what they are, how are they identified and how are they used in business and individual performance management.

Copeland et al (1995:103) defined KVDs as performance variables that drive the value of the business. Implied in this definition is that value creation is the intended outcome of business performance. In economics, the traditional neoclassical theory of the firm asserts that: Management's primary goal is to maximize the value of the firm (Samuelson & Marks, 2003:15). Purists may argue that the concept of the firm is a hypothetical construct used by economists to analyse decision-making within microeconomic competitive environment and therefore the concept bears no direct relation to what happens in the real world. In practice, many of the consequences of the theory of the firm are applied in practical managerial analysis and decision-making, albeit with some modifications.

There are other definitions of key value drivers that may differ in semantics but not in substance from Copeland et al's (1995) definition. The following are some examples of variations in the definition of key value drivers.

L.E.K consulting (1977) defined a key value driver as a factor that contributes to value creation of the business. They further describe the two definitive attributes of KVDs as being that, firstly, they have significant impact on value creation and secondly they are controllable by management.

Ehrbar (1998) defined a value driver as that piece of the company's performance over which the employees deeper down in the organization have control. Partners-In-Performance (P.I.P) consultants simply define key value drivers as "gears that power a business" and they represent issues in a business in a manner that is economically correct and useful for making trade-off decisions in the business (P.I.P Consultants, 2008).

Copeland et al (1995) gave two reasons why an understanding of key value drivers by management is essential. The first reason is that the organization cannot act directly on value. The organization has to act on things it can influence, such as, customer satisfaction, cost and capital expenditure. The second reason is that through these drivers of value, senior management can learn to understand the rest of the organization and to establish a dialogue about what management expects to be accomplished.

Value creation is generally quantified in financial terms, for example net present value (NPV) is measured in dollars or other currency terms. However, the drivers of value are not exclusively financial in nature. There are two broad categories of key value drivers, financial key value drivers that primarily guide senior management and non-financial key value drivers that motivate the entire organization.

3.2 Defining Value

The idea that investors in a business do so with the expectation of realizing a return on their investment is well accepted. Similarly the idea that businesses should be judged on the economic value they create can hardly be said to be controversial.

Disagreement arises on how the value created is to be measured. What exacerbates this disagreement is the so-called "Agency Problem".

The Agency Problem exists within the context of the Agency Model of the firm. Lambert (2007:248) describes the agency model in its simplest form, as reducing the organization to two people: the Principal and the Agent. The principal's roles are to supply capital, bear risk and construct incentives, while the roles of the agent are to make decisions on the principal's behalf and also bear some risk. A performance contract is entered into between the principal and the agent. In terms of this contract, the agent is compensated for his/her effort in maximizing the principal's net proceeds generated by the firm.

In the principal-agent relationship there is always a possibility of conflict of interest between the principal and the agent. Such conflict is called an Agency Problem. According to Eisenhardt (1989:58), the agency problem arises when:

a. The desires or goals of the principal and agent conflict and
b. It is difficult or expensive for the principal to verify what the agent is actually doing

In order to assess the performance of the managers the owners need to measure the value that the business creates. Measurement of value created is therefore a proxy for measurement of management performance and can be used to determine management remuneration.

Managers are also interested in measurement of value from a perspective that is internal to the business because they need to make trade-off decisions on how to apply the business' resources in order to maximize profits, more specifically, they need to assess and compare capital investment opportunities on the basis of the value creation potential of those opportunities.

Two competing paradigms have been used to measure business performance in relation to the creation of shareholder value; these are the Accounting model and the Value Based Management paradigms.

3.2.1 The Accounting Perspective to Business Performance Measurement

From the perspective of the investors, i.e. shareholders and lenders, the corporate value of an entity such as a company or a business unit is the sum of the values of its debt and its equity. In other words, it is the value of the cash invested in the company by its lenders and shareholders. The debt portion of the corporate value can in turn be made up of several components such as market value of debt obtained from banks, unfunded pension liabilities and market value of other claims such as preference shares. The equity portion is the market value of shares held by shareholders. In companies that are traded in a stock exchange, the market value of equity will be the product of the share price multiplied by the number of shares.

Investors are interested in how much value has the business created in the past and what value is it expected to create in the future. They will remain invested in the business if they are satisfied that the value they will realize will be superior to that they would realize if they had invested in other businesses of comparable risk.

The accounting perspective to performance management is based on the use of traditional financial statements, namely the balance sheet and the income statement (or profit and loss statement), to analyse business performance. The use of the cash flow statement is a relatively recent phenomenon in comparison to the use of the balance sheet and the income statement. According to Horrigan (1968:284), the need for financial statements increased as the management of enterprises in various industrial sectors transferred from enterprising capitalists to the professional managers and as the financial sector became a more predominant force in the economy.

A popular way in which financial data are used is in the form of financial ratios. Horrigan (1968) discussed the evolution of financial ratios from the second half of the nineteenth century to the 1960's. He highlighted the two main reasons for the development of ratio analysis as being the creditors' concern with the ability of businesses to meet their liabilities and management's requirement to assess the profitability of the businesses they were managing. Table 3.1 below lists Horrigan's (1968) classification of financial ratios

Grouping	Ratio
1. Short-term liquidity ratios	a. Current assets to current debt (current ratio) b. Current assets less inventory to current debt (quick ratio) c. Cash plus marketable security to current debt
2. Long-term solvency ratios	a. Net operating profit to interest (times-interest-earned ratio) b. Net worth to total debt c. Net worth to long-term debt d. Net worth to fixed assets
3. Capital turnover ratios	a. Sales to accounts receivable b. Sales to inventory c. Sales to working capital d. Sales to fixed assets e. Sales to net worth f. Sales to total assets
4. Profit margin ratios	a. Net operating profit to sales b. Net profit to sales
5. Return on investment ratios	a. Net operating profits to total assets b. Net profits to net worth

Table 3. 1: Classification of Financial Ratios (Horrigan, 1968:559)

Accounting Ratios based on Earnings

The theory of the firm states that the fundamental purpose of a business is to maximize returns to its shareholders. Total shareholder return (TSR) is the sum of dividends paid out plus the increase in the market value of the shares. It was Miller and Modigliani (1961) who posed the question: "What measures of corporate performance does the market capitalize"? The dominant response to this question was that the measures that determine the market value of a corporation were earning per share (EPS) and price to earnings ratio (P/E). The reported EPS and P/E ratios are normally based on historical earnings. In order to determine the present market value of a share it is necessary to forecast what the future earnings of the company are going to be. Traditionally this was done by capitalizing a company's EPS at an appropriate P/E multiple (Stewart, 1991:23). The process of calculating earnings (and therefore EPS) is dependent on a number of methodological choices and assumptions that the accountants can make. Therefore, earnings can be variable depending on the approach used to calculate them.

Rappaport (1986:20) advanced five reasons why earnings fail to measure the economic value of the firm:

1. Alternative accounting methods lead to different earnings results:

There are a number of choices that accountants can make when calculating earnings that can significantly impact the earnings reported. For example switching from FIFO (First-In First-Out) to LIFO (Last-In First-Out) inventory costing in times of increasing prices reduces the company's reported earnings because the higher price stock is expensed first.

Another example is the way the company chooses to deal with non-cash items such as depreciation and amortization. This can reduce or increase the company's reported earnings although they have no impact on the cash that was generate.

It is therefore difficult to compare reported earnings numbers of different companies or even of the same company for different periods without painstakingly trying to find all the assumptions and choices that where made when these numbers were calculated.

2. Earnings figures do not incorporate consideration of risk

There are two types of risks commonly referred to as "business risk" and "financial risk". Business risk arises from the nature of the business operations and financial risk arises from how the company is financed with a mixture of debt and equity.

Reported P/E ratios are based on historical figures. If we need to forecast future earnings, we need to understand the company's strategy and the likelihood of achievement of performance targets. Variability in the expected earnings (measured by the standard deviation of expected earnings) is an indication of the business risk associated with the strategy under consideration. In most instances, investors are provided with earnings growth figures that are accepted and used at face value.

When debt is introduced in the company's capital structure, the required rate of return for investors increases because the required rates of return does not only take business risk into consideration but financial risk as well.

3. Investment Requirements Excluded

Investments in working capital and fixed capital are not correctly reflected in earnings calculations.

Working capital consists of receivables, inventory and payables. In earnings calculation, revenue is recognized when the transaction takes place regardless of whether cash was exchanged or not. Therefore, for a company with increasing receivables, the revenue figure is an over-statement of the cash received.

An increase in the company's inventory requires cash to be spent on the additional inventory. Therefore, for companies with expanding inventory levels the cost of sales figure will understate the cash outflow for the period.

Accounts payable and accrued liabilities represent unpaid bills included as expenses in calculation of earnings. Therefore, a company with increasing payables overstates the cash outflow in its income statement.

Assets such as property, equipment and plant are initially recorded at cost and included in the balance sheet as fixed assets. Their cost is then allocated over a period of their estimated useful life. Depreciation cost calculation was based on original cost of the assets and not on current valuation of assets. Although the depreciation cost might appear as an expense in earnings calculation, no cash movement actually takes place.

4. Dividend Policy not considered

There is normally disagreement on whether a company should pay out maximum dividends so that the investors can choose how to re-invest these or retain them for reinvestment at a positive rate of return in order to maximize earnings in the long run. The problem can arise if the rate of return on retained dividends is less than what investors can obtain in the market, this situation will result in a decrease in the market value of the shares. Stewart (1991:43) argues for payment of dividends only as a last resort for the following reasons:

1. It is better for management to retain dividends for growth
2. If no worthwhile growth investment opportunities are available, the next best option should be a share "buy-back".
3. If payment of dividends is viewed to be extremely desirable, them consideration should be given to borrowing funds to pay them.

5. Time Value of Money

Earning calculations ignore the time value of money. Valuation methods generally calculate the value of a company based on discounted values of the anticipated cash flows.

In addition to EPS and P/E ratios, there are two other accounting ratios that are used to assess the performance of the business or management performance, namely, the Return on Equity ratio (ROE) and the Return on Investment ratio (ROI). ROI is commonly used to measure performance at the business unit or divisional level, ROE is more commonly used to measure performance at corporate level (Rappaport, 1986:42) .The increase in the popularity of ROE, and ROI was as a result of growing recognition that earnings increases are no guarantee of increases in shareholder value.

Stewart (1991:87) refers to ROE as a measurement of rate of return from a financing perspective and the ROI as the rate of return from the operating perspective.

As is the case with EPS and P/E ratios, authors such as Rappaport, Stewart and many others expressed some reservations regarding the use of ROE and ROI as measures of value creation by the business.

1. ROE as a measure of business performance.

The rate of return on equity is calculated be by dividing bottom-line net income available to the shareholders (or common stock holders) by bottom-line accounting equity capital.

ROE = Income available to common stock holders / Common Equity or stated differently:

ROE = Net Income/Book value of shareholder's equity

ROE is easy to compute and understand[10]. It also popular as a corporate measure of performance on the grounds that it is a measure of primary concern to investors.(Rappaport,1986:42).However, as is the case with EPS and P/E ratios, ROE suffer from distortions that limit its usefulness as an accurate measure of value creation. The distortions arise from two primary sources (Stewart, 1991:84):

1. Accounting Distortions: ROE calculation is based on the earnings whose shortcomings were discussed above. Consequently ROE suffers from similar

[10] ROE may also be decomposed into three ratios as follows :
ROE = After-tax profit margin X Asset Turnover X Asset Leverage
= (Net Income/Sales) X (Sales/Assets) X (Assets/ Common equity)

distortions to EPS and P/E calculations arising from , for example, the choice of LIFO or FIFO for inventory costing, Expensing R & D, the use of successful effort instead of full cost to account for risky investments (such as exploration) and the consequences of accrual accounting on the treatment of current assets.

2. Financing Distortions: ROE calculation is influenced both the mix of debt and equity and the rate of interest paid on the debt. For example, management might artificially grow earnings by financing projects from debt and in this way increase the ROE. This may lead to value destroying behaviour whereby good projects that require equity finance are overlooked and poor projects that require debt financing are preferred. The increase in ROE obtained by liberal use of debt should be weighed against the resultant increase in financial risk and the impact of this increased risk on the value of the company.

2. ROI as a measure of business performance

In place of ROE, the alternative measure of business performance that can be used is the Return on Investment measure (ROI). This is calculated by dividing the net operating profit after tax by the total capital employed in the operations.

ROI = Net Operating Profit after Tax / Total Capital

ROI is an attempt to measure the productivity of the capital employed without regard to the method of financing. The denominator in the ROI ratio, namely Total Capital, is the sum of all cash that has been invested in the company's assets without regard to "financing form", accounting name or business purpose (Stewart, 1991:86).The numerator, namely Net Operating Profit after Tax (NOPAT), is the profits derived from the company's operations after taxes were deducted but before interest costs or other non-cash items. It is thus the total pool of cash available to provide a cash return to all financiers. Depreciation is the only non-cash cost that is subtracted in calculation of the NOPAT. The reason for this is that depreciation is taken as a true economic cost of the assets that were used to generate the returns by the business.

3.2.2 Value Based Management Approach to Business Performance Management

Many of the critics of traditional accounting approaches to business value measurement were proponents of the so-called Value Based Management (VBM) approach. There is a plethora of other management approaches for improving business performance and consequently business value, for example, Total Quality Management, Six Sigma, Continuous Improvement and others, however there is still no general agreement on the best way to create, manage or measure value.

Value Based Management (VBM) was widely touted from the early 1990s by the security analysts and management consultants as a new tool to help investors assess companies and help executives evaluate business performance and shareholder value.

What is Value Based Management (VBM)?

VBM is a generic term for a set of management tools used to facilitate managing a firm's operations in a way that enhances shareholder value(Martin and Petty, 2000:xiii).The management tools span across a number of functional areas in the business; for example, in finance VBM adopts a DCF valuation paradigm. From a strategic planning point of view, VBM has accepted the idea that a firm creates value by investing in opportunities where it has some competitive advantages over its rivals. From an organizational behaviour point of view VBM has adopted the idea that "what gets measured gets done", meaning that employees tend to focus most of their energy on those activities where they know that their superiors are most interested in the results that are achieved.

Lastly, from an accounting perspective VBM adopts the basic structure of a firm's accounting statements and modifies them when necessary for its own purposes.

Slater and Olson (1996:49) separated value based management approaches into two categories based on the intended objective. They distinguished between value-based techniques for:

(a) Planning and evaluating new strategic initiatives.

(b) Analysing and improving current operations.

According to Slater and Olson (1996), discounted cash flow techniques are most appropriate for evaluating new strategic initiatives and because these techniques focus on future cash flows, it is difficult to apply them to analysis of current operations. On the other hand, Economic Value Added (EVA) and Equity Spread (ES) models were developed specifically for assessing the value creating potential of current operations. The two categories of techniques as suggested by Slater and Olson (1996) are not mutually exclusive in their application and VBM implementations will normally use many techniques with a preference or emphasis of one category of techniques over the other depending on the context.

Martin and Petty (2000) listed three principal methods that are used in VBM and who the key proponents of these methods are from the management consulting fraternity:

1. The Free Cash Flow (FCF) method that is championed by consulting firms such as McKinsey and LEK/Alcar.
2. The economic value added/ market value added (EVA/MVA) method championed by Stern, Stewart & Co consultants.
3. The Cash flow return on investment (CFROI) approach espoused by the Boston Consulting Group and HOLT Value Associates.

Although all the above principal methods of VBM are underpinned by the DCF methods for evaluating investments, the methods differ in how they seek to mobilize the organization and the different functional areas into ensuring that the value creation process is sustainable.

VBM implementations are generally designed for specific firms and the implementation approaches vary somewhat from firm to firm. Ittner and Larcker (2000:353) list six basic VBM implementation steps that are found in most frameworks:

1. Identifying specific internal objectives that lead to shareholder value enhancement.
2. Selecting strategies and organizational designs consistent with the achievement of the identified objectives.
3. Identifying the value drivers that actually create value in the business given the organization's strategies and organizational design.
4. Developing action plans, selecting performance measures, and setting targets based on the priorities identified in the value driver analysis.
5. Evaluating the success of action plans and conducting organizational and managerial performance evaluations
6. Assessing the ongoing validity of the organization's internal objectives, strategies, plans, and control systems in light of current results, and modifying them as required.

Weaver and Weston (2003) conducted comparative study of four alternative performance metrics used in VBM, namely:

1. Intrinsic value analysis (IVA).
2. Discounted cash flow (DCF)
3. Economic Profit (EP)

4. Market to book ratio (or Market Value Added)

Weaver and Weston (2003) found significant (positive) correlation amongst the four matrices. In addition, they proposed what they referred to as a "Unifying Theory of Value Based Management" that could be used with any of the performance matrices studied. Fig 3.1 below is a diagrammatic representation of Weaver and Weston's (2003:30) Unified Theory of Value Based Management.

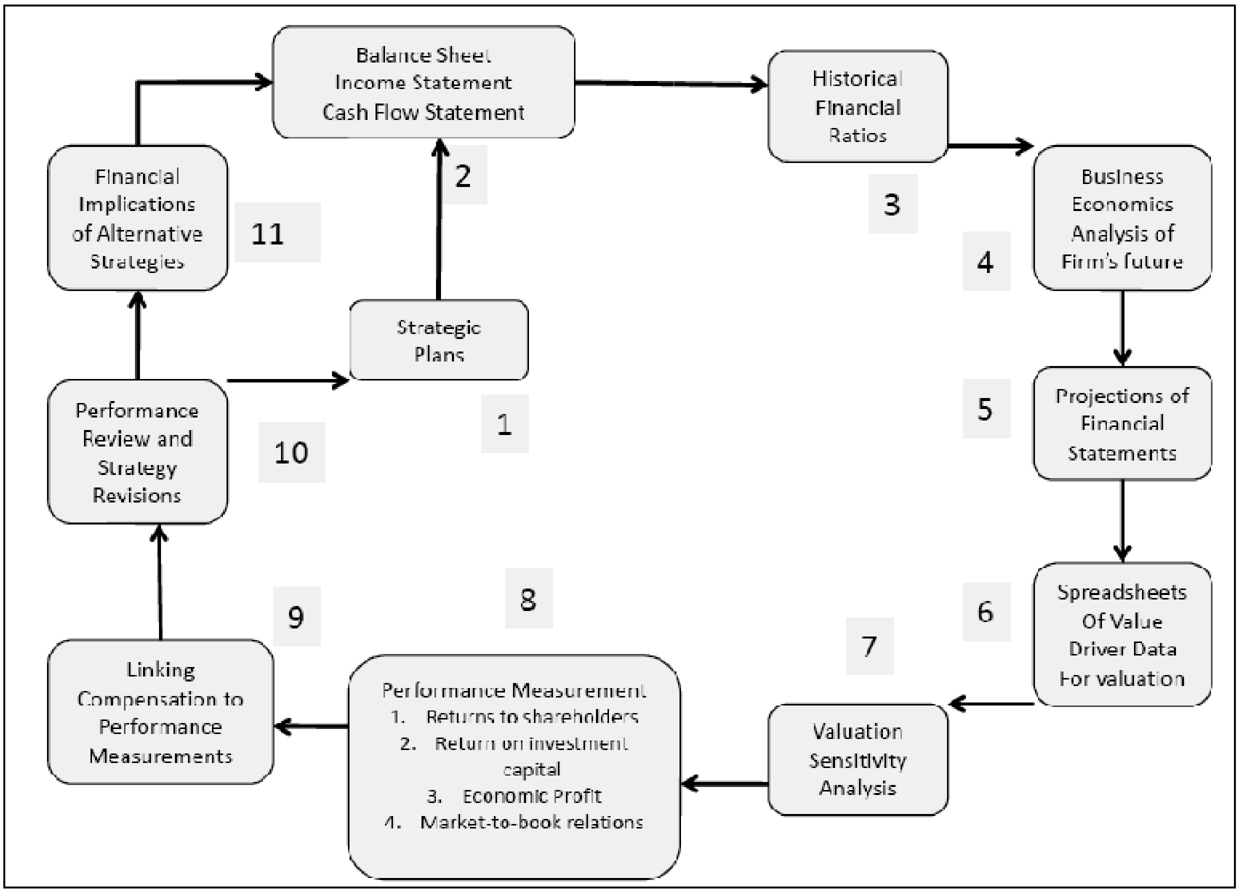


Fig 3. 1: Unifying Theory of Value Based Management (Weaver and Weston, 2003:30)

The two causative factors for VBM adoption were the increasing level of shareholder activism and the need to negate the "agency problem" in the face of increasing management compensation. Larmande and Ponssard (2007:3) quoting O'Hanlon and Peasnell (1998) listed four steps through which EVA schemes address the agency problem:

1. The use of residual income as a starting point in the design of a yearly performance measure.
2. The introduction of adjustments regarding accounting conservatism relative to goodwill and R&D expenses…, earnings management relative to provision for

bad debt, guarantees…, methods to value assets….to derive economic value added from residual income.

3. The determination of appropriate benchmarks to evaluate value creation, through a methodology that in principle makes the variation of EVA from previous year to this year related to the excess return expected by the shareholders
4. Introduction of a bonus bank as a last line of defence, in order to induce managers to assume a long-term perspective of the business and their performance.

Larmande and Ponssard (2007) conducted a survey of companies that had adopted VBM approaches and concluded that most of those companies did not realize the claimed benefits that VBM approaches were supposed to deliver. However, the VBM movement remains relevant to this research largely because of two ideas that emanated from VBM. Firstly the realization that value cannot be managed solely through financial measures and secondly that the whole organization needs to understand what value creation levers are available. These levers for value creation are nothing other than Key Value Drivers (KVD)

3.3 Identification of Key Value Drivers

There are two primary reasons why it is important to identify the KVDs of a business. The first reason arises out of the need by managers of the business to determine the critical drivers that they need to focus on in order to manage or control the business. The second reason arises out of the need by the owners of the business to determine the critical factors that they should consider in order to assess the performance of the business or managers. KVDs can be identified for these same reasons at different levels in the business, for example, in the case of BHP Billiton; KVDs can be identified at BHP Billiton Group Level, at the Manganese CSG level, at Manganese Business Unit level and even at plant level within a business unit.

Value Based Management frameworks invariably include a step that identifies KVDs. However, KVDs are not the exclusive preserve of VBM. As Martin and Petty (2000:7) pointed out: the drivers of value creation can be identified from both the Accounting Model paradigm and the VBM paradigm. From the perspective of the Accounting Model, the determinants of earnings and the P/E ratio would be the key value drivers and from the DCF (or VBM) perspective, the determinants of the firm's future cash flows and the opportunity cost of capital would be the key value drivers. The study of Weaver and Weston (2003) demonstrated that in addition to the strong positive correlation amongst the four performance metrics used in VBM , namely, IVA, DCF, EP and MVA, there is also significant positive correlation between each of the metrics and the traditional accounting metrics of EPS and P/E. It is therefore to be expected that there would be common KVDs between the Accounting Model paradigm and the VBM approaches. In any case, VBM calculations use data from traditional accounting reports such as Income Statement, Balance Sheet and Cash flow statement, albeit with some adjustments.

Discussion on performance management and KVDs is often frustrating because of lack of common terminology. Melnyk et al (2005:318) observed during their empirical study on metric alignment in performance management, that interview respondents used the term "metric" to denote a measure, a standard, a set of measures or even a set of objectives. According to Melnyk et al (2005), this lack of common terminology does not only make discussion frustrating but also hinders theory building and dissemination.

For the purposes of this discussion, the following convention will apply in respect of KVD. Each KVD will be described in terms of one or more of the following attributes:

I. **A name** is a word or words denoting or describing the KVD, for example, revenue.
II. **A measure** is a quantitative indication of the extent, amount, dimensions, capacity or size of the KVD. A measure is a result of a measurement process performed on the KVD. In the case of the revenue example above $10 Million can be regarded as a measure of the revenue.
III. A **metric** is a quantitative measure of the degree or extent to which a KVD possesses some attribute. Revenue expressed as $/t of product sold would then be a metric. According to Melnyk et al (2005:314), a metric consists of three elements, namely: the specific measure (what is being measured), the standard (the numeric value that identifies the minimum threshold of performance, as captured by the measure, considered acceptable to management) and the environment or context within which the activity or person being measured operates. Rasmussen et al (2009:24) define a metric as "a standard of unit of measure, such as mile or second."

IV. An **Indicator** is a metric or combinations of metrics that have been chosen to provide insight or information about a specific KVD or set of KVDs. According to Rasmussen et al (2009:23), a key performance indicator (KPI) is a metric that is tied to the business strategy or a target in the strategy and can be acted upon, therefore, although KPIs are metrics not all metrics are KPIs.

In literature the above terms are in most instances, used interchangeably, i.e., KVD are referred to as measures, either metrics or even Key Performance Indicators (KPI). What follows is summary of criteria that can be used in identifying KVDs.

3.3.1 Criteria for KVD identification

<u>A KVD should have a significant impact on the value creation process</u>

There are many factors that managers take into account in order to operate the business. Not all factors are equally important or have equal impact on the value creation process in the company. Value driver analysis is an important foundation for strategic planning in any company that enables management to sort through their operations in order to identify critical strategic levers (LEK Consulting, 1977:3).

To understand where the business' value drivers lie, the first step is normally a breakdown of the company high-level operating parameters, such as sales growth and operating profit, down to the level where operating management decisions are made. The second step is to test the sensitivity of the high-level operating parameters to the identified factors or drivers. This requires a model that can be used to simulate the impact of changing the identified drivers.

There are three categories of value drivers based on how the impact on value creation. These categories are: Growth drivers, Efficiency drivers and Financial drivers. The categorization of drivers into groups facilitates the allocation of management responsibility for the drivers, for example, Operation management will assume greater responsibility for efficiency drivers, whereas Marketing and Sales would assume responsibility for growth drivers.

Larmande and Ponssard (2007:1) use the concept of congruity or congruence (from Contract Theory) to describe the alignment of a management performance measure or value driver with the value creation objective of the principal .The impact of identified value drivers on the value creation process is therefore an important attribute that ensures congruity of the business or management performance system

A KVD should be controllable by Management

Once the KVDs have been identified and a sensitivity analysis is performed to ascertain their impact on value creation, the next step is an assessment of the KVD controllability by management. Controllability is the extent to which Management can control the identified KVD. Larmande and Ponssard (2007:1) define the controllability as the absence of noise factors outside the control of a manager.

The lower down the organization the driver analysis goes the more susceptible to noise the identified drivers will be and therefore the less controllable they will also be (Melnyk et al, 2005).

It is important to identify both the KVDs that managers do control and those that they can control but do not control.

KVDs should be judgmentally independent in the sense that it should be possible to analyse one KVD at a time.

Controllability of KVD is implicit in the Principal –Agent contractual relationship. The owners and the managers of a business have to agree that the managers have capacity to control the business. The business context can change this controllability assumption; for example, price may be a controllable KVD in a contract sale but may be uncontrollable in spot sale.

A KVD should be measurable

The measures and/or metrics that are associated with the identified KVDs should be measurable accurately and precisely. Accurate measurement implies that the reported measures and metrics must reflect what they purport to measure. Precise measurement implies that the measurement process or tool should be standard and give the same measurement under a given set of conditions.

For a variable to be controllable, it has to be measurable in order for a comparison to be made between the measured value and the control set point. However not all measurable variables are necessarily controllable and including them as key value drivers is of no consequence as managers cannot vary or influence them in order to create value.

The ability to compare level of performance to a set point makes it possible for a system of feedback and review to be implemented. This in turn is an important enable of continuous improvement.

KVDs should relate directly to the business strategy

The strategy formation process often involves choice of a value creation path from many other possible options. Only KVDs related to the chosen strategy should be considered once the strategic choice has been made. (Suwignjo et al, 2000). Therefore, similar companies in the same industry serving the same market may have different KVDs based on their chosen strategy; furthermore, the KVDs of a specific company can change over time as the strategy evolves.

A KVD set should be minimal but complete / comprehensive

All relevant drivers identified should be included in the KVD set but only the minimum required number should be used.

3.3.2 Approaches to KVD identification

Management Accounting

Traditionally Management accounting has had a primary role in developing KVDs and performance measures that were being used in planning and control of organizations. Horrigan (1968) gave a historical account of the evolution of ratio analysis from around 1900. According to Horrigan, the Du Pont Company started using the ratio ‘triangle’ that formed the basis of the now famous Du Pont identity from around 1919.

Different approaches such as variance analysis, standard costing, activity-based costing and a variety of profit-based measures have been developed and some are still used in many companies.

The drawbacks of Management Accounting measures were that the measures tended to be highly aggregated focused on the internal operations of the business and were backward looking.

The desire to have value drivers that could be used in real time to control the business and that could also assist in assessing the effectiveness and efficiency of specific arrears such as operations, marketing and human resources resulted in concerted efforts by functions to develop functional sets of value drivers. (Chenhall and Langfield-Smith, 2007).

Chenhall and Langfield-Smith (2007) cited a number of publications that started appearing in the 1980's advocating for the replacement or complementary use of financial measures with non-financial measures. (Johnson and Kaplan, 1987; Howell and Saucy, 1987; Bromwich and Bhimani, 1989 and Berliner and Brimson, 1988)

Functional Approaches to KVD identification

<u>Operations Management:</u>

Operations Management is the function in the business that is concerned with processes of production and is often referred to as manufacturing or production management. Other names such as advanced manufacturing and world-class manufacturing have been used to describe specific approaches to operations management.

The focus of operations management is the achievement of improvements through the more efficient design of production processes and effective control of operations. From a KVD perspective, we can therefore expect to find a majority of efficiency value drivers in the realm of operations management.

A variety of operation management practices and programs proliferated under names such as Total quality Management (TQM), Just-in-time (JIT), Flexible Management Systems (FMS) and so on. Each of these approaches had its own way for identification and tracking of KVDs that encompassed both financial and non-financial measures. Examples of non-financial measures that were popularised by these approaches are; on-time delivery, cycle-time, recycle-rates, product defect rates and others. (Chenhall and Langfield-Smith, 2007)

<u>Marketing</u>

Marketing is everything a company does to acquire customers and maintain relationships with them. Marketing's objective should be to maximize the revenue that the business receives from its relationship with the customers.

Marketing value drivers can focus on the customer, the product or brand and the financial value created.

Defining and measuring customer satisfaction and understanding the link between customer satisfaction, service quality and organizational performance has been studied extensively. (Chenhall and Langfield-Smith, 2007:270)

Brand equity surveys and published lists of brand equity are common in many commercial publications. Brand equity is an intangible-value added aspect of a good or service.

The financial value of a customer relationship can be expressed as a metric called lifetime value of a customer (CLV). CLV is the net profit or loss to a firm from a customer flowing from the lifetime of transactions of the customer with the firm. (Chenhall and Langfield-Smith, 2007:271)

KVDs identified from a marketing function's point of view include drivers for customer satisfaction such as quality and delivery time, drivers for CLV such as margin per product, and drivers for brand equity such as market share and market growth.

Human Resources

Human Resources Management (HRM) has an interest in the identification of KVDs from both the perspectives of business performance measurement and reward and recognition processes.

HRM measures can be identified in any of the traditional HR processes, for example, recruitment efficiency, employees' performance ratings, training and development, employee relations and so on.

Integrated Performance Measurement Frameworks

Integrated performance measurement frameworks were born out of the realization by managers that traditional financial measures were not sufficient to enable them to manage effectively. Attempts to supplement financial measures with functional measures were found to be inadequate mainly because cross-functional effects were not being considered, for example, HRM strategy of improving employee relations by paying above average salaries could negatively affect the cost of production measure from operations management.

The emergence of integrated performance frameworks was aimed at addressing the inadequacy of pure finance measures while at the same time ensuring that there was balance amongst the different non-financial functional measures. The overriding objective was that all the measures that were included in the integrated framework could be linked directly to the business strategy.

Balanced Scorecard

The balanced scorecard was developed and introduced by Kaplan and Norton in 1992 as a tool to articulate, execute and monitor strategy using a mix of financial and non-financial measures. The balanced scorecard uses four perspectives, namely, Financial, Customer, Internal business process and Learning and Growth to translate vision and strategy into objectives and measures for implementation.

According to Mooraj et al, (1999: 482); the primary motivations in developing the balanced scorecard were: Firstly, that top management was being overwhelmed with data and was spending too much time on data analysis instead of making decisions. Secondly, the balance scorecard was an attempt to overcome the bias towards the use of financial measures. The balanced scorecard paradigm was that the financial results are a consequence of successful implementation of strategic initiatives in the key business perspectives.

The balanced scorecard guards against sub-optimisation by forcing managers to consider important measures together. Seeing all the measures together enables them to ensure that progress in one area is not achieved at the expense of another. (Kaplan and Norton, 2006).

The balanced scorecard facilitates the identification of goals and measures in the four perspectives by considering the following question in each perspective:

I. Financial perspective: how does the business look to the shareholders?
II. Customer perspective: How do the customers see the business?
III. Internal business perspective: What must the business excel at?
IV. Innovation and Learning perspective: Can the business continue to improve and add value?

The Performance Prism

The Performance Prism developed by the Centre for Business Performance based at Cranfield School of Management was designed to adopt a broader stakeholder view than the BSC. Whereas the BSC's point of departure is the question: What is the organization strategy and what should the organization be measuring? The Performance Prism asks the question: Who are the stakeholders to whom this organization must deliver value? How important are the stakeholders relative to one another? Who takes priority and what does the organization need to do to satisfy the competing needs of different stakeholders. (Neely, 2004). The Performance Prism considers each stakeholder as a contributor to the business while at the same time recognizing that each stakeholder has requirements to be met by the business.

The performance prism attempts to address the criticism levelled at the balanced scorecard by Atkinson et al (1997:26) that the balanced scorecard failed to:

I. Highlight employee and supplier contributions
II. Identify the role of the community in defining the business context
III. Identify performance measurement as a two-way process, which should enable managers to assess stakeholders' contribution to the business and the stakeholders to assess whether the business is capable of fulfilling its obligations to them.

Mckinsey's 7-S Framework

The 7-S model was developed by the McKinsey & Co consultants as a tool aimed at ensuring that managers address organizational change issues that arise as a result of strategy implementation or other business improvement initiatives. The 7-S framework looks at the key elements that make organizations successful, namely, Strategy, Structure, Systems, Style, Skill, Staff, and Shared values.

1. **Shared values** (also called Super ordinate Goals) refer to what an organization stands for and believes in. This includes things like the long-term vision of the organizations, its charitable ideals, or its core guiding principles.
2. **Staff** refers to the number and type of people employed by the organization.
3. **Skills** refer to the learned capabilities of staff within the organization.
4. **Style** refers to the way things are done within the organization, that is, the work culture.
5. **Strategy** refers to the plans an organization has for the allocation of its resources to achieve specific goals.
6. **Structure** refers to the way in which an organization's business units relate to each other. For example, a company may use a centralized system where all key decisions are made at the head office.
7. **Systems** are the practices and procedures that an organization uses to get things done, e.g. financial systems, information systems, recruitment and performance review systems, etc

Excellence frameworks

There are over 70 national Business Excellence frameworks around the world (Bell, 2002:xix).The frameworks are similar and are based on three foundation frameworks, namely, the American Malcolm Baldridge Quality Award, the European Foundation for Quality Management and the Australian Business Excellence Framework.

Excellence models are self-assessment frameworks that drive continuous improvement. The frameworks are normative in nature and based on actual experience of successful organizations. The drivers of success are organized into criteria against which a company's progress towards excellence is evaluated. The criteria are generally divided into two main groups, namely, the enablers and the results. The enablers assess the organization's approach to doing things and the results measure the extent to which the organization achieves its objectives and the sustainability of the achievement of the objectives. Table 3.2 below gives excellence criteria examples from the FNQ framework (Brazil) and the Malcolm Baldrige framework (USA)

FNQ Framework (Brazil)	Malcolm Baldrige Award (USA)
1. Leadership 2. Strategy and Plans 3. Customers 4. Society 5. Information and Knowledge 6. People 7. Processes 8. Results	1. Leadership 2. Strategic Planning 3. Customer and Market Focus 4. Measurement, Analysis and Knowledge Management 5. Workforce Focus 6. Process Management 7. Results

Table 3. 2 : FNQ and Malcolm-Baldrige Award Criteria (FNQ,2007 and Baldrige National Quality Program,2009)

The excellence frameworks use scoring tables to evaluate companies on three dimensions for each criterion. The first dimension assesses the approach the company uses for each criteria, the second dimension, assesses the extent to which the company has deployed the alleged approach, and thirdly the results of the company are assessed (tend analysis) to ascertain that the performance is improving and sustainable.

This section has examined different approaches for identifying KVDs. Identification of KVDs is an important prerequisite for evaluation of KVDs as a decision support tool in strategy implementation. It is an important part of defining what is to be evaluated.

3.4 Key Value Drivers and Strategy Development and Implementation

Once KVDs have been identified as described in section 3.3.1 above, the next question that can be asked is how does the business use these KVD in order to ensure that the objective of creating value is realized?

KVDs can be used in the following four ways as part of the value creation process:

1. **Planning**

   Planning activities relate to strategies that a business uses to achieve its objectives. Value driver analysis is an important foundation of the strategic planning process. For a given strategy, the understanding of KVDs enable management to focus their attention on the activities that will have the greatest contribution towards the implementation of the strategy and to define key strategic levers that management and employees can use to maximize value.

As a result of the KVD identification process, an appreciation of important measures, measurement processes and expected levels of the results of these measurements can be gained.

The BHP Billiton strategic planning process (CAP) described in section 2.3 above includes a KVD identification step. The KVD identified in a specific planning cycle will be a function of the strategic thrust in that cycle, for example, if the planning were taking place in a high price environment, the strategic thrust would probably be revenue maximization as opposed to cost competitiveness. Under revenue-maximization conditions, the KVDs selected will be reflective of this paradigm, for example, product volumes, delivery lead times, number of new customers and so on. Another way to link particular strategic orientation to KVDs is to categorize KVDs into Growth drivers (focusing on growth rate and operating profit), efficiency drivers (focusing on the use of capital) and financial drivers (focusing on the use and cost of capital).In a high price environment the emphasis will be on growth drivers and in a low price environment the emphasis might shift to efficient drivers. (L.E.K Consulting, 1977)

2. **Co-ordination**

Value is created when the plans resulting from the strategic planning process are executed. In order to execute the plans effectively, the objectives and activities of the individuals and teams that are responsible for the execution ought to be coordinated and aligned.

KVDs can be used as tools to ensure both vertical and horizontal co-ordination. Vertical co-ordination is a process of ensuring that the objectives and actions arising from different levels in the corporation are coordinated. In the case of BHP Billiton Manganese, this entails ensuring that the objectives and activities of the individual Business Units (BUs), the Customer Sector Groups (CSGs) and the BHP Billiton Group are aligned and executed in a coordinated manner. The CAP process by prescription of the planning process attempts to institutionalise vertical alignment. Vertical co-ordination within an individual Business Unit entails the alignment of objectives and activities amongst the individual employee, his team, the department and the Business Unit.

Horizontal coordination within the corporation entails the co-ordination of the objectives and activities of different Customer Sector Groups (CSGs). Within individual CSGs, horizontal co-ordination is amongst different Business Units and within a Business Unit the co-ordination amongst different departments and teams.

3. Monitoring

Monitoring of business or individual performance can be based on the measurement results obtained for KVDs.

Monitoring information identifies (Atkinson et al, 1997):

I. Realized performance levels on each KVD
II. Opportunities for process improvement
III. Whether existing processes are making the expected contribution towards meeting the business objectives, i.e. are they having the expected impact?
IV. Whether the existing processes are achieving their performance potential.

Monitoring enables management to take prompt action when necessary to ensure that the business stays on course to implement its strategy.

4. Diagnosis

The diagnostic role that KVDs can play is in the identification of cause-and-effect relationships between process results. The establishment of the links between tactical activities and higher-level strategic objectives is necessary in order to ensure that the resources of the business are expended effectively. Tactical activities are normally non-financial in nature, whereas higher-level strategic objectives are normally measured in financial terms. The understanding of the cause-and-effect relationships is even more important in instances where integrated performance management frameworks have been adopted.

3.5 Key Value Drivers as a Decision Support tool

The use of KVDs in planning, co-ordination, monitoring or as a diagnostic tool in strategy implementation depends on getting accurate and timely decision-relevant information to the key players in the strategy implementation process. In order to provide decision makers with decision-relevant KVD information we need similar type of architecture as that used in DSS of old. Referring again to the four DSS systems as described by Turban et al (2007:92):

I. **The Data Management Subsystem:** KVD information derived from measurements and the resultant metrics need to be stored in a database. A sophisticated database and database management system software is required to handle large volumes of data may be created over long periods of time.

II. **The Model Management System**: KVDs are seldom used individually. In most instances, they are used as part of a model, for example, a financial accounting model or a plant-processing model. A set of KVD may be used in more than one model at a time. It is therefore necessary to ensure that the model management software will provide access to KVD data for analysis while at the same time ensuring the integrity of the data.

III. **The User Interface System:** Users of KVD information is likely to be located in different locations. In the case of BHP Billiton Manganese, these will be five different locations in Australia and South Africa. Each user would require accessing the information relevant to the decision making required in his role. In order to ensure vertical co-ordination, some of Manganese CSG information needs to be accessible to users in the BHP Billiton Group.

IV. **The Knowledge-based Management System:** This is the system that provides intelligence to augment the users' own intelligence. The knowledge based system will need to mirror the integrated system was used as the basis of KVD identification.

3.6 Chapter Summary

Key Value Drivers are performance variables that drive the value of the business (Copeland et al, 1995:103).

The two important characteristics of KVDs are that they must have a significant impact on value and they must be controllable.

The Agency Model of the firm explains the firms in terms of a contractual relationship between the owners or principals and managers or agents (Lambert, 2007:248). Managers make decisions on behalf of owners with the objective of maximizing the owners' net proceeds from the firm. KVD are important variables that form the basis of the performance-monitoring pact between owners and managers.

Two perspectives of business performance were examined, namely, the Accounting perspective and the Value-Based perspective. The Accounting perspective is based on the use of traditional financial statements, namely the Balance Sheet and the Income Statement to analyse business performance. The Value-based perspective is based on the ideal of maximizing shareholder value and a number of methods have been developed and were championed by VBM practitioners and consultants. Examples of VBM methods are the Free Cash Flow, Economic Value Added and the Cash Flow Return on Investment methods.

There are a number of approaches that can be used to identify KVDs. The traditional Management Accounting approaches such as variance analysis, standard costing and activity based costing. Functional approaches to KVD identification are based on functional models such as those used in Operations Management, Marketing and Human Resources. Integrated approaches to KVD identification were developed to address cross-functional effects of performance management and these include approaches such as: the Balanced Scorecard, The Performance Prism, McKinsey 7-S, and Business Excellence Frameworks.

KVD are used in strategy development, implementation and monitoring. In order for KVD to be used as a decision support tool, a typical DSS architecture as described by Turban et al (2007:92) is required, i.e. a Data Management , Model Management, User-Interface and Knowledge Management Systems.

The use of KVDs requires that the business be equipped to manage the large amount of data that would require storage, retrieval, analysis and communication to other users.

Business Intelligence platforms are one of the means for managing data and information that is used in management decision-making. Chapter 4 examines Business Intelligence and the BHP Billiton BI implementation roadmap.

4 BUSINESS INTELLIGENCE

As discussed in Chapter 3 and subject to the principal-agent problems highlighted management's primary goal is to maximize the value of the firm (Samuelson, 2003:15).However, managers cannot act directly on value and they use KVDs as variables through which they can control the value creation process (Copeland et al, 1995). Questions that arise are: what information do managers need to make decisions and how do we make sure that the relevant information is made available where and when it is required? Stated differently: how do we ensure that relevant information is available to enable management to exercise control over the KVDs in order to impact value creation?

In this chapter, we examine the concept of Business Intelligence (BI) and how it can be used as a hosting environment in order to ensure easy and timely access of KVD information by decision-makers. Alternatively, how the use of the existing BHP Billiton Manganese KVD model as the basis for the BI implementation might enhance value realization from the BI implementation.

4.1 Definitions of Business Intelligence

What is Business Intelligence and how is it different from Business Information?

Krizan (1999:7) quoting Brei (1964) explains the difference between information and intelligence as follows: "Intelligence is more than information. It is knowledge that has been prepared for a customer's unique circumstances." Intelligence can therefore be regarded as information that is provided to the business based on validated business requirements. March and Hevner (2007:1032) went further and drew a distinction between intelligence, in its general sense of information and Business Intelligence. According to March and Hevner (2007:1032), intelligence is "information acquired to aid the purposeful execution of a business process", whereas Business Intelligence refers to "inferences and knowledge discovered by applying algorithmic analysis to acquired information." Business Intelligence is therefore a broad concept that encompasses both the content (intelligence) and the process of producing the content (algorithmic analysis and supporting technology).

Hans Peter Luhn first used the term Business Intelligence System at IBM in 1958 to describe a system whose objective was "to supply suitable information to support specific activities carried out by individuals, groups, departments, divisions, or even larger units". (Luhn, 1958:315). According to Eckerson (2006:45), BI emerged as a distinct function in the early 1990s as a way to provide end-users with better access to information for decision-making. In general, BI is used as an umbrella term that combines architectures, tools, databases, analytical tools, applications and methodologies (Turban et al 2007: 24)

Davenport and Harris (2007:7) defined BI as a set of technologies and processes that use data to understand and analyse business performance.

Williams and Williams (2007:2) started off their definition of what BI is by stating what BI is not. This is a useful approach because in most instances a single aspect of BI is masqueraded as the whole BI concept. According to Williams and Williams (2007), BI is not:

1. A *single product* that can be bought and installed "out of the box"
2. A *technology* although well established technologies such as data warehouses (DW) are critical components on BI systems.
3. A *methodology*, although most successful BI implementations require use of rigorous methodologies such as Williams and Williams' BI Pathway®.

Williams and Williams (2007:2) defined BI as "business information and business analysis within the context of key business processes that lead to decisions and actions".

Gartner Research (2008:48) defined BI as follows:

> "An interactive process for exploring and analysing structured, domain-specific information (often stored in data warehouses) to discern business trends or patterns, thereby deriving insights and drawing conclusions. The business intelligence process includes communicating findings and effecting change. Domains include customers, suppliers, products, services and competitors"

There are many slight variants of BI definitions in literature but the above selection of definitions are meant to illustrate the point that BI, as was the case with DSS, means different things to different people. Both BI and DSS support decision-making and action in a business. However, the key difference is that BI is usually a business –wide undertaking and can support a wide variety of decision- making instances, as opposed to most DSS applications that were problem specific.

The pitfall for most BI implementations is that even in the best-case scenario, BI initiatives must integrate multiple vendors, formats, and standards. The BI systems also need to access heterogeneous data sets, offer support for many different operating systems and accommodate a wide range of client types such as PC workstations, network drives and hand-held mobile devices. (Hennen, 2009:92)

4.2 The Strategic Importance of Business Intelligence

In Chapter 2, we examined the BHP Billiton Group processes and how business processes such as Life-of-Asset Planning, Budgeting, Project Management and Performance Management are integrated through the CAP process. Furthermore, consideration was given to the important role that KVDs play in supporting decision-making in important business processes such as BU Performance Reviews, Business Improvement, Individual Performance Management and Benchmarking studies.

The BHP Billiton BI initiative was launched after it became more and more evident that the availability of accurate information to different decision-makers is a prerequisite for successful execution of all of the above business processes.

Listed below are some of the triggers that led to preliminary investigations on the desirability and feasibility of a BI project in BHP Billiton Manganese.

1. Historical use of KVD information:
   MS Excel Management reports based on KVD have been in use in BHP Billiton Manganese since 2000. A typical BU report is about 25 pages long and each page contains up to 30 lines of data. The pages have metrics grouped functionally (HR, Safety and so on). Each month senior corporate managers have at least 125 pages or 3750 line items of data to review. It became apparent that most of the information contained in these reports was not being used and the quality of the data was deteriorating as time went.

2. Cumbersome month-end reporting process:
   Personnel in the Finance departments at the Corporate Office and the Business Units were spending excessive amounts of time in preparing management reports. BHP Billiton Group reporting deadlines were being missed and the reports contained an unacceptable level of errors. A way had to be found to make the month-end reporting process more efficient.

3. Under-utilization of Finance personnel:

Highly qualified Finance and Accounting personnel were being used to gather and report data rather than to analyse data and provide strategic insight. This situation was causing frustration and motivational problems amongst the employees.

4. Low relevance of Group Business Warehouse (BW) information:
   Although the BHP Billiton Group had a SAP BW in operation for some time, it became evident that most of the information required at group level was not very useful for decision-making at BU level largely due to the high level of data aggregation.

5. Bespoke BU Information System:
   Each Manganese BU was engaged in projects aimed at improving their data utilization. The problem was that there was little co-ordination amongst the BUs and any potential for synergies was being squandered.

The triggers listed above are tactical and operational. This is not unique, most BI initiatives start with the objective of solving what appears to be tactical and operational issues and mature into more strategic issues. Fig 4.1 below illustrates that at tactical and operational levels BI needs are often manifested as access and reporting requirements. As the use of BI in the business increases, higher-level business needs centred on analytical capability of BI become more dominant.

Fig 4. 1: Business Intelligence and Analytics (Davenport and Harris, 2007:8)

The Y-axis in fig 4.1 above is “competitive advantage”, this emphasizes that the ultimate objective of any BI initiative is to improve the competitive advantage of the business. As Sprague (1980:4) puts it: “Improving the performance is the ultimate objective of information systems – not the storage of data, the production of reports or even “getting the right information to the right person at the right time”. The ultimate objective must be viewed in terms of the ability of information systems to support the improved performance of people in organizations”. The strategic objective of BI in BHP Billiton Manganese is to improve the performance of the business by ensuring that each decision-maker in the business has access to correct information, in the correct format at the right time.

The KVDs ensure that decision-makers focus on the significant drivers of business value and thus the resultant decisions that are made are effective. The BI system ensures that the information required in order to use the KVDs is accessible and reliable and that the analysis performed is carried out in an efficient manner. The KVDs and the BI System are therefore complementary for effective (focused) and efficient decision-making.

In Chapter 2 we examined Daft’s (2006) Contingency Decision-Making Framework and superimposed the BHP Billiton’s CAP process on the framework (Fig 2.4). The last three stages of the CAP process, namely, the Five Year Plan, The Two Year Plan and the KPI setting stage are primarily concerned with implementation of the strategy that was developed in stages 1 to 4 of CAP. In these strategy implementation stages, the predominant decision-making approach is the “Rational Approach” for individual and the “Management Sciences” approach for the organization. Both the Rational Approach and the Management Sciences approach are predominantly data or fact based approaches as opposed to being intuitive.

Examining the nature of the questions that BI is concerned with as listed in fig 4.1 above, we also realize that BI need not be a reactive esoteric process based primarily on historical data. BI progresses from the historical perspective of how did we do? To the present perspective of how are we doing? And to the future perspective of how are we going to do? The historical, present and future capabilities of BI enable it to support business review processes (past performance), business control processes (present performance) and business planning and forecasting processes (future performance).

How does BI impact on value creation in the business? The process of identifying areas where BI can impact positively on value creation is analogous to the process of identifying KVDs that was discussed in Chapter 3. BI can be used to support any area of a balanced scorecard or any criteria in a business excellence framework in order to improve business performance.

Howson (2008:2) explained how BI provides business value by adopting an "objective based" approach. She identified the following types of BI by their intended objectives:

1. BI for Management and Control: In this instance, BI provides managers with information on what is going on in the business and where variations exist that require corrective action.
2. BI for Improving Business Performance: BI avails performance indicators that can be analysed to identify improvement opportunities. Improvement may be brought about by launching new initiatives or by stopping existing activities that are destroying value.
3. Operational BI: This might be in process control of primary value-chain processes or in streamlining processes in secondary value –chain activities.
4. BI to make the world better: BI can be used to support decision-making in Health, Safety, Environment and Community initiatives.
5. BI for discovering New Business Opportunities: BI can be used to identify new business opportunities by exploring data and testing new theories, for example, customer purchasing behaviour data can uncover areas that are under-serviced.

Davenport and Harris (2007) classified BI applications based on supported processes. The processes were further classified in terms of whether they were internally or externally focused.

1. *Internal Processes*
    a. Financial:
        i. External reporting to regulatory bodies and shareholders.
        ii. Enterprise Performance Management and scorecards.
        iii. Cost Management
    b. Mergers and Acquisition Analytics.
    c. Manufacturing, Operations and Quality Management.
    d. Research and Development Analytics.

e. Human Resources.

2. *External Processes*

a. Customer Based Processes

i. Attracting and retaining customers

ii. Pricing Optimisation

iii. Brand Management

iv. Converting customer interactions into sales

v. Managing Customer life-cycles

vi. Personalizing customer content

b. Supplier-Facing Processes

i. Connecting customers and suppliers

ii. Logistics Management

Eckerson (2006:48) listed the benefits of BI under two categories, namely, tangible and intangible benefits. Table 4.1 gives examples of BI benefits in terms of Eckerson's classification.

Tangible Benefits	Intangible Benefits
1. Time savings 2. Cost savings 3. Return on Investment 4. New Revenues 5. Total cost of ownership 6. Shareholder value added	1. Single version of the truth 2. Better strategies and plans 3. Better tactics and decisions 4. More efficient processes 5. Greater customer satisfaction

Table 4. 1: Benefits of BI (Eckerson, 2006:48)

Hennen (2009) summarized the benefits of BI as follows:

1. BI turns well-defined data into meaningful information.
2. BI drives operational decisions at multiple levels
3. Existing underused data can be taken advantage of using BI
4. Integrated dashboards can be used to visualize and improve actionable workflow.

The above examples of illustrate that the impact and/or the value of BI can be described in many different ways depending on the business under consideration, but the common theme that runs through all these descriptions is that BI makes information available that can be used to support decision-making required for improved business performance.

4.3 BI Implementation Approach

Implementing BI is a project that needs a rigorous and integrated project management process, as is the case with other complex projects. Trade-offs need to be made amongst cost to implement the project, the time to complete the project and the quality of the project output. A well-developed Body of Knowledge (BoK) for Project Management exists and many countries have specific Project Management codes and quality standards.

Projects in the Information Management field are often executed using the PRINCE methodology .The PRINCE methodology is a customization of general project management practice for use in controlled environments. A typical PRINCE project execution roadmap has the following process stages (Bentley, 2005:7):

1. *Starting Up a Project*: The key issues in this stage are: Are there valid reasons for the project? Who will be responsible for what? What are the customers' expectations?
2. *Initiating a Project:* Key issues**:** Project Planning, Cost-Benefits analysis, Change Control process to ensure that expectations are met, project risk assessment and quality management plan.
3. *Controlling Stage*: The key issues in this stage are: Project progress tracking, Change control and keeping control of products used (configuration management).
4. *Managing Product Delivery:* Issues in this stage are: Project Team plans, Escalation of Issues and Project Team quality control.
5. *Managing Stage Boundaries*: Issues in this stage are: Keeping Project Plan up to date, preparing for next project stages, monitoring the project risk status and the business case.
6. *Closing a Project:* Key issues in this stage are: Ensuring that everything has been delivered, customers are happy, hand-over has taken place and are the project benefits are being realized as envisaged.

Howson (2008:140) described a "Waterfall Development Process" for implementing BI. Fig 4.2 below is a graphical representation of the waterfall project methodology.

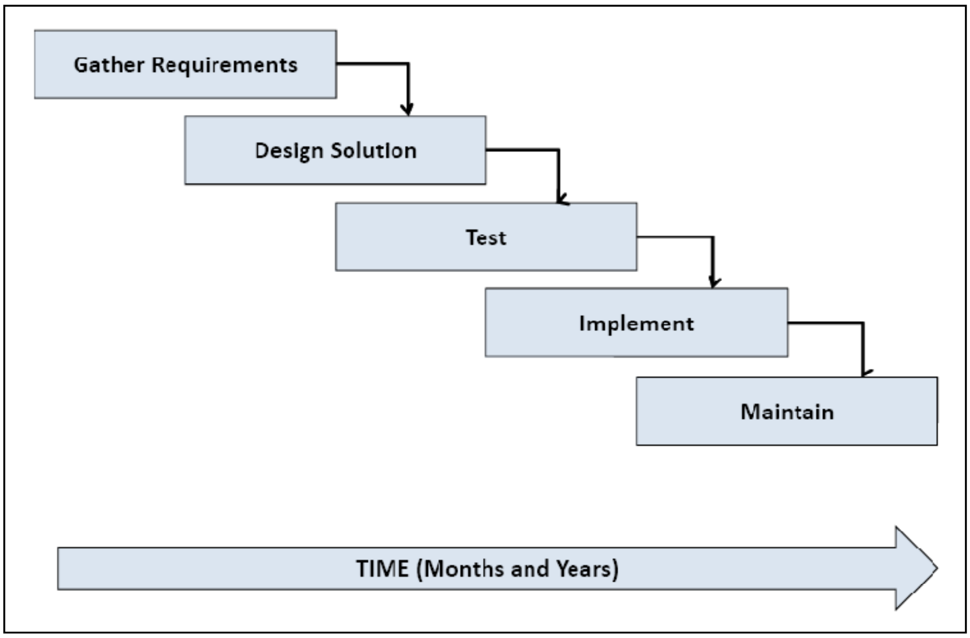


Fig 4. 2:Waterfall Project Methodology (Howson,2008:140)

Project Management methodologies as exemplified above rely on correct determination of the user requirements. Wetherby (1991:52) commenting a study conducted by the MIS Research Centre at Minnesota University made the following observation: "One of the most important revelations about managers and information that has come from research and practice is that *managers don't know what information they need*" (author's italics).

The difficulty in accurately determining user requirements is the key risk in any BI deployment approach. Any deployment approach that is selected should make room for project variations while at the same time ensuring that the project is sufficiently controlled to achieve time and cost targets.

Historically BI implementations, as was the case for Data Warehousing (DW) and other Information Systems projects, focused mainly on the technical aspects of the project. Williams and Williams (2007: 12) pointed out that the recent key innovation in BI implementations has been the use of "business-centric BI methods." These 'business-centric BI methods' extend the established technical methods by "designing ROI (return on investment) into BI initiatives from the outset and systematically drive the use of BI into the core business processes and decisions that determine business results" (Williams and Williams, 2007: 12).

BHP Billiton BI Implementation Roadmap

The implementation roadmap derives from the notion that a BI implementation will cause the business to migrate from some current stage of maturity to a future desired state. At the onset of the BI project, a BI readiness assessment would be conducted to determine the business current maturity and readiness to undertake a BI implementation. In the case BHP Billiton Manganese, Microstrategy Technical Advisory Services (TAS) conducted a readiness assessment in August 2008. After interviews with representatives across different business areas and Information Technology (IT) Units, TAS helped the business to synthesize the "End State" in terms of the following business goals:

1. Alignment of information model with corporate goals to support management review, planning and monitoring and business improvement.
2. Formalization of standard definitions, application of business rules, KVDs and KPIs.
3. Facilitation of timely and flexible access to a unified and single version of Corporate and BU information.
4. Improvement of data quality, accuracy, integrity and relevancy
5. Support of BHP Billiton Manganese Management decision processes.

In addition to the above business goals, IT specific goals were defined to support attainment of above business goals. The IT specific goals were:

1. Supporting the strategic business goal of a single version of Corporate and BU information.
2. Gathering and rationalizing disparate company data in a unified corporate information warehouse.
3. Rationalizing reporting functionality in order to support decision-makers' needs.
4. Implementing a modern BI environment compliant with BHP Billiton Group guidelines and standards.

After senior management accepted the above business and IT goals, the BI project team facilitated the development of a roadmap to move the business to the desired 'End State'.

The BHP Billiton BI Roadmap was made up of two main phases, namely, the BI Asset Construction Phase and the BI Value Realization Phase. The design of the roadmap was partly influenced by Williams and Williams' BI Pathway Implementation Methodology (Williams and Williams, 2007:73)

BI Asset Construction Phase:

The objective of this phase is to deliver the BI infrastructure that will be able to meet the business goals or expectations. This phase is focused largely on BI infrastructure and is driven primarily by the IT Team. Using the Waterfall methodology illustrated in fig 4.2 above, the key features and issues of the BI construction phase are summarized below:

1. Gathering User Requirements:
   The first problem in ascertaining user requirements was that managers did not know what information they required to support their decision-making. The second problem was that most managers adopted a narrow functional or business unit view and found it hard to articulate their needs in the context of a Manganese-wide BI initiative. Thirdly, there are many legacy information systems that are well liked by their present users and there was resistance to the idea that these legacy systems may have to be decommissioned.

2. Design Solution:
   The key issue in this case involved the data warehouse design approach. Whether to adopt a top-down enterprise data warehouse approach or a bottom-up data mart approach. Corporate managers favoured a top-down approach whereas BU managers favoured a decentralized bottom-up approach. The final decision was to have a single enterprise wide data warehouse with the option of creating virtual data marts if required by BUs.

3. Testing:
   Hardware and software testing would be conducted using existing IT protocols. As far as the development and testing of BI dashboards and other general user functionality is concerned, it was decided to follow a prototyping approach. I.e. the users' are involved early on in the development of the dashboards and their comments are incorporated as the design evolves.

4. Implementation:

The BI delivery is by means of a series of individually scoped and managed projects, for example, development of the Marketing dashboard would be scoped and managed as a project with a business sponsor from the Marketing function. A BI Forum was constituted to oversee the planning and prioritisation of the BI project pipeline. The members of the forum were drawn from senior management at the Corporate Office and from the Bus.

5. Maintenance:
   Maintenance of the BI system is the responsibility of the IT function and as infrastructure components are commissioned, they are handed over from the project team to the operational IT team.

BI Value Realization Phase

Although the two phases are distinct from each other, they do not occur sequentially. The question of how will the BI system deliver a return on investment is asked at onset of the BI implementation and as the implementation progresses more opportunities for value creation are identified and logged. Williams and Williams (2007:170-182) listed four critical success factors for BI value realization:

1. Establishing the Value Proposition: There must be alignment between the BI strategy and the business strategy. In the case of BHP Billiton Manganese, it was decided that the KVDs that were identified and reviewed as part of the CAP process should be used as the core of BI dashboards.
2. Establishing and Managing a BI Project: The BI project was led by a Senior Manager in line with the BHP Billiton Project Management Framework. A formal Project Governance structure was put into place. The Senior Manager (Project Director) reported to the Chief Operating Officer of BHP Billiton Manganese in order to ensure project sponsorship at the highest level.
3. Optimising Information Technology Infrastructure for BI: The BI platform vendor (Microstrategy) and an implementation partner provided support on infrastructure design and optimisation. The BI Project Implementation Manager was a senior IT manager who was previously responsible for IT in Manganese CSG, this ensured that there was coordination amongst the corporate office and the different BUs.
4. Managing Organizational Change need to capture value: A Change Management Consultant was recruited and embedded in the project team. The Change

Management Consultant developed a change program that integrated communication, training, user testing and management of change.

Fig 4.3 below is a diagrammatic representation of the 2-Phase BI implementation roadmap for BHP Billiton Manganese.

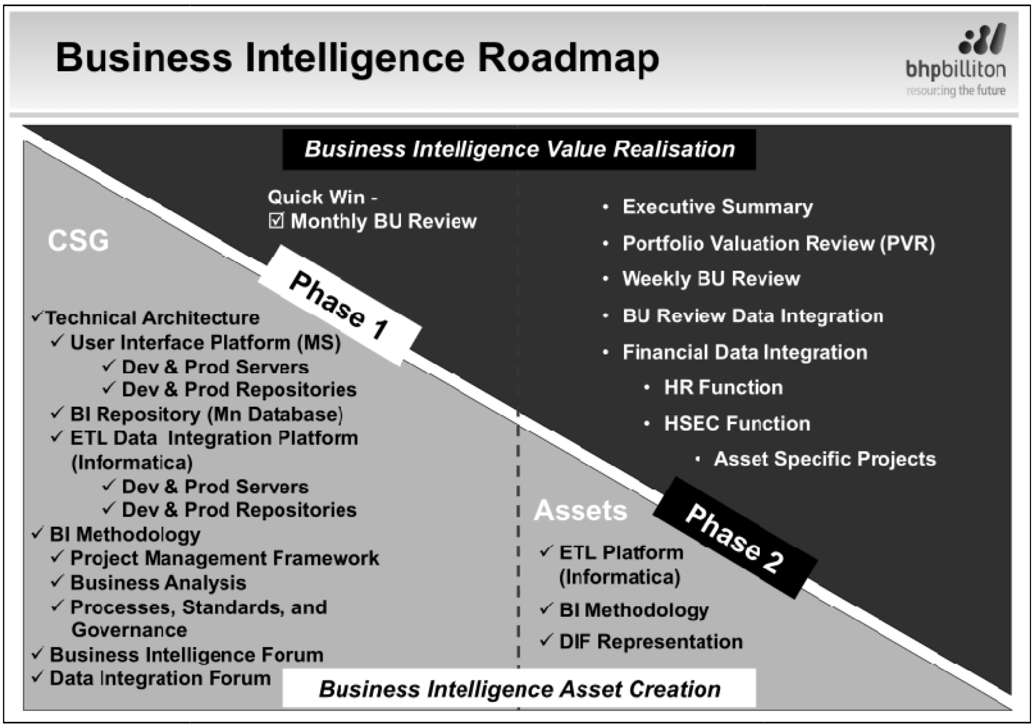


Fig 4. 3: The Two Phases of BHP Manganese BI Roadmap (Author's presentation slide, BHP Billiton, 2009)

4.4 Chapter Summary

There are many definitions of BI that differ in terms of their emphasis on BI products, technology or methodology. Whatever definition of BI is used, there is consensus that the ultimate aim of Business Intelligence is improving business performance by ensuring that decision makers have access to accurate, relevant and timely information they need to make decisions.

Organizations can use BI to support tactical, operational and strategic decisions. The trigger for BI implementation in BHP Billiton Manganese was the requirement to improve the reporting process and as this requirement was being addressed; other operational and strategic requirements began to become apparent. An implementation roadmap was designed to provide a pathway for BI maturity in BHP Billiton Manganese.

The BHP Billiton Manganese BI implementation roadmap is based on what Williams and Williams (2007) referred to as "business-centric BI methods" and the roadmap uses KVDs as the foundation upon which value realization (ROI) can be designed into BI initiatives at the outset. The roadmap integrates BI Asset construction with BI value realization.

The previous two chapters have examined the concepts of decision support systems and key value drivers. This chapter examined Business Intelligence and the BHP Billiton implementation roadmap. The next chapter will examine some of the evaluation approaches that can be used for DSS and other Information Systems. This will indicate if there are evaluation approaches that can be replicated in this study or whether a new evaluation process should be designed.

5 EVALUATION APPROACH

In Chapter 2 we reviewed the history of decision support systems and examined decision support within the context of BHP Billiton Manganese. Chapter 3 reviewed key value drivers and their use in focusing the efforts of decision-makers on variables that are important in achieving the value creation objectives of the business. Chapter 4 looked at Business Intelligence as a strategic initiative that supports access to relevant, correct and timely information required for decision-making.

In this chapter, we review the subject of evaluation in order to examine how key value drivers can be evaluated as a decision support tool in strategy implementation.

5.1 The Concept of Evaluation

What is to evaluate? The dictionary definition of evaluate is: "to form an idea of the amount or value of something."(Oxford Compact dictionary, 2005). That is to assess or appraise something in order to find the amount, degree or value of the object of evaluation.

In traditional Project Management, the success criteria for project execution are; on-time delivery, within approved budget and meeting the stipulated quality standards. In the case of BI implementations (or any information system), performance evaluation continues throughout the life of the asset that was built during the project.

In Information Systems literature, Adelman (1992:187) defined evaluation as a "systematic application of 'explicit and appropriate methods' for making judgments and decisions inherent in system development". Evaluation is therefore a process that generates feedback for system sponsors and developers, as the system is being built to enable them to implement corrections and or enhancements that may be required.

In BHP Billiton Manganese, a BI implementation is underway based on the use of the KVD model as a key decision support tool for strategy implementation and the current evaluation of KVDs as a decision support tool can be regarded as a form of "hypothesis testing". The sponsors' hypothesis at the start of the BI initiative was that "the current KVD model was an effective decision support tool for strategy implementation" and therefore the BI roadmap was designed based on the use of KVDs.

The systematic application of some method in order to make judgments and decisions inherent in system development is not a new concept.

As far back as 1969, John D.C Little (1970:470) in his definition of a 'decision calculus'[11] went further to posit what would make a DSS successful. He stated that a successful DSS would be:

1. *Simple*: Easy to understand
2. *Robust*: Hard to get absurd answers from
3. *Easy to control*: User know what input data would be required to produce desired output answers
4. *Adaptive*: The model can be used as new information is acquired
5. *Complete*: important phenomenon will be included even if they require judgmental estimates of their effect.
6. *Easy to communicate with*: It is easy for the manager to change inputs and the output obtained is also easy to understand.

In 1977, Dickson et al (1977) published a paper on the so-called Minnesota experiments. The objective of the Minnesota experiments was to determine the relationship between the structure of information presented for decision-making and the ensuing effectiveness of the decision and to examine the significance of information system characteristics on the decision activity. Table 5.1 below summarizes what Dickson et al (1977) identified as the independent and dependent variables that impact on information systems development.

[11] Little (1970: 470) defined a 'decision calculus' as a model-based set of procedures for processing data and judgments to assist a manager in his decision making

Independent Variables			**Dependent Variables**
The Decision Maker	The Decision Environment	The Characteristics of the Information System	Decision Effectiveness
Indirectly Acquired Attributes -Aptitudes -Attitudes	**Function** -Finance -Production -Marketing -Personnel -R&D	**Format** -Content -Form -Presentation Media	**Quality** -Cost -Profit -Time
Directly Acquired Attributes -Training -Experience	**Level** -Strategic -Tactical -Operational	**Time Availability**	
	Environmental -Stability -Competitiveness -Time Pressure	**Decision Aids**	

Table 5. 1: Independent and dependent variables influencing Information System Design (Dickson et al, 1977:914)

Kivijarvi (1987) in his study entitled “Implementing Model-Oriented Decision Support Systems” examined what he referred to as the “implementation problem” in DSS implementation. This problem was widely reported in studies indicating that the intended users were not accepting the majority of DSS implementations. Implementation success factors reported by Kivijarvi from his literature survey were: top management support, participation, technical complexity of a system, availability of input data, or manager’s decision style.

Adelman (1992:7) classified DSS and expert systems’ evaluation methods into the following three categories:

1. Logic-based or technical evaluation methods for testing the logical consistency of the rules in the system’s knowledge base.
2. Empirically based methods for testing the predictive accuracy of the knowledge base against the judgmental accuracy of experts or some other measures of accuracy in the field.
3. Subjective based methods, such as issuing questionnaires to assess users’ opinions of the system’s strength and weaknesses.

Subjective based methods were used extensively in field studies that became to be collectively known as Usability Studies. Frokjaer et al (2000) described three aspects of usability based on the International Standards Organization's (ISO) definition:

1. *Effectiveness*, which is the accuracy and completeness with which users achieve certain goals. Indicators of effectiveness include quality of solution and error rates.
2. *Efficiency*, which is the relation between (1) the accuracy and completeness with which users achieve certain goals and (2) the resources expended in achieving them.
3. *Satisfaction*, which is the users' comfort with and positive attitudes towards use of the system.

Adelman and Riedel (1997) examined a number of approaches for evaluating knowledge based and expert systems based on multi-attribute hierarchical methods. These methods are aimed at estimating the overall utility of a system based on a hierarchy of dimensions, criteria and attributes. Adelman and Riedel (1997:35) defined these hierarchical levels as follows:

1. A dimension refers to a general concept such as 'system performance speed' that usually cannot be measured directly but can be broken up into concepts that are more specific. For example, system performance speed can be broken up into data retrieval speed, task completion time and so on.
2. In the example given in point 1 above, data- retrieval speed and task-completion time would be criteria used to define the general dimension of system performance speed.
3. Each criterion can be measured in terms of a more granular concept that is an attribute. For example, the criteria of data retrieval speed can be measured in bytes per second or by some subjective measure obtained from the users.

The hierarchy can be used with some scoring and weighting procedures to obtain an estimate of the overall utility of the system.

Most difficulties with evaluation frameworks and method arise at the attribute-measurement level. Adelman and Riedel (1997:187) summed up these challenges with respect to system performance in three questions:

1. What should I measure to find out if the system improves performance?
2. How do I measure it?
3. What methods can I use so that I can confidently conclude that the system result in better performance most of the time?

In evaluating KVDs as a decision support tool for strategy implementation, similar questions as those posed by Adelman and Riedel (1997) can be asked:

1. What should be measured to find out that KVDs improve decision making for strategy implementation?
2. How should this be measured?
3. What methods can be used to confidently conclude that the use of KVDs will result in better performance most of the time?

5.2 The Process of Evaluation

The questions that should be asked at the onset of an evaluation are:

1. What is the scope of the evaluation? (Or what system is to be evaluated?)
2. What method is to be used?
3. When or what is the period of evaluation?
4. What are the expected judgments or decisions to be made from the evaluation data?

What system is to be evaluated?

The system to be evaluated in this study is the BHP Billiton Microsoft Excel KVD model that was developed over the past five years. This model is being used as the model component of the BI implementation project that is underway.

What evaluation method is to be used?

The evaluation method to be used is mainly a function of what the expected judgments or decisions to be made from the evaluation are. In this instance the key question is whether the KVD do what they are purported to do, namely, they provide BHP Billiton Manganese with relevant, correct and timely information that can be used to make decisions that ensures effective implementation of the strategy. If it is found that the current KVD model is an effective decision support tool for strategy implementation, then the decision to use the KVD model in the BI implementation was justified.

Using Adelman's (1992:7) classification of evaluation methods described above, should the evaluation method be logic-based (technical), empirical or subjective? To answer this question we consider that this evaluation is not happening in isolation. As part of the MS Excel Model development, there were technical evaluations and user acceptance testing to ensure that the developed application met the user specification. As part of the BI project management process, there are tollgates that have to be passed in terms of the BHP Billiton Project Management Procedures that ensure that the components of the system are of the required quality and meet the design specification. The aim of the evaluation in this study is to obtain the subjective evaluation of the KVD models by the users.

When or what is the period of the evaluation?

Evaluation is an on-going iterative process and should be carried out throughout the system development cycle. The current evaluation can therefore be regarded as the base-line evaluation that establishes the evaluation questions and will highlight areas where improvements and or changes might be required. As the BI implementation progresses, more evaluations will need to be conducted to supplement this one.

Adelman and Riedel (1997:9-11) discussed some of the key features of evaluations in the context of information system development:

1. Evaluation is an iterative process consistent with the prototyping approach used in knowledge system development. The prototyping approach is being used in the BI implementation process and the results of the current evaluation will fit into the existing development process. (See BI implementation Roadmap in Chapter 4 section 4.3).
2. Evaluation should involve different users and subject matter experts than those involved in development. In the case of BHP Billiton Manganese, most sponsors and developers are based in the Johannesburg Corporate Office, whereas most of the users are dispersed in the BUs in South Africa and Australia. The current evaluation is the formal process for systematically collecting user feedback on the effectiveness of the KVD models.

3. Reliability and validity are two critical testing concepts for any evaluation. Adelman (1992:186) defines the reliability and validity as follows:
    a. Reliability is demonstrating that the operations of a study can be repeated with the same results.
    b. Validity is demonstrating that the results of the study are well grounded
4. Evaluation is not just testing it is making judgments about what the test results mean. The results of this evaluation are going to be used firstly to confirm an important hypothesis in BI development that KVDs are an effective decision support tool in strategy implementation and secondly are going to be used in designing a future value-realization strategy for the BI implementation. In terms of the BI implementation roadmap in section 4.3 above the results of this evaluation are going to be used in both the BI asset construction phase and the value-realization phase

5.3 Chapter Summary

The evaluation of KVDs as a decision support tool in strategy implementation is aimed at obtaining subjective feedback from BHP Billiton Manganese on the usability of the current MS Excel KVD model and confirming to the BI project sponsors that the use of KVDs as the main model component of the BI system is justified.

The hierarchical multi-attribute approach as described by Adelman and Riedel (1997) can be used as the basis for evaluating the MS Excel KVD model as a decision support tool.

The evaluation of KVD as a decision support tool in strategy implementation using a multi-attribute approach is not sufficient on its own and has to be used in conjunction with other technical evaluations that are required in terms of the BHP Billiton Project Management Procedures. These technical evaluations emphasize the project variables of time and cost.

Chapter 5 concluded the literature review chapters for this study. In Chapter 6, the literature will be synthesised with the objective of developing research hypotheses that can be tested in order to answer the research question.

6 SYNTHESIS

6.1 Literature Synthesis

The primary aim of the research is to evaluate KVDs as a decision support tool for strategy implementation in BHP Billiton Manganese.

As an introduction to the Literature Review, a brief overview of the BHP Billiton Manganese business was undertaken based largely on internal business documentation. The overview discussed the Manganese industry and the position of BHP Billiton as one of the top four integrated producers in the industry. The four Business Units that constitute BHP Billiton Manganese were listed and briefly described. The research takes place in BHP Billiton Manganese and the overview was aimed at providing contextual appreciation of the research sample and the business environment.

In order to undertake the evaluation of KVDs as a decision support tool in strategy implementation, literature on Decision Support Systems (DSS), Key Value Drivers (KVD), Business Intelligence (BI) and Evaluation Approaches was reviewed. Drawing on the reviewed literature on DSS, KVD, BI and Evaluation Approach, the literature is synthesized as follows:

There is agreement in the DSS literature that a DSS is a system that supports managers in decision-making. Power (2003) characterized the decade ending in 1969 as a “decision sciences dominated” period in the definition of DSS, meaning that most authors from this period tended to emphasize the type of decisions that could be supported with DSS. The work of Gorry and Scott-Morton (1971) was cited earlier in the literature review illustrating an attempt to map potential computer support to managerial activity.

The notion of a DSS as ‘support’ rather than replacement for managers in decision-making situations was reinforced by several authors: Ginsberg and Stohr (1982:3) viewed the support of DSS as an “extension of the managers capabilities” but not a replacement of his judgment. Eom and Lee (1990) drawing on DSS publications between 1971 and 1988 identified the fact that DSS support decision-makers rather than replacing them as one of the four key characteristics of DSS.

Literature on the benefits of DSS reinforces the notion that DSS supports managers in decision-making. Money et al (1988:226) having surveyed DSS literature up to 1988 identified classes of DSS benefits such as, clerical benefits, management time utilization and better problem appreciation. These benefits arise from the support role of the DSS. In Mallach's (2000:18-23) categorization of DSS benefits, he also defines categories such as; improving Personal Efficiency and Improving Problem Solving as broad categories into which DSS benefits can be classified. The question on what DSS benefit is most important or desirable depends on the specifics of the business situation as Alavi and Joachimsthaler (1992:97) pointed out: "No single approach to the definition of DSS implementation success currently exist in literature, this construct has been represented in terms of a variety of variables, such as; system use, decision-making performance(decision cost or profit), decision-making time, user satisfaction with the system, user confidence in the decisions and user attitudes towards DSS".

Adelman and Riedel (1997) in their description of the Multi-Attribute Utility Assessment hierarchy for use in evaluating information systems described an assessment dimension called "effect on task performance" which is based on subsidiary criteria of Process Quality[12] and Product Quality[13]. These two criteria capture the essence of the clerical, management time utilization and problem appreciation benefits as described by Money et al (1988) and Mallach's (2000) Personal Efficiency and Problem Solving improvement categories of DSS benefits.

In seeking to evaluate KVDs as a decision support tool for strategy implementation, one of the potential research objectives is *an assessment of the effect of using the current KVDs on the task performance of the users in BHP Billiton Manganese*

The actions of individual managers making decisions in order to perform individual tasks are the basic building blocks of the strategy implementation process. However, this is an oversimplification of what actually happens in the organization. Firstly, managers are most likely to perform their tasks as part of a team and not as individuals. Secondly, the tasks are most likely to occur in groups or clusters that are a part of a larger business process or system. The evaluation of KVDs as a decision support tool for strategy implementation needs to extend to an organizational setting that goes beyond one decision –maker making one decision. Sprague's (1980:6)

[12]In Adelman and Riedel's (1997) MAUA Process Quality consists of six attributes: (1) data quality,(2)explanation capability(3)knowledge representation scheme,(4)problem solving approach,(5)time to perform task and (6)the system's response time.

[13] Product Quality consists of (1) quality of the results generated, (2) Confidence in the products or outputs of the system and (3) overall system effectiveness.

definition of a DSS captures this organizational aspect of a DSS: Sprague (1980) defined a DSS as “a class of information system that draws on the transaction processing systems and interacts with other parts of the overall information system to support the decision-making activities of managers and other knowledge workers in the organization.” This definition brings to the fore two important aspects to be considered in attempting to set evaluation criteria for a DSS. The first aspect is how well the DSS is integrated with other information systems and the second aspect is how well the DSS supports task performance amongst different stakeholders in the organization.

The effect of using KVDs on the task performance of the decision makers can also be considered from the perspective of bounded rationality that was discussed in chapter 2 section 2.2.2. KVDs address the situational factors that lead to bounded rationality by:

i. Reducing decision making variables that individual managers need to consider.
ii. Introducing standardised analysis techniques and consequently reducing time that is required for analysis.

The Process Quality attributes that Adelman and Riedel (1977) define for task performance, such as, quality of the system’s information, problem solving approach, time to perform task and the system’s response time, operationalize the effectiveness of KVDs in addressing factors that contribute to bounded rationality.

The CAP process is the core strategy development and implementation process in BHP Billiton Manganese and we have examined the different decision-making contexts that exist in different CAP sub-processes and analysed these in terms of Daft (2006:469) Contingency Decision Making Model.

Bourgeois and Brodwin (1984) proposed five models that attempted to describe strategy implementation from a process point of view, namely, The Commander, Change, Collaborative, Cultural and the Crescive models. All these five models describe possible relationships amongst the decision makers in the organization. The BHP Billiton Operating Model is aimed at clarifying the delineation of responsibility and accountability amongst, Group, Customer Sector Groups and Business Units. The Operating Model addresses what Bourgeois and Brodwin (1984) refer to as the implementation problem in the Change model. The Change is defined as an extension of the Commander model because strategy (the BHP Billiton Group strategy) is decided at the top of the organization but processes (the Operating Model) are put in place to ensure successful implementation (deal with the implementation problem).

In his framework for development of decision support systems, Sprague (1980) proposed six DSS performance objectives as viewed from a manager's perspective:

1. A DSS should provide support for decision-making, but with emphasis on semi-structured and unstructured decisions.
2. A DSS should provide decision-making support for managers at all levels assisting in integration between the levels whenever possible.
3. A DSS should support decisions that are interdependent as well as those that are independent.
4. A DSS should support all phases of the decision-making process.
5. A DSS should support a variety of decision making processes but not be dependent on any one
6. A DSS should be easy to use.

An assessment of the effect of using the current KVDs on the task performance of the users as suggested above will provide an assessment of the extent to which the BHP Billiton Manganese KVD model meets performance objective No.1 from Sprague's (1980) framework.

Performance objectives 2 to 5 require an assessment of the alignment between the current KVD model and other key Mn business processes. Adelman and Riedel (1997) in their MAUA referred to this as a dimension called "system fit". Under this dimension Adelman and Riedel defined the following assessment criteria as summarized in Table 6.1 below:

Fit with the User	**Fit with the Organization**
1. Fit with the need of the User 2. Fit with training of the User 3. Fit with problem solving approach of the user	1. Fit with core doctrine, e.g. the BHP Billiton Way 2. Other Information Systems 3. Prevailing priorities 4. Prevailing attitudes 5. Organization Structuring

Table 6. 1: Criteria for assessing System Fit (Adelman and Riedel, 1997:249)

Having reviewed literature on DSS, KVD, BI and Evaluation Approaches in information systems and having examined some core strategy development and implementation processes as required by CAP a second possible research objective emerges: *An assessment of the extent to which the Current BHP Billiton Manganese KVD model is aligned with Mn business processes.*

The sixth performance objective proposed under Sprague's (1980) framework for the development of decision support systems concerns the ease of use of a DSS. The DSS should be easy to use. Little (1970:470) included the following requirements for a DSS to be successful: a DSS ought to be easy to understand, easy to control and easy to communicate with.

Frokjaer et al (2000) in defining the concept of system usability, describes User "satisfaction" as the comfort with and positive attitude towards the use of the system.

The acceptance of the KVDs as a decision support tool for strategy implementation depends on "ease of use" of the KVD model experienced by the role players in strategy implementation.

How can we evaluate ease of use?

Adelman (1992:7)[14] classified DSS and expert systems' evaluation methods into three categories, namely, Technical evaluation, Empirical Evaluation and Subjective evaluation methods. Subjective evaluation methods are based on soliciting user feedback using methods such as questionnaires, interviews and so on.

Adelman and Riedel (1997:248) defined an evaluation dimension called System Usability and list the following criteria for evaluating system usability:

i. General ease of use or how easy the system is to operate
ii. Flexibility or the degree of user discretion and user control
iii. Ease of training users on the system
iv. Human factors such as: use of colour, ease of navigation, ease of data entry and so on.
v. Workload the system imposes on the user, for example, is the user required to remember complicated formulae.

[14] See chapter 5.1 for definitions of Adelman evaluation methods categories.

vi. Functional allocation or the extent to which the system performs the functions that the user expects it to perform.
vii. The quality of the user's mental model of the system or the ease with which the user understands the system's layout and features.

The discussion indicates that an assessment of the "ease of use" of the current BHP Billiton Manganese KVD model will provide an indication of the likely adoption and usage of the KVD model. A third research objective can be stated as follows: *An assessment of the KVD system usability or ease of use as experienced by BHP Billiton Manganese Managers.*

Key Value Drivers are defined as performance variables that drive the value of the business (Copeland et al, 1995:105).Literature on KVD focused on three areas:

1. The definition of value and risk from the perspective of the owners and managers of the business and requirement of the owners of the business to assess the performance of the managers of the business and within the business itself supervisors need to assess the performance of subordinate managers (Lambert,2007 and Eisenhardt,1989). KVD are performance variables that are used to set-up the performance goals between the principal and the agent or between the supervisor and the subordinate.
2. KVDs as an integral component of Value Based Management approaches. We reviewed literature of VBM proponents such as Stewart (1991), Rappaport (1986) and Martin and Petty (2000). The proponents of VBM approaches contrasted VBM with traditional accounting based methods of valuation to expose shortcomings of using historical ratios such as EPS, ROE and ROI in business valuation. VBM approaches suggested alternate measures such as Free Cash Flow (FCF), Economic Value Added (EVA) and Cash Flow Return on Investment (CFROI).VBM implementation frameworks are based on identification of KVDs allocation of accountability and monitoring of performance against agreed targets.
3. Identification of KVDs was reviewed in terms of generic criteria for KVD identification and an examination of some frameworks that are used in identifying KVDs.

The following criteria for identifying KVDs were discussed:

i. A KVD should have significant impact on the value creation business.
ii. A KVD should be controllable by management.
iii. A KVD should be measurable.
iv. A KVD should relate directly to the business strategy.
v. A KVD set should be minimal but complete.

Frameworks for identifying KVDs fell into three categories:

i. Management Accounting based frameworks such as Ratio Analysis (Horrigan, 1968) and the Du Pont Identity.
ii. Functional Approaches such as Operations Management, Marketing and Human Resources methods of KVD identification (Chenhall and Langfield-Smith, 2007).
iii. Integrated Performance Management Frameworks such as Balanced Scorecard, Performance Prism, McKinsey 7-S and Business Excellence frameworks.

KVDs have been in use in BHP Billiton Manganese since 2000. The CAP process formalized the incorporation of KVD identification into the planning process and business appraisal process. There have been no previous attempts to test if the current set of KVDs meets the criteria of having significant impact on value-creation and of being controllable by managers. Larmande and Ponssard (2007) surveyed companies that had adopted VBM approaches (mainly EVA) and found that most of these companies did not realized anticipated benefits largely because EVA performance objectives were not controllable by managers. Most performance objectives were found to have significant impact on value.

The evaluation of KVDs as a decision support tool for strategy implementation in BHP Billiton Manganese will be incomplete if we do not confirm that the current set of KVDs are indeed true drivers of business value and that management perceive these KVDs to be controllable. We can therefore add two further research objectives to the three already suggested:

Fourth research objective: *an assessment of the extent to which the current set of Mn business KVDs are perceived to have an impact on value creation.*

Fifth research objective: *an assessment of the extent to which managers perceive the current set of KVDs to be controllable.*

Sixth research objective: *a review of the research literature in the light of empirical findings that will result from the above five research objectives, in order to ascertain whether the empirical findings support or conflict findings from reviewed literature.*

6.2 Research Theory, Aim, Objectives and Hypotheses

The **research theory** can be stated as follows:

Key Value Drivers are an effective decision support tool for strategy implementation in BHP Billiton Manganese.

The research is concerned with BHP Billiton Manganese as a single business and there was no expectation that there will be literature focusing on BHP Billiton Manganese KVDs. However, the research theory was partly based on observation of current practice in the business where management has designed key processes (such as CAP and the Business Appraisals) and systems (Business Intelligence) on the basis of existing KVDs. If this research falsifies the theory, BHP Billiton Manganese will be facing potential negative impacts resulting from processes and systems designed on the basis of an incorrect theory.

The **research aim** is:

To examine whether Key Value Drivers are an effective decision support tool for strategy implementation in BHP Billiton Manganese.

The research objectives are:

1 To examine the effect of use of KVDs on task performance of BHP Billiton managers.

2 To examine the alignment (or good system fit) between the current KVD model and other BHP Billiton Manganese business processes.
3 To examine the extent to which the current Microsoft Excel KVD model is easy to use, i.e. that the system has high usability.
4 To examine whether current KVDs have a significant impact on value creation in BHP Billiton Manganese.
5 To examine whether current KVDs are perceived by BHP Billiton Manganese managers to be controllable.
6 To review the research literature on which the above research objectives were based in the light of the empirical findings of this research in order to ascertain whether the empirical findings support or conflicts findings from reviewed literature.

Following from the above research objectives the following **research hypotheses** were formulated:

Research hypothesis 1:

H_0: The use of KVDs has a positive effect on the task performance of BHP Billiton managers.

H_1: The use of KVDs does not have a positive effect on the task performance of BHP Billiton managers.

Research hypothesis 2:

H_0: The current KVD Model is aligned with other BHP Billiton Manganese business processes.

H_1: The current KVD Model is not aligned with other Mn business processes.

Research hypothesis 3:

H_0: The current Microsoft Excel KVD Model is easy to use or has a high degree of usability.

H_1: The current MS Excel KVD Model is not easy to use or does not have a high degree of usability.

Research hypothesis 4:

H_0: The current KVDs have a significant impact on value creation.

H_1: The current KVDs do not have a significant impact on value creation.

Research hypothesis 5:

H_0: The current KVDs are controllable by managers.

H_1: The current KVDs are not controllable by managers.

Research hypothesis 6:

H_0: The empirical findings of this research support literature review findings.

H_1: The empirical findings of this research do not support literature review findings

6.3 Chapter Summary

In this chapter, the literature reviewed on Decision Support Systems, Key Value Drivers, Business Intelligence and Evaluation Approach was synthesised.

Based on the literature reviewed and synthesised the research theory, aim and six research hypotheses were developed.

In the next chapter, the research strategy will be developed and the methods required to implement the strategy will be identified.

7 RESEARCH DESIGN AND METHOD

7.1 Introduction

The question that this research seeks to answer is whether KVDs are an effective decision support tool for strategy implementation in BHP Billiton Manganese or not. The first step in attempting to answer this question was to conduct a literature review covering the following topics: Decision Support Systems, Key Value Drivers, Business Intelligence and Evaluation Approaches for DSS. The review of published literature in the aforementioned areas together with the review of BHP Billiton procedures provided the context in which the research takes place. The usefulness of this contextualization is that, firstly, concepts such as DSS, KVD, and BI were described and their relevance to strategy implementation examined. Secondly, the synthesis of literature culminated in generation of a number of hypotheses that can be tested in order to answer the above research question.[15]

The next stage following the development of research hypotheses is developing a research strategy that will enable the collection of data that can be used to test the hypotheses. This chapter covers the development of the research strategy and the selection of the research method that will be used for conducting the research.

7.2 What is to be tested? (Hypotheses and Measure Variables)

7.2.1 Research Hypotheses

Six hypotheses were generated during the literature review process:

Research hypothesis 1:

H_0: The use of KVDs has a positive effect on the task performance of BHP Billiton managers.

H_1: The use of KVDs does not have a positive effect on the task performance of BHP Billiton managers.

Research hypothesis 2:

H_0: The current KVD Model is aligned with other BHP Billiton Manganese business processes.

[15] In the Research Proposal, the Literature Review leading up to the generation of hypotheses was referred to as the "framing" stage. The output of this stage is concepts and categories of concepts that can be used in framing questions for further research (Strauss & Corbin, 1998)

H_1: The current KVD Model is not aligned with other BHP Billiton Manganese business processes.

Research hypothesis 3:

H_0: The current MS Excel KVD Model is easy to use or has a high degree of usability.

H_1: The current MS Excel KVD Model is not easy to use or does not have a high degree of usability.

Research hypothesis 4:

H_0: The current KVDs have a significant impact on value creation.

H_1: The current KVDs do not have a significant impact on value creation.

Research hypothesis 5:

H_0: The current KVDs are controllable by managers.

H_1: The current KVDs are not controllable by managers.

The sixth research hypothesis is aimed at reviewing the findings generated for the above five research hypotheses in order to ascertain whether the findings support or conflict the reviewed literature. This hypothesis will not be considered further until results for the above five hypotheses have been generated and analysed, only then will the reviewed literature be revisited in order to test hypothesis 6.

Before proceeding with research design and method selection, we examine the research hypotheses in order to ascertain whether they are suitable as a basis for further research.

Gravetter and Forzani (2006:25) suggested the following four elements that are important characteristics of good research hypotheses.

1. **Logical**: A good hypothesis should be founded on established theories or developed from the results of previous research.
2. **Testable**: A testable hypothesis is one where all of the variables, events and individuals are real and can be defined and observed.
3. **Refutable**: A refutable hypothesis is a hypothesis that can be demonstrated to be false.

4. **Positive:** A testable hypothesis must make a positive statement about the existence of something, usually the existence of a relationship, a difference or an effect.

All the research hypotheses generated were based on previous research and theories that were examined during the literature review. The hypotheses are also logically connected to the research question posed, the results of testing each of these hypotheses will generate information that can be used to improve business processes linked to KVDs, and strategy implementation is BHP Billiton Manganese.

The issue of testability and refutability will be considered further in developing specific measurement variables to be used in the research. What can be said at this stage is that because the hypotheses are based on previous research and all the “concepts” used are not imaginary it is very probable that the hypotheses will meet the requirements for testability and refutability.

All the hypotheses are positive because they posit the existence of some relationship or effect.

7.2.2 Measurement Variables

An examination of the generated hypotheses reveals that none of the hypotheses contains variables that can be measured directly. Examples of variables that can be measured directly are mass in kilograms, time in seconds and so on. The generated hypotheses consist of intangible and abstract attributes such as task performance, usability, alignment, value impact and controllability. None of these attributes can be observed or measured directly in order for the hypotheses to be tested.

In order to measure these hypothetical attributes we need to generate operational definitions of the attributes. An operational definition is a procedure for measuring and defining a construct[16] (Gravetter and Forzano, 2006:65).

It is not necessary to develop new operational definitions in every research design and as Gravetter and Forziano (2006:66) point out the “best method of determining how a variable should be measured is to consult previous research involving the same variable”.

[16] A construct is a hypothetical attribute that helps explain and or predict some immeasurable attribute in a theory, for example, employee motivation is a construct that is not directly observable but can be used to explain employee behavior in a theory.

Operationalization of hypotheses 1, 2 and 3 was performed based on a questionnaire for evaluating utility and usability of decision-aiding systems developed by Adelman and Riedel (1997:244). Adelman and Riedel's (1997) questionnaire was developed following a five-step process:

1. Identification of different attributes of usability defined in literature.
2. Combination of usability attributes into broader usability concepts that were used to create a Multi-attribute Assessment hierarchy (MAUA).
3. Development of two or more questions for measurement of each bottom level attributes.
4. Piloting the questionnaire to ensure content validity and demonstrate good psychometric characteristics.
5. Further refinement to ensure that the questionnaire was usable for different decision-aiding systems and possessed good psychometric characteristics.

Hypothesis 1

H_0: The use of KVDs has a positive effect on the task performance of BHP Billiton managers.

H_1: The use of KVDs does not have a positive effect on the task performance of BHP Billiton managers.

The construct that requires Operationalization is "task performance". Adelman and Riedel's (1997) defined two criteria for "task performance", namely, Process Quality and Product Quality.

Six attributes were defined for Process Quality, namely:

1. Quality of the system's information.
2. Explanation capability.
3. Knowledge representation scheme.
4. Problem-solving approach.
5. Time to perform task.
6. The system's response time.

Three attributes were defined for Product Quality, namely:

1. Quality of the results generated using the system

2. Users' confidence in the results obtained using the system
3. Cost-effectiveness or efficiency of the system

One or more questions were developed for each of the above attributes to be asked to the users of the system. Appendix 8.4 gives a list of the questions that were developed for BHP Billiton Manganese.

Hypothesis 2

H_0: The current KVD Model is aligned with other Mn business processes.

H_1: The current KVD Model is not aligned with other Mn business processes.

The construct that requires Operationalization is "alignment" or "system Fit". Adelman and Riedel (1997:249) defined two criteria for alignment, namely, "Fit with the User" and "Fit with the Organization".

"Fit with the User" has three attributes:

1. Matching the needs of the user
2. Matching the training that the user was given
3. Matching the problem-solving approach of the user.

"Fit with the Organization" has five attributes:

1. Match with the organizational doctrine, for example, the BHP Billiton Way[17].
2. Fit with organizational structuring
3. Effect on information flow.
4. Effect on other people's workload
5. Attitude of others towards the system.

More questions were developed for each attribute as listed in appendix 8.4.

Hypothesis 3

H_0: The current MS Excel KVD Model is easy to use or has a high degree of usability.

[17] The BHP Billiton Way is a collective noun given to the BHP Billiton Operating Model and Philosophy.

H_1: The current MS Excel KVD Model is not easy to use or does not have a high degree of usability.

"Easy to use" or Usability is the construct that requires Operationalization in hypothesis 3. Adelman and Riedel (1997:248) defined seven criteria for assessing usability:

1. *General ease of use,* which is how easy it is to operate the system.
2. *Flexibility*, which is the degree of user discretion and user control.
3. *Ease of training*, which is the easiness with which the system can be learnt.
4. *Human factors guidelines*, which is the extent to which the system follows normative human-computer interface tenets.
5. *Workload* that the system imposes on users.
6. *Functional allocation*, which is a measure of the degree to which activities allocated to the machine are appropriate for the system to do.
7. *Quality of the user's mental model* of the system, which is defined in terms of how easy it is for the user to understand the system layout and features.

Three attributes were defined for ease of training:

1. Learnability.
2. On-line help functions.
3. System documentation.

Seven attributes were defined for Human factor guidelines:

1. Consistency.
2. Error prevention.
3. System navigation.
4. Use of colour.
5. Ease of data entry.
6. System Feedback
7. Reliability

Two attributes for workload are:

1. Strain, which is the amount of physical and mental pressure that the system imposes on the user.

2. Memorization, which is the amount of information the user need to remember in order to operate the system.

For each attribute, one or more questions were developed as listed in appendix 8.4.

Hypotheses 4 and 5

In the case of hypotheses 4 and 5, the list of KVDs that are being used in BHP Billiton Manganese were given to the users and the users were asked to rate them on the basis of their perception of what the KVD impact on value creation is and the extent to which they feel management has control over the KVDs. This process was based on a method that L.E.K Consulting (2007) had used in assisting their client to identify true drivers of value in their businesses.

Having re-examined the hypothesis that were generated during the literature review and having defined some variables that can be observed and measured, the next step is selection of an appropriate research method that can be used to collect data that can be used for testing the generated hypotheses.

7.3 Research Method

7.3.1 Sampling Method Selection

The evaluation of KVDs as a decision support tool for strategy implementation is taking place in one sample, namely, BHP Billiton Manganese. Within this one sample, it is however necessary to identify and delineate individuals that are potential participants in the research, i.e. individuals who should be asked to answer questions as contemplated in section 7.1 above.

In research methodology, a population is usually defined as the entire set of individuals of interest to a researcher (Gravetter and Forzano, 2006: 177). However cases of interest to the researcher need not always be individuals, it can be companies, products and so on (Saunders et al, 2003: 151). In this research, the population is made up of BHP Billiton employees that are responsible for decision making in strategy implementation. Within this population, we can define a target population[18] made up of those employees that are responsible for decision-making in strategy implementation and are users of the current KVD model.

[18] A target population is a group defined by the researcher's specific interest (Gravetter and Forzano, 2006:118)

Sampling methods are grouped into two main categories, namely, probability and non-probability sampling. The selection of a specific sampling method is determined by the circumstances of the research, such as, the research objectives, orientation, resource-availability and population characteristics. Fig 7.1 is a graphical summary of sampling techniques.

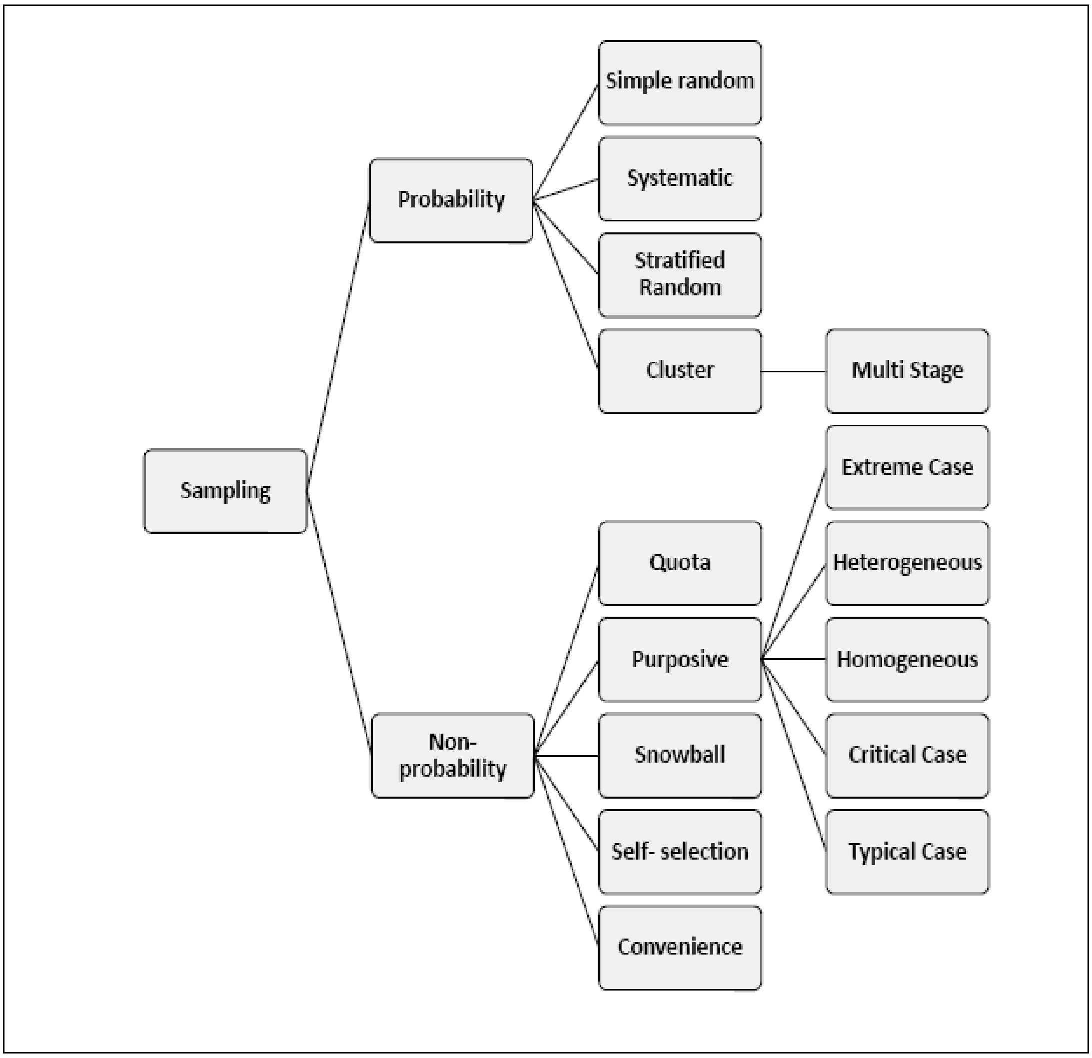


Fig 7. 1: Sampling Techniques (Saunders et al, 2003:153)

Saunders et al (2003: 171) provided a sequential set of questions that can be asked in order to select an appropriate sampling technique. Following the scheme of Saunders et al (2003: 171), the situation pertaining to this research can be summed up as follows:

1. It is extremely difficult to collect data from the entire population and we therefore need a sampling procedure.
2. The main objective is not to make statistical inferences about the population but to describe and to a limited extent explain how KVD are effective decision support

tool for strategy implementation in BHP Billiton. There is therefore no need for Probability Sampling.

3. There are further constraints that need to be taken into account in deciding what kind of non-probability sampling would be appropriate:
    a. The total number of manager and superintendent level employees is small varying between120 and140. This inevitably results in a small sample size.
    b. It is not possible to define clear criteria for representativity, except to say the selected individuals should be users of the KVD model and be decision-makers in strategy implementation.
    c. The focus of the study is mainly description of key themes regarding the research question and to a limited extent offers explanations for observations.

Based on the sampling conditions described above the most appropriate sampling technique will be a heterogeneous sample of the target population. Saunders et al (2006) define heterogeneous sampling[19] as a "purposive sampling method, which focuses on obtaining the maximum variation in the cases selected." In the case of this research, this means that participants were deliberately selected from all the business units, from different departments and functions and across organizational levels, the requirements for selecting respondents were that they were users of the KVD model and were decision-makers in strategy implementation.

7.3.2 Research Method Selection

According to Saunders et al (2006: 90), a research strategy is a general plan of how we intend to answer the research question. Analysis of the generated hypotheses and the variables that require to be measured in order to test the hypotheses was the first step of the research strategy development. Now that we understand what is to be tested the next step is to consider the data sources and data collection methods that will enable us to collect the necessary data to answer the research questions.

Different authors adopt different classification preferences for research strategies; for example, Saunders et al (2006:91) list the following as the main research strategy types: Experimentation, Surveys, Case Study, Grounded Theory, Ethnography, Action Research,

[19] Definition obtained from glossary of terms available on the on-line book-site: WWW.booksites.net/saunders

Cross-sectional/ Longitudinal studies and Exploratory, descriptive and explanatory studies. Gravetter and Forzano (2006:138) list research strategies as being: Experimental, Quasi-experimental, Non-experimental, Correlational and Descriptive.

Research Validity

Regardless of the strategy classification scheme adopted, the requirement is that the research strategy should answer the research question. The validity of a strategy is the degree to which the strategy answers the research questions posed (Gravetter and Forzano, 2006:139). The issue of validity is central to the selection of the research method to be used in whatever research strategies are selected.

There are two kinds of validity, namely, internal and external validity. According to Gravetter and Forzano (2006:140), a research study is said to have internal validity if it produces a single, unambiguous explanation for the relationship between two variables. In the case of this research, the issue of internal validity arises in two ways:

1. Will the test results on the hypotheses unambiguously demonstrate that KVDs are an effective decision support tool to strategy implementation in BHP Billiton Manganese?
2. Will the measurements on the identified variables or answers to evaluation questions asked enable us to unambiguously confirm or refute the hypotheses?

The way in which these two threats to internal validity were addressed was to rely on previous and published research in developing the hypotheses and the necessary variables for testing the hypotheses.

External validity refers to the extent to which we can generalize the results of a research study to people, settings, times, measures and characteristics other than those in the study (Gravetter and Forzano, 2006:140). This study is concerned with BHP Manganese only and the most important generalization that is required is that the results of the study should be applicable to the whole of BHP Billiton Manganese. The key threat to external validity of the research is that the assumption that prior research that was used to generate hypothesis and measurement variables is applicable to the BHP Billiton Manganese situation.

Data Collection Method

The selection of a data collection method is dependent on the requirement for validity as discussed above and on what data sources are available. Table 7.1 below is a classification of data sources that are usually available.

CATEGORY	EXAMPLES
Observation	Systematic observation under controlled experimental or laboratory conditions
	Participant observation in natural field settings
Self-Reporting	Personal and group face-to-face interviews
	Telephone interviews
	Mail and electronic surveys
Archival/Documentary Sources	Historical documents, diaries, letters, speeches, literary texts, narratives, memoranda, business plans, annual reports and so on.
Physical Sources	Blood samples, cell tissue, chemical compounds, materials etc

Table 7. 1: A classification of data sources (Mouton, 2005:99)

Except for Physical Sources of data as described in table 10 above all three categories of data sources were considered for this research.

Observation: Systematic observation under controlled experimental conditions was considered inappropriate largely because strategy implementation decisions do not occur under controlled conditions but mainly in the course of day-to-day business operations. Observation of participants in field settings is a possible data collection method for this study but its main drawback would be the cost (financial and time) to cover the four business units in Africa and Australia.

Self-Reporting: Personal and group face-to-face interviews were also considered unsuitable because of the possible cost. Although telephone interviews, mail and electronic surveys are all feasible data collection methods from a financial cost point of view, telephone interviews with a large number of participants in different time zones would pose serious scheduling challenges. The target population is comprised of people who are computer literate and have access to email. This makes email a more efficient and cost effective method of administering a survey compared to mail.

<u>Archival / Documentary Sources</u>: This data source was used in identifying current KVDs and understanding the strategy development and implementation process in BHP Billiton Manganese. This source is also important should actual operational data be necessary to verify any of the results obtained from the electronic survey.

The primary data collection method selected is an electronic survey that will be conducted amongst managers and superintendents in BHP Billiton Manganese. No data-collection method is without shortcomings. Saunders et al (2006:92) listed some of the shortcomings of surveys, for example, the surveys may not be as wide-ranging as other research methods, there is a limit to the length of questionnaires that can be used and the respondents work independently and may do the questionnaires badly. In designing a deployment approach for the selected data collection methods these shortcomings need to be taken into consideration.

In addition to the survey data collection method two supplementary data collection methods are to be used, namely, archival search and personal face-to- face interviews with selected top BHP Billiton Manganese managers.

7.4 Survey Data Collection

The aim of this section is to describe how the selected data collection method, namely, electronic survey of a heterogeneous sample of managers and superintendents, was implemented.

7.4.1 Survey Software:

The selected survey hosting service was SurveyMonkey. SurveyMonkey is a web based electronic survey tool that is accessible by subscription. SurveyMonkey was selected because it had been used previously in BHP Billiton and the researcher and respondents would be familiar with its usage.

7.4.2 Survey Questionnaire Development

Survey questionnaire development was carried out in a three-step process:

1. A draft questionnaire was developed.

2. The draft questionnaire pretested by distribution to a selected number of respondents
3. A final questionnaire was developed incorporating feedback from pretesting

Draft Questionnaire

The draft survey questionnaire was divided into three sections:

Section 1: Demographic Data

The respondents were asked to provide the name of their Business Unit and their organizational level. These two questions were multiple-choice questions allowing the respondents one choice per question. The third demographic information question was optional and required the respondent to provide their name if they were willing to participate in a lucky draw for a prize.

Section 2: Assessment of KVDs impact on value-creation and level of controllability

In this part of the questionnaire the respondents were asked to rate, each of 54 KVDs with respect to its impact on value creation and the extent to which management can exercise control over the KVD. The question type used was a matrix of drop down menus as illustrated in Table 7.2 below:

Impact on value	Management Control
0-25 %	0-25 %
26-50 %	26-50 %
51-75 %	51-75 %
76-100%	76-100%

Table 7. 2: Drop-down menus for rating KVDs

The respondents would rate the KVD by selecting a row in each of the two columns that represents his perception.

The aim of this section of the questionnaire was to collect data that could be used for testing hypotheses 4 and 5:

Research hypothesis 4:

H_0: The current KVDs have a significant impact on value creation.

H_1: The current KVDs do not have a significant impact on value creation.

Research hypothesis 5:

H_0: The current KVDs are controllable by managers.

H_1: The current KVDs are not controllable by managers.

Section 3: Assessment of KVD model based on Multi-Attribute Utility Assessment Questionnaire (MAUA)

Seventy-four questions were developed based on Adelman and Riedel's (1977:244) MAUA questionnaire for evaluating decision-aiding systems.

In this section, the respondents were asked to rate statements regarding individual KVDs and the current Microsoft Excel based KVD model on a scale of 1-7 indicating their agreement/disagreement with each statement.

Section 3 of the questionnaire was aimed at collecting data for testing hypotheses 1, 2 and 3.

Research hypothesis 1:

H_0: The use of KVDs has a positive effect on the task performance of BHP Billiton managers.

H_1: The use of KVDs does not have a positive effect on the task performance of BHP Billiton managers.

Research hypothesis 2:

H_0: The current KVD Model is aligned with other Mn business processes.

H_1: The current KVD Model is not aligned with other Mn business processes.

Research hypothesis 3:

H_0: The current MS Excel KVD Model is easy to use or has a high degree of usability.

H_1: The current MS Excel KVD Model is not easy to use or does not have a high degree of usability.

Pretesting of Questionnaire

The objective of the pre-testing stage was to refine the questionnaire in order to ensure that respondents would not experience unnecessary problems in answering the questions and to ensure that the responses were collected in a format that was usable for subsequent analysis.

An email containing a web link to MonkeySurvey was sent to 11 BHP Billiton Manganese employees with a request to complete the questionnaire and provide feedback on the following points:

1. Clarity of instructions for completing the survey
2. Does the survey contain any typing errors?
3. Are all questions relevant and acceptable?
4. Structure of the survey (questions, pages and navigation)
5. Effort and time to complete the questionnaire.
6. The MonkeySurvey tool
7. Any other comments

Five of the eleven respondents completed the survey.

Final Questionnaire

Based on the feedback from the five respondents to the pre-test, the following changes were implemented to the draft survey:

1. The covering email that was to be used to distribute the link to the questionnaire should make specific mention that it is the MS Excel based model that was being rated not any Business Intelligence prototypes that the respondents might have come into contact with.

2. The question type for section 2 was changed from a “matrix of drop-down menus” to a 7-point rating scale as for section 3. This reduced the number of computer mouse-clicks required to complete the total questionnaire by 33 % and made the type of data collected similar for all questions linked to the research hypotheses.
3. A fourth section, asking for any KVDs that in the opinion of the respondent were omitted was added. The comment field was also included under this section.

7.4.3 Questionnaire administration

The main concern in administering the questionnaire was to obtain as high a response rate as possible from the heterogeneous group of 90 managers and superintendents from the four BHP Billiton Manganese BU’s.

The following actions were taken in order to increase the response rate:

1. An email was sent to forewarn the respondents about the impending survey. This email also gave the assurance that the BHP Billiton Manganese top management has agreed to the research being conducted.
2. Individual emails were sent to each of the respondents with the survey link.
3. An email reminder was sent to all respondents a week before the survey closed.
4. A prize of an iPod was offered for those who opted to participate in the lucky draw.

Individual emails with the survey link were distributed on 16 November 2009 and the survey was closed on 15 December 2009.

7.5 Archival Search

The objective of this data collection method is to peruse BHP Billiton Manganese historical business documents in order to confirm that the results obtained from the electronic survey are aligned with what happens in the business.

Three main groups of documents were considered:

1. **BHP Billiton Operating Model**: These are policies, procedures and standards that are mandatory throughout BHP Billiton. The Operating model documents

specify what the Customer Sector Groups (such as Manganese) deliverables are and the delegation of authority from top to bottom in the Group.

The BHP Billiton Operating Model documents were sourced from the Operating Model Project Documentum e-room™. The database contains 21 Policies, 45 Procedures and 43 Standards.

2. **Manganese CSG Strategy Development and Implementation:** These are records and results of various CAP linked activities as carried out in the Manganese CSG.

   The documents were sourced from the Manganese Strategy and the Business Intelligence Project e-room™ .

3. **Manganese BU Management Reports**: These are operational reports that are used internally in BHP Billiton Manganese to monitor operational performance and strategy implementation progress.

   BU Management Reports were sourced from the legacy SAP Business Warehouse and saved in a portable computer drive.

7.6 Face-to-face Interviews

There were two objectives of this data collection method:

1. The first objective was to confirm that the concepts and categories of concepts that were used in the survey are similar to those that management uses in strategy implementation discussion.
2. The second objective was to obtain managers comments on the survey process and the preliminary results obtained.

Interview Sample

Interviews were conducted with eight selected managers from the BHP Billiton Manganese Corporate Office in Johannesburg who are senior managers and/or Functional leaders. These are the people who are responsible for signing off strategy documents and reports that are submitted to BHP Billiton Group.

Interview Method

The semi-structured interview method was selected based on the following considerations:

The strengths of the semi-structured interview methods are:

1. Easy to build positive rapport between interviewer and interviewee and it may be possible to make observations concerning immeasurable things such as feelings, emotions and body language.
2. People are able to talk about issues in detail and in depth.
3. Complex issues can be discussed. The interviewer is able to probe areas suggested by the interviewee’s responses.
4. With a few pre-set questions, the interviewer is not pre-judging what information is important or not.
5. It is easy to record the interview, for example, audio recordings were made in this instance.

There are some disadvantages for this method, for example,

1. The interviewer may give unconscious signals that may affect the interviewee’ responses.
2. The method may be time consuming.
3. The information obtained may be difficult to analyse particularly because the answers may be non-standardized.
4. It may be difficult to generalize from the interview results.

Implementation of interview method

Interview appointments were set-up with individual managers using MS Outlook.

An interview pack was sent by email to each interviewee in advance (Appendix 7.1). The pack comprised of a basic question set and a Mn KVD list generated from the survey results. The interviews were conducted at the BHP Billiton Johannesburg offices and the duration varied between 30 and 45 minutes. Audio recordings of the interviews were made.

7.7 Chapter Summary

This chapter covered the development of a research strategy for collecting data that could be used in the testing of research hypotheses that were developed during the Literature Review stage.

The following three data collection methods were selected:

1. An electronic survey questionnaire distributed to 90 Managers and Superintendents who are the traditional users of the Manganese KVD Model. The survey is to be used to collect subjective evaluation data on the existing KVD model used in Manganese.
2. A review of BHP Billiton Manganese archives aimed at ascertaining the extent of KVD usage in the business.
3. Interviews with BHP Billiton top Management to check whether the concepts used to design the questionnaire are aligned with concepts used by management in strategy development and implementation.

The results that were obtained using the above three methods are going to be presented and analysed in the next chapter (Chapter 8).

8 RESULTS AND ANALYSIS

8.1 Introduction

Six research hypotheses were developed in order to meet the research objectives that are necessary for evaluation of Key Value Drivers (KVD) as a decision support tool for strategy implementation in BHP Billiton Manganese.

A Research Strategy was developed in order to test five of the six research hypotheses .The sixth hypothesis would only be tested once the findings of the first five are known. The Research Strategy consisted of the following stages: Identification of Measurement Variables, Research Method selection and Implementation of selected research method. The primary research method was an electronic survey questionnaire administered to a heterogeneous sample of the target population. Two secondary research methods were selected, namely, document/archive search and in-depth interviews with a selected number of top managers in BHP Billiton Manganese.

The aim of this chapter is to present and analyze the results that were obtained using the selected research methods.

8.2 Survey Questionnaire Results

8.2.1 Questionnaire Data Preparation

The questionnaire was divided into three sections:

1. Demographic data.
2. Assessment of KVDs impact on value-creation and level of controllability.
3. Assessment of KVD model using Multi-attribute utility assessment.

The collected responses were downloaded from the secure SurveyMonkey® website as a MS Excel file. No preparation was required for the demographic data.

Demographic data preparation.

Demographic data can be downloaded from the SurveyMonkey tool and be used in MS Excel without a need for further preparation. The SurveyMonkey tool has a facility to filter data on the basis of user-defined criteria such as BU selected or organization roles.

Data preparation steps for assessment of KVDs impact on value-creation and controllability (section2).

1. The downloaded data for section 2 was saved in a dedicated file for analysis (Appendices 8.1 and 8.2)
2. The KVDs were sorted in descending order in terms of the rating averages for both impact on value-creation and controllability, where the rating average for a 7-point Likert item is calculated as follows:

   Rating Average = $(A\times7+B\times6+C\times5+D\times4+E\times3+F\times2+G\times1)\div(RC-K)$ ……(1.0)

   Where:

   A to G are scores (counts) for rating categories 7 to 1 and a rating of 1 represents Low Impact on value or Low Controllability and a rating of 7 represents High Impact on value or High Controllability.

   RC is the total responses for the question (Likert item)

   K is the number (count) of "I don't Know" responses for that item

3. Minitab-15 statistical software was used to calculate the basic statistics for the Impact on Value-creation and Controllability. Fig 8.1 below is an example of Minitab-15 report generated.
4. Using the Minitab report the KVDs were grouped into four groups (quartiles), which were then used to plot the KVDs on Controllability vs. Impact on Value-creation matrix.

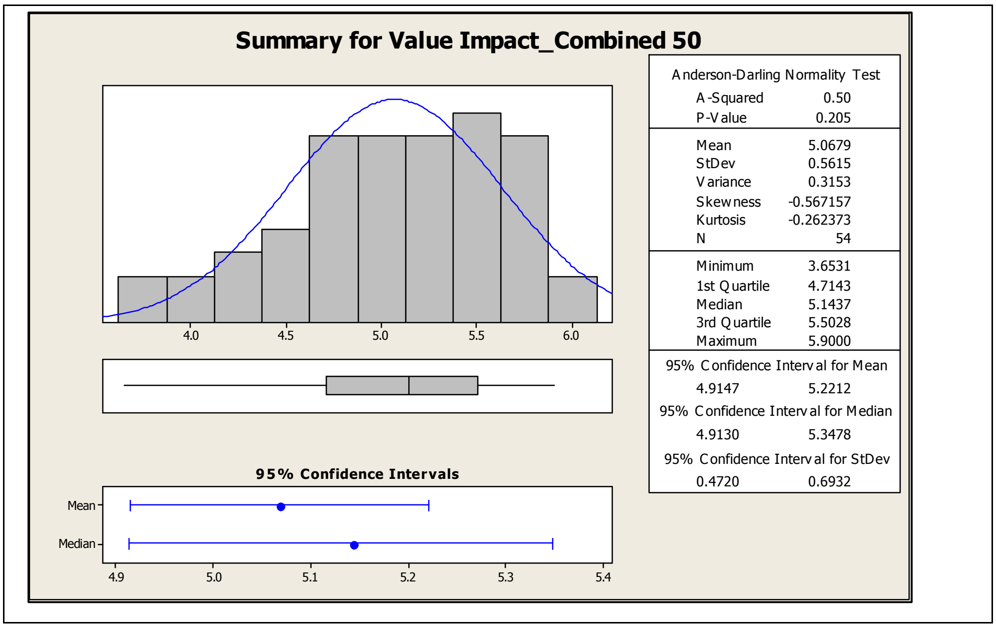


Fig 8. 1: Example of Minitab basic summary report

Data preparation steps for Assessment of KVD model using Multi-Attribute Utility Assessment.

1. The downloaded data for section 3 was saved in a dedicated file for analysis. (Appendix 8.3)
2. The individual questions (Likert items) were classified under their relevant attributes, the attributes were then classified under their relevant criteria and the criteria were classified under relevant dimensions. Each of the three dimensions corresponded to a research hypothesis (see section 7.1.2 on Measurement Variables).
3. The data can be used to calculate proportions and/or percentages for each rating category at question attribute criteria or dimension level.

Skipped Questions

In both section 2 and 3 of the questionnaire skipped questions were treated as neutral responses (rating 4).

8.2.2 Respondents' Demographics

A survey link was distributed to 90 managers and superintendents from the four BHP Billiton Manganese Business Units and the Corporate Office. 50 responses were received resulting in a response rate of 55.5 %.

Table 8.1 below summarizes the responses received by Business Unit.

Business Unit	Response Count	Response Percent
Corporate Office	15	30.0%
Gemco Mine	4	8.0%
Hotazel Mines	15	30.0%
Metalloys Smelter	6	12.0%
Temco Smelter	10	20.0%
TOTAL	50	100.0%

Table 8. 1: Responses by Business Unit

Table 8.2 below summarizes the results by BU type.

Business Unit Type	Response Count	Response Percent
Mines	19	38.0%
Smelters	16	32.0%
Corporate Office	15	30.0%
TOTAL	50	100.0%

Table 8. 2: Responses by BU Type

Table 8.3 below summarizes the responses by organizational role:

Role	Response Count	Response Percent
Managers	20	40.0%
Superintendents	30	60.0%
TOTAL	50	100.0%

Table 8. 3: Responses by Organizational level

8.2.3 $H_0$1: The use of KVDs has a positive effect on the task performance of BHP Billiton managers.

A total of 18 questions in the questionnaire were asked in order to test this dimension (hypothesis). The questions were grouped under two criteria, namely, Process Quality (11 questions) and Product Quality (7 questions).

Table 8.4 below is a summary of the responses received for the dimension. The detailed responses to individual questions are listed in appendix 8.4.

EFFECT ON TASK PERFORMANCE			
Total rating for the dimension			
% Agree	% Neutral	% Disagree	% I don't know
30.0	53.6	4.7	11.8
Process Quality			
% Agree	% Neutral	% Disagree	% I don't know
29.1	54.2	5.5	11.3
Product Quality			
% Agree	% Neutral	% Disagree	% I don't know
31.4	52.6	3.4	12.6

Table 8. 4: Rating Summary for KVD Effect on Task Performance

8.2.4 $H_0$2: The current KVD model is aligned with other BHP Billiton Manganese business processes

The questionnaire contained 16 questions that tested this dimension. The 16 questions were grouped under two criteria, namely, Fit with the User (6 questions) and Fit with the Organization (10 questions). The detailed responses to the 16 questions are listed in appendix 8.4. Table 8.5 below summarizes the responses received for this dimension.

SYSTEM FIT			
Total rating for the dimension			
% Agree	% Neutral	% Disagree	% I don't know
30.9	53.5	5.1	10.5
Fit with User			
% Agree	% Neutral	% Disagree	% I don't know
27.7	56.0	4.3	12.0
Fit with Organization			
% Agree	% Neutral	% Disagree	% I don't know
32.8	52.0	5.6	9.6

Table 8. 5: Rating Summary KVD alignment with other business processes

8.2.5 $H_0$3: The current MS Excel KVD model is easy to use or has a high degree of usability

33 questions were asked in the questionnaire to test this dimension. The 33 questions were grouped under 7 criteria as follows:

Criteria	No. of Questions
1. General Ease of Use	3
2. Flexibility	1
3. Ease of Training	7
4. Human Guidelines for Person-Machine interactions	13
5. Workload	3
6. Functional Allocation between Person and Machine	2
7. Quality of the User Mental model of the System	4

Table 8. 6: System Usability Criteria

The detailed responses to the 33 questions are listed in appendix 8.4. Table 8.7 below summarizes the responses received for this dimension.

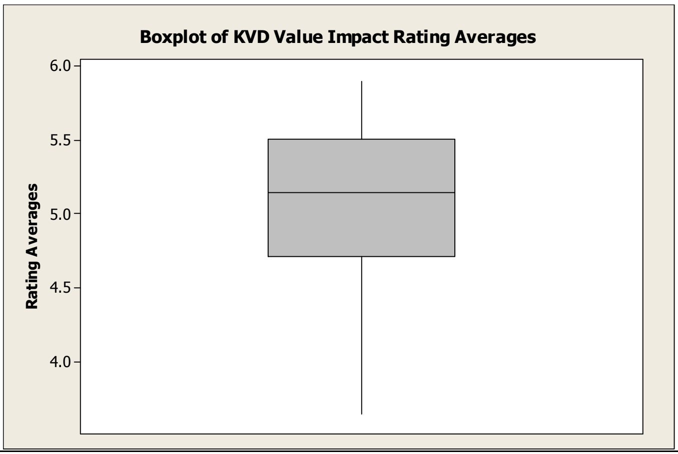
SYSTEM USABILITY			
Total rating for the dimension			
% Agree	% Neutral	% Disagree	% I don't know
25.8	52.4	7.2	14.6
General Ease of Use			
% Agree	% Neutral	% Disagree	% I don't know
30.0	46.0	7.3	16.7
Flexibility			
% Agree	% Neutral	% Disagree	% I don't know
32.0	50.0	6.0	12.0
Ease of Training			
% Agree	% Neutral	% Disagree	% I don't know
20.9	54.0	9.1	16.0
Human Factor Guidelines			
% Agree	% Neutral	% Disagree	% I don't know
23.5	52.9	8.0	15.5
Workload			
% Agree	% Neutral	% Disagree	% I don't know
28.7	54.0	6.7	10.7
Function allocation between Person and Machine			
% Agree	% Neutral	% Disagree	% I don't know
30.0	53.0	5.0	12.0
Quality of User's Mental Model of System			
% Agree	% Neutral	% Disagree	% I don't know
33.0	51.5	3.0	12.5

Table 8. 7: Rating Summary for System Usability

8.2.6 $H_0$4: The current KVDs have a significant impact on value creation

The respondents were asked to rate a list of 54 KVDs on a 7 point rating scale where a rating of 1 indicated that a KVD has a low impact on value and a rating of 7 indicating a high impact on value. A rating average for each KVD was calculated as described in 8.1.2 above.

Table 8.10 is a list of KVDs rated in descending order terms of their impact on value creation.



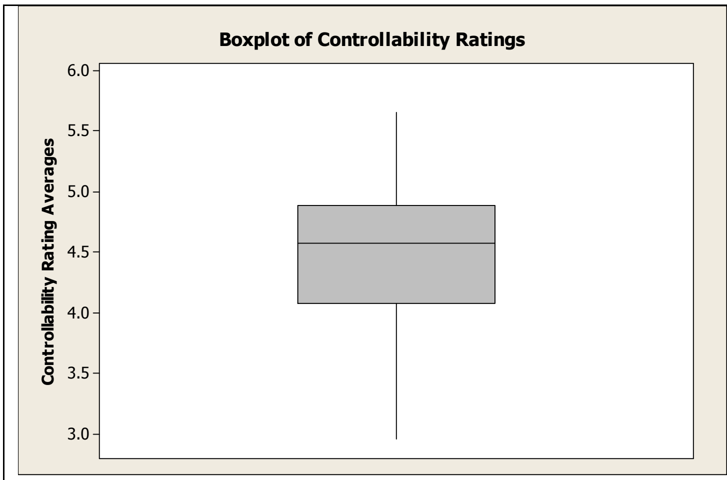
Basic Statistics	
Mean	5.07
Std Dev.	0.56
Median	5.14
Minimum	3.65
Maximum	5.90
Range	2.25
Mode	5.55
Count	54

Table 8. 8: Descriptive Statistics for KVD impact on value averages

8.2.7 $H_0$5: The Current KVDs are Controllable by managers

The respondents were asked to rate the 54 KVDs used in 8.1.6 above in terms of their perception of the extent of control that managers have on the KVDs. The same 7 –point rating scale was used and the rating averages were calculated as described in 8.1.2 above.

Table 8.11 is a list of KVDs rated in descending order terms of their controllability.



Basic Statistics	
Mean	4.40
Std Dev.	0.71
Median	4.58
Minimum	2.35
Maximum	5.66
Range	3.31
Mode	4.58
Count	54

Table 8. 9: Descriptive Statistics of KVD Controllability Rating Averages

8.2.8 Graphical representation of KVD Controllability and Impact on Value-creation

The rating data from tables 8.10 and 8.11 can used to plot each KVD on a two-dimensional grid, with Impact on Value-creation on the X-axis and Controllability on the Y-axis. The resultant grid enables clustering of KVDs and subsequent analysis on the basis of combined Controllability and Impact on value ratings. (See Fig 8.2 in section 8.3.5).

Key Value Driver (Impact on Value-Creation)	Rating Average
Production cost ($/mtu)	5.90
High Plant Availability	5.90
Operating Profit	5.84
High Plant Utilization	5.82
Safe working environment	5.82
Product Grade (Ore)	5.79
Production Volume (ore or alloy)	5.72
Sales Volume (ore or alloy)	5.69
Production Cost (local currency/ton)	5.68
Production Cost per Process Unit ($/ton cost for a furnace or mine section)	5.65
Net Product Price(Gross Product Price- Distribution Cost)	5.55
Healthy and Productive Workforce	5.55
Production Cost per Product Type (e.g. $/ton HCFeMn or $/ton MSS)	5.54
High Process Units' Efficiencies (e.g. yields, recycle rates, current efficiency)	5.49
Power Costs	5.45
Product Grade (Alloy)	5.44
Capital Expenditure	5.40
Labor Productivity	5.39
Gross Product Price	5.38
High Mobile Equipment availability	5.37
Raw material costs	5.31
Effective Health, Safety, Environmental and Community Systems	5.31
Exchange Rate (local currency to USD)	5.26
High Mobile Equipment utilization	5.26
Product Mix	5.22
Operating Margin(USc/mtu)	5.21
Effective Project Management System (PPM)	5.20
Effective ERP System (SAP)	5.08
Effective Business Intelligence System	5.08
High employee morale	5.06
Distribution Cost (Us/mtu)	5.02
Product Inventory	5.00
Effective Knowledge Management Systems	5.00
Raw Material Inventory	4.94
Product tons per employee	4.90
Sustainable use of Natural Resources	4.85
Innovation	4.84
Payroll cost per ton of product produced	4.82
Number of improvement initiatives	4.78
Labor Turnover (%)	4.73
Positive Industrial Relations Climate	4.71
Effective HR Processes	4.71
Cost per employee	4.68
Effective office Information Management System	4.55
Time to fill vacant positions	4.47
Compliance with Group Level Documents	4.45
Positive Community Relations	4.39
Time spent on training (%)	4.36
Absenteeism	4.31
Shifts lost to strikes (%)	4.30
Community Social Investment Spent	4.10
Water Cost	3.96
Time to resolve a grievance or disciplinary case	3.79
Number of Grievances	3.65

Table 8. 10: KVD rated on basis of impact on value-creation

Key Value Driver (Controllability)	Rating Average
Safe working environment	5.66
High Plant Utilization	5.28
Labor Productivity	5.28
High Employee Morale	5.24
High Plant Availability	5.22
Compliance with Group Level Documents	5.22
Number of Improvement Initiatives	5.20
Innovation	5.08
High Mobile Equipment Utilization	5.04
Healthy and Productive Workforce	4.98
Effective Health, Safety, Environmental and Community Systems	4.98
Positive Industrial Relations Climate	4.98
Production Volume (ore or alloy)	4.92
Absenteeism	4.88
High Mobile Equipment availability	4.82
Effective Project Management System (PPM)	4.73
Production cost ($/mtu)	4.71
Production Cost per Process Unit ($/ton cost for a furnace or mine section)	4.69
Capital Expenditure	4.68
Production Cost per Product Type (e.g. $/ton HCFeMn or $/ton MSS)	4.67
Effective HR Processes	4.67
High Process Units' Efficiencies (e.g. yields, recycle rates, current efficiency)	4.65
Product tons per employee	4.64
Product Grade (Alloy)	4.60
Time to resolve a grievance or disciplinary case	4.60
Effective Business Intelligence System	4.59
Number of Grievances	4.58
Time spent on training (%)	4.58
Effective office Information Management System	4.58
Positive Community Relations	4.54
Production Cost (local currency/ton)	4.53
Effective Knowledge Management Systems	4.52
Shifts lost to strikes (%)	4.41
Raw Material Inventory	4.36
Cost per employee	4.28
Sustainable use of Natural Resources	4.21
Community Social Investment Spent	4.16
Effective ERP System (SAP)	4.12
Labor Turnover (%)	4.12
Product Inventory	4.10
Operating Margin(USc/mtu)	4.08
Payroll cost per ton of product produced	4.08
Product Mix	4.08
Operating Profit	4.06
Time to fill vacant positions	4.04
Product Grade (Ore)	4.02
Sales Volume (ore or alloy)	3.39
Net Product Price(Gross Product Price- Distribution Cost)	3.21
Water Cost	3.20
Raw material costs	3.12
Distribution Cost (Us/mtu)	3.10
Power Costs	2.96
Gross Product Price	2.78
Exchange Rate (local currency to USD)	2.35

Table 8. 11: KVD sorted on basis of Controllability

8.3 Survey Questionnaire Results Analysis

8.3.1 Statistical Tests Selection

Tables 8.1, 8.2 and 8.3 give different demographic units into which the 50 survey respondents may be grouped. Statistical tests are required in order to determine whether the differences in responses between two or more of these units are significant.

There are a large number of statistical tests that can be used to determine whether a difference between two or more groups is significant. Table 8.12 summarizes some of the more frequently encountered tests of differences.

<table>
<tr><th>Nature of criterion variable</th><th>Type of Test</th><th>Type of data</th><th>No. of Comparison groups</th><th>Name of Test</th></tr>
<tr><td rowspan="2">Categorical (nominal or frequency)</td><td rowspan="2">Non-parametric</td><td rowspan="2">Unrelated</td><td>1</td><td>Binomial</td></tr>
<tr><td>2 +</td><td>Chi-Square</td></tr>
<tr><td rowspan="12">Non-categorical</td><td rowspan="5">Non-parametric</td><td rowspan="2">Unrelated</td><td>2</td><td>Mann-Whitney U</td></tr>
<tr><td>3+</td><td>Kruskal-Wallis H</td></tr>
<tr><td rowspan="3">Related</td><td>2</td><td>Sign</td></tr>
<tr><td>2</td><td>Wilcoxon</td></tr>
<tr><td>3+</td><td>Friedman</td></tr>
<tr><td rowspan="4">Parametric Means</td><td rowspan="2">Unrelated</td><td>1-2</td><td>t-test</td></tr>
<tr><td>2+</td><td>ANOVA</td></tr>
<tr><td rowspan="2">Related</td><td>2</td><td>t-test</td></tr>
<tr><td>3+</td><td>ANOVA</td></tr>
<tr><td rowspan="2">Parametric Variances</td><td>Unrelated</td><td>2</td><td>F-Test Levenes's tests</td></tr>
<tr><td>Related</td><td>2</td><td>t-test</td></tr>
</table>

Table 8. 12: Tests of differences (Bryman and Duncan, 1996:112)

Table 8.12 was used as a guide in selecting statistical tests that were used in the analysis of the results. Minitab-15 statistical software package was used to perform the tests.

8.3.2 Multi-Attribute Utility Assessment Construct Validity

Appendix 8.4 lists the detailed results of the MAUA portion of the questionnaire. Appendix 8.4 lists the 74 questions in the questionnaire. 67 of the 74 questions assess bottom-level attributes and criteria as already described. The other 7 questions assess the respondents' global perceptions about the KVD model. The 7 questions are collectively referred to as 'Overall System Utility" (node.0.0) whereas the 67 questions are referred to as "Overall System Utility- Questionnaire Totals". The extent of agreement between these totals demonstrates the construct validity of the questionnaire (Adelman and Riedel, 1997:251). Construct validity refers to the extent to which Operationalization of a construct does actually measure what is intended. According to Gravetter and Forzano (2006:71), construct validity is demonstrated when scores obtained from a measure are directly related to the variable itself. Table 8.13 below compares the two ratings as percentages of responses in each rating category.

	Strongly Agree (%)			Neutral (%)			Strongly Disagree (%)	Don't Know (%)
Rating Scale	1	2	3	4	5	6	7	0
Overall System Utility-Questionnaire Totals	5.7	10.5	12.0	53.0	2.5	2.2	1.3	12.9
Overall System Utility	8.0	12.3	13.4	53.7	1.7	1.4	0.3	9.1

Table 8. 13: Test data for questionnaire "construct validity"

Using Minitab-15 two comparison tests were performed:

1. Test 1: The Pearson correlation of Overall Utility Questionnaire and Overall Utility Global was calculated to be 0.994 with a P-Value of 0.000.
2. Test 2: A Mann-Whitney test was performed and the results are given in Table 8.14 below:

Mann-Whitney Test and CI: Overall Utility Questionnaire, Overall Utility

```
                                N  Median
Overall Utility Questionnaire  8    8.10
Overall Utility                8    8.55


Point estimate for ETA1-ETA2 is 0.55
95.9 Percent CI for ETA1-ETA2 is (-9.80,10.31)
W = 69.0
Test of ETA1 = ETA2 vs. ETA1 not = ETA2 is significant at 0.9581
```

Table 8. 14: Mann-Whitney test between Overall Utility-Questionnaire and Overall Utility

The Pearson's correlation r measures the strength of association between two variables, in this case the variables are: Overall Utility Questionnaire and Overall Utility Global. The value of r can vary between -1 and +1.

The P- Value determines the appropriateness of rejecting the null hypothesis in a hypothesis test. P-values range from 0 to 1. The smaller the p-value, the smaller the probability of rejecting the null hypothesis when the null hypothesis should not be rejected. Before conducting any analyses, determine your alpha (a) level. A commonly used value is 0.05. If the p-value of a test statistic is less than your alpha, you reject the null hypothesis.

In the above case the null hypothesis is r=0, i.e. the two test variables are not correlated. P-Value of 0.00 implies that there is a 0.00 probability that rejecting this probability is a mistake and we therefore reject the null hypothesis that there is no correlation between the two variables. The two variables are strongly (positively) correlated with r=0.994.

The Mann-Whitney test is a nonparametric hypothesis test to determine whether two populations have the same population median (η). It tests the null hypothesis that the two population medians are equal (H_0: $\eta_1 = \eta_2$). The Mann-Whitney test makes the following assumptions:

1. The data is not normally distributed.
2. The populations of interest have the same shape.
3. The populations are independent.

In the above test was set at α=0.05 (95% significance level) and the calculated P-Value was 0.9581. P being > 0.05 implies that we fail to reject the null hypothesis at 95 % level of significance. The two samples come from populations that have the same medians.

The selection of the non-parametric Mann- Whitney test was made after testing each of the MAUA dimension rating results for normality. Anderson-Darling tests for normality were carried out using Minitab-15. All but one of the distributions for the ratings were found to be non- normal as illustrated if Table 8.15.

	Demographic Unit	Anderson-Darling P-Value	Normal (Yes/No)
Use of KVD Effect on Task Performance	Managers	**0.068**	Yes
	Superintendents	**<0.005**	No
	Corporate Office	**<0.005**	No
	Mines	**0.019**	No
	Smelters	**0.006**	No
KVD Model Alignment with other Mn Business Processes	Managers	**0.042**	No
	Superintendents	**<0.005**	No
	Corporate Office	**<0.005**	No
	Mines	**0.020**	No
	Smelters	**0.008**	No
System Usability	Managers	**0.018**	No
	Superintendents	**<0.005**	No
	Corporate Office	**<0.005**	No
	Mines	**<0.005**	No
	Smelters	**0.007**	No

Table 8. 15: P-Values for Anderson-Darling Normality test of MAUA ratings for different demographic units.

8.3.3 The Effect of Organization Roles on MAUA Ratings

From Table 8.3 it can be seen that 20 of the 50 questionnaire respondents were managers and 30 were superintendents. By comparing the results of the manager and superintendent groups it is possible to determine whether there are differences in ratings between the two groups with regards to hypotheses 1-3.

The testing for differences in ratings between managers and superintendents were conducted using Pearson's correlation and Mann-Whitney test as in 8.2.1 above.

$H_0$1: The use of KVDs has a positive effect on the task performance of BHP Billiton managers.

	Strongly Agree (%)			Neutral (%)			Strongly Disagree (%)	Don't Know (%)
Rating Scale	1	2	3	4	5	6	7	0
Managers	13.3	17.8	9.7	39.7	1.7	4.2	2.8	10.8
Superintendents	0.6	6.9	15.4	62.8	0.6	0.7	0.7	12.4

Table 8. 16: Managers' and Superintendents' ratings for KVD effect on task performance

The correlation coefficient between the managers and superintendents' ratings is 0.913 with a P-value of 0.002. The P-value of 0.002 (less than α=0.05) means that we reject at 95% significance level, the null hypothesis that there is no correlation between the two sets of ratings.

The P-value of the Mann-Whitney test on the two sets of ratings is 0.318. The P-value of 0.318 (greater than α=0.05) means that we cannot reject, at 95% significance level, the null hypothesis that the two samples come from two populations with equal medians

$H_0$2: The current KVD model is aligned with other BHP Billiton Manganese business processes

	Strongly Agree (%)			Neutral (%)			Strongly Disagree (%)	Don't Know (%)
Rating Scale	1	2	3	4	5	6	7	0
Managers	16.3	15.6	9.7	40.9	2.8	3.4	1.9	9.4
Superintendents	0.8	8.1	14.8	61.9	1.9	1.0	0.2	11.3

Table 8. 17: Managers' and Superintendents' ratings of KVD model's System Fit

The correlation coefficient between the managers and superintendents' ratings is 0.910 with a P-value of 0.002. The P-value of 0.002 (less than α=0.05) means that we reject at 95% significance level, the null hypothesis that there is no correlation between the two sets of ratings.

The P-value of the Mann-Whitney test on the two sets of ratings is 0.294. The P-value of 0.294 (greater than α=0.05) means that we cannot reject, at 95% significance level, the null hypothesis that the two samples come from two populations with equal medians.

$H_0$3: The current MS Excel KVD model is easy to use or has a high degree of usability

	Strongly Agree (%)			Neutral (%)			Strongly Disagree (%)	Don't Know (%)
Rating Scale	1	2	3	4	5	6	7	0
Managers	11.4	15.0	8.9	41.2	5.0	3.0	2.6	12.9
Superintendents	0.8	6.4	12.3	59.8	2.4	2.0	0.5	15.8

Table 8. 18: Managers' and Superintendents' rating on KVD model's System Usability

The correlation coefficient between the managers and superintendents' ratings is 0.949 with a P-value of 0.000. The P-value of 0.000 (less than α=0.05) means that we reject at 95% significance level, the null hypothesis that there is no correlation between the two sets of ratings.

The P-value of the Mann-Whitney test on the two sets of ratings is 0.372. The P-value of 0.372 (greater than α=0.05) means that we cannot reject, at 95% significance level, the null hypothesis that the two samples come from two populations with equal medians.

8.3.4 The Effect of Business Unit Type on MAUA Ratings

Table 8.2 gives the distribution of survey respondents by BU type. In this section we test whether the respondents' ratings differ on the basis of the respondents' Business Units.

The Mann-Whitney test is an appropriate non-parametric test for differences were the number of comparison groups is two. In the case of three or more comparison groups the appropriate equivalent test is the Friedman test (Bryman and Crammer, 1996: 113). As can be seen from Table 8.2, the comparison groups are Mines, Smelters and Corporate Office, the Friedman test will therefore be used to test for differences.

$H_0$1: The use of KVDs has a positive effect on the task performance of BHP Billiton managers.

	Strongly Agree (%)			Neutral (%)			Strongly Disagree (%)	Don't Know (%)
Rating Scale	1	2	3	4	5	6	7	0
Mines	8.2	14.0	19.9	47.7	2.0	4.1	3.2	0.9
Smelters	0.7	6.9	11.5	55.2	0.7	0.7	0.7	23.6
Corporate Office	7.8	12.2	6.3	59.3	0.0	1.1	0.4	13.0

Table 8. 19: KVDs effect of task performance by Business Unit types

The P-value of the Friedman test on the above data is 0.040 (adjusted for ties). P = 0.040 is less than α=0.05 and we can therefore reject the null hypothesis that the three populations medians are equal at 95% significance level. The null hypothesis can also be stated as: H_0: The locations of all the 3 populations are the same (Stephens, 2004:211). From the above Friedman test result we conclude that at least two population locations differ.

Table 8.20 below is a matrix of Pearson's correlation coefficients amongst the three comparison groups:

	Mines	Smelter	Corporate Office
Mines	r =1.00 P=0.000		
Smelter	**r =0.835** P=0.010	r =1.00 P=0.000	
Corporate Office	r =0.911 P=0.002	**r =0.955** P=0.000	r =1.00 P=0.000

Table 8. 20: Pearson's correlation coefficient for BU type rating of KVDs effect on task performance

The correlation coefficients indicate that the ratings for the Mines and Smelters are least correlated (r = 0. 835), whereas the ratings for Smelters and Corporate Office are most correlated (r = 0.955).

$H_0$2: The current KVD model is aligned with other BHP Billiton Manganese business processes

	Strongly Agree (%)			**Neutral (%)**			**Strongly Disagree (%)**	**Don't Know (%)**
Rating Scale	1	2	3	4	5	6	7	0
Mines	9.5	15.1	19.7	45.7	2.3	3.3	2.0	2.3
Smelters	1.2	7.4	12.1	53.9	2.7	1.2	0.4	21.1
Corporate Office	10.0	10.0	4.6	62.9	1.7	1.3	0.0	9.6

Table 8. 21: KVD Model's System Fit rating by BU type

The P-value of the Friedman test on the above data is 0.022 (adjusted for ties). P = 0.022 is less than α=0.05 and we can therefore reject the null hypothesis that the three populations medians are equal at 95% significance level. The locations of at least two populations differ.

Table 8.22 below is a matrix of Pearson's correlation coefficients amongst the three comparison groups:

	Mines	Smelter	Corporate Office
Mines	r =1.00 P=0.000		
Smelter	**r =0.858** P=0.006	r =1.00 P=0.000	
Corporate Office	r =0.913 P=0.002	**r =0.942** P=0.000	r =1.00 P=0.000

Table 8. 22: Pearson's correlation coefficients for BU type ratings on KVD Model's System Fit

The correlation coefficients indicate that the ratings for the Mines and Smelters are least correlated (r = 0. 858), whereas the ratings for Smelters and Corporate Office are most correlated (r = 0.942).

$H_0$3: The current MS Excel KVD model is easy to use or has a high degree of usability

	Strongly Agree (%)			Neutral (%)			Strongly Disagree (%)	Don't Know (%)
Rating Scale	1	2	3	4	5	6	7	0
Mines	6.5	14.0	16.9	47.7	5.1	3.8	2.4	3.5
Smelters	0.8	5.5	10.2	50.4	2.7	2.1	0.6	27.8
Corporate Office	7.7	9.1	4.2	60.4	2.2	1.0	0.8	14.5

Table 8. 23: KVD Model's System Usability rating by BU type.

The P-value of the Friedman test on the above data is 0.024. P = 0.024 is less than α=0.05 and we can therefore reject the null hypothesis that the three populations medians are equal at 95% significance level. The locations of at least two populations differ.

Table 8.24 below is a matrix of Pearson's correlation coefficients amongst the three comparison groups:

	Mines	Smelter	Corporate Office
Mines	r =1.00 P=0.000		
Smelter	**r =0.811** P=0.015	r =1.00 P=0.000	
Corporate Office	r =0.922 P=0.001	**r =0.931** P=0.001	r =1.00 P=0.000

Table 8. 24: Pearson's correlation coefficients for BU type ratings of the KVD Model's System Usability

The correlation coefficients indicate that the ratings for the Mines and Smelters are least correlated (r = 0. 811), whereas the ratings for Smelters and Corporate Office are most correlated (r = 0.931).

8.3.5 KVD Controllability vs. Impact on Value-creation

The ratings of KVDs in terms the KVDs impact on value-creation and the extent to which managers believe they have control over the KVDs as reported in Tables 8.10 and 8.11 were used to construct a grid of KVD Controllability (Y-axis) vs. Impact on Value (X-axis). Fig 8.2 is the grid of KVD Controllability vs. Impact on Value-creation for the total questionnaire sample of 50 respondents.

Tables 8.10 and 8.11 as well as Fig 8.2 depicts the Manganese CSG view on what the KVD for the business are. As indicated by the bubbles on Fig 8.2 the KVDs can be divided roughly into four groups:

1. HC-HI: These are KVDs that were rated to be highly controllable and as having a high impact on value creation. In terms of the L.E.K Consulting (2007) definition these are the ‘true’ KVDs.
2. LC-LI: These are KVDs that were rated to be lowly controllable and also as having a low impact on value creation. In terms of the L.E.K Consulting (2007) definition these drivers are not KVDs and may act as ‘noise’ or distractions to managers in decision-making.
3. LC-HI: These are KVDs that are rated as having low controllability and high impact on value creation. Drivers in this group need to be considered carefully in the Risk Management process because of the value impact they have and the fact that they are perceived to be lowly controllable.
4. HC-LI: This group is made up of KVDs that are highly controllable and have low impact on value creation. These drivers need to be considered carefully in Business Improvement processes because any value-creating opportunity identified in this group can be exploited to a greater extent because the drivers are highly controllable.

Similar questions to those posed in the case of MAUA ratings can also be asked in this case, namely,

1. Are there differences in perception on what the KVDs are based on organizational roles?
2. Are there differences in perceptions on what the KVDs are based on the respondents’ Business Unit type?

The product of the Controllability Rating and the Impact on Value Ratings of a KVD from Tables 8.10 and 8.11 ($C \times I$) is a proxy for the position of a KVD on the grid illustrated in Fig 8.2 above. In order to statistically test for differences amongst different demographic units of the sample we compute these products for all the KVDs. Table 8.28 lists the demographic breakdown of Controllability Rating multiplied by Impact on value.

In order to select the appropriate statistical test for rating differences amongst the demographic units, it is necessary to first establish if the ratings are normally distributed or not. Table 8.25 below summarizes the results of the Anderson-Darling normality tests conducted on C×I for each demographic unit using Minitab-15.

Demographic Unit	Anderson-Darling P-Value	Normal (Yes/NO)
Combined (Total)	0.935	Yes
Managers	0.865	Yes
Superintendents	0.866	Yes
Corporate Office	0.953	Yes
Mines	0.182	Yes
Smelters	0.886	Yes

Table 8. 25: Normality Test results for C×I values for each demographic unit

The distributions of the product C×I are normal for all demographic units. It is there for appropriate to use parametric tests to test for differences.

BHP Billiton Manganese KVD Controllability vs. Value Impact

Compliance with Group Level Documents Positive Industrial Relations Climate	High Employee Morale Innovation Number of improvement initiatives	Labour Productivity Effective HSEC Systems High Mobile Equipment Utilization	High Plant Availability High Plant Utilization Safe Working Environment Healthy and Productive Workforce Production Volume (Ore and Alloy
Absenteeism Time to resolve a grievance or disciplinary case Effective HR Processes	Effective Knowledge Management System Effective Business Intelligence System Product Tons per Employee	High Process Unit Efficiency Product Grade (Alloy) Capital Expenditure High Mobile Equipment Availability Effective Project Management (PPM)	Production Cost ($/mtu) Production Cost per product Type Production Cost per Process Unit
Number of Grievances Positive Community Relations Effective Office Information Management System Time spent on Training Shifts Lost to Strikes Community Social Investment Spent Cost per Employee	Effective ERP System (SAP) Raw Material Inventory Sustainable use of Natural Resources Labour Turnover (%) Product Inventory		Production Cost (local currency/ton)
Time to fill vacant positions Water Cost	Distribution Cost (USc/mtu) Payroll cost per ton of product produced	Power Costs Gross Product Price Raw Material Cost Exchange Rate (local currency to USD) Product Mix Operating Margin (USc/mtu)	Operating Profit Product Grade (Ore) Sales Volume (Ore and Alloy) Net Product Price (Gross Price – Distribution Cost)

HC-LI HC -HI

LC-LI LC-HI

Controllability (Low) → (High)

Impact on Value (Low) → (High)

Fig 8. 2:Controllability vs. Impact on Value for BHP Billiton Manganese

Test 1: Are there differences in perception on what the KVDs are based on organizational roles?

The paired t-test was conducted on the C×I products of ratings by managers and superintendents (Bryman and Crammer, 1996: 113). The null hypothesis for the paired t –test is that the mean difference between the comparison groups is zero, and that the distributions of the comparison groups are identical. The results of the paired t-test on the C×I product for managers and superintendents are given in Table 8.26 below:

Paired T-Test and CI: MAN, SUP

```
Paired T for MAN - SUP

             N    Mean  StDev  SE Mean
MAN         54  22.568  4.661    0.634
SUP         54  22.127  4.679    0.637
Difference  54   0.441  2.225    0.303


95% CI for mean difference: (-0.166, 1.049)
T-Test of mean difference = 0 (vs. not = 0): T-Value = 1.46  P-Value = 0.151
```

Table 8. 26: Paired t-test for Managers' and Superintendents' C×I Product

From table 8.26 above it can be seen that the P-value for the paired t-test obtained was 0.151, therefore we cannot reject the null hypothesis at (α=0.05) 95 % significance level. The distributions of the C×I ratings for managers and superintendents are therefore identical.

Test 2: Are there differences in perceptions on what the KVDs are based on the respondents' Business Unit type?

There are three BU types, namely, Corporate Office, Mines and Smelters. The appropriate parametric test for differences amongst the C×I ratings in this case would be the One-Way ANOVA (Bryman and Crammer, 1996: 113).

Analysis of variance (ANOVA) tests the hypothesis that the means of two or more populations are equal. The null hypothesis states that all population means are equal while the alternate hypothesis states that at least one of the means is different.

Table 8.27 below is the Minitab-15 result for a One-way ANOVA test on the C×I of the ratings grouped by BU type.

One-way ANOVA: CORP, MINES, SMELTERS

```
Source     DF       SS     MS     F      P
Factor      2    144.9   72.5  2.79  0.064
Error     159   4124.5   25.9
Total     161   4269.5

S = 5.093   R-Sq = 3.39%   R-Sq(adj) = 2.18%


                              Individual 95% CIs For Mean Based on
                              Pooled StDev
Level      N    Mean  StDev  -------+---------+---------+---------+--
CORP      54  21.748  3.723     (--------*--------)
MINES     54  23.502  4.356                (--------*--------)
SMELTERS  54  21.315  6.707  (--------*--------)
                             -------+---------+---------+---------+--
                                 21.0      22.5      24.0      25.5

Pooled StDev = 5.093
```

Table 8. 27:One-way ANOVA results for Corporate, Mines and Smelter C×I

The One-way ANOVA test result on the three BU types gives a P-value of 0.064. This means that we cannot reject the null hypothesis that the three population means are equal at (α=0.05) 95 % significance level.

Fig 8.3 below is the interval-plots of the data from the total survey sample and for the three BU types. The graphical depiction of the data seems to confirm the One-way ANOVA result that stated that the three population means estimated from the three demographic units are equal.

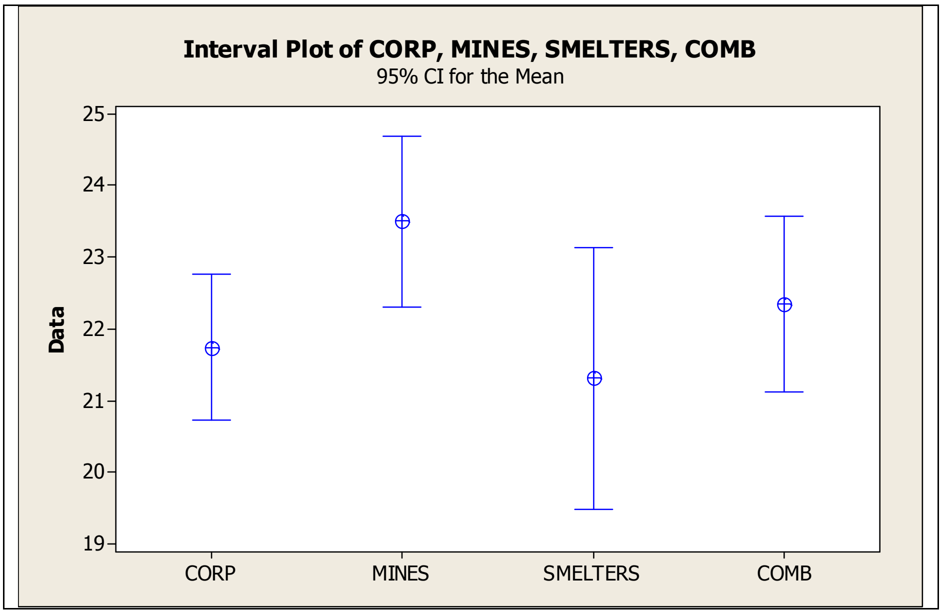


Fig 8. 3: Interval Plot of C×I data for Corporate, Mines, Smelters and Combined ratings

Key Value Driver	Controllability X Impact on Value Rating					
	Comb	Man	Sup	Corp	Mine	Smelt
Safe working environment	32.92	30.24	34.77	28.08	32.20	38.64
High Plant Availability	30.79	31.26	30.49	29.93	31.10	31.17
High Plant Utilization	30.73	31.63	30.11	28.59	31.42	31.82
Labour Productivity	28.45	29.69	27.59	25.32	30.86	28.49
Production Volume (ore or alloy)	28.14	28.00	28.19	27.09	28.23	28.93
Production cost ($/mtu)	27.79	29.16	26.94	25.69	30.30	26.82
Healthy and Productive Workforce	27.64	28.22	27.25	25.92	25.82	31.63
High employee morale	26.52	25.53	27.06	22.31	27.70	29.22
Production Cost per Process Unit ($/ton)	26.51	26.97	26.20	23.61	26.77	29.23
High Mobile Equipment utilization	26.51	27.54	25.85	26.65	28.77	23.75
Effective Health, Safety, Environmental and Community Systems	26.42	25.50	27.09	24.30	25.84	29.10
High Mobile Equipment availability	25.87	27.04	25.14	27.13	28.70	21.66
Production Cost (local currency/ton)	25.73	27.69	24.40	24.45	27.87	24.18
Production Cost per Product Type (e.g. $/ton HCFeMn)	25.60	28.91	23.91	24.14	28.60	24.33
High Process Units' Efficiencies (e.g. yields, recycle rates)	25.36	25.07	25.89	24.84	25.09	26.82
Capital Expenditure	25.27	26.78	24.20	25.22	28.25	21.76
Product Grade (Alloy)	25.01	25.19	24.78	23.91	25.75	25.22
Number of improvement initiatives	24.86	23.58	25.70	20.88	26.67	26.57
Effective Project Management System (PPM)	24.62	26.02	23.78	24.00	25.79	23.90
Innovation	24.57	22.65	25.80	20.48	25.31	27.50
Operating Profit	23.71	23.31	23.88	23.91	25.88	20.17
Positive Industrial Relations Climate	23.48	22.34	24.18	20.94	23.32	25.94
Effective Business Intelligence System	23.32	24.15	22.81	23.67	22.42	24.15
Product Grade (Ore)	23.26	22.19	23.98	20.63	25.23	23.43
Compliance with Group Level Documents	23.22	20.98	24.64	18.11	24.33	26.87
Product tons per employee	22.63	22.79	22.69	22.42	20.66	25.56
Effective Knowledge Management Systems	22.60	22.54	22.66	21.76	22.35	23.63
Effective HR Processes	21.78	22.52	21.74	22.33	21.76	21.90
Raw Material Inventory	21.54	21.84	21.28	19.01	25.81	19.05
Product Mix	21.30	23.59	19.85	24.64	21.04	18.66
Operating Margin(USc/mtu)	21.25	23.63	19.69	22.52	23.43	16.58
Absenteeism	21.01	19.16	22.30	19.01	21.61	22.31
Effective ERP System (SAP)	20.94	20.16	21.53	21.22	23.07	18.17
Effective office Information Management System	20.84	20.74	20.82	23.24	18.44	21.29
Product Inventory	20.50	22.66	19.11	20.48	25.19	15.52
Sustainable use of Natural Resources	20.42	19.96	20.76	22.22	20.47	18.59
Cost per employee	20.03	18.27	21.15	19.09	20.25	20.54
Number of Grievances	20.02	16.28	17.03	15.72	18.71	15.46
Time spent on training (%)	19.97	19.11	20.56	19.29	21.41	18.87
Positive Community Relations	19.92	20.54	19.43	20.11	21.43	17.59
Payroll cost per ton of product produced	19.65	22.05	18.04	19.92	20.88	17.17
Labour Turnover (%)	19.51	19.36	19.57	19.92	22.08	16.13
Sales Volume (ore or alloy)	19.30	22.96	16.84	22.28	20.68	14.20
Shifts lost to strikes (%)	18.95	18.83	19.01	19.03	17.96	20.03
Time to fill vacant positions	18.06	19.14	17.29	17.62	21.88	14.16
Net Product Price(Gross Product Price- Distribution Cost)	17.82	18.80	17.16	21.29	18.47	13.44
Time to resolve a grievance or disciplinary case	17.44	16.18	18.19	18.00	18.13	15.46
Community Social Investment Spent	17.06	17.36	16.83	17.38	18.39	15.21
Raw material costs	16.58	17.49	15.96	16.42	18.00	13.98
Power Costs	16.13	16.35	15.97	18.02	17.73	11.09
Distribution Cost (Us/mtu)	15.57	15.74	15.48	18.36	17.69	9.84
Gross Product Price	14.94	16.33	14.01	17.43	18.16	8.46
Water Cost	12.67	11.84	13.29	12.93	14.93	9.61
Exchange Rate (local currency to USD)	12.36	12.88	11.98	12.98	16.32	7.21

Table 8. 28: Controllability × Value-Impact

8.3.6 Summary: Survey Questionnaire Results

The aim of section 8.3 (Survey Questionnaire Results Analysis) was to describe how data that were collected from the survey questionnaire were prepared and analysed in order to assess the perceptions of the respondents with regards to the research hypotheses.

Fifty responses to the survey were received from the 90 electronically distributed questionnaires resulting in a response rate of 55.5 %.

A demographic breakdown of the respondents in terms of organisational roles and Business Unit was provided.

Percentage ratings of the respondents' perceptions regarding the effect of using KVDs on task performance, the alignment of the KVD model with other business processes and the usability of the KVD model were reported. The respondents' perceptions can be summarised as follows:

1. 30 % of the respondents agreed with the assertion that the use of KVDs to have a positive effect on task performance. 4.7 % disagreed.
2. 30.9 % of the respondents agreed with the assertion that there is good system-fit between the current KVD model and other BHP Billiton business processes.5.1 % disagreed.
3. 25.8% of the respondents agreed with the assertion that the current KVD model is easy to use.7.2% disagreed.

The respondents rated a set of 54 currently used KVDs in terms of the KVDs perceived impact on value-creation and the extent to which managers have control on the KVDs. The resultant ratings were used to develop a Controllability/Impact grid for the Manganese Customer Sector Group.

Minitab statistical software package was used to perform a number of statistical tests for differences. These tests for differences are important in determining whether KVDs are perceived to offer adequate level of decision-making support irrespective of the organizational role or BU type of origin. The results of the statistical tests can be summarised as follows:

1. The MAUA questionnaire's construct validity test was conducted by performing a Mann-Whitney test on two sets of questions that purported to measure the same

construct. The responses for the two sets of questions were found to be similar at 95 % confidence level.

2. Mann-Whitney tests were performed to test whether the ratings of managers and superintendents (i.e. based on organizational roles) were different with regards to the effect of KVDs on task performance, KVD model usability and system-fit between model and other business processes. The three tests indicated that the ratings were not different at 95% confidence level.
3. A Friedman test was conducted to test for differences amongst the ratings of respondents based on their type of the BU where they are employed. The test results indicated that at least two sets of ratings were different at 95 % confidence level. An analysis of correlation coefficients amongst the rating groups indicated that ratings by Smelters' employees were more positively correlated to ratings by Corporate Office employees than to the ratings by Mines' employees.
4. A paired t-test was conducted to compare the KVD ratings on Controllability × Impact on value-creation by managers and superintendents. The paired t-test results indicated that the results were not different at 95 % significance level.
5. An Analysis of Variance (ANOVA) test was conducted to test whether the KVDs' Controllability × Impact on value-creation ratings were different based on the BU type of the respondents. It was found that the ratings were not different at 95 % significance level

In addition to the survey data collected, an archival search of business documentation and interviews with some managers were conducted in order to enhance the validity of the research results. In the next two sections, results for the archival search and interviews are reported.

8.4 Archival Search Results

An examination of BHP Billiton Manganese historical business documentation was conducted in order to determine the extent to which KVD are actually used in the business and to check whether the results of the questionnaire are in agreement with the current business practices. The document search focused on three areas, namely :

1. The BHP Billiton Operating Model.
2. Manganese CSG Strategy Development and Implementation.
3. Manganese BU Management Reports

8.4.1 BHP Billiton Operating Model

The BHP Billiton Operating Model is a detailed description of how the BHP Billiton Group will deliver on its Corporate Objective of creating long-term shareholder value through the discovery, development and conversion of natural resources, and the provision of innovative customer and market focused solutions. (BHP Billiton, 2008c)

The Operating Model is comprised of policies, procedures and standards that are mandatory and applicable to the entire BHP Billiton group. These documents are collectively referred to as Group Level Documents (GLDs). All 101 GLDs stored in the Operating Model Project e-room were reviewed.

The Operating Model defines the CSG mandate as the translation of the Group strategy for the product(s) that the CSG is responsible for and ensuring that the CSG strategy is implemented (BHP Billiton, 2008c). In the context of KVDs this mandate means that the Manganese CSG is responsible for the identification of KVD for the business and for deciding whether these are used or not, as a tool for strategy implementation. Notwithstanding the CSG mandate the group has identified 6 strategic drivers that are deemed common to all Group operations. These are: People, License to Operate, World-Class Assets, Financial Strength and Discipline, Project Pipeline and Growth Options.

KVDs are specifically mentioned in two GLDs procedures used in the CAP process (Corporate Alignment Process, which is the BHP Billiton prescribed way of strategy development):

1. The Resources Development Potential (RDP) Procedure requires RDP teams to conduct value-driver analysis. The procedure defines value-driver analysis as a "process to determine the key variables that affect the value of the operation."(BHP Billiton, 2008c)
2. The Life of Asset (LOA) Procedure stipulates that LOA Working-groups should review historical plans and performance with the objective of setting improvement objectives. In these reviews the Working-groups should focus on: Key Value-Drivers and Performance Variances and reasons for the variances.(BHP Billiton, 2008c)

Whilst the BHP Billiton does not specify a process for identifying KVD or prescribe how the KVDs should be used, there is an explicit expectation that the Strategy Development process as carried out through the CAP process will incorporate identification and use of KVDs.

8.4.2 BHP Billiton Manganese Strategy Implementation

KVDs in Strategy Development

The use of KVDs in Manganese strategy development preceded the implementation of the BHP Billiton Operating Model in 2008.This is evidenced by the monthly Management Reports (BU Reports) that have been using KVDs since the year 2000 .

The archival search concentrated on documents that are used in communication external to the Manganese CSG. This was done in order to ensure that there would have been some control on the extent to which the ideas and views reflect the official business positions. A total of 15 documents were used in this part of the archival search.

In addition to complying with the requirements of procedures 012 and 013 as described in 8.41 above, a review of Manganese business documentation revealed four ways in which the use of KVDs is aligned or incorporated in the key business processes.

1. **Building an integrated long-term value-based strategic view**. In July 2008 a note to Senior Management titled "The Manganese Way of Planning" the following assertion is made regarding the use of KVDs: "Care should be taken to convey a 5 year story that is coherent and without obvious extrapolations and disconnects especially years 3 through to 5, traditionally the case and a symptom of a budget mentality. *Here we need to use value drivers (VDs) and understand the key levers in the organization and their EBIT sensitivity. Non-financial drivers are also important and require as much thought and rigor*" (my emphasis).
2. **The "wiring" philosophy of the Manganese Improvement Process**. "Wiring" is a process of ensuring a clear line-of-sight between the actions of individuals or teams and the required business outcomes as contained in the business plans. KVDs provide the process and financial links between organizational units and promotes the organization of teams into logical units for execution of business improvement plans(Manganese Letter of Intent, 2010)
3. **Short-term budgeting.** One of the agenda items in Budget Review Meetings between the Group and the CSG is "High level review or variance analysis based on value-drivers of historical performance and planned 5-year performance" (BHP Billiton, 2008b).

4. **Business Performance Management**. All Manganese Performance Management monitoring processes are based on performance indicators that related directly to KVDs. Table 8.29 below summarizes the key performance management fora.

Weekly	Monthly	Quarterly	Yearly
Meetings: • Mn Exco Meeting • BU Managers • BU Sectional Meetings • Shift Meetings	**Meetings:** • BU Reviews • CSG Functional Reviews • Mn Exco Review • CSG President Review	**Meetings:** • Bi-annual BU appraisal • Bi-annual BU Exco site visits	**Meetings:** • Budget Review • 5-Year Plan Review • Strategy Review
Meeting Objective: • Shift, Daily or Weekly performance review. • KPI and KVDs review. • Update Performance Forecasts	**Meeting Objective:** • Current Month Performance review • Year to date Performance review • KPI and KVD review for, BU, Functions and CSG • Project Reviews	**Meeting Objective:** • Review Year to Date performance • Review BU plans, initiatives and projects	**Meeting Objective:** • Review long-term strategy • Review medium-term business plans • Review current year budget

Table 8. 29: Manganese Business Performance Review Fora

8.4.3 Business Units Reports

BU Reports are Management Reports that are used within the Manganese CSG for performance reporting and monitoring. Since their inception in 2000 the BU reports have gone three stages of evolution.

The first BU Reports were MS Excel workbooks that were created by the individual BU every month and submitted to the Corporate Office for consolidation into CSG Reports. The data used to compile these reports was sourced from multiple sources that were largely inaccessible to users outside individual BU’s. Identification of KVDs to include in these reports was by means of a top-down approach. Corporate management decided what was to be reported and discussed in monthly BU review sessions.

The second stage of evolution was the development of BU Reports in the form of Key Value Driver Trees (still in MS Excel).This Excel KVD trees offered better graphical displays including trend graphs and some basic “what-if analysis” capability. Source data used to compile the reports was still only accessible to individual BU’s. Identification of KVDs to include in these models was based on a review of the then existing BU reports and focus-group discussions with BU based teams facilitated by an external consultant.

The latest development is the rendering of the BU Reports through Microstrategy Business Intelligence platform. This will give the users full BI capability of Microstrategy as described in Chapter 4.

The aim of conducting the archival search was to check whether there was alignment between the survey results and what happened in the business. In this instance we would like to check whether historical BU data is in agreement with the survey results. The BU reports are formally reviewed in monthly BU Review meetings as listed in Table 8.29.

The monthly BU Review meetings are the most important performance review sessions because in these meetings BU management gets feedback from top management on BU performance and also what the corporate expectations are for the future period. In turn corporate management obtains detailed information on operations, which they use to report to BHP Billiton Group management.

The BU Review discussions focus on the operating performance as measured by the Operating Profit. The primary drivers of Operating Profit are Sales Volume, Sales price and the Cost of sales. In these meetings actual performance is compared to previously budgeted performance and explanations are sought for variances from budget. The Operating Profit variance is broken down into Price, Volume and Cost impacts.

The Operating Profit variance is defined as the difference between the actual Operating Profit and the Budgeted Operating Profit. The Sales Volume impact on operating profit is calculated by multiplying the Sales Volume variance (actual sales-budgeted sales) by actual Price and subtracting actual Cost of Goods sold for that volume variance. The Price impact on the Operating Profit is calculated by multiplying the Price Variance by the actual volume minus cost of goods sold for the actual volume. The Cost impact is calculated by multiplying the Cost variance (per unit) by the actual sales volume.

Tables 8.30 –8.34 summarize the impacts of Net Average Prices, Cost of Goods Sold and Sales Volume on the quarterly Operating Profit (and variance) for the Manganese CSG and the constituent Business Units. Tables 8.30-8.34 were compiled using data from monthly BU reports for the period July 2007 to June 2009 (24 Months).

Quarter Ending (Gemco Mine)	Sep 07	Dec 07	Mar 08	Jun 08	Sep 08	Dec 08	Mar 09	Jun 09
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
	US $ 000							
Budget Operating Profit	90 676	82 607	78 993	87 371	340 123	350 986	272 427	240 547
Actual Operating Profit	73 228	90 955	175 220	337 831	408 933	105 244	61 541	40 100
Variance	**-17 448**	**8348**	**96 227**	**250 460**	**68 810**	**-245 742**	**-210 886**	**-200 447**
Price Impact	-9 569	2 866	114 837	255 357	82 009	-57 373	-109 224	-118 288
Cost Impact	-5 612	-6 908	-14 438	-15 538	-3 193	-542	-2 059	- 5 678
Volume Impact	-2 267	12 390	- 4 172	10 642	-10 007	-187 828	-99 603	-76 481

Table 8. 30: Price, Cost and Volume Impacts on Operating Profit Quarterly Variance-Gemco Mine

Quarter Ending (Hotazel Mine)	Sep 07	Dec 07	Mar 08	Jun 08	Sep 08	Dec 08	Mar 09	Jun 09
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
	US $ 000							
Budget Operating Profit	11 554	11 813	24 136	26 123	201 665	178 038	166 883	139 993
Actual Operating Profit	12 977	12 638	66 833	203 733	264 506	84 107	39 699	3 462
Variance	**1 423**	**825**	**42 697**	**177 610**	**62 841**	**-93 931**	**-127 184**	**-136 531**
Price Impact	7 465	5 572	48 655	160 174	47 714	-6 194	-25 570	-79 496
Cost Impact	-4 858	-7 202	-3 402	-6 046	-1 291	4 580	1 194	-5 281
Volume Impact	-1 184	2 455	-2 556	23 482	16 418	-92 317	-102 808	-51 754

Table 8. 31: Price, Cost and Volume Impacts on Operating Profit Quarterly Variance-Hotazel Mine

Quarter Ending (Metalloys Smelter)	Sep 07	Dec 07	Mar 08	Jun 08	Sep 08	Dec 08	Mar 09	Jun 09
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
	US $ 000							
Budget Operating Profit	70 288	74 671	61 873	48 470	188 488	209 310	180 695	174 762
Actual Operating Profit	78 109	108 639	173 805	363 513	218 037	-22 456	12 422	139 802
Variance	**7 821**	**33 968**	**111 932**	**315 043**	**29 549**	**-231 766**	**-168 273**	**-34 960**
Price Impact	11 613	69 154	130 600	326 306	10 082	-272 502	-34 010	167 833
Cost Impact	5 944	-11 354	-2 396	-17 165	4 999	9 049	4 620	16 965
Volume Impact	-9 736	-23 833	-16 272	5 902	14 467	31 688	-138 883	-219 757

Table 8. 32: Price, Cost and Volume Impacts on Operating Profit Quarterly Variance-Metalloys Smelters

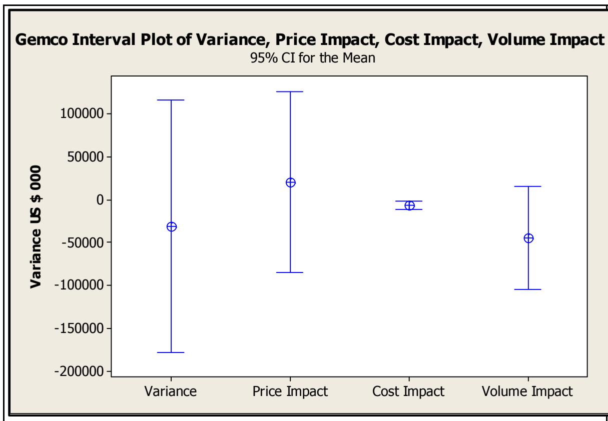
Quarter Ending (Temco Smelter)	Sep 07 Q1	Dec 07 Q2	Mar 08 Q3	Jun 08 Q4	Sep 08 Q5	Dec 08 Q6	Mar 09 Q7	Jun 09 Q8
	US $ 000							
Budget Operating Profit	31 404	38 528	27 365	25 420	112 201	89 592	73 645	98 851
Actual Operating Profit	24 613	51 936	55 591	96 740	96 206	87 029	30 765	5 256
Variance	**-6 791**	**13 408**	**28 226**	**71 320**	**-15 995**	**-2 563**	**-42 880**	**-93 595**
Price Impact	-4 283	14 967	33 779	80 907	6 362	-18 687	-10 144	-75 369
Cost Impact	845	-809	-2 728	-3 804	6 010	12 626	6 194	14 407
Volume Impact	-3 353	-749	-2 826	- 5 783	-28 367	3 498	-38 928	-32 632

Table 8. 33: Price, Cost and Volume Impacts on Operating Profit Quarterly Variance-Temco Smelter

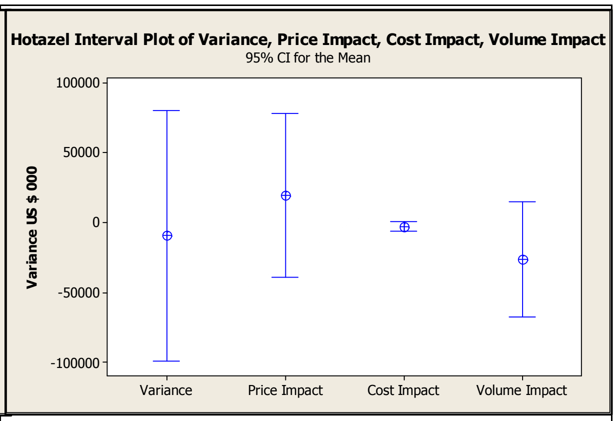
Quarter Ending (Manganese CSG)	Sep 07 Q1	Dec 07 Q2	Mar 08 Q3	Jun 08 Q4	Sep 08 Q5	Dec 08 Q6	Mar 09 Q7	Jun 09 Q8
	US $ 000							
Budget Operating Profit	203 922	207 619	192 367	187 384	842 477	827 926	693 650	654 153
Actual Operating Profit	188 927	264 168	471 448	1001818	987 680	253 924	144 429	188 622
Variance	**-14 995**	**56 549**	**279 081**	**814 434**	**145 203**	**-574 002**	**-549 221**	**-465 531**
Price Impact	5 226	92 559	327 871	822 744	146 167	-354 756	-178 948	-105 320
Cost Impact	-3 681	-26 273	-22 964	-42 553	6 525	25 713	9 949	20 413
Volume Impact	-16 540	-9 737	-25 826	34 243	-7 489	-244 959	-380 222	-380 624

Table 8. 34: Price, Cost and Volume Impacts on Operating Profit Quarterly Variance-Manganese CSG

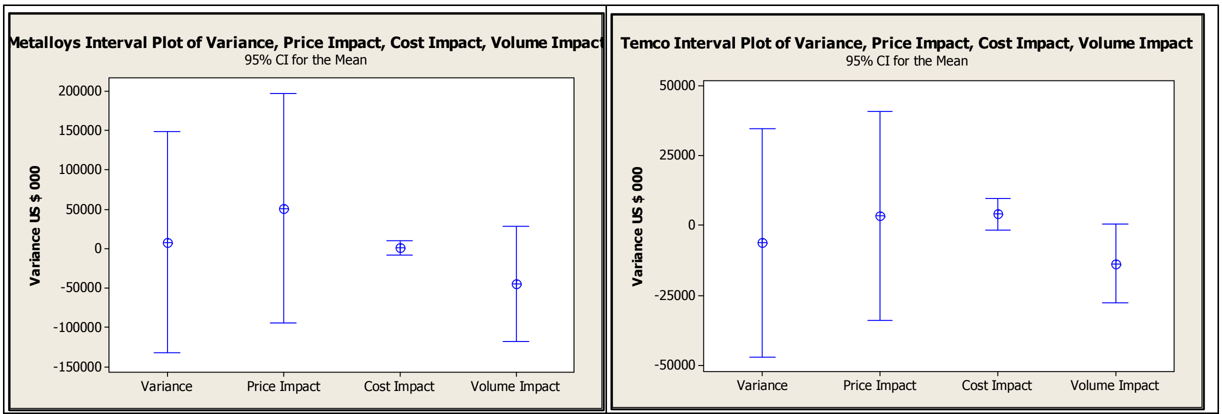
The data in Tables 8.30 – 8.34 above can be represented graphically as interval plots in order to qualitatively determine the contribution to Operating Profit variability from Price, Cost and Volume variability. Figures 8.4 and 8.5 below are interval plots of the data in table KK-KK above.



Gemco Mine



Hotazel Mine



Metalloys Smelter	Temco Smelter

Fig 8. 4: Interval Plots of Operating Profit Variance, Price, Cost and Volume Impacts on Variance: July 2007 to June 2009

Fig 8.5 below gives the interval plot and an area graph for the Manganese CSG based on data in table 8.34 above.

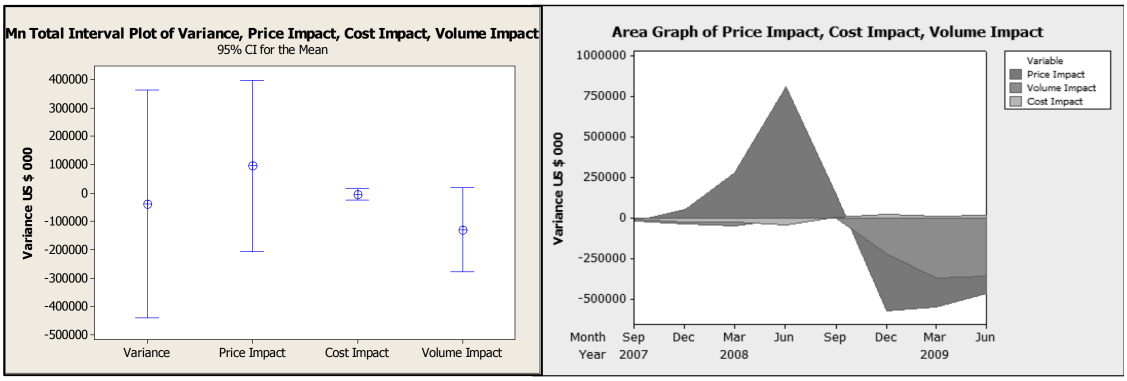


Fig 8. 5: Interval Plots and Area Graph of Operating Profit Variance, Price, Cost and Volume Impacts on Variance: July 2007 to June 2009

Tables 8.30-8.34 and Figures 8.4 and 8.5 illustrate that the largest contributor to Operating Profit variation from budget is the Price variation, followed by Volume variation and then Cost variation.

What do the above data signify in terms of both KVD value impact and controllability?

<u>Impact on value</u>: In terms of the BHP Billiton Operating Model the CSG and its constituent BUs' performance is measured in terms of Operating Profit. Comments on variances in Operating Profit, Price, Volume and cost variances are mandatory in all BU Reports' executive summaries. From Fig 8.2 it can be seen that Production Cost (in both US$ and local currencies), Sales Volume and Net Product Cost have been rated in the fourth (top) quartile of the Impact on Value axis.

Controllability: The variability of a variable as depicted by its interval plot as in Fig 8.4 above can be expected to vary inversely to its controllability[20]. From Interval Plots in Fig 8.4 if we were to rank the variables in terms if their controllability, the ranking order from lowest to highest controllability would be Price Impact, Volume Impact and then Cost Impact. This ranking order is in agreement with the ranking order obtained from the survey results as shown in Fig 8.2. In Fig 8.2 ; Net Product Price and Sales Volume are ranked in the first (lowest) quartile of the Controllability axis and Production Cost (US$/mtu) in the third quartile of the Controllability axis.

The above analysis of BU data and survey results suggests that the perceptions of the survey respondents are aligned with current practice in BU performance reviews.

8.4.4 Summary: Archival Search Results

The BHP Billiton Operating Model prescribes CAP as a strategy development process for all BHP Billiton operated businesses. The Resource Development Potential and the Life of Asset Procedures require that all business identify KVDs and use these in their planning.

In addition to the mandatory use of KVDs in planning, the Manganese CSG use KVDs in Business Improvement and Business Performance Management.

The respondents' perceptions of the key drivers of value are aligned with BU and Corporate managements' perceptions of what the drivers of Operating Profit are. These drivers of Operating Profit are used in BU review discussions.

The next section reports the results of semi-structured interviews that were conducted with eight top managers from the Manganese Corporate Office in Johannesburg.

8.5 Face to face Interview Results

Semi-structured interviews were conducted with eight managers selected from the BHP Billiton Office in Johannesburg. The first objective of the interviews was to confirm that the concepts and categories of concepts that were used in the survey are similar to those that management uses in strategy implementation discussion. The second objective was to obtain managers' comments on the survey process and the preliminary results obtained.

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[20] This is assumption is based on the Six Sigma notion of Control. Pyzdek (2001:381) quoting Shewhart (1931) defines control as follows; "A phenomenon will be said to be controlled when, through the use of past experience, we can predict, at least within limits, how the phenomenon may be expected to vary in future."

8.5.1 Interview Guide

The basic question set that was used to guide discussion in the interview was divided in to two sections:

1. Section 1: The interviewees were asked to respond “yes” or “No” to five questions based on the research hypotheses. The questions were :
    a. Does the use of KVD have a positive effect on task performance?
    b. Is the current KVD model aligned with other Manganese business processes?
    c. Is the current KVD model easy to use?
    d. Do all the current KVDs (in the model) have a significant impact on value creation?
    e. Are all the current KVDs (in the model) controllable by managers?

    After answering Yes or No to each of the above questions the interviewee was asked to explain or discuss his answer to the question.
2. Section 2: The interviewees were asked to comment on the KVD list and the KVD Impact on value-creation vs. Controllability matrix. The following questions were used as trigger questions:
    a. Is the KVD Impact on value-creation vs. Controllability in line with your experience in the business?
    b. Comment on the balance amongst KVDs with respect to, for example, People vs. Process drivers, Balance amongst Functional drivers, Group, CSG and BU drivers.
    c. What can be done do reduce the number of “I don’t know” responses or improve the understanding with regards to the use of KVDs?

8.5.2 Interview Results

Research Hypothesis:

Table 8.36 below lists the interviewees’ responses to the five questions based on the research hypotheses.

Question	Yes	No
a. Does the use of KVD have a positive effect on task performance?	7	1
b. Is the current KVD model aligned with other Manganese business processes?	8	0
c. Is the current KVD model easy to use?	6	2
d. Do all the current KVDs (in the model) have a significant impact on value creation?	0	8
e. Are all the current KVDs (in the model) controllable by managers?	0	8

Table 8. 35: Interviewees' responses to research hypotheses

The negative response to question (a) arose because one of the interviewees was of the opinion that the KVD do not cover all functional areas, in particular the Information Technology area.

Three reasons were advanced why the current KVD model is not easy to use:

1. It is difficult to navigate to required information using the model.
2. The model's capability for performing "what-if" analysis is very limited.
3. The model is cumbersome to maintain because it requires data from many data sources.

There was unanimity that the model contained too many KVDs and that not all of the KVDs were controllable. The exchange-control rate between the US dollar and local South African and Australian currencies and product prices were the most often cited examples of non-controllable KVDs.

Coding Process

Strauss and Corbin (1998: 3) define coding as an analytic process through which data are fractured, conceptualised and integrated to form theory. The objective of the interviews was to compare the labels (words, phrases and concepts) that managers used in discussing KVDs and strategy implementation with the labels that were used in the survey questionnaire. The coding procedure for the first three questions that was followed consisted of three steps:

1. Partial transcripts each of the tapes were made listing the reasons that were given for answers to the hypothesis questions.
2. The reasons were matched against the MAUA assessment attributes.
3. The results of all the interviews were consolidated.

The type of coding process for question 4 and 5 was different from that used for questions 1-3. In questions 1-3 the labels were being categorized against existing categories (MAUA criteria) and sub-categories (MAUA attributes). Strauss and Corbin (1998:124) term this type of coding process axial coding. In the case of questions 4-5 no pre-existing categories were used and the interview results were examined to identify any emerging themes. Strauss and Corbin (1998:101) term this type of coding process: open coding.

Coding Results

1. Does the use of KVD have a positive effect on task performance?

Interviewees in explaining their affirmative answer to the above question used the following MAUA attributes:

a. **Process Quality:**
   i. Explanation Capability: The model enables employees to unpack an issue into its component parts.
   ii. Problem-solving approach : The model is used in RPM meetings (RPM meetings are small team meetings that are aimed at implementing business improvement ideas)
   iii. Time to perform task: The model enables the employees to focus their time and resources at the most important problems.
   iv.

b. **Product Quality**:
   i. Cost effectiveness or Efficiency of the system: The model enables the employees to focus their time and resources at the most important problems.

The following Process Quality attributes were not mentioned at all by any of the interviewees:

i. Quality of system information.
ii. Knowledge representation scheme.
iii. System response time.

The following Product Quality attributes were not mentioned at all by any of the interviewees:

i. Quality of the results generated using the system.
ii. Users' confidence in the results.

2. Is the current KVD model aligned with other Manganese business processes?

Interviewees in explaining their affirmative answer to the above question used the following MAUA attributes:

a. Fit with the user

i. <u>Matching with the needs of the user</u>: The model helps users to focus on most important areas.
ii. <u>Matching the problem-solving approach of users</u>: The model is being used extensively in the Manganese Improvement Process (MIP).

b. Fit with the Organization

i. <u>Matching organizational doctrine</u>: CAP, MIP and Partners-In-Performance Consultants improvement methodology had helped in entrenching the use of KVD throughout Manganese CSG. KVDs are now also being used in non-traditional areas such as Health, Safety, Environment and Community (HSEC) and Human Resources (HR).
ii. <u>Fit with Organizational Structuring</u>: KVDs support team-based business improvement methods (MIP). KVDs are the basis of Performance Monitoring for Business Units and individuals.
iii. <u>Effect on other people's workload</u>: Reduces workload by enabling employees to focus on important drivers. Use of KVDs has made it possible to standardise team meetings amongst BUs.
iv. <u>Attitude of others towards the system:</u> Motivates employees by giving them clear line of sight and maximising their contribution. The system has credibility because most KVDs were derived from practical use and employees at the BU were involved in development of the model.

The following "Fit with the User" attributes **were not** mentioned at all by any of the interviewees:

i. Matching the training that the user was given

The following "Fit with the Organization" attributes **were not** mentioned at all by any of the interviewees:

i. Effect on Information Flow

3. Is the current KVD model easy to use?

Interviewees in explaining their affirmative answer to the above question used the following MAUA attributes:

a. **General Ease of Use:** The model is in MS Excel and the user needs a good working knowledge of Excel to use the model.
b. **Ease of Training:** There is no formal training material for the model. There is no on-line help function and system documentation is generally not available to users.
c. **Human Factor Guidelines**
    i. Consistency: The model has the same look-and-feel for all assets and is used in a consistent manner.
    ii. System Navigation: There is standardisation of inputs and parameters across BU.
    iii. Ease of data entry: The model is hard to maintain because it relies on a large number of data sources. The quality of the data is also not consistent across all BUs and the original sources of the data are not always known.
d. **Quality of the User's Mental model** : The model has limited "what-if" analysis capability

The following "Ease of Use" criteria and /or attributes **were not** mentioned at all by any of the interviewees:

i. Flexibility
ii. Ease of Training : Learnability
iii. Human Factor Guidelines
    a. Error Prevention
    b. Use of Color
    c. System Feedback

d. Reliability

iv. Workload

a. Strain

b. Memorization

v. Functional Allocation between Man and Machine

The survey questions were based on 29 attributes and 2 criteria (that did not have subsidiary attributes). Out of these 31 attributes and criteria 17 attributes or 54.8 % of the total attributes were used by managers in explaining their responses to the questions based on research hypothesis. Fourteen attributes and two criteria were not mentioned at all by the managers in their interview discussions.

Table 8.36 below is a list of attributes that the managers used in explaining their responses rated in terms of decreasing % agreement score from the survey questionnaire results.

Attributes used by Managers	**Agree**	**Neutral**	**Disagree**	**I don't Know**
	%	%	%	%
Fit with organization structuring	40.0	52.0	2.0	6.0
Attitude of others toward the system	36.0	51.0	2.0	11.0
Matching organization doctrine	33.0	51.0	4.0	12.0
Quality of user mental model	33.0	51.5	3.0	12.5
Cost effectiveness or Efficiency	32.0	53.0	3.0	12.0
Time to perform task	30.0	54.0	4.0	12.0
General ease of use	30.0	46.0	7.3	16.7
Consistency	30.0	49.0	4.0	17.0
Problem-solving approach	29.0	56.0	4.0	11.0
System Navigation	29.0	54.0	4.0	13.0
Explanation Capability	28.0	60.0	2.0	10.0
Matching with the needs of user	28.0	56.0	3.0	13.0
Matching Problem-solving	26.0	58.0	3.0	13.0
Effect on other people's workload	20.7	56.7	11.3	11.3
On-line documentation	20.0	51.0	12.0	15.0
Ease of data entry	17.0	52.0	10.0	21.0
System Documentation	15.0	56.0	12.0	17.0

Table 8. 36: Attributes used by managers in interviews and corresponding survey scores

Table 8.37 below is a list of attributes not used by managers in explaining their responses to research hypotheses listed in order of decreasing % agreement.

Attributes NOT used by Managers	**Agree**	**Neutral**	**Disagree**	**I don't Know**
	%	%	%	%
Effect on Information flow	48.0	42.0	6.0	4.0
Use of Colour	36.0	46.0	4.0	14.0
Quality of system information	35.3	50.0	4.7	10.0
Quality of results generated	34.7	51.3	2.7	11.3
Function allocation Man/machine	30.0	53.0	5.0	12.0
Strain	29.0	54.0	7.0	10.0
Matching the training of user	28.0	54.0	3.0	10.0
Memorization	28.0	54.0	6.0	12.0
System response time	26.0	52.0	6.0	16.0
User confidence in the results	26.0	54.0	5.0	15.0
Learnability	25.3	54.7	4.0	16.0
Error Prevention	22.0	50.0	13.0	15.0
Knowledge representation scheme	21.0	57.0	11.0	11.0
System Feedback	20.0	56.0	8.0	16.0
Reliability	17.0	60.0	11.0	12.0

Table 8. 37: Attributes not used by managers in interviews and corresponding survey scores

2-t statistical tests on rating categories from the two groups of attributes in tables 8.36 and 8.37 show that there is no difference in rating scores for the two groups of attributes. Table 8.38 below lists the p-Values obtained from the 2-t tests. The test null hypothesis for the 2-t test is that the difference in population means is zero (H_0: μ_1-μ_2=0 and H_1: μ_1-$\mu_2 \neq 0$)

2 –t Test Result	% Agree	% Neutral	% Disagree	% I don't Know
p-Value (α=0.05)	0.885	0.563	0.366	0.470

Table 8. 38: P-Values for 2t-tests on rating categories for used and unused attributes in managers' interviews

From table 8.38 we cannot reject the null hypothesis that the difference in the mean ratings between the groups of attributes used by managers in the interviews and the group of attributes not used by managers in the interviews is zero (at 95 % confidence level). The fact that the 14 attributes in Table 8.37 were not used by managers in the interview discussions does not mean that the survey respondents' perceptions of them are any different from those used in the interview discussions (Table 8.36)

4. Do all the current KVDs (in the model) have a significant impact on value creation?

From table 8.35 it can be seen that not all of the current KVDs are perceived to have a significant impact on value. The reasons that were advanced in substantiating these perceptions can be grouped under the following headings:

1. There are too many KVDs in the current model: Individual users have to sift through a large number of KVDs to find what is relevant for their area of interest. In some instances the KVDs are mixed with other operational data and metrics.
2. The importance of KVDs changes from time to time : What is important in the business changes with time and the key drivers of this change are :
   i. Strategic imperatives at the time, for example, the implementation of the new BHP Billiton Operating Model has transferred some responsibilities from Group to CSG.
   ii. Industry Conditions, for example the changing mining legislation in South Africa has increased the importance of Community and Sustainability related KVDs.
   iii. Market conditions, the bid price swings between 2008 and 2008 required the BUs to shift emphasis from volume growth (under high prices) to cost containment (under low prices).
3. The value impact of non-financial KVDs is not fully understood. HSEC and HR related KVDs do not have a directly measurable financial impact and therefore they tend to be under-emphasized.
4. KVD list is not necessarily exhaustive, an example that was used was the dearth of Information Technology related KVDs.
5. Individual vs. Collective impact: The value impact of each KVD when looked individually may be easy to discern, but when looking at the KVDs collectively the value impact becomes blurred.
6. KVDs are business specific: Currently there is no clarity on which KVDs apply to a specific BU only and which apply to all BUs.

5. Are all the current KVDs (in the model) controllable by managers?

Not all the KVDs in the current model are perceived to be controllable by managers as can be seen from the negative responses recorded in table 8.35. The following reasons were given by interviewees in substantiating their responses:

1. Group controlled KVDs: There are KVDs that are only monitored by the BU but are controlled at Group level, for example, Marketing related KVDs.
2. Uncontrollable KVDs: There are KVDs that are not even controllable at Group level, for example, prices and currency exchange rates.
3. BU vs. Group focus: BUs tend to focus on 'bottom-line' KVDs whereas Group tends to focus on 'top-line' KVDs.
4. There are too many KVDs in the current model: The number of the current KVDs makes it difficult for managers to maintain focus.
5. Controllability does not imply that the KVDs are controlled: What is important is whether controllable KVDs are being controlled in practice. It was felt that the BHP Billiton Operating Model has helped in clarifying where responsibility lies for control of different KVDs

Manager's comments on survey results preview:

1. Comments on the Controllability vs. Impact on value: In general interviewees were of the opinion that the survey results were aligned with their experience in the business. Two points were raised by a number of managers; firstly, the perception of value and controllability depends on the position of the person in the organization and secondly the perception depends on what the imperatives of the moment are. The first point exemplified by the respondents' perception of Group related KVDs such as Compliance to Group Level Documents, being rated as having low impact to value creation. Viewed from a Group perspective the same KVD might be rated as having a very high impact on value-creation. The second point is exemplified by the relatively low rating of capital-expenditure

management because of the cutbacks in capital expenditure during the current downturn in the market.

2. Is there a balance amongst the KVDs? This question generated comments that can be grouped in four categories:
    a. People related vs. Process Related KVDs: There was some concern that People related KVDs were generally perceived to have low impact on value creation.
    b. BHP Billiton Group vs. Manganese KVDs: All top managers (members of the Manganese Executive Committee) felt that group related KVDs have a greater impact on value than the survey results suggested. A possible explanation for this discrepancy is that the value impact may be not in the line of sight for most survey respondents, for example, it may be difficult for a manager at a BU to appreciate the financial impact of compliance with Group Level Documents across the whole of BHP Billiton.
    c. Management of Capital expenditure: Interviewees confirmed that in most instances the control of capital expenditure by BUs is inadequate. The explanation offered for this inadequacy was that before the implementation of the Project and Portfolio Management System (PPM) the capital expenditure planning and monitoring systems were cumbersome and not transparent for all users.
    d. Differences in non-financial KVD ratings by between Smelters and Mines: Managers were asked to comment on why the top 10 KVDs as rated by Smelter managers contained 6 non-financial (people related) KVDs whereas the top 10 KVDs as rated by Mine managers contained only 2 non-financial KVDs (based on data in Table 8.28). Explanations for the different ratings between smelters and mines can be summarized as in Table 8.40 below.

	Mines	Smelters
People	• Rural populations • Majority of workforce lowly skilled • Autocratic Management culture	• Urban populations • Skilled workforce • More participative Management culture
Technical/Process	• High reliance on Mobile equipment • Low level of automation • Variable Raw materials (ore bodies) • Variable production rates	• Low reliance on Mobile equipment • High level of automation • Consistent raw material and products • Production rate fixed by number of furnaces in operation

Table 8. 39: Key differences between Mn Smelters and Mines

8.5.3 Summary: Face-to-face Interviews

The responses of the interviewees were aligned with the survey results with respect to all the research hypotheses.

When top managers discussed their perceptions regarding KVDs effect on task performance, alignment with other business processes and usability of KVD model, they used 17 out of the 31 attributes and criteria that were used in designing the survey questionnaire.

The survey results regarding KVD controllability and impact on value-creation were accepted by interviewees as being aligned to their own experience in the business. In particular, the group of KVDs that were rated as being highly controllable and as having a high impact on value-creation was confirmed to be comprised of 'true' KVDs as discussed in 8.3.5 above.

8.5.4 Chapter Summary

In this chapter results that were obtained using the three selected data collection methods were presented and analyzed.

1. Survey data collected was prepared for analysis in two different ways. Firstly, data relating to the MAUA was prepared for analysis by grouping Likert items of the different attributes and criteria under the three dimensions: Effect on task performance, System Fit and System Usability. The scores were summed to give overall scores for the dimensions.

   The second category of data related to KVDs' Impact on value and Controllability ratings. In this case the average rating for each Likert item was calculated and used to sort the KVDs in terms of the magnitude of the ratings obtained.

   Analysis of survey data revealed that:

   i. The use of KVD is perceived to improve task performance by managers.
   ii. The current KVD model is easy to use.
   iii. There is good system-fit between the current KVD model and other business processes.
   iv. The MAUA ratings were not different on the basis of organizational roles (i.e. managers and superintendents)
   v. The MAUA ratings from respondents based on Mines were weakly correlated to those of respondents based on Smelters and the Corporate Office.
   vi. The KVD Controllability × Impact on value-creation were not different on the basis of either organizational roles of BU type.

2. A search of BHP Manganese business documentation was conducted to ascertain whether survey results were aligned to actual business practices. It was found that in addition to the mandatory use of KVDs in Planning the Manganese CSG formally uses KVDs in Business Improvement and Performance Management.

   The variance analysis that is used in BU and CSG performance reviews is based on drivers of Operating Profit that are aligned in terms of their perceived controllability and impact on value-creation with the results of the survey.

3. Semi-structured interviews were conducted with top managers from BHP Billiton Manganese who are involved in Strategic Planning and Implementation in order to check whether the concepts that were used in formulating survey questions are aligned to the concepts that are used by managers in their strategy discussions.

The interview results indicated that the managers used fewer concepts in their discussions than was used in the survey.

Interviewed managers confirmed the results of the survey regarding the groupings of KVDs based on their Controllability × Impact on value-creation ratings. KVDs that were rated highly in terms of both controllability and impact on value-creation were confirmed to be those that attract higher management attention in practice.

Overall there is good alignment amongst the results obtained using each of the three data collection methods. This alignment amongst the results enhances the overall confidence in the research findings that are going to be reported and discussed in Chapter 9.

9 CONCLUSIONS AND DISCUSSION

9.1 Introduction

The main aim of this research is to evaluate Key Value Drivers (KVDs) as a decision support tool for strategy implementation in BHP Billiton Manganese.

The evaluation methods used are subjective methods that rely on assessment of users' opinions on the strengths and weaknesses of the subject of evaluation (Adelman, 1992:7). The primary evaluation method used was an electronic survey questionnaire. In addition to the survey questionnaire an archival search of business documentation was conducted as well as semi-structured interviews with some top BHP Billiton Manganese managers.

The evaluation methods were based on a set of research hypotheses that were developed from a literature review on Decision Support Systems, Key Value Drivers, Business Intelligence and Evaluation Approaches in Business information Systems.

The aim of this chapter is, firstly, to report the key findings from the research, examine theoretical and practical significance of the findings and utilize the findings in making a conclusion regarding the research question.

9.2 Summary of Findings

9.2.1 Research hypothesis 1:

H_0: The use of KVDs has a positive effect on the task performance of BHP Billiton managers.

H_1: The use of KVDs does not have a positive effect on the task performance of BHP Billiton managers.

The results of the survey questionnaire indicated that the use of KVD has a positive effect on task performance of BHP Billiton managers (Table 8.4).

9.2.2 Research hypothesis 2:

H_0: The current KVD Model is aligned with other Mn business processes.

H_1: The current KVD Model is not aligned with other Mn business processes.

The results of the survey questionnaire indicated that the current KVD Model is aligned with other Mn business process (Table 8.5)

9.2.3 Research hypothesis 3:

H_0: The current MS Excel KVD Model is easy to use or has a high degree of usability.

H_1: The current MS Excel KVD Model is not easy to use or does not have a high degree of usability.

The results of the survey questionnaire indicated that the current MS Excel model is easy to use (Table 8.7)

9.2.4 Research hypothesis 4:

H_0: The current KVDs have a significant impact on value creation.

H_1: The current KVDs do not have a significant impact on value creation.

The results of the survey questionnaire indicated that current KVDs have varying degrees of impact on value creation (Table 8.8). KVDs that have the highest level of both Impact to value creation and Controllability are:

- *High Plant Availability*
- *High Plant Utilisation*
- *Safe Working Environment*
- *Healthy and Productive Workforce*
- *Production Volume (Ore and Alloy)*

9.2.5 Research hypothesis 5:

H_0: The current KVDs are controllable by managers.

H_1: The current KVDs are not controllable by managers.

The results of the survey questionnaire indicated that the current KVDs have varying degrees of controllability by managers (Table 8.9). The highest ranked KVDs in terms of Impact on value-creation and Controllability are listed in subsection 9.2.4 above.

9.2.6 Survey Questionnaire Construct Validity

The MAUA questionnaire as applied in this research measured what it purports to measure, namely, the subjective rating of the KVD model based on MAUA dimensions, criteria and attributes (Tables 8.13 and 8.14).

9.2.7 The Effect of Organizational Roles on Survey Results

There is no difference in the rating results of managers and superintendents to survey questions relating to research hypotheses 1-3 concerning:

1. *The effect of KVD on task performance.*
2. *The alignment of the KVD model with other business processes.*
3. *The usability of the current KVD model.*

There are no differences in perceptions of managers and superintendents of what the KVDs for BHP Billiton Manganese are (Table 8.26).

9.2.8 The Effect of Business Unit Type on the Survey Results.

All the three BU types, namely, Mines, Smelters and Corporate agreed with the following three null hypotheses:

1. *The effect of KVD on task performance.*
2. *The alignment of the KVD model with other business processes.*

3. *The usability of the current KVD model.*

However, there was significant difference in the level of agreement between the mines on one hand and the smelters and corporate on the other hand. The extent of agreement was higher in the case of mines for all the three hypotheses (Tables8.19 -8.24).

There are no significant differences in perceptions amongst Mines, Smelters and Corporate Office of what are the KVDs for BHP Billiton Manganese (Tables 8.27).

9.2.9 Archival Search

A review of BHP Billiton Manganese business documents revealed the following information:

1. *The use of KVDs is prescribed in the Resource Development Potential and the Life of Asset Group procedures. These two procedures are part of the prescribed BHP Billiton way of planning (CAP).*
2. *BHP Billiton Manganese uses KVD in the following business processes: Planning, Business Improvement (MIP), Short-term budgeting and Business Performance Management.*
3. *Operating Profit is used as a measure of BU performance. The drivers of variance in operating profit, in order of the magnitude of their impact, are: Product Price, followed by Sales Volume and then Cost of Goods Sold.*
4. *The perceived impact on value and controllability of the drivers of Operating Profit as measured in the survey is aligned to the variability of the KVDs in historical BU data.*

Analyses of data collected during semi-structured interviews with BHP Billiton Manganese top management revealed the following information:

1. *Managers' responses to the research hypotheses were aligned to the survey findings as summarized in 9.2.1 to 9.2.8 above (Table 8.36).*
2. *Managers used 17 out of 31 or 54.8 % of criteria and attributes that were used in formulating the survey questions. There were no differences in the rating distributions of the two groups of attributes (i.e. the ratings of*

attributes used in the explanations compared to the ratings of the attributes not used in the explanations: Table 8.38)

3. *The preliminary survey results were found to be aligned with the experience of the managers in the business.*

9.3 Conclusion

This thesis was based on a research proposition that it is possible to evaluate KVDs as a decision support tool for strategy implementation. The challenge in defining management concepts such as KVDs, Decision support tool and strategy implementation was the key hurdle to be overcome in designing a research strategy that could produce data that would allow examination of the research hypotheses and answering of the research question. The literature review and field studies that were undertaken as described in chapters 2 to 8 enabled the collection and analysis of data upon which the above findings were based.

Considering the above findings collectively, the conclusion of this research is that *Key Value Drivers (KVDs) are an effective decision support tool for strategy implementation in BHP Billiton Manganese.*

The above conclusion also confirms that the decision by BHP Billiton Manganese management to use KVDs as the basis of the Business Intelligence implementation was justified.

This research has thrust KVDs as a potential tool for integrating key business processes in BHP Billiton manganese, including but not limited to; Planning, Monitoring, Business Improvement and Performance Management. The integration of these key business processes is a key requirement for sustained success in strategy implementation.

9.4 Discussion of Findings

In this section we examine the findings and conclusions listed in sections 9.2 and 9.3 above with the view of further examining and reflecting on the answer to the question: Are Key Value Drivers an effective decision support tool for strategy implementation in BHP Billiton Manganese? The degree to which a research study accurately answers the question it was intended to answer is called the validity of that study (Gravetter and Forzano, 2006: 139).

The questions that will be considered in this section are:

1. What is the validity of this research study?
2. Are the findings consistent with reviewed literature?
3. What is the significance of the findings?
4. What are the limitations of the research strategy used?
5. Does the study unearth new areas of potential research?

9.4.1 Research Validity

The External Validity of this Research

External validity refers to the extent to which we can generalise the results of a research study to people, settings, times, measures and characteristics other than those used in the study (Gravetter and Forzano,2006:140).

<u>Generalization from the sample to the general population</u>: The population that the study sample sought to represent is BHP Billiton Manganese. The total number of employees in BHP Billiton Manganese is about 3650 of these about 140 are managers and superintendents. The survey questionnaire was sent to 90 potential respondents on the basis of their familiarity with the KVD model. 50 responses were received giving a response rate of 55.5 % of the users of the model. The results of the study are indicative for the population of 140 managers and superintendents in BHP Billiton Manganese.

The predominant research paradigm of this research was phenomenological and the objective of the study was to understand and explain phenomenon. Generalization in phenomenological studies is context-bound and is often limited to generalizing from one setting to another. The results of this study are therefore bound to the context of BHP Billiton Manganese.

<u>Generalization from a research study to the real world situation</u>: Except for some controls in sample selection there were no further constraints on the study that could have created an artificially controlled experimental environment that would cause the results of the study not to be directly applied in BHP Billiton Manganese. The controls in sample selection were that in the case of the survey,

respondents were selected on presumed familiarity with the KVD model and in the case of interviews, the managers selected were Functional leaders involved in strategy development and implementation monitoring.

The risk of Reactivity: Reactivity occurs when participants modify their natural behavior in response to the fact that they are participating in a research study. This risk was to a great extent mitigated against by the design features of the questionnaire, for example, multiple questions measuring a common attributes will be located at different parts of the questionnaire, the responses were anonymous unless the respondent wanted to reveal his/her identity and the questionnaire has a construct validity test that would detect attempts to deliberately return biased responses (see 9.2.6 above).

The internal Validity of this Research:

A research study has internal validity if it produces a single, unambiguous explanation for the relationship between study variables (Gravetter and Forzano, 2006:140).

Unlike studies under the positivist paradigm, phenomenological studies try to understand phenomena rather than identify law like generalizations. To mitigate the threats against internal validity, three data collection methods were used in order to be able to crosscheck the results that were obtained.

The MAUA questionnaire and the method for analyzing the questionnaire results were sourced from literature and the questionnaire is reported to have been subjected to validation studies (Adelman and Riedel, 1997: 250)

Construct Validity

Construct validity refers to the extent to which operationalization of a construct does actually measure what is intended .The MAUA questionnaire on which the survey was based has a built-in construct validity test as described in 8.3.2. The notion of construct validity can be extended to include the statistical analyses that were used with the test and the evidence that the findings are correlated with other measures that theoretically they are supposed to be correlated to.

Statistical Testing

Findings with respect to hypotheses 1-3, as listed in 9.2.1 to 9.2.3 above, were made directly from summation of the ratings obtained from the individual Likert items (questions). In summing attribute scores to obtain criteria scores, equal weightings were assigned to each attribute scores. Similarly when criteria scores were summed to obtain dimension (hypothesis level) scores equal weightings were assumed. There was no reason why each attribute and criteria should not be accorded equal importance.

The statistical tests for differences conducted with respect to hypotheses 1-3 were based on non-parametric tests because normality tests indicated that the dimension rating scores were not normally distributed (Table 8.15).

The aggregate "% Neutral" and "% I don't know" ratings for the whole questionnaire are 53.0 % and 12.9 % respectively (Table 8.13). This suggests that the respondents could not or would not give a subjective rating to over 65.9 % of the questions asked. Possible explanations to this high neutral rating include:

1. Low user awareness about the model. The respondents' knowledge of the KVD model and their experience as users is limited.
2. It could be a form of "reactivity" where the respondents settle for neutral response rather than give a negative response.

Managers were reluctant to posit any reasons for the high neutral response.

The sorting of KVDs in terms of the Impact on value-creation and Controllability ratings is a straightforward MS Excel data sort operation and plotting of the resultant scores on the grid (Fig 8.2) is fairly straightforward. The data for rating-averages for hypotheses 4 and 5 were found to be normally distributed (Table 8.25) hence the use of parametric tests for differences.

Questionnaire Evaluation Instruments

The design of the survey questionnaire was based on two different instruments both obtained from the literature survey.

1. Adelman and Riedel's (1997) Multi Attribute Utility Assessment method was the basis of the questionnaire design for testing hypotheses 1-3.The practice of using literature as a source of concepts and categories to be used in determining how a research variable is to be measured is widespread (Gravetter and Forzano,2006:65). The advantage of adopting this practice was demonstrated by the fact that the interview process with the managers managed to identify only 54.8% of the attributes that were obtained from literature. If an attempt was made to discover the concepts and categories from scratch, there would be a good chance that some of the concepts and categories that were not used by the managers (the other 45.2%) would have been omitted from the questionnaire.
2. The KVD Impact on value-creation and Controllability grid was also obtained from literature (L.E.K Consulting, 1977:3). The method as describe by L.E.K Consulting makes used of focus –groups and personal interviews to identify and rank the KVDs in order to construct the grid. In this research, the deployment of the method was improved by using an electronic platform to survey a large number of respondents at once and then using statistical analyses to test for differences among demographic units of the respondent sample.

Non-response bias

Non-response bias refers to the bias that exists when respondents to a survey are different from those who did not respond in terms of demographic or attitudinal variables (Sax, Gilmartin & Bryant 2003).

There are two sources of non-response bias namely total non-response and item non-response. Total non-response bias arises from respondents who did not respond to the survey in its totality whereas item non-response bias arises from respondents who did not respond to some items in the survey.

A response rate of 55.5 % was achieved in the survey questionnaire, implying a total non-response rate of 44.5 %. In order to establish the potential bias that can potentially arise from this non-response we need to have some demographic or attitudinal data of the non-respondents. In the case of this research, no follow-up surveys were conducted to profile the non respondents. The only data that is available is the distribution of non-respondents by business unit (Corporate 25%, Temco 37.5%, Gemco 69.2 %, Hotazel 31.8 % and Metalloys 68.4%).

The main strategy for mitigating the total non-response bias is to increase the response rate. Steps taken to increase the response rate were discussed in Chapter 7 under section 7.4.3 on Questionnaire administration.

Item non-response was dealt with by treating skipped questions as 'neutral ratings' as described in Chapter 8 under section 8.2.1 on Questionnaire data preparation. The drawback of this technique for dealing with item non-response is that it tends to reduce standard errors and enhance significance in statistical tests. This reinforces the need for caution in attempting to generalise the results of the survey.

Triangulation

The use of two secondary data collection methods, namely, archive search and semi-structured interviews, in order to check that the survey questionnaire results were aligned with past and present business practice.

9.4.2 Consistency of findings with reviewed literature

The objective of this section is to examine the extent to which the research findings are consistent with reviewed literature.

The research question of whether KVDs are an effective decision support tool for strategy implementation in BHP Billiton Manganese or not, arose in the context of a Business Intelligence project that was being implemented based on an untested theory that KVDs were an effective decision support tool for strategy implementation.

In order to answer the research question, a literature review was conducted under the headings: Decision Support Systems, Key Value Drivers, Business Intelligence and Evaluation Approach. The literature review process enabled the formulation of the research hypotheses that were used in answering the research question.

Users regard the current MS Excel KVD model as a Decision Support Tool. A number of definitions of a DSS were examined in the literature review (Gorry and Scott-Morton

(1971), Sprague (1980), Ginzberg and Stohr (1982) and Eom and Lee (1990)). The common theme of all the definitions is that a DSS supports managers in decision-making but does not replace them. The survey design was based on the assumption that the subject of evaluation is a "decision-aiding system" and the attributes that were in the questionnaire were compiled from literature (Adelman and Riedel, 1997: 245). No suggestion was made in the interviews or any evidence found during the archive search that there was an expectation that the KVD model should be used to replace rather than support managers, for example, by using the model as a component in plant automation systems.

The benefits of using the KVD model are in line with DSS benefits reported in literature. Money et al (1988:226) listed the following categories of DSS benefits from literature : Clerical benefit, Management time utilization benefit, Decision-making benefit, Problem-appreciation benefit, Data utilization benefit, Planning and control benefit, Decision search benefit and Communication benefit. The scope of the survey questionnaire covered all the above benefits. In the interviews, two managers were critical of the KVD model's data management capability. The model relies on data from many sources and there is no data quality management standard that is in force at the moment. The reliance on numerous data sources makes the maintenance of the model difficult and increases the probability of compromising the integrity of the data.

The findings that there were no differences in perceptions based on organizational roles (managers and superintendents) and Business Unit types (Mines, Smelters and Corporate Office) with respect to the effect of KVDs on task performance, the alignment of the KVD model with other business processes and the usability of the current KVD model, meet the criteria set by Sprague (1980) for DSS objectives. Sprague (1980) suggested a DSS should provide decision-making support for managers at all levels assisting in integration between levels where possible and furthermore a DSS should support decisions that are independent (BU specific) and interdependent (across BUs).

The findings that the use of the KVD model has a positive effect on task performance and that the KVD model is aligned with other business processes collectively suggest that the dominant decision making approach in BHP Billiton Manganese is the rational approach. The usefulness of the KVDs is in mitigating some of the shortcomings of the rational approach to decision-making (Daft, 2006):

1. KVDs standardize and reduce the amount of information that managers need to consider in decision-making.
2. KVDs enable managers to reduce complex problems into simple basic components that they can focus on to resolve the (bigger) problem.

The usefulness of KVDs in supporting a rational approach to decision-making should not obscure the fact that the identification process for KVDs used for the current KVD model in BHP Billiton Manganese was partly intuitive in nature. Financial and Process drivers were obtained directly from financial statements and process flow-sheets , other drivers such as HR and HSEC drivers which cannot be directly linked to financial outcomes were largely derived based on managerial judgement. The current KVD model is therefore also a means of institutionalising intuitive decision-making, making it possible to develop heuristics for decision making under frequently encountered decision situations. Jones and George (2006) cautioned against over-reliance on heuristics as these may lead to systematic errors that may result in bad management decisions. The current research and the findings produced can be viewed as a necessary check to ensure that the KVDs are fulfilling the purpose for which they were originally intended.

The first three research hypothesis sought to test perceptions of managers on the effectiveness and usability of the KVD model as a decision-support tool for strategy implementation. The last two research hypotheses were concerned with the KVDs themselves, i.e. their perceived impact on value-creation and controllability.

The findings that there were no differences in perceptions based on organization roles and Business Unit types with respect to the perceived KVD impact on value creation and controllability is important in ensuring that the KVD model enjoys credibility throughout BHP Billiton Manganese. In the literature review it was highlighted that the definition and measurement of value is important because of the requirement to align the goals of the principals and the agents and to ensure that principals can set performance criteria that will ensure that managers behave like owners (Eisenhardt, 1989:58). Larmande and Ponssard (2007:1) suggested that successful implementation of EVA depended on both congruity and controllability of performance measures.

The finding that BHP Billiton managers have similar perceptions of the value impact of KVDs means that there is high possibility for goal congruence. The analysis of BU data did confirm the existence of congruence or congruity (Larmande and Ponssard, 2007) in terms of how the measurement of value-creation and performance is cascaded from BU level to BHP Billiton Group level through a number of review and appraisal meetings (Table 8.29).

The finding that the KVDs are controllable does not imply that they are actually controlled, but indicates that the process of negotiating and contracting on performance measures would have credibility because contracting parties believe that the variables are controllable. According to Larmande and Ponssard (2007:4); ‘the literature on controllability ordinarily focuses on the noise in the performance measure itself.’ This noise may come from external as well as internal sources. The BU data on Operating Profit variance can also be explained in terms of noise factors on the three drivers of this variance, namely, Product Price, Sales Volume and Product Cost. Product Prices are strictly speaking not controllable by one company in the presence of other market participants as discussed in Chapter 1. The noise factors that affect sales volume could arise from market, the distribution channels and internally from decisions that managers make. Noise factors that affect Product cost can also arise externally, e.g. Input costs or internally from process and policy inefficiencies.

Controllability and impact on value-creation were the two defining characteristics of KVDs that were identified from literature (L.E.K Consulting, 2007) and were used as measurement variables in this study. Considering table 8.28 the KVDs that were rated low in terms of both controllability and impact on value-creation, are therefore strictly speaking, not KVDs in terms of the above criterion. The bottom five KVDs from table 8.28 are Power costs, Distribution costs, Gross product price, Water costs and Exchange rate. There are no objective criteria for determining the cut-off point in the ratings in order to decide what to include or exclude as a KVD and management would have to apply subjective judgment to the ratings in table 8.28 in order to make a determination.

Implementation studies on VBM and EVA emphasised the use of KVD in Performance Monitoring and Rewards Management whilst this study also examined the use of KVD in Strategic Planning and Implementation. The implementation of a Business Intelligence solution designed on the basis of KVD is aimed at improving business performance by ensuring that managers have relevant information required for business processes under their control, including but not limited to Strategic Planning, Implementation and Performance Monitoring. This is in agreement with Sprague’s (1980:4) assertion that “improving performance is the ultimate objective of information systems”. The evaluation of KVDs as a decision support tool should therefore be viewed in terms of the current KVD model's ability to support the improved performance of people in organizations. The BHP Billiton Manganese KVD model acts as a common integrator amongst a number of business systems and in this way improves the performance of people in the organization as a whole.

The literature review on KVDs dealt with approaches to KVD identification.Initial approaches to identifying KVDs were from a Management Accounting perspective (Horrigan,1968), Chenhall and Langfield-Smith(2007)) followed by other Functional Approaches such as Operations Management, Marketing and Human Resources (Chenhall and Langfield-Smith(2007)). The third approach to KVD identification is based on Integrated Performance Frameworks such as the Balanced Scorecard (Kaplan and Norton,1992), Performance Prism (Neely,2004) and the more than 70 Business Excellence frameworks that exist around the world (Bell,2002). Integrated performance frameworks emerged after the realization by managers that financial measures on their own were not adequate for effective management and piece-meal addition of other functional measures did not address the cross-functional effects amongst the measures.

From table 8.28 it can be seen that four of the top ten KVDs rated are non-financial KVDs. There are no objective criteria of what the ratio of financial to non-financial KVDs should be. The research findings (management interviews) do indicate that there is awareness that a balance is necessary between financial and non-financial drivers. The results of the interview with managers suggested that Top Management were of the view that People related and BHP Billiton Group KVDs were generally underrated in the survey (subsection 8.5.2).

There was alignment between survey and interview results on the assertion that the current Excel KVD model is easy to use. However, the survey results also indicate that the highest % Disagree and the lowest % Agree ratings were both recorded against the System Usability dimension of the questionnaire (Tables 8.4, 8.5 and 8.7). In particular, the "Ease of Training" and "Human Factor Guidelines" criteria received 9.1% and 8.0% Disagree ratings respectively. The following two points were raised in the management interviews (subsection 8.5.2 item 3):

- Ease of Training: There is no formal training material for the model. There is no on-line help for users and the system documentation is generally not available to users.

- Ease of data entry: The Model is difficult to maintain because it relies on a large number of data sources. The quality of data is not consistent across all businesses and data sources are not always known.

The above findings are consistent with literature on how Business Intelligence evolved from earlier versions of DSS. Power (2003) classified DSS progressively from Decision Sciences dominated DSS, to Model-driven DSS, then Data-driven DSS and more recently, Web enabled DSS. The shortcoming of most of the traditional DSS is that they are application specific and can become overly complex if they are extended to cover multiple applications (Williams and Williams, 2007:5).The KVD model started as a Management Reporting tool that was meant to be used by a limited number of senior managers. Over time, the use of the model extended to other areas such as Business Improvement and the number of users also increased significantly. The increase in the number of uses and users of the model resulted in the surfacing of the shortcomings of the model such as those highlighted in the interviews with management. These shortcomings in turn triggered investigations that led to the conception of the BI Project. According to Davenport and Harris (2007:8), the triggers for a BI requirement are often manifested at operational and tactical levels, as was the case for BHP Billiton Manganese where the key trigger was the desire to simplify the month-end reporting process.

The inability to perform required tasks using the KVD model is possibly due to the lack of formal training and lack of on-line help on the model, but can equally be because the system does not have the required functionality.

The difficulty associated with data entry and model maintenance can be addressed by implementation of modern data warehousing and data integration platforms as part of the BI project.

The resolution of the above two issues will increase the ease of use of the current model, but it is not the "end state" in the case of a BI implementation. As the business matures in the use of BI more strategic information needs should emerge, such as the need for statistical modelling, forecasting and predictive modelling (Davenport and Harris, 2007).The use of more sophisticated BI tools can therefore be expected as users become more proficient in the Microstrategy BI platform. Similarly the perceptions of Top Management regarding how the use of KVDs support strategy implementation can be expected to expand to include more and more of those attributes and criteria that currently do not feature in their explanations, for example, the use of colour in reports, data quality management and on-line help and training functionality.

The research method was developed based on what was required to test the research hypothesis (section 7.2.2).In the same way the findings should be understood in the context of the research method that was used to obtain them.

The aim of this research was to evaluate KVDs as a decision-support tool. Adelman (1992:187) stated that the objective of evaluation in the context of an Information System Implementation (the BI implementation in this case), is to provide feedback to the developers and sponsors in order to implement corrections and enhancements. The findings can be used to design enhancements that are implementable by both developers and sponsors, for example, developers could identify enhancements that will simplify data entry and maintenance of the data management component of the BI systems. Sponsors could develop strategies for increasing user awareness of the system capability and more formalised training material on KVDs. Kivijarvi (1987:16) stated that “early implementation (Information System Projects) studies data was collected mainly from specialists, designers and modellers. Now, in a large number of empirical studies data is collected from the users of models.” The data collection approach that was adopted in this study is in line with the trend of involving users of information systems in the design of these systems and thus bridging the divide between the purely technical view of information system development and a view that is more functional or application oriented.

An important feature of the research method was the use of three different methodologies for data collection, namely, a survey questionnaire, semi-structured interview and archival search. Pinsonneault and Kraemer (1993:97) conducted a survey on the use of survey-research in Management Information Systems between 1980 and 1990 and reported that 10% of the studies using survey-research used multiple methods for triangulation. The use of triangulation in this study should increase the confidence that can be placed on the overall result.

Abernethy et al (2005) published a paper on the use of a multi-method approach for building a performance management model instead of using a top-down approach that is common in most balanced scorecard implementations. Abernethy et al’s (2005) multi-method approach used the following three methods:

1. Computerized analysis of thematic links in interview transcripts of employees (not just top managers)
2. Ethnographic analysis of interview data
3. Interactive mapping by expert participants.

Although the above methods are not identical to those used in this research, what is common is the finding by Abernethy et al (2005:17) that “none of the three methods used in the study, by itself, revealed the complexities” of the measurement variables and the relationships amongst them.

At this stage, we have reviewed the empirical research findings in the light of the literature that was reviewed during the literature review stage. We are now able to express an opinion regarding the last research objective on whether the empirical findings of this study support or conflict the findings that would be expected from reviewed literature. *The empirical results obtained in the course of this study are generally aligned with what can be expected from the literature.*

The findings of this research are going to be used to answer the research question through an inductive process. Qualitative research is often associated with decision-making by induction (Ghauri and Grønhaug,2005:14).This means, notwithstanding that all the research null hypotheses were accepted, we can never be 100% sure that our answer to the research will always be true .In particular business requirements are always evolving and information technology is also improving at a very fast pace.

9.4.3 Significance of the findings

Theoretical Significance

1. This study was the first systematic study of KVDs and their role in strategy development and implementation. The study has created a theoretical framework that integrates many important business processes that exist in BHP Billiton Manganese :
   i. The study has examined the evolution of Decision Support Systems (DSS) into modern day Business Intelligence (BI) systems and how the BHP Billiton Manganese BI implementation can be used to support different types of business decisions.

ii. The BHP Billiton Corporate Alignment Process (CAP) was examined in the context of Daft's (2006:469) Contingency Decision-Making Model. This provides a potential external resource for CAP sub- process design and benchmarking.

iii. KVDs were examined in relation to Planning, Business Improvement, Performance Management and Business Information Systems.

iv. The survey has provided BHP Billiton with additional concepts and categories of concepts that can be incorporated in other evaluation tools.

2. The study has provided a bridge between the "hard and soft systems" perspectives of information technology (Goede and De Villiers, 2003).The BI implementation project, the Manganese Improvement Process, CAP, Performance Management and other business processes can use KVDs as a common integrator. The evaluation dimension of "System Fit" highlights the role of Information Systems as an enabler for enhancing employee performance.

Practical Significance

1. The study confirms that BHP Billiton Manganese decision to implement a Business Intelligence system designed on the basis of KVDs was justified. A BI system designed on the basis of KVDs will be able to support other business processes such as Planning, Performance Management and Business Improvement.
2. The study provides the company with a more comprehensive framework for evaluating the KVD model. This evaluation framework can be used for other Management Information systems with little no modification. This is important in the light of the results of semi-structured interviews that show that in the absence of a formal evaluation framework managers used just over 50 % of the criteria that are already available in literature.
3. The study provides the company with an efficient method of assessing which KVDs are regarded as having high impact on value-creation and controllable by managers.

4. The subjective evaluation process that was used in this study can be used as a complementary process to the technical evaluation procedures that are used to evaluate Information Systems project implementations.
5. The results of the study highlight areas where managers can focus on in order to make improvements:
    a. The current training and system support given users of the KVD model is inadequate. Usability related attributes in general received more negative ratings than Effect on Task Performance and System Fit attributes. Training interventions that should be used in this case should highlight the available functionality that users maybe unaware of and additional performance assessment criteria such as those used in the survey.
    b. The high percentage of “Neutral” and “I don’t know” suggests that more awareness training may be beneficial. The effectiveness of communication being used in CAP, MIP and BI require to be reevaluated as all these systems include the use of KVDs. Training offered in this case should integrate business process training (CAP, MIP and so on) with business information system training(KVDs and BI/Microstrategy)
    c. The variance analyses results suggest that BUs should focus their attention on Management/Control of Production Volumes and Cost of Goods Sold (in that order) in view of the fact that BHP Billiton Group Marketing Manages the Net Product Price of the Ores and Alloys.
    d. The Value-creating impact of Non-financial KVDs needs to be communicated more explicitly so that required attention is also paid to Human Resources (HR), Health, Safety, Environment and Community (HSEC) and BHP Group KVDS. In this case, what may be required are long-term culture change interventions rather than once-off training interventions.
    e. The current list of KVDs evolved from what was being used and there is no guarantee that all other functional KVDs are included as evidenced in the interviews when it was pointed out that the Information Technology Functional KVDs were missing.

f. The perceptions of Managers and Superintendents from all BUs are aligned on what the KVDs are and the KDVs' effect on task performance, ease of use and alignment with other business processes.

9.4.4 Limitations of the Research

The findings of this research were made in the context of the deployed research strategy. The following are limitations to how the findings can be interpreted and used:

1. Research Sample: The research was conducted in one sample, namely, BHP Billiton Manganese, and therefore the applicability of the findings is limited to BHP Billiton Manganese.
2. Cross-sectional study: The data collection was done at a specific period, namely, between November 2009 and April 2010. The incumbents in roles surveyed change due to normal personnel turnover and therefore the subjective ratings might change over time. The KVDs and their impact to value-creation and controllability may also change over time depending on the business environment and the company's operating model. The applicability of the results is therefore limited to the current context.
3. Qualitative method: The method used is predominantly qualitative and therefore the findings are used inductively to arrive at the overall research conclusion. It is possible that future studies may invalidate one or more of the findings and weaken the overall research conclusion.

9.4.5 Potential for Further Research

Further research in the following areas may be considered as a result of the findings of the current research:

1. The research can be extended to other BHP Billiton Customer Sector Groups in order to obtain results that could be applicable to BHP Group or even the entire resources industry.
2. The methodology can be refined for general use in evaluating Business Information Projects.
3. The research can be repeated at future intervals to develop a longitudinal business profile.

9.4.6 Closure

The above discussions on the findings and conclusions indicate that within the acknowledged limitations of this research, the main conclusion that Key Value Drivers are an effective decision support tool for strategy implementation in BHP Billiton Manganese is justifiable. The value of any enquiry is not solely in the answers produced, but in new questions posed. This research has opened a new exploration field for further research in BHP Billiton.

10 APPENDICES

Appendix 7.1 Interview Pack

Evaluation of KVDs as a decision support tool for strategy implementation in BHP Billiton Manganese - Interview Matrix

Name :	
Role in BHP Billiton Mn :	
Interview Date :	

Research Hypothesis		Notes
1. Does the use of KVD have a positive effect on task performance?	a. Yes or No? b. Describe and/or explain how?	
2. Is the current KVD Model aligned with other Mn Business Processes?	a. Yes or No? b. Describe and/or explain how?	
3. Is the current KVD Model easy to use?	a. Yes or No? b. What can be done to improve the model's Usability?	
4. Do **all** the current KVDs have a significant impact on value creation?	a. Yes or No? b. Which KVDs have high/moderate/low impact c. What is your understanding of 'Value'?	
5. Are **all** the current KVDs controllable by managers?	a. Yes or No? b. Which are highly/moderately or lowly controllable? c. What is your understanding of 'controllability'?	

Other Comments regarding above 5 questions		
Survey Results		**Notes**
What are your comments on the KVD Impact vs. Controllability Matrix?	a. Is the matrix aligned with your experience in the business? Explain	
What are your comments on the balance amongst KVD types?	a. People related vs. Process related KVDs. b. Functional KVDs? c. KVD associated with leading and lagging performance indicators d. Group, CSG and BU related KVD.	
Comment on the extent of use of the KVD models in the different BU?	What can be done to improve understanding of the use of KVDs?(and reduce the number of "I don't know responses"	
Other comments you have on the survey results.		

BHP Billiton Manganese KVD Controllability vs. Value Impact

Controllability \ Impact on Value	(Low)			(High)
(High)	**Compliance with Group Level Documents** **Positive Industrial Relations Climate**	**High Employee Morale** **Innovation** **Number of improvement initiatives**	**Labour Productivity** **Effective HSEC Systems** **High Mobile Equipment Utilization**	**High Plant Availability** **High Plant Utilization** **Safe Working Environment** **Healthy and Productive Workforce** **Production Volume (Ore and Alloy)**
	Absenteeism Time to resolve a grievance or disciplinary case Effective HR Processes	Effective Knowledge Management System Effective Business Intelligence System Product Tons per Employee	High Process Unit Efficiency Product Grade (Alloy) Capital Expenditure High Mobile Equipment Availability Effective Project Management (PPM)	Production Cost ($/mtu) Production Cost per product Type Production Cost per Process Unit
	Number of Grievances Positive Community Relations Effective Office Information Management System Time spent on Training Shifts Lost to Strikes Community Social Investment Spent Cost per Employee	Effective ERP System (SAP) Raw Material Inventory Sustainable use of Natural Resources Labour Turnover (%) Product Inventory		Production Cost (local currency/ton)
(Low)	Time to fill vacant positions Water Cost	Distribution Cost (USc/mtu) Payroll cost per ton of product produced	Power Costs Gross Product Price Raw Material Cost Exchange Rate (local currency to USD) Product Mix Operating Margin (USc/mtu)	Operating Profit Product Grade (Ore) Sales Volume (Ore and Alloy) Net Product Price (Gross P – Distr Cost)

QUESTIONNAIRE RESULTS SUMMARY SHEET

Overall Utility-Questionnaire			
% Agree	% Neutral	% Disagree	% Don't Know
28.1	53.0	6.0	12.9

0.0 Overall Utility			
% Agree	% Neutral	% Disagree	% Don't Know
33.7	53.7	3.4	9.1

1.0 Effect on Task Performance			
% Agree	% Neutral	% Disagree	% Don't Know
30.0	53.6	4.7	11.8

1.1 Process Quality			
% Agree	% Neutral	% Disagree	% Don't Know
29.1	54.2	5.5	11.3

1.2 Product Quality			
% Agree	% Neutral	% Disagree	% Don't Know
31.4	52.6	3.4	12.6

2.0 System Usability			
% Agree	% Neutral	% Disagree	% Don't Know
25.8	52.4	7.2	14.6

2.1 General Ease of Use			
% Agree	% Neutral	% Disagree	% Don't Know
30.0	46.0	7.3	16.7

2.2 Flexibility			
% Agree	% Neutral	% Disagree	% Don't Know
32.0	50.0	6.0	12.0

2.3 Ease of Training			
% Agree	% Neutral	% Disagree	% Don't Know
20.9	54.0	9.1	16.0

2.4 Human Factors Guidelines			
% Agree	% Neutral	% Disagree	% Don't Know
23.5	52.9	8.0	15.5

2.5 Workload			
% Agree	% Neutral	% Disagree	% Don't Know
28.7	54.0	6.7	10.7

2.6 Function allocation Person/Machine			
% Agree	% Neutral	% Disagree	% Don't Know
30.0	53.0	5.0	12.0

2.7 Quality of User's Mental Model of System			
% Agree	% Neutral	% Disagree	% Don't Know
33.0	51.5	3.0	12.5

3.0 System Fit			
% Agree	% Neutral	% Disagree	% Don't Know
30.9	53.5	5.1	10.5

3.1 Fit with User			
% Agree	% Neutral	% Disagree	% Don't Know
27.7	56.0	4.3	12.0

3.2 Fit with Organization			
% Agree	% Neutral	% Disagree	% Don't Know
32.8	52.0	5.6	9.6

KVD CLASSIFICATION

Primary KVD : High Value Impact and High Controllability
High Plant Availability High Plant Utilization Safe Working Environment Healthy and Productive Workforce Production Volume (ore and Alloy)
Production Cost ($/mtu) Production Cost per product type Production Cost per Process Unit
Labour Productivity Effective HSEC Systems High Mobile Equipment Utilization
High Process Unit Efficiency Product Grade (Alloy) Capital Expenditure High Mobile Equipment Availability Effective Project Management (PPM)

Secondary KVD : High Impact/Moderate Controllability and High Controllability/Moderate Impact
Production Cost (local currency/ton)
High Employee Morale Innovation Number of improvement initiatives
Effective Knowledge Management System Effective Business Intelligence System Product Tons per Employee

Tertiary KVD : Moderate to High Controllability and Low Value Impact (High Opportunity-Low Risk)
Compliance with Group Level Documents Positive Industrial Relations Climate
Absenteeism Time to resolve a grievance or disciplinary case Effective HR Processes

Tertiary KVD : Moderate to High Value Impact and Low Controllability (High Risk-Low Opportunity)
Operating Profit
Product Grade (Ore)
Sales Volume (Ore and Alloy)
Net Product Price (Gross P – Distribution Cost)
Power Costs
Gross Product Price
Raw Material Cost
Exchange Rate (local currency to USD)
Product Mix
Operating Margin (USc/mtu)

Tertiary KVD : Moderate Value Impact and Moderate Controllability
Effective ERP System(SAP)
Raw Material Inventory
Sustainable use of Natural Resources
Labour Turnover (%)
Product Inventory

Noise : Low Value Impact and Low Controllability
Number of Grievances
Positive Community Relations
Effective Office Information Management System
Time spent on Training
Shifts Lost to Strikes
Community Social Investment Spent
Cost per Employee
Time to fill vacant positions
Water Cost
Distribution Cost (USc/mtu)
Payroll cost per ton of product produced

Appendix 8.1: KVD Impact on Value Ratings

Based on your own judgment, rate the following Key Value Drivers in terms of their impcat on value creation in BHP Billiton Manganese. A rating of 1 means the KVD has a low value creation and a rating of 7 means the KVD has a high impact on value creation.

Answer Options	Low impact on value			Medium impact			High impact on value	I don't know	Rating Average
Production Volume (ore or alloy)	1	1	0	2	6	14	19	0	6.00
Production cost ($/mtu)	1	1	0	1	4	12	24	0	6.21
Exchange Rate (local currency to USD)	3	2	1	3	3	12	15	4	5.49
Production Cost (local currency/ton)	0	1	2	1	8	13	18	0	5.95
Distribution Cost (Us/mtu)	2	2	2	3	8	15	7	4	5.21
Net Product Price(Gross Product Price- Distribution	1	1	1	2	7	15	15	1	5.81
Gross Product Price	1	1	1	8	1	16	13	2	5.61
Product Grade (Ore)	0	0	2	2	5	12	19	3	6.10
Product Grade (Alloy)	0	1	2	5	6	14	13	2	5.68
Product Inventory	1	0	4	9	10	8	10	1	5.17
Sales Volume (ore or alloy)	1	0	1	3	6	12	19	1	5.98
Product Mix	1	0	3	4	11	13	10	0	5.45
Operating Profit	0	0	1	2	3	18	18	0	6.19
Operating Margin(USc/mtu)	1	1	3	3	8	14	10	2	5.45
Raw Material Inventory	2	0	2	7	15	11	6	0	5.09
Production Cost per Product Type (e.g. $/ton HCFeMn	1	2	1	1	5	16	15	2	5.80
Production Cost per Process Unit ($/ton cost for a	0	0	1	5	3	20	13	1	5.93
Capital Expenditure	0	0	0	6	14	13	10	0	5.63
High Plant Availability	1	0	0	1	1	19	19	1	6.27
High Plant Utilization	0	0	1	2	3	19	17	0	6.17
High Mobile Equipment availability	1	1	1	4	7	15	12	1	5.63
High Mobile Equipment utilization	1	1	1	5	7	22	6	0	5.47
High Process Units' Efficiencies (e.g. yields, recycle	1	1	0	4	9	12	15	1	5.74
Raw material costs	1	2	1	4	7	14	12	2	5.54
Power Costs	1	0	5	4	6	5	21	1	5.69
Water Cost	3	7	6	9	5	8	2	2	3.95
High employee morale	0	4	1	7	9	11	10	1	5.24
Positive Industrial Relations Climate	0	2	2	15	9	10	4	1	4.83
Effective HR Processes	0	3	1	14	8	11	4	1	4.85
Labor Productivity	0	0	0	7	10	14	10	1	5.66
Cost per employee	3	2	2	9	10	12	5	0	4.79
Payroll cost per ton of product produced	3	1	3	7	10	10	8	1	4.95

Product tons per employee	3	1	3	3	13	12	7	1	5.05
Labor Turnover (%)	1	3	2	8	13	8	6	1	4.88
Absenteeism	1	4	6	11	11	6	3	1	4.36
Shifts lost to strikes (%)	5	3	5	8	4	6	8	3	4.36
Number of Grievances	0	14	5	15	2	4	2	1	3.60
Time to fill vacant positions	1	2	6	14	8	5	6	1	4.55
Time to resolve a grievance or disciplinary case	4	8	7	7	7	6	2	2	3.76
Time spent on training (%)	0	6	5	11	10	8	3	0	4.42
Effective Knowledge Management Systems	0	1	2	9	13	13	5	0	5.16
Innovation	0	3	1	9	15	9	5	1	4.98
Safe working environment	0	1	4	2	2	6	27	1	6.12
Healthy and Productive Workforce	0	1	1	4	5	16	14	1	5.85
Effective Health, Safety, Environmental and	0	2	3	3	8	12	13	1	5.56
Sustainable use of Natural Resources	1	2	3	10	6	10	8	3	5.00
Positive Community Relations	1	5	2	12	11	10	1	1	4.45
Community Social Investment Spent	1	3	8	14	11	4	1	1	4.12
Number of improvement initiatives	1	4	2	5	13	15	3	0	4.91
Effective ERP System (SAP)	0	2	1	6	10	16	5	2	5.30
Effective Project Management System (PPM)	1	1	2	5	13	7	13	1	5.40
Effective Business Intelligence System	0	1	3	8	9	16	6	0	5.26
Effective office Information Management System	0	4	3	13	8	12	2	1	4.64
Compliance with Group Level Documents	2	4	6	8	7	10	5	1	4.52
									answered question
									skipped question

Appendix 8.2 : KVD Controllability Ratings

Rate the following KVDs on a scale of 1 -7 in terms of your judgment on how much control Manganese personnel have over them. A rating of 1 means personnel have low contr KVD and a rating of 7 means personnel have hign control over the KVD.

Answer Options	Low personnel control			Medium personnel control			High personnel control	I don't know	Rating Average
Production Volume (ore or alloy)	1	2	1	4	10	14	5	1	5.22
Production cost ($/mtu)	1	2	3	9	4	13	5	1	4.95
Exchange Rate (local currency to USD)	26	4	2	2	0	2	1	1	1.81
Production Cost (local currency/ton)	1	3	3	7	11	9	3	1	4.70
Distribution Cost (Us/mtu)	12	7	5	5	3	3	1	2	2.81
Net Product Price(Gross Product Price- Distribution	10	7	5	7	2	2	2	3	2.94
Gross Product Price	19	4	5	5	0	2	2	1	2.38
Product Grade (Ore)	7	2	5	6	7	9	2	0	4.03
Product Grade (Alloy)	2	3	2	6	7	12	4	2	4.81
Product Inventory	2	7	5	8	6	6	4	0	4.13
Sales Volume (ore or alloy)	10	8	3	4	5	7	0	1	3.19
Product Mix	2	9	5	6	3	9	4	0	4.11
Operating Profit	4	2	4	12	7	5	2	2	4.08
Operating Margin(USc/mtu)	3	3	5	12	6	3	4	2	4.11
Raw Material Inventory	3	5	4	4	9	7	6	0	4.47
Production Cost per Product Type (e.g. $/ton HCFeMn	1	3	1	8	8	13	3	1	4.89
Production Cost per Process Unit ($/ton cost for a	1	3	2	8	7	10	6	1	4.92
Capital Expenditure	1	4	2	7	8	9	7	0	4.89
High Plant Availability	0	0	2	3	8	15	8	1	5.67
High Plant Utilization	1	0	0	3	9	17	8	0	5.68
High Mobile Equipment availability	3	0	4	2	9	13	6	1	5.08
High Mobile Equipment utilization	2	0	3	2	8	16	7	0	5.37
High Process Units' Efficiencies (e.g. yields, recycle	1	2	1	9	13	6	5	1	4.86
Raw material costs	10	12	3	3	3	4	1	1	2.81
Power Costs	16	6	2	7	1	2	2	1	2.58
Water Cost	11	8	4	5	4	5	0	1	2.95
High employee morale	0	0	3	6	6	10	13	0	5.63
Positive Industrial Relations Climate	1	0	1	8	9	11	7	1	5.30
Effective HR Processes	2	2	5	3	10	7	8	1	4.89
Labor Productivity	0	1	2	2	9	10	13	0	5.73
Cost per employee	1	5	6	7	8	8	3	0	4.37
Payroll cost per ton of product produced	4	6	4	5	7	8	3	1	4.11

Answer Options	Low personnel control			Medium personnel control			High personnel control	I don't know	Rating Average
Product tons per employee	1	3	2	7	10	12	3	0	4.84
Labor Turnover (%)	4	2	7	10	5	3	6	0	4.16
Absenteeism	1	2	4	6	6	8	11	0	5.16
Shifts lost to strikes (%)	5	2	2	7	5	9	6	1	4.56
Number of Grievances	1	1	4	13	6	7	6	0	4.76
Time to fill vacant positions	4	4	8	6	5	8	3	0	4.05
Time to resolve a grievance or disciplinary case	3	1	2	9	9	8	6	0	4.79
Time spent on training (%)	1	5	1	8	9	8	6	0	4.76
Effective Knowledge Management Systems	3	1	7	4	7	11	5	0	4.68
Innovation	0	0	2	5	12	10	8	0	5.46
Safe working environment	0	0	1	2	6	9	20	0	6.18
Healthy and Productive Workforce	1	0	2	7	8	11	8	0	5.32
Effective Health, Safety, Environmental and	1	1	3	5	9	9	10	0	5.29
Sustainable use of Natural Resources	1	5	5	6	7	9	1	3	4.29
Positive Community Relations	1	0	6	10	7	10	3	0	4.73
Community Social Investment Spent	4	3	10	3	5	8	5	0	4.21
Number of improvement initiatives	0	2	0	6	5	14	10	1	5.59
Effective ERP System (SAP)	5	5	2	8	6	6	5	1	4.16
Effective Project Management System (PPM)	3	0	1	6	9	14	3	1	5.00
Effective Business Intelligence System	1	1	4	10	8	9	4	1	4.78
Effective office Information Management System	3	2	2	11	5	6	9	0	4.76
Compliance with Group Level Documents	1	0	2	4	10	7	14	0	5.61

Appendix 8.3 Detailed Responses to MAUA questions

Rate the following statements on a scale of 1 to 7 where 1 indicates Strong Agreement and 7 indicates Strong Disagreement:

Answer Options	Strongly Agree			Neither agree nor			Strongly Disagree	I don't know	Rating Average
1 The KVD model fits in well into our Management	6	6	10	7	1	1	0	2	2.81
2 The KVDs facilitate the flow of information in BHP	4	8	12	4	2	1	0	2	2.84
3 I can obtain sufficient on-line help on how to use	2	4	5	7	2	6	2	5	4.04
4 Other people in BHP Billiton Manganese will support	2	12	6	9	0	0	1	3	2.90
5 The KVD model is cost-effective because the	1	8	7	9	1	0	0	6	3.04
6 I don't have to exert much mental effort to use the	2	6	7	7	5	0	0	6	3.26
7 The displayed results of the KVD model are easy to	3	8	7	5	3	0	0	7	2.88
8 The KVD model has been designed to match the	1	4	10	9	2	2	0	5	3.46
9 It is easy to form a mental picture of how the KVD	4	6	11	7	1	0	0	4	2.83
10 I think our operational version of the KVD model is	3	3	9	9	3	1	0	4	3.32
11 The current KVD Model responds quickly to user	1	2	10	8	1	2	0	8	3.50
12 The use of KVD is consistent with the BHP Billiton	2	8	10	8	0	1	0	4	2.97
13 The KVD are using the right data for controlling	1	5	11	7	0	4	0	5	3.43
14 The displayed results of the KVD model are easy	2	9	8	4	1	1	0	7	2.84
15 The KVD model helps to prevent errors in	1	6	7	8	2	2	1	6	3.52
16 Overall, the KVD Model provides me with useful	6	5	7	7	0	0	1	7	2.77
17 Using KVD I can analyze business performance	4	5	8	8	0	1	1	6	3.07
18 The KVD model supports all the tasks that require	3	4	7	8	2	1	1	7	3.35
19 The KVD system provides adequate feedback on	2	2	7	10	2	1	0	9	3.46
20 The KVD are a valuable tool for implementing our	2	10	8	6	0	1	0	6	2.81
21 The KVD layouts (KVD Trees) are similar for	3	3	8	8	0	1	1	9	3.25
22 The KVD model requires no re-training for	2	4	4	9	2	2	1	9	3.63
23 The KVD model does not increase the workload for	4	2	4	9	4	2	1	7	3.65
24 I do not have to memorize commands on how to	3	5	6	10	2	0	1	6	3.26
25 The KVD trees use colour in an intuitive way (e.g.	4	9	5	6	2	0	0	7	2.73

Rate the following statements on a scale of 1 to 7 where 1 indicates Strong Agreement and 7 indicates Strong Disagreement:									
Answer Options	Strongly Agree			Neither Agree nor Disagree			Strongly Disagree	I don't know	Rating Average
26 I am able to enter the data the KVD model requires	1	1	6	6	2	3	0	10	3.84
27 The KVD model performs root-cause- analysis the	2	3	5	10	0	3	0	6	3.52
28 In general, it is easy to keep the KVD model up to	2	1	4	8	2	4	2	6	4.17
29 Overall the KVD are a useful approach for	6	5	6	6	0	0	1	5	2.71
30 The KVD contain relevant information required to	4	6	9	5	0	0	1	4	2.80
31 I have a lot of confidence in decisions made using	4	5	5	9	0	0	0	6	2.83
32 The organization of menu models is easy to	4	6	6	4	0	0	0	9	2.50
33 The KVD model approach to variance analysis	3	6	7	6	0	0	0	7	2.73
34 It is always clear which part of the KVD tree I am	2	8	5	3	0	2	1	8	3.05
35 The KVD model uses a logically sound approach	4	5	6	5	0	1	1	7	2.95
36 The KVD model meets my needs for analyzing and	2	7	4	6	1	1	1	7	3.18
37 Our KVD are based on sound theoretical	2	9	6	4	1	1	0	6	2.83
38 I am confident that the technology used to deliver	1	4	7	3	1	1	3	9	3.70
39 The KVD models are presented using similar	1	6	9	3	0	1	1	8	3.10
40 It is easy to enter data into the KVD model	1	3	5	4	1	4	0	11	3.72
41 Use of KVD improves our business performance	1	6	10	6	0	1	0	5	3.04
42 One can learn to use KVD in less than two hours of	4	3	7	5	0	0	1	9	2.90
43 Using the KVD model supports rather than negates	4	6	3	5	1	1	1	8	3.00
44 The KVD Model supports quality decision-making	3	6	8	6	0	0	1	5	2.92
45 The system can prompt the user on what to do next	1	2	6	7	2	1	2	7	3.86
46 The labels on the menu choices correctly describe	2	6	4	5	2	1	0	9	3.10
47 If an error occurs when using the KVD model, it is	3	4	1	4	2	4	2	9	3.90
48 My superiors would strongly favour using the KVD	4	8	4	4	0	0	1	8	2.62
49 Inputting data into the KVD model is easy	1	3	4	4	2	3	1	11	3.89
50 The help features of the KVD model are easy to	2	2	5	6	1	2	1	10	3.63

Rate the following statements on a scale of 1 to 7 where 1 indicates Strong Agreement and 7 indicates Strong Disagreement:									
Answer Options	Strongly Agree			Neither Agree nor			Strongly Disagree	I don't know	Rating Average
51 I can move easily between different areas of the	4	4	6	7	1	0	0	5	2.86
52 The amount of work required to use the KVD model	3	7	4	7	0	1	1	4	3.04
53 Using KVDs improves the quality of my work	3	8	6	3	2	0	0	5	2.68
54 Learning to use KVD was easy	5	4	5	7	0	0	0	6	2.67
55 It is easier to analyze and report performance using	5	4	6	6	0	0	0	6	2.62
56 The KVD model provides me with value that makes	2	9	5	3	0	1	1	6	2.86
57 Completing a task using KVD is significantly faster	2	7	4	6	0	1	1	6	3.10
58 The KVD model allows users to examine the	4	4	6	4	0	1	2	5	3.14
59 The KVD model's approach to troubleshooting and	3	4	7	5	1	2	0	5	3.14
60 The KVD are useful for troubleshooting	3	6	5	7	0	2	0	4	3.04
61 Overall KVD improve employees' focus on what is	4	7	4	6	1	1	0	4	2.83
62 From a "Manganese Wiring " perspective the KVD	9	3	6	5	0	0	0	4	2.30
63 It is easy to interpret the results of our KVD model	4	6	4	6	1	0	0	5	2.71
64 The KVD model reduces the workload of other	4	4	4	7	3	0	0	5	3.05
65 The KVD model provides me with the right kind of	4	7	5	5	1	0	0	5	2.64
66 I understand most of the terms that are used in the	4	10	3	5	2	0	0	3	2.63
67 I control the order in which I want to perform	2	7	7	2	3	0	0	6	2.86
68 An easy to understand manual exists explaining the	1	1	6	4	4	1	2	8	4.05
69 The KVD are a valuable tool for identifying	5	8	5	4	1	0	0	4	2.48
70 The KVD are a valuable tool for planning	7	4	5	5	1	1	0	4	2.65
71 The KVD model is always available and up to date	2	5	0	7	4	3	1	5	3.86
72 The process of using KVDs is well documented	1	2	4	5	3	0	2	9	3.88
73 The same inputs to the KVD model always	4	5	1	7	3	0	0	7	3.00
74 The KVD Model does not change the workload of	1	4	4	6	3	2	2	5	3.91

Appendix 8.4 Detailed Answers to MAUA Questionnaire arranged by attribute, criteria and dimension

		Likert Items #	Strongly Agree			Neiher			Strongly Disagree	I Don't Know
	Overall System Utility- Questionnaire Totals	**67**	**190**	**352**	**401**	**1774**	**84**	**75**	**43**	**431**
	Overall System Utility	**7**	**28**	**43**	**47**	**188**	**6**	**5**	**1**	**32**
10.0	I think our operational version of the KVD model is good enough to use in employee training exercises		3	3	9	27	3	1	0	4
20.0	The KVD are a valuable tool for implementing our strategy		2	10	8	23	0	1	0	6
70.0	The KVD are a valuable tool for planning		7	4	5	28	1	1	0	4
29.0	Overall the KVD are a useful approach for understanding the drivers of value creation in our business		6	5	6	27	0	0	1	5
69.0	The KVD are a valuable tool for identifying business improvement opportunities		5	8	5	27	1	0	0	4
41.0	Use of KVD improves our business performance		1	6	10	27	0	1	0	5
61.0	Overall KVD improve employees' focus on what is important in the business		4	7	4	29	1	1	0	4
	Effect on Task Performance	**18**	**51**	**101**	**118**	**482**	**9**	**19**	**14**	**106**
	Process Quality	**11**	**31**	**56**	**73**	**298**	**5**	**17**	**8**	**62**
	Quality of the Information (Data and Knowledge)	**3**	**7**	**20**	**26**	**75**	**1**	**5**	**1**	**15**
13.0	The KVD are using the right data for controlling business performance		1	5	11	24	0	4	0	5
30.0	The KVD contain relevant information required to operate the business		4	6	9	26	0	0	1	4
37.0	Our KVD are based on sound theoretical understanding of our business		2	9	6	25	1	1	0	6
	Quality of the Explanation Capability / Reasons	**1**	**4**	**6**	**4**	**30**	**1**	**0**	**0**	**5**
63.0	It is easy to interpret the results of our KVD model		4	6	4	30	1	0	0	5
	Quality of the Representation, Examination and Modification of Knowledge Stored in System	**2**	**6**	**5**	**10**	**57**	**2**	**5**	**4**	**11**
28.0	In general, it is easy to keep the KVD model up to date as the business unit changes		2	1	4	29	2	4	2	6
58.0	The KVD model allows users to examine the underlying logic upon which it is built		4	4	6	28	0	1	2	5
	Quality of the Problem Solving Approach	**2**	**7**	**11**	**11**	**56**	**0**	**3**	**1**	**11**
35.0	The KVD model uses a logically sound approach for identifying the important drivers of our business		4	5	6	26	0	1	1	7
60.0	The KVD are useful for troubleshooting		3	6	5	30	0	2	0	4
	Time to Perform Tasks	**2**	**6**	**12**	**12**	**54**	**0**	**2**	**2**	**12**
17.0	Using KVD I can analyze business performance variances relatively quickly		4	5	8	25	0	1	1	6
57.0	Completing a task using KVD is significantly faster than using other data sources		2	7	4	29	0	1	1	6
	System Response Time	**1**	**1**	**2**	**10**	**26**	**1**	**2**	**0**	**8**
11.0	The current KVD Model responds quickly to user commands		1	2	10	26	1	2	0	8
	Product Quality	**7**	**20**	**45**	**45**	**184**	**4**	**2**	**6**	**44**
	Quality of the Results (KVDs)	**3**	**12**	**19**	**21**	**77**	**2**	**0**	**2**	**17**
16.0	Overall, the KVD Model provides me with useful results		6	5	7	24	0	0	1	7
44.0	The KVD Model supports quality decision-making		3	6	8	27	0	0	1	5
53.0	Using KVDs improves the quality of my work		3	8	6	26	2	0	0	5
	Overall Confidence	**2**	**5**	**9**	**12**	**54**	**1**	**1**	**3**	**15**
31.0	I have a lot of confidence in decisions made using KVDs		4	5	5	30	0	0	0	6
38.0	I am confident that the technology used to deliver KVD is sound (i.e. disparate MS Excel instances as opposed to a centralised Mn wide app		1	4	7	24	1	1	3	9
	Cost-Effectiveness	**2**	**3**	**17**	**12**	**53**	**1**	**1**	**1**	**12**
5.0	The KVD model is cost-effective because the overall benefits from using it exceeds its costs		1	8	7	27	1	0	0	6
56.0	The KVD model provides me with value that makes the effort required of me worthwhile		2	9	5	26	0	1	1	6

	System Usability	**33**	**83**	**162**	**181**	**864**	**57**	**40**	**22**	**241**
	General Ease of Use Questions	**3**	**6**	**20**	**19**	**69**	**6**	**4**	**1**	**25**
7.0	The displayed results of the KVD model are easy to read		3	8	7	22	3	0	0	7
14.0	The displayed results of the KVD model are easy to understand		2	9	8	22	1	1	0	7
49.0	Inputting data into the KVD model is easy		1	3	4	25	2	3	1	11
	Flexibility (Discretion and User Control)	**1**	**2**	**7**	**7**	**25**	**3**	**0**	**0**	**6**
67.0	I control the order in which I want to perform activities using KVD		2	7	7	25	3	0	0	6
	Ease of Training	**7**	**17**	**20**	**36**	**189**	**12**	**11**	**9**	**56**
	Learnability	**3**	**11**	**11**	**16**	**82**	**2**	**2**	**2**	**24**
22.0	The KVD model requires no re-training for infrequent users		2	4	4	26	2	2	1	9
42.0	One can learn to use KVD in less than two hours of training		4	3	7	26	0	0	1	9
54.0	Learning to use KVD was easy		5	4	5	30	0	0	0	6
	On-line Help function	**2**	**4**	**6**	**10**	**51**	**3**	**8**	**3**	**15**
3.0	I can obtain sufficient on-line help on how to use KVDs		2	4	5	24	2	6	2	5
50.0	The help features of the KVD model are easy to use		2	2	5	27	1	2	1	10
	Documentation	**2**	**2**	**3**	**10**	**56**	**7**	**1**	**4**	**17**
72.0	The process of using KVDs is well documented		1	2	4	29	3	0	2	9
68.0	An easy to understand manual exists explaining the use of KVD		1	1	6	27	4	1	2	8
	Human Factors Guidelines for Person Machine Interactions	**13**	**29**	**58**	**66**	**344**	**21**	**22**	**9**	**101**
	Consistency	**2**	**4**	**9**	**17**	**49**	**0**	**2**	**2**	**17**
21.0	The KVD layouts (KVD Trees) are similar for different sections and plants		3	3	8	25	0	1	1	9
39.0	The KVD models are presented using similar computer screen layouts		1	6	9	24	0	1	1	8
	Error Prevention and Handling	**2**	**4**	**10**	**8**	**50**	**4**	**6**	**3**	**15**
15.0	The KVD model helps to prevent errors in analyzing and reporting business performance		1	6	7	25	2	2	1	6
47.0	If an error occurs when using the KVD model, it is easy to correct the error		3	4	1	25	2	4	2	9
	System Navigation	**2**	**6**	**12**	**11**	**54**	**1**	**2**	**1**	**13**
34.0	It is always clear which part of the KVD tree I am looking at		2	8	5	24	0	2	1	8
51.0	I can move easily between different areas of the KVD trees/model in order to do the required task		4	4	6	30	1	0	0	5
	Use of Color	**1**	**4**	**9**	**5**	**23**	**2**	**0**	**0**	**7**
25.0	The KVD trees use color in an intuitive way (e.g. red for negative quantities)		4	9	5	23	2	0	0	7
	Ease of Data Entry	**2**	**2**	**4**	**11**	**52**	**3**	**7**	**0**	**21**
26.0	I am able to enter the data the KVD model required for my area of responsibility		1	1	6	27	2	3	0	10
40.0	It is easy to enter data into the KVD model		1	3	5	25	1	4	0	11
	Feedback	**2**	**3**	**4**	**13**	**56**	**4**	**2**	**2**	**16**
19.0	The KVD system provides adequate feedback on when it processes commands		2	2	7	27	2	1	0	9
45.0	The system can prompt the user on what to do next		1	2	6	29	2	1	2	7
	Reliability	**2**	**6**	**10**	**1**	**60**	**7**	**3**	**1**	**12**
71.0	The KVD model is always available and up to date		2	5	0	30	4	3	1	5
73.0	The same inputs to the KVD model always produces the same results		4	5	1	30	3	0	0	7

	Workload	**3**	**8**	**18**	**17**	**81**	**7**	**1**	**2**	**16**
	Strain	**2**	**5**	**13**	**11**	**54**	**5**	**1**	**1**	**10**
6.0	I don't have to exert much mental effort to use the KVDs to analyze business performance		2	6	7	24	5	0	0	6
52.0	The amount of work required to use the KVD model is acceptable		3	7	4	30	0	1	1	4
	Memorization	**1**	**3**	**5**	**6**	**27**	**2**	**0**	**1**	**6**
24.0	I do not have to memorize commands on how to use the KVD model		3	5	6	27	2	0	1	6
	Functional Allocation between Person and Machine	**2**	**7**	**11**	**12**	**53**	**3**	**1**	**1**	**12**
18.0	The KVD model supports all the tasks that require support when analyzing and reporting business performance		3	4	7	25	2	1	1	7
65.0	The KVD model provides me with the right kind of support for business performance management		4	7	5	28	1	0	0	5
	Quality of the User's Mental Model of the System	**4**	**14**	**28**	**24**	**103**	**5**	**1**	**0**	**25**
9.0	It is easy to form a mental picture of how the KVD system works		4	6	11	24	1	0	0	4
32.0	The organization of menu models is easy to understand		4	6	6	25	0	0	0	9
46.0	The labels on the menu choices correctly describe the choice		2	6	4	26	2	1	0	9
66.0	I understand most of the terms that are used in the KVD model		4	10	3	28	2	0	0	3
	How well the System Fits In	**16**	**56**	**89**	**102**	**428**	**18**	**16**	**7**	**84**
	Fit or Match with User	**6**	**16**	**28**	**39**	**168**	**4**	**8**	**1**	**36**
	Match with Users' Needs	**2**	**7**	**11**	**10**	**56**	**1**	**1**	**1**	**13**
36.0	The KVD model meets my needs for analyzing and reporting performance		2	7	4	27	1	1	1	7
55.0	It is easier to analyze and report performance using the KVD model than with our previous procedures		5	4	6	29	0	0	0	6
	Match with Users' Training	**2**	**4**	**8**	**17**	**54**	**3**	**4**	**0**	**10**
8.0	The KVD model has been designed to match the computer skills of employees who would use it		1	4	10	26	2	2	0	5
59.0	The KVD model's approach to troubleshooting and problem solving matches with how I was trained to perform these tasks		3	4	7	28	1	2	0	5
	Match with Users' Problem Solving Approach	**2**	**5**	**9**	**12**	**58**	**0**	**3**	**0**	**13**
27.0	The KVD model performs root-cause- analysis the way I do		2	3	5	31	0	3	0	6
33.0	The KVD model approach to variance analysis matches my idea of how this task should be done		3	6	7	27	0	0	0	7
	Fit or Match with the Organization	**10**	**40**	**61**	**63**	**260**	**14**	**8**	**6**	**48**
	Match with the BHP Billiton Way (Operating Model)	**2**	**6**	**14**	**13**	**51**	**1**	**2**	**1**	**12**
12.0	The use of KVD is consistent with the BHP Billiton Way (Operating Model)		2	8	10	25	0	1	0	4
43.0	Using the KVD model supports rather than negates compliance with Group Level Documents (GLDs)		4	6	3	26	1	1	1	8
	Organizational Fit	**2**	**15**	**9**	**16**	**52**	**1**	**1**	**0**	**6**
1.0	The KVD model fits in well into our Management System		6	6	10	24	1	1	0	2
62.0	From a "Manganese Wiring " perspective the KVD model is a good fit		9	3	6	28	0	0	0	4
	Effect on Information Flow	**1**	**4**	**8**	**12**	**21**	**2**	**1**	**0**	**2**
2.0	The KVDs facilitate the flow of information in BHP Billiton Manganese		4	8	12	21	2	1	0	2
	Effect on Other People's Workload	**3**	**9**	**10**	**12**	**85**	**10**	**4**	**3**	**17**
23.0	The KVD model does not increase the workload for other people involved in business performance measurement and reporting		4	2	4	26	4	2	1	7
64.0	The KVD model reduces the workload of other people involved in business performance measurement and reporting		4	4	4	30	3	0	0	5
74.0	The KVD Model does not change the workload of other people involved in business performance measurement and reporting		1	4	4	29	3	2	2	5
	Attitude of Others (Political Acceptability)	**2**	**6**	**20**	**10**	**51**	**0**	**0**	**2**	**11**
4.0	Other people in BHP Billiton Manganese will support the KVD model implementation when they get to know about it		2	12	6	26	0	0	1	3
48.0	My superiors would strongly favor using the KVD model		4	8	4	25	0	0	1	8

11 LIST OF ENDNOTES

Chapter 1

[1] One Mn unit (mtu) is equivalent to 10 Kg of 100% Mn, for example, an ore containing 35 % Mn, contains 350 Kg of Mn per ton or 35mtu/ton.
[2]The extent of integration measured as a percentage mtu sold as alloy from the total saleable product mtu.
[3] Beneficiation refers to the upgrading of a primary ore to a stage where the product(s) can be used in a manufacturing process. (Lurie, 2001:87). In the case of Mn ore can be upgraded or beneficiated by dense-medium separation, sintering and/ or smelting.
[4] Corporation Alignment Planning

Chapter 2

[5]Rational utility theory: Given accurate information, the decision-maker will arrive at a logical conclusion about the decision most likely to produce the desired result. (Dearlove, 1998:18)
[6]"infinite regress" in this context results from the fact that a decision-making process is made up of decisions and therefore each decision can always be broken up into an infinite chain of preceding decisions. The regress potential creates ambiguity as to whether decision-making is a process or a single action or choice.
[7]An expert system is typically an interactive computer program designed to emulate the problem –solving process of one or more experts in a particular problem domain. The typical user of an expert system is not the expert but more inexperienced personnel. (Adelman L.1992. Evaluating Decision Support and Expert Systems, Wiley-Interscience, NY.) p 2
[8]PRO.013: Resource Development Potential Procedure, PRO.012: Life of Asset Procedure and PRO.021: Five Year Plan Procedure. All these procedures are contained in the BHP Billiton Operating Model
[9] PPM is a product of Hewlett-Packard Corporation configured to support the Manganese Business Processes.

Chapter 3

[10] ROE may also be decomposed into three ratios as follows:
ROE = After-tax profit margin X Asset Turnover X Asset Leverage
= (Net Income/Sales) X (Sales/Assets) X (Assets/ Common equity)

Chapter 5

[11]Little (1970: 470) defined a 'decision calculus' as a model-based set of procedures for processing data and judgments to assist a manager in his decision making

Chapter 6

[12]In Adelman and Riedel's (1997) MAUA Process Quality consists of six attributes: (1) data quality,(2)explanation capability(3)knowledge representation scheme,(4)problem solving approach,(5)time to perform task and (6)the system's response time.
[13] Product Quality consists of (1) quality of the results generated, (2) Confidence in the products or outputs of the system and (3) overall system effectiveness.

[14] See chapter 5.1 for definitions of Adelman evaluation methods categories.

Chapter 7

[15]In the Research Proposal, the Literature Review leading up to the generation of hypotheses was referred to as the "framing" stage. The output of this stage is concepts and categories of concepts that can be used in framing questions for further research (Strauss & Corbin, 1998)
[16]A construct is a hypothetical attribute that helps explain and or predict some immeasurable attribute in a theory, for example, employee motivation is a construct that is not directly observable but can be used to explain employee behaviour in a theory.
[17]The BHP Billiton Way is a collective noun given to the BHP Billiton Operating Model and Philosophy.
[18]A target population is a group defined by the researcher's specific interest (Gravetter and Forzano, 2006:118)
[19] Definition obtained from glossary of terms available on the on-line book-site: WWW.booksites.net/saunders

Chapter 8

[20]This is assumption is based on the Six Sigma notion of Control. Pyzdek (2001:381) quoting Shewhart (1931) defines control as follows; "A phenomenon will be said to be controlled when, through the use of past experience, we can predict, at least within limits, how the phenomenon may be expected to vary in future."

12 REFERENCES

Abernethy M.A., Horne M., Lillis A.M., Malina M.A. & Selto F.H. (2005) A Multi-Method Approach to Building Causal Performance Maps from Expert Knowledge. *Management Accounting Research*, 16(2), p. 135-155.

Adelman L. (1992) *Evaluating Decision Support and Expert Systems*, Wiley-Interscience, New York.

Adelman L. & Riedel S. (1997) *Handbook for Evaluating Knowledge-based Systems: Conceptual Framework and Compendium of Methods*, Kluwer Academic Publishers, Norwell, Massachusetts.

Alavi M. & Joachimsthaler E.A. (1992) Revisiting DSS Implementation Research. *MIS Quarterly*, 16(1), p. 95-116.

Anthony R.N. (1965) *Planning and Control Systems: A Framework for Analysis*, Harvard University, Boston.

Atkinson A.A., Waterhouse J.H. & Wells R.B. (1997) A Stakeholder Approach to Strategic Performance Management. *Sloan Management Review*, 38(3), p. 25-37.

Baldrige National Quality Program (2009) Criteria for Performance Excellence, available from www.baldrige.nist.gov (accessed January 2010)

Bell G. (2002) *The Competitive Enterprise: 10 Principles of Business Excellence for Increased Market Share*, McGraw-Hill Australia, Sydney.

Bentley C. (2005) *Practical PRINCE2*, The Stationary Office, Norwich.

BHP Billiton LTD. (2007a) Annual Report for 2007, Melbourne.

BHP Billiton LTD. (2007b) Samancor Manganese Integrated Strategy: 2007-2011, Johannesburg.

BHP Billiton LTD. (2008a) Business Intelligence Roadmap: Report by Microstrategy Technical Assistance Services, Johannesburg.

BHP Billiton LTD. (2008b) Internal memorandum to Business Units, Johannesburg.

BHP Billiton LTD. (2008c) The BHP Billiton Operating Model, Melbourne.

BHP Billiton LTD. (2009a) Manganese CSG Review FY09, Melbourne.

BHP Billiton, LTD. (2009b) 2010 Manganese Letter of Intent, Johannesburg

Bourgeois III L.J. & Brodwin D.R. (1984) Strategic Implementation: Five Approaches to an Elusive Phenomenon. *Strategic Management Journal*, 5(3), p. 241-264.

Bryman A. & Cramer D. (1996) *Quantitative data analysis with Minitab: A guide for Social Sciences*, Routledge, New York.

Chenhall R.H. & Langfield-Smith K. (2007) Multiple Perspectives of Performance Measures. *European Management Journal*, 25(4), p.266-282.

Cohen M.D., March J.G. & Olsen J.P. (1972) The Garbage Can Model of Organizational Choice. *Administrative Science Quarterly*, 17(1), p. 1-25.

Copeland T., Koller T. & Murrin J. (1995) *Valuation: Measuring and Managing the Value of Companies*, 2nd edition, John Wiley & Sons, New York.

Courtney J.F. (2001) Decision making and knowledge management in inquiring organizations: toward a new decision-making paradigm for DSS. *Decision Support Systems,* 31 (2001), p. 17-38.

Cyert R.M. & March J.G. (1963) *A Behavioural Theory of the Firm*, Prentice-Hall, Englewood Cliffs, New Jersey.

Daft R. (2007) *Organization Theory and Design*, 9th edition, Thomson South-Western, Mason.

Davenport H.T. & Harris J.G. (2007) *Competing on analytics*, Harvard Business School Press, Boston.

Dearlove D. (1998) *Key Management Decisions- Tools and techniques of the executive decision-maker*, Financial Times - Pitman Publishing, London.

Dickson G.W., Senn J.A. & Chervany N.L. (1977) Research in Management Information Systems: The Minnesota Experiments. *Management Science*, 23(23), p. 913-923.

Eckerson W.W. (2006) *Performance Dashboards: Measuring, Monitoring and Managing your Business*, John Wiley & Sons, New Jersey.

Ehrbar A. (1998) *EVA: The Real Key to Creating Wealth*, John Wiley & Sons, New York.

Eisenhardt K.M. (1989) Agency Theory: An Assessment and Review. *Academy of Management Review*, 14(1), p. 57-74

Eom H.B. & Lee S.M. (1990) A survey of decision support system applications (1971-April 1988), *Interfaces*, 20(3): p. 65-79

Eom S.B., Lee S.M., Kim E.B. & Somarajan C. (1998) A survey of decision support system applications (1988-1994), *Journal of the Operational Research Society*, 49(2), p. 109-120.

Frokjaer E., Hertzum M. & Hornbæk K. (2000) Measuring Usability: Are Effectiveness, Efficiency and Satisfaction really correlated? Available from www.ACM.org (accessed October 2009)

Fundação Nacional Da Qualidade (2007) 2007 Criteria for Excellence, available from www.fnq.org.br (accessed June 2009)

Gartner Research Group (2008) The Gartner Glossary of Information Technology Acronyms and Terms, available from www.gartner.com, (accessed April 2008)

Ghauri P. & Grønhaug K. (2005) *Research Methods in Business Studies*, Prentice Hall, Harlow.

Ginzberg M.J. & Stohr E.A. (1982) Decision Support Systems: Issues and Perspectives, New York University, available from http://ssrn.com, (accessed December 2007)

Goede R. & De Villiers C. (2003) The applicability of grounded theory as a research methodology in studies on the use of methodologies in IS practices, *Proceedings of SAICSIT 2003*: p208-217, available from www.acm.org (accessed May 2008).

Gorry G. A. & Scott Morton M. S. (1971) A Framework for management information systems. *Sloan Management Review,* 13 (1): p. 55 – 70

Gravetter F.J. & Forzano L.B. (2006) *Research Methods for the Behavioural Sciences*, 2nd edition, Wadsworth, Belmont.

Gupta J.N.D., Forgionne G.A. & Mora M. (2006) *Intelligent decision-making support systems, Foundations, Applications and Challenges*, Springer-Verlag, London.

Hennen J. (2009) Targeted Business Intelligence Pays off. *Healthcare Financial Management*, March, p. 92-97

Horrigan J.O. (1968) A Short History of Financial Ratio Analysis. *The Accounting Review*, 43(2), p. 284-294.

Howson C. (2008) *Successful Business Intelligence: Secrets to Making BI a Killer Application*, McGraw-Hill, New York.

Ittner C.D. & Larcker D.F. 2000. Assessing empirical research in managerial accounting: a value-based management perspective. *Journal of Accounting,* 32, pp. 349-410.

Jones G.R. & George J.M. (2003) *Contemporary Management*, 3rd edition, McGraw-Hill, New York.

Kaplan R.S. & Norton D.P. (2006) *Alignment: Using the Balanced Scorecard to Create Corporate Synergy*, Harvard Business School Press, Boston.

Kaplan R.S. & Norton D.P. (1992) The Balanced Scorecard: Measures That Drive Performance. Harvard Business Publishing, Boston, available from www.hbr.org (accessed October 2008)

Kivijärvi H. (1987) *Implementing Model-Oriented Decision Support Systems*, The Helsinki School of Economics, Helsinki.

Koller T. (1994) What is Value Based Management? *The McKinsey Quarterly*, 3(1994), p. 87-101, available from www.mckinsey.com (accessed April 2008)

Konsynski B.R., Stohr E.A. & McGee J.V. (1992) A Review and Critique of DSS, New York University working paper IS-92-17, available from http://w4.stern.nyu.edu/faculty/research/ (accessed January 2008)

Krizan L. (1999) Intelligence Essentials for Everyone, Joint Military Intelligence College, Washington, DC.

Lambert R.A. (2007) *Agency Theory and Management Accounting*. In Chapman C.S., Hopwood A.G. & Shields M.D. (eds) *Handbook of Management Accounting Research*, Elsevier, Amsterdam.

Larmande F & Ponssard J. (2007) The lack of controllability of EVA explains its decline: A field study, Ecole Polytechnique, Paris, available from http://ceco.polytechnique.fr/ (accessed October 2008)

Little J.D.C. (1970) Models and Managers: The Concept of a Decision Calculus. *Management Science*, 16(8), p. 466-469.

Luhn H.P. (1958) A Business Intelligence System. *IBM Journal*, October, p314-319.

Lurie J. (2001) *South African Geology for Mining, Metallurgical, Hydrological and Civil Engineering*, Lupon Publishing, Johannesburg.

L.E.K Consulting (2007) Shareholder Value Added, Identifying and Managing Key Value Drivers, available from www.lek.com (accessed 18 April 2008)

Mahoney J.T. (2005) *Economic Foundations of Strategy*, Sage Publications, Thousand Oaks, California.

Mallach E.G. (2000) *Decision Support and Data Warehouse Systems*, McGraw-Hill, Singapore.

March S.T. & Hevner A.R. (2007) Integrated decision support systems: A data warehousing perspective. *Decision Support Systems*, 43(3), p. 1031-1043

Martin J.D. & Petty J.W. (2000) *Value Based Management*, Harvard Business School Press, Boston.

McKinsey & Co. The 7-S Framework, available from www.mckinseyquarterly.com (accessed October 2009)

Menlyk S. A., Calantone R.J., Luft J., Stewart D.M., Zsidisin G.A., Hanson J. & Burns L. (2005) An empirical investigation of the metrics alignment process. *International Journal of Productivity and Performance Management*, 54(5), p. 312-324.

Miller M.H. & Modigliani F. (1961) Dividend Policy, Growth and the Valuation of Shares. *The Journal of Business*, 34(4), p. 411-433.

Mintzberg H., Raisinghani D. & Théorêt A. (1976) The Structure of "Unstructured" Decision Processes. *Administrative Science Quarterly*, 21(2), p. 246-275.

Money A., Tromp D. & Wegner T. (1988) The Quantification of Decision Support Benefits within the Context of Value Analysis. *MIS Quarterly*, 12(2), p. 223-236.

Mooraj S., Oyon D. & Hostettler D. (1999) The Balanced Scorecard: a Necessary Good or an Unnecessary Evil? *European Management Journal*, 17(5), p. 481-491.

Moore J.H and Chang M.G. (1980) Design of Decision Support Systems. *Data Base*, 12(1-2), p. 8-14.

Mouton J. (2005) *How to succeed in your Master's and Doctoral Studies*, Van Schaick Publishers, Paarl.

Neely A. (2004) The Challenges of Performance Management. *Management Decision*, 42(8), p. 1017-1023.

Olsson K.O., Ribbling J. & Werner M. (2002) *The discounted cash flow approach to firm valuation*. Masters Theses. Goteborg University, available from http://hdl.handle.net (accessed December 2007)

O'Hanlol J. & Peasnell K. (1998) Wall Street's contribution to management accounting: the Stern Stewart EVA financial management system. *Management Accounting Research,* 8(4), p. 421-444.

Pyzdek T. (2001) *The Six Sigma Handbook: A Complete Guide for Greenbelts, Blackbelts & Managers at all levels*, McGraw-Hill, New York.

Pinsonneult A. & Kraemer K.L. (1993) Survey Research Methodology in Information Management Systems: An Assessment. *Journal of Management Information*, 10(2), p. 75-105.

P.I.P Consultants (2008) Focusing Business Improvement, P.I.P Newsletter, available from www.pipint.com (accessed January 2009)

Power D.J. (2003) A Brief History of Decision Support Systems, available from www.DSSResources.com (accessed December 2008)

Rasmussen N., Chen C.Y. & Bansal M. (2009) *Business Dashboards: A Visual Catalog for Design and Deployment*, John Wiley & Sons, New Jersey.

Rappaport A. (1986) *Creating Shareholder Value: The New Standard for Business Performance*, The Free Press, New York.

Robbins S.P. (2001) *Organizational Behaviour*, 9th edition, Prentice Hall, New Jersey.

Samuelson W.F. & Marks S.G. (2003) *Managerial Economics*, 4th edition, John Wiley & Sons, New York.

Saunders M., Lewis P. & Thornhill A. (2003) *Research Methods for Business Students*, 3rd edition, Prentice-Hall, London.

Sax L.J., Gilmartin S.K. & Bryant A.N. (2003) Assessing Response Rates and Nonresponse Bias in Web and Paper Surveys. *Research in Higher Education*, 44(4). p. 409-432

Simon H.A. (1965) *The New Science of Management Decision*, Prentice-Hall, New Jersey.

Shim J.P., Warkentin M., Courtney J.F., Power D.J., Sharda R. & Carlsson C. (2002) Past, present, and future of decision support technology. *Decision Support Systems*, 33(2): p. 111-126.

Slater S.F. & Olson E.M. (1996) A Value-Based Management System, *Business Horizons*, September-October 1996.

Soans C. & Hawker S. (eds) (2005) Compact Oxford English Dictionary of Current English, 3rd edition, Oxford University Press, Oxford.

Sprague R.H. (1980) A Framework for the Development of Decision Support Systems, *MIS Quarterly*, 4(4), p. 1-26.

Stewart III G.B. (1991) *The Quest for Value: A Guide for Senior Managers*, Harper Business, New York.

Strauss A. & Corbin J. (1998) *Basics of Qualitative Research, techniques and procedures for developing Grounded Theory*, 2nd edition, Sage Publications, London.

Suwignjo P., Bititchi U.S. & Carrie A.S. (2000) Quantitative Models for Performance Measurement System. *International Journal of Production Economics,*64 (2000), p. 231-241.

Taylor W.T. (1998) *The Principles of Scientific Management*, Dover Publications, Minneola, New York. (Originally published in 1911 by Harper & Bros, New York)

Turban E., Aronson J.E., Liang T. & Sharda R. (2007) *Decision Support and Business Intelligence Systems*, 8th edition, Prentice Hall, New Jersey.

Weaver S.C. & Weston J.F. (2003) A Unifying Theory of Value Based Management, University of California, available from http://www.anderson.ucla.edu (accessed January 2008).

Wetherby J.C. (1991) Executive Information Requirements: Getting It Right, Management Information System Research Centre, University of Minnesota, available from https://umdrive.memphis.edu (accessed December 2007)

Williams S. & Williams N. (2007) *The Profit Impact of Business Intelligence*, Morgan Kaufmann Publishers, San Francisco.