A PROJECT HEALTH CHECK FOR COAL MINING COMPANIES

Case of Douglas / Middelburg Optimisation Project

FINAL RESEARCH REPORT

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MASTER'S DEGREE IN BUSINESS LEADERSHIP

by

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STATEMANT OF OWN WORK

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EXECUTIVE SUMMARY

The purpose of the study is to develop a project health check model to evaluate the status of projects within the coal mining industry. The model will be based on the Buttrick (2000) project health check model as described in his book "The Interactive Project Workout".

The model assesses the current "health" or status of a project. It looks at the full project environment and uses a set of question results in an assessment of the overall risk associated with the project. The model evaluates seven key project success factors which include:

1. Project Plan
2. Resources
3. Ownership
4. Justifiable Case
5. Expertise
6. Clear Specification
7. Top Level Support

The model fulfils two roles:

- As a checklist, and
- As a tool to indicate where a project manager's efforts should be directed.

This study will give an overview of the coal mining industry and the way projects are being evaluated and prioritised. The Buttrick (2000) project health check model will be assessed and adapted to evaluate projects within the coal mining industry. The "new / adapted" model will be applied to the Douglas / Middelburg Optimisation (DMO) to evaluate the health status of the project which is currently at the end of definition (feasibility) stage within BHP Billiton Energy Coal South Africa.

The results obtained from the new health check model showed that the DMO project was in a healthy state with a project health check score of 47.33. It could

thus be concluded that the DMO project is ready to move in to the execution phase of the BHP Billiton capital investment process.

The results obtained from the project team member participants were split into management perception and team members' perception. The overall health of the DMO project between the two parties gave similar results with the team members score of 43.76 being slightly lower than the management health score of 45.42. The only major difference was observed on the "Communication" project evaluation criteria where the management perspective on the communication effectiveness was higher than that of the project team members.

Table of Content

LIST OF TABLES

LIST OF FIGURES

ACRONYMS, ABBREVIATIONS AND DEFINITIONS

BECSA – BHP Billiton Energy Coal South Africa Ltd
CAPEX – Capital Expenditure
CEO – Chief Executive Officer
CSG – Customer Sector Group
DMO Project – Douglas/Middelburg Optimisation Project
ENPV – Expected Net Present Value
EPCM project – Engineer, Procure, Construct, Manage projects
HOD – Head of Department
IAR – Investment Approval Request
IPR – Independent Peer Review
IRC – Investment Review Committee
IRR – Internal Rate of Return
Mt – Million tons
NPV – Net Present Value
OPEX – Operational Expenditure
PIR – Post Investment Review
PP – Payback Period
ROA – Return on Assets
ROI – Return on Investment
RRAA – Role, Responsibility, Accountability, Authority
UNISA – University of South Africa

CHAPTER 1: ORIENTATION

1. Introduction

1.1. Audience

The research project will be directed at the following audience:

- UNISA – University of South Africa,
- BHP Billiton board and BHP Billiton executive committee,
- DMO Project director, manager and team members,
- DMO Project Auditors – Independent Peer Review (IPR) team and Investment Risk Committee (IRC),
- Middelburg Mine and Douglas Colliery management teams,
- The three main EPCM contractors, and
- Other interested parties.

1.2. Origin and contextual setting of the research problem

On 23 March 2006, Mahomed Seedat, President of the Energy Coal Customer Sector Group BHP Billiton, announced that based on the findings of a feasibility study, the diversified mining group would investigate injecting money into its Middelburg and Douglas mines. The project, Douglas / Middelburg Optimisation (DMO), will include the mining of coal reserves in the Middelburg / Witbank area of Mpumalanga, South Africa, and the construction of a new processing plant to beneficiate the coal reserves. The new processing plant will form part of the integration process of the Douglas plant situated at Van Dyks Drift and the North Export Plant at Middelburg Mine 30km south from Middelburg, Mpumalanga.

It was proposed that a project health check be done on the DMO project which is currently at the end of the definition (feasibility) stage, awaiting approval to go onto execution. The project health check will be based on the model as

discussed in his book “The Interactive Project Workout” written by Buttrick (2000).

The Buttrick project health check model uses a questionnaire to analyse seven key project success factors. These factors include: Project Plan, Resources, Ownership, Justifiable Case, Expertise, Clear Specification and Top Level Support.

The current Buttrick (2000) health check model will be assessed and adapted to evaluate projects in the coal mining industry. The “new” adapted model will be used to evaluate the risk associated with the DMO project and to determine the project readiness to go onto execution and construction. The “new” health check model could also be extrapolated to evaluate similar projects in the coal mining industry.

1.3. Research question

To what extent can the Buttrick (2000) project health check be adapted to evaluate coal mining projects on a strategic level?

1.4. Research objectives

The following objectives have been identified for the research study:

- A thorough literature review of accredited research to assess all relevant strategic project evaluation criteria,
- Developing a new excel project health check model, based on the Buttrick (2000) model, to be able to evaluate projects in the coal mining industry, and
- To do a project health check on the DMO project by applying the “adapted” Buttrick (2000) project health check model.

1.5. Delimitations of the study

The research project scope will be limited to:

- Evaluation of the Douglas / Middelburg Optimisation (DMO) project that is currently at the end of definition (feasibility) stage in BHP Billiton Energy Coal South Africa, valued at $415 000 000,
- The research will be focused on a capital project to be done within the coal mining industry within the borders of South Africa, and
- The evaluation method will be limited to the Buttrick (2000) project health check model.

1.6. Importance of the study

Practitioners:

The evaluation of the DMO project will give valuable insight into the "readiness" and feasibility of the project for BHP Billiton Energy Coal South Africa. The outcomes of the study could be used by practitioners to benchmark future projects against in terms of the key project success factors: Project Plan, Resources, Ownership, Justifiable Case, Expertise, Clear Specification and Top Level Support (as well as any additional project specific evaluation criteria that might be identified during the study).

Top level management:

By applying the new project health check model to projects which are at a feasibility stage will provide top management with evidence that support the strategic importance of projects within BHP Billiton Energy Coal South Africa.

Academics and business science researchers:

The outcomes from this study could be used by academics and business researchers to understand the project evaluation methodology within different industries. The adapted project health check model will provide an analytical tool to evaluate projects in similar industries. The study will also highlight

strategic importance of different evaluation criteria for different projects and industries.

1.7. Possible constraints to the research

The major research project constraints that have been identified include:

- Copy right concerning the Buttrick (2000) model and the possibility of adapting the model to evaluate projects in the coal mining industry,
- Availability of key stake holders to complete a questionnaire, be interviewed and/or questioned,
- Knowledge of how the DMO project will fall into the business strategy of BHP Billiton, and
- Accessibility of confidential information regarding BHP Billiton business strategy.

1.8. Key assumptions

It is assumed that:

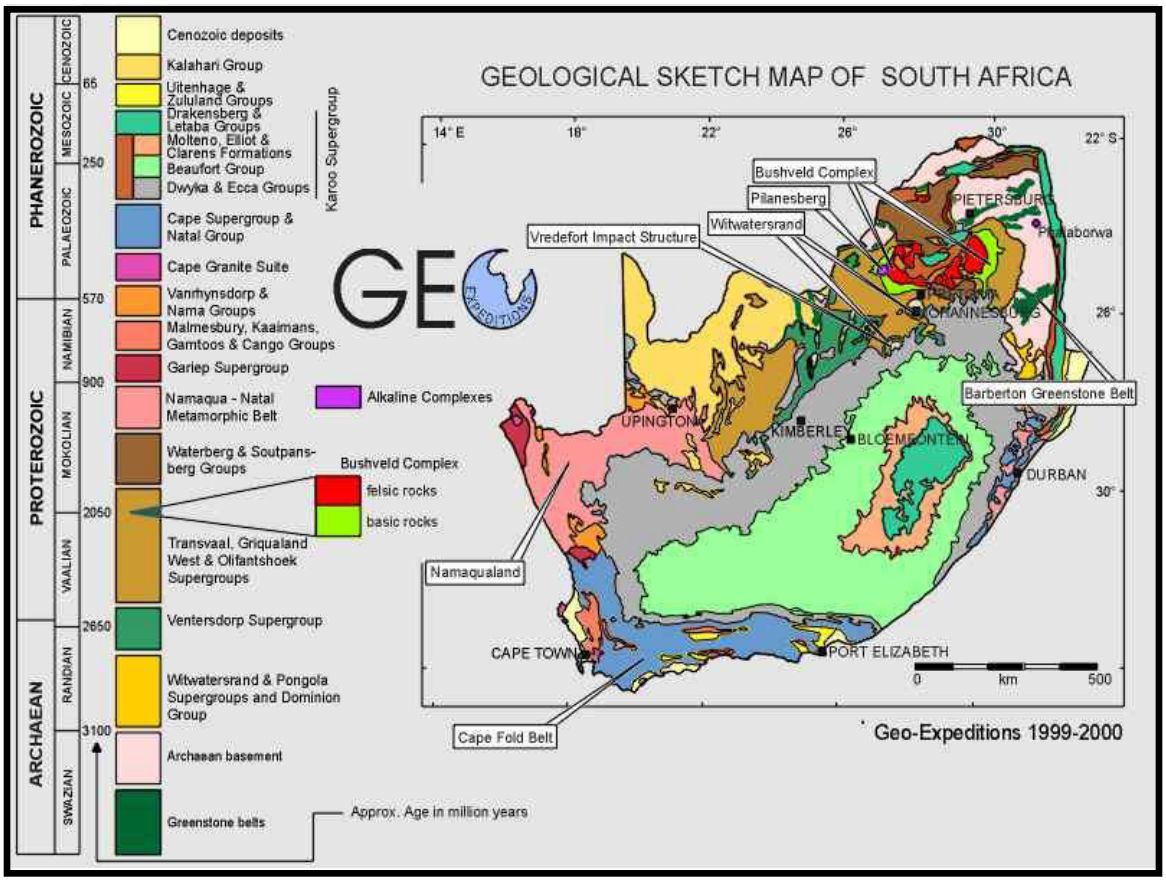
- The DMO project follow the international standards of project steps which include concept phase, pre-feasibility study, feasibility study, project approval, project execution, commissioning and final handover,
- By definition the DMO project is at the end of its feasibility stage, and
- It is assumed that the project execution date is fixed and that all capital quoted prices will not be subjected to inflation.

CHAPTER 2: REVIEW OF THE COAL MINING INDUSTRY IN SOUTH AFRICA

2.1. The geology of South Africa in relation to coal deposits

South African coal deposits are confined to the area east of 26^0E (Paulsen et al 2001). Within the main Karoo Basin, coal is present in the in the Vryheid Formation of the Ecca group and the Normandien Formation of the Beaufort Group north of the 29^0S, and also in the Molteno Formation in the Eastern Cape. The coal deposits are found in two major tectonic settings, namely cratonic platforms and fault-boundary rift basins. Those in the main Karoo basin are typically of the former and those of the northern parts of South Africa of the latter. The following map shows the geology of South Africa (refer to **Figure 1**).

Figure 1: Geology of South Africa



Source: www.geotoursafrica.com, 15/04/2007

The coal deposits in South Africa are located in 19 main areas of which Witbank, Ermelo, Highveldt, Klip River and Utrecht are the largest. The following map shows the localities of these coal deposits in South Africa (refer to **Figure 2**).

Figure 2: The South African coal deposits

Source: A venture into the unknown, The challenge that was Ermelo Mines (Paulsen 2001), 17/04/2007

It could be seen from **Figure 2**, that Witbank and Middelburg is located to the Northern outskirts of deposit 7, which represents one of the largest thermal coal deposits in South Africa. Middelburg Mine which is located ± 20km to the south of Middelburg is thus situated right on top of the Witbank deposit (deposit 7).

2.2. Coal as a mineral

Coal is readily combustible sedimentary rock containing more than 50 percent by mass and more than 70 percent by volume of carbonaceous material. It is formed by the accumulation, compaction and indurations' of various altered plant remains. Coal is one of the major primary energy sources in the world and is the backbone of the metallurgical and electrical supply industries.

Coal is the most complex natural raw material and more than 20 variables must be determined to fully characterise a coal. These include moisture, ash, volatile matter, carbon, hydrogen, oxygen, sulphur, and nitrogen contents, specific heat contents (calorific value), several coking parameters, ash composition and ash fusion characteristics. However, most of the inherent properties of the organic substance of coal are interrelated and any coal can consequently be classified in terms of grade, type and rank (Paulsen et al 2001).

2.3. The South African coal industry (prior to 2000)

Coal was first mined in 1857 and South Africa's first collieries were established in the eastern part of the Cape Province following the discovery of coal at Cyfergat in 1859. Oil began to be produced from coal in 1950's to reduce South Africa's dependence on imported oil. Coal plays a vital role in South Africa's domestic economy, accounting for over 80 percent of the countries primary energy requirements in 1990 and some 70 percent in 1996. South Africa's industrial development was based on coal, most of which was mined in the Witbank area. The scale and trading of coal took lace largely through producer associations such as the Transvaal Coal Owners Association (TCOA), founded in 1923, and Natal Associated Collieries (NAC). With the establishment of the Electricity Supply Commission (Eskom) in 1922 and its policy of construction pithead power stations, the opportunity to win Eskom coal supply tenders preoccupied coal producers. Large power station supply contracts were awarded periodically to

captive producers who owned the next most economical coal field able to deliver between 4Mt/a and 12Mt/a over a 30 year period. By 1980, with an output of 130Mt, South Africa had become the sixth largest hard coal producer in the world. At the turn of the centaury, end of 1999, coal was produced from 74 collieries, 33 opencasts and 41 underground, producing 106Mt and 120Mt of saleable coal respectively. A major factor in the development of South Africa's coal output was the very rapid growth of exports. South Africa rapidly reached and maintained a position as the world's third largest sea-born coal exporter and in year 2000 exports of 65Mt earned the country just on R11 billion in foreign exchange.

2.4. The "modern" South African coal industry (after 2000)

In 2003 South Africa produced 215 Mt of Bituminous and 1.2 Mt of anthracite, however, the Rand's strength against the dollar resulted in sharp cuts in rand profits and revenues for South Africa's coal producers (**Sources:** www.mbendi.co.za – A Mbendi profile of coal mining in South Africa).

Ready availability of coal on world markets affected South Africa's export mines until late 2002. South Africa's coal industry is the second biggest mining sector after gold, with sales contributing 16% of export revenue in 2003 (ZAR 20 billion in 2000) to South Africa's mineral sales and 4% to the GDP. Coal production for 2003 was estimated at 215 Mt compared with 217 Mt in 2002. Coal sales for 2003 were estimated at ZAR 26.86 billion. South Africa's coal production rose 6% in 2003 but despite this the 18% decrease in the rand price of coal meant a decrease in coal revenues. Today South Africa is the world's second largest coal exporter, after Australia, as well as second lowest cost producer, after Indonesia.

The following table (refer to **Table 1**) shows the South African steam coal (Bituminous coal) production, export and domestic consumption.

Table 1: South African steam coal production, exports and domestic use

Year	Total Steam Coal Production (Mt)	Exports (Mt)	Domestic Use (Mt)
FY2002	217	66.7	150.3
FY2003	215	67.8	147.2
FY2004	228	68.7	159.3
FY2005	236	65.8	170.2
FY2006	239	67.6	171.4
FY2007	243	66.1	176.9

Source: South African Coal Report, Issue 1806, June 2007

It could be seen that the production of coal increased by 12% over the last six years. This increased production could be ascribed to better mining processes and coal extraction technology.

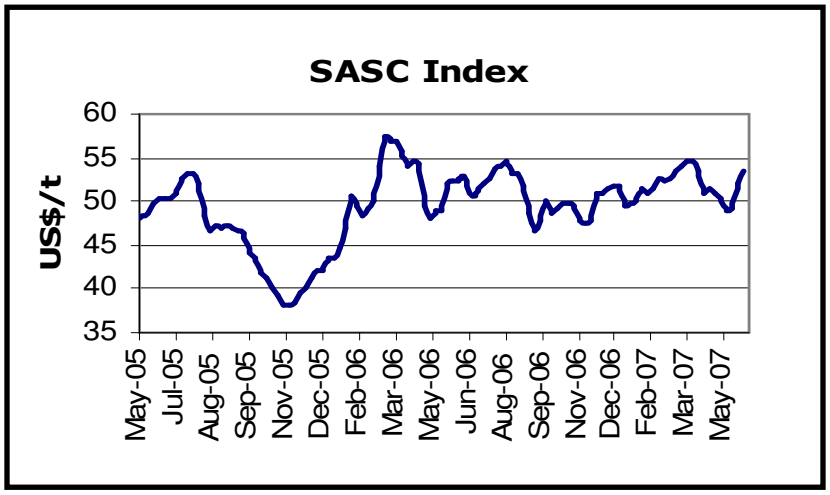
Bituminous or steam coal remains South Africa's main export coal, with anthracite having to be imported, due to diminishing reserves. 60% of South Africa's coal exports are currently destined for the European market. Most of the coal produced is consumed locally, with the power generation using 41% of total production.

Out of the 176 Mt of coal produced for the domestic market in FY2007, Eskom helped itself to 110 Mt and Sasol 44 Mt. The remainder is used in the metallurgical industry and for domestic use.

Taking into account apparent government energy system policies, macroeconomic factors and climate change policies it is forecasted that the export segment of the global thermal coal demand to grow from around 478 Mt in 2004 to 614 Mt in 2015 (BHP Billiton research report, 04/04/2007).

The following figure (refer to **Figure 3**) shows the spot coal price trend since May 2005 to May 2007.

Figure 3: South African spot coal price index



Source: South African Coal Report, Issue 1806, June 2007

It could be seen from **Figure 3** that the price of thermal export quality coal stabilised around the 50 – 55 US$/t.

Most of South Africa's export coal is dispatched through the Richards Bay Coal Terminal (RBCT) on the Kwazulu Natal north coast. RBCT has an export capacity of 76 Mtpa of which 4 Mtpa has been allocated to BEE companies. BHP Billiton Energy Coal South Africa owns 37.4% of 72 Mtpa which equals to 26.9 Mtpa.

South Africa has limited coal reserves. An estimated 34 billion tons remain, and based on present consumption rates, South Africa could have a mere 7 billion tons remaining by 2040. (In 1982, reserves were estimated at 50 billion tons). Currently most of South Africa's coal mines are situated in the Mpumalanga, Free State, northern Kwazulu – Natal and Northwest provinces. Most collieries are concentrated around the towns of Witbank, Ermelo and Secunda (**Sources:** www.mbendi.co.za - A Mbendi profile of coal mining in South Africa, 15/05/2007).

As in the South African gold industry, the coal sector has undergone similar mergers, acquisitions and name changes over the past few years. What has

emerged are three major coal producers and exporters, viz. Anglo American Coal (Anglo Coal), BHPBilliton Energy Coal South Africa (BECSA, a BHP Billiton subsidiary) and Xstrata (previously Duiker, with Swiss Glencore International as a major shareholder).The entrance of a black consortium Eyesizwe Coal was pre empted by BECSA and Anglo Coal, involving several properties. Eyesizwe will be producing coal for the local market, producing 18Mt annually, with resources of 4 – 5 billion tons, representing 8% of South Africa's resources and making it South Africa's fourth largest producer. Eyesizwe's major coal producer is the Matla Colliery, which produces 12Mt / year, most of which supplies the nearby Matla Power station. Other collieries include New Clydesdale, Glisa, and the underground operation of Arnot.

Although traditionally seen as an electricity generator and distributor, Eskom may be entering the local and export coal market. Based on its extensive stockpiles (estimated at 20Mt) as well as interests in a developing coal mine located at Usutu on the border between Mpumalanga and KZN, Eskom could become South Africa's latest producer. Eskom has signed an agreement with Dutch based Anker to develop a small high grade export operation near Usutu.

2.5. BHP Billiton

(Sources: www.bhpbilliton.com, 04/04/2007)

BHP Billiton is the world's largest mining company. It was formed through the 2001 merger of the Broken Hill Proprietary Company (BHP), an Australian company, and Billiton, a British company with a South African background. The two together form a dual-listed company.

Broken Hill Proprietary Company (BHP)

(Sources: www.bhpbilliton.com, 04/04/2007)

The Broken Hill Proprietary Company or BHP was incorporated in 1885, operating the silver and lead mine at Broken Hill in western New South Wales. In 1915, the company ventured into steel manufacturing, with its operations based primarily in Newcastle, New South Wales. The company grew to become Australia's largest corporation.

The company began petroleum exploration in the 1960s with discoveries in Bass Strait, an activity which became an increasing focus.

BHP began to diversify offshore in a variety of projects. One project was the Ok Tedi copper mine in Papua New Guinea, where the company was successfully sued by the indigenous inhabitants because of the environmental damage caused by the mine operations. BHP had better success with the giant Escondida copper mine in Chile (57.5% owned) and the Ekati Diamond Mine in northern Canada.

The inefficiencies of what was, by global standards, a small steel operation in Newcastle finally caught up with the company and the Newcastle operations were closed in 1999. The 'long products' side of the steel business was spun off to form OneSteel in 2000.

In 2001, BHP merged with the Billiton mining company to form BHP Billiton, the largest mining company in the world. In 2002, the 'flat products' steel business spun off to form BHP Steel. In 2003, BHP Steel fulfilled a condition of the spin out when it changed its name to BlueScope Steel.

Billiton

(Sources: www.bhpbilliton.com, 04/04/2007)

Billiton was the name of a Dutch and later British-based mining company. Billiton (mining co.) origins stretch back to 29 September 1860, when the articles of

association were approved by a meeting of shareholders in the Groot Keizerhof hotel in The Hague, Netherlands.

Two months later, the company acquired the mineral rights to tin-rich islands of Banka and Billiton in the Indonesian archipelago, off the eastern coast of Sumatra.

Billiton's initial business forays included tin and lead smelting in The Netherlands, followed in the 1940s by bauxite mining in Indonesia and Suriname. In 1970, Royal Dutch/Shell acquired Billiton and accelerated the scope of progress of this growth. The tin and lead smelter in Arnhem, Netherlands was shut down in the 80s.

In 1997, Billiton Plc became a constituent of the FTSE 100 Index.

Throughout the 1990s and beyond, Billiton Plc experienced considerable growth. Its portfolio included aluminium smelters in South Africa and Mozambique, nickel operations in Australia and Colombia, base metals mines in South America, Canada and South Africa, coal mines in Australia, Colombia and South Africa, as well as interests in operations in Brazil, Suriname, Australia (aluminium) and South Africa (titanium minerals and steel and ferroalloys).

In 2001 Billiton Plc merged with the Broken Hill Proprietary Company (BHP) to form BHP Billiton.

2.5.1. BHP Billiton company structure

(Sources: www.bhpbilliton.com, 04/04/2007)

The Australian BHP Billiton Limited and the British BHP Billiton Plc are separate listed companies and have separate shareholder bodies, but they operate as one business with identical boards of directors and a single management structure. The main headquarters is in Melbourne with other key offices located in London, Perth, Johannesburg, Santiago, Singapore, Shanghai, Houston and The Hague.

The company operates a wide variety of mining and processing operations in 25 countries, including iron ore, diamonds, manganese, coal (both coking and thermal), copper, nickel, petroleum and bauxite with a global workforce of over 40,000 people.

The company has eight primary operational units:

1. Iron ore
2. Manganese
3. Petroleum
4. Aluminum
5. Base metals
6. Coal
7. Stainless steel materials
8. Diamonds & specialty products

In March 2005 BHP Billiton announced a US$7.3 billion agreed bid for another mining company WMC Resources, owners of the Olympic Dam uranium mine in South Australia, nickel operations in Western Australia and Queensland, and a fertilizer plant also in Queensland. The takeover achieved 90% acceptance on 17 June 2005, and 100% ownership was announced on 2 August 2005, achieved through compulsory acquisition of the last 10% of the shares.

The group publishes its accounts in US Dollars. Its revenue (or turnover) for the year ending 30 June 2006 was $32.153 billion. Profit before tax was $14.166 billion and profit for the year was $10.534 billion. Both of these figures were up significantly on the previous year as BHP Billiton benefited from a continued global escalation of commodity prices and higher production levels.

Table 2: BHP Billiton company profile

Type	Public
Founded	Billiton plc 1860; Merger of BHP & Billiton 2001(creation of DLC)
Headquarters	Melbourne, Australia
Key people	Charles "Chip" Goodyear, CEO Don Argus , Chairman
Industry	Mining
Products	Iron, diamonds, coal, manganese, gold, petroleum, aluminium, copper, nickel, uranium, silver
Revenue	$32.153 billion USD (2006)
Net income	$10.534 billion USD (2006)
Employees	40,000
Website	www.bhpbilliton.com

Sources: www.bhpbilliton.com, 17/04/2007

2.5.2. BHP Billiton Energy Coal South Africa Ltd (BECSA)

(Sources: www.bhpbilliton.com, 04/04/2007)

- **Ownership:** 100% by BHP Billiton
- **Product:** Thermal coal
- **Location:** Mpumalanga province in South Africa

BHP Billiton Energy Coal South Africa Ltd, one of the largest energy coal exporters in the world, owns and operates five collieries (Douglas, Khutala, Klipspruit, Middelburg and Optimum) in the Mpumalanga Province in South Africa. BHP Billiton wholly-owns Khutala, Klipspruit and Optimum collieries. Middelburg and Douglas mines are jointly owned with Xstrata Plc but are managed by BHP Billiton Energy Coal South Africa.

BHP Billiton Energy Coal South Africa has a 37.43 per cent stake in the Richards Bay Coal Terminal (RBCT), making it the largest single shareholder. A separate energy coal marketing coal office is situated in The Hague and RBCT is pivotal in the exporting activities of this office.

In the financial year ending 30 June 2006, production totaled 51,948 million tonnes of coal - predominantly steam coal - supplying the export market, Eskom (the local power utility) and the local market.

BHP Billiton Energy Coal South Africa employs 5 297 people.

BHP Billiton Energy Coal South Africa is one of the largest suppliers to the seaborne energy coal market. This coal is sold into Europe, the Far East, India, Africa and South America. A lower grade coal is sold to South Africa's local utility company, Eskom. BHP Billiton Energy Coal South Africa is Eskom's largest supplier. Relatively small quantities of coal are supplied into the local market (excluding Eskom).

2.5.3. Middelburg Mine

(Source: Middelburg mine portal, 04/04/2007**)**

Situated approximately 20 kilometers south of Middelburg in Mpumalanga Province, Middelburg Mine is the largest producer in the BHP Billiton Energy Coal South Africa group. It is co-owned in a joint venture partnership between BHP Billiton Energy Coal South Africa (84 per cent) and Xstrata (16 per cent) and managed by BHP Billiton Energy Coal South Africa.

The mine is an opencast operation using five large draglines to produce up to 17 million saleable tonnes of coal per year from the number 2 and 4 seams. The principal products are power station grade coal for Eskom's nearby Duvha Power station and higher quality export grade products for the seaborne steam coal markets.

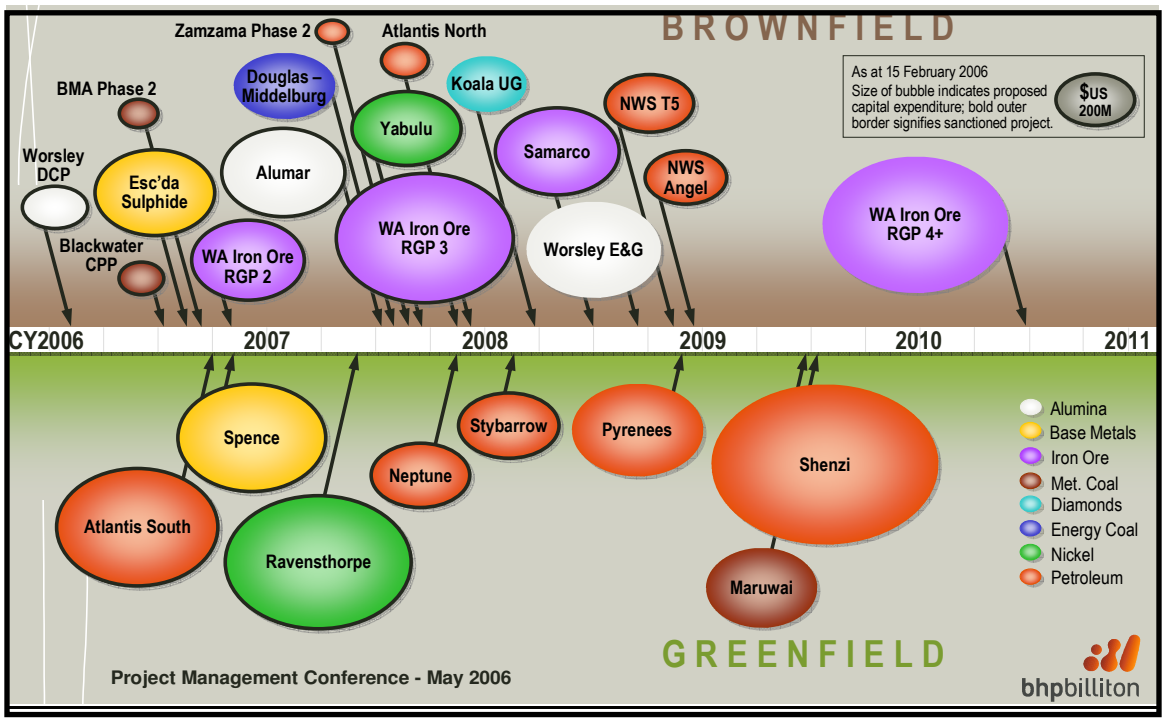
Employment: 1800, Reserves: 30-year mine life.

2.5.4. Current projects within BHP Billiton

(Sources: www.bhpbilliton.com)

The following graph shows the Brownfield and Greenfield projects that are currently in the BHP Billiton Capital Project Pipeline. The colour of the bubble indicates the customer sector group, the size of the bubble indicates the proposed capital expenditure and the bold outer border signifies sanctioned projects.

Figure 4: BHP Billiton Brownfield and Greenfield capital project pipeline



Sources: www.bhpbilliton.com, 04/04/2007

It is clear from **Figure 4**, that the Douglas-Middelburg Optimisation Project is an unsanctioned, medium sized (relative to the projects in the BHP Billiton project pipeline) Brownfield project.

The following table shows a list of all the current projects in the BHP Billiton pipeline that are currently in either execution phase or in definition (feasibility) phase (refer to **Table 3**).

Table 3: Projects within BHP Billiton in either execution or definition phase.

For capital projects, greater than US$100 million BHP Billiton share

Project	Customer Sector Group	Project Manager	Location
Projects in the Execution Phase			
Alumar 3.5 Mtpa Expansion	Aluminium	Alcoa	Brazil
Escondida West 9 Crusher Relocation	Base Metals	BHP Billiton	Chile
San Manuel Closure	Base Metals	BHP Billiton	USA
Ekati Koala Underground	Diamonds & Specialty Products	BHP Billiton	Canada
Rapid Growth Project 3 (RPG3)	Iron Ore	BHP Billiton	Australia
Rapid Growth Project 4 (RPG4)	Iron Ore	BHP Billiton	Australia
Samarco 3rd Pellet Plant	Iron Ore	Samarco	Brazil
BMA Comet	Metallurgical Coal	BHP Billiton	Australia
Atlantis South	Petroleum	BP	GoM, USA
Mad Dog Spar Drilling Phase B	Petroleum	BP	GoM, USA
Neptune	Petroleum	BHP Billiton	GoM, USA
NWS 5th LNG Train	Petroleum	Woodside	Australia
NWS Angel	Petroleum	Woodside	Australia
Shenzi	Petroleum	BHP Billiton	GoM, USA
Stybarrow	Petroleum	BHP Billiton	Australia
Ravensthorpe Nickel Project (RNP)	Stainless Steel	BHP Billiton	Australia
Yabulu Extension Project (YEP)	Stainless Steel	BHP Billiton	Australia
Potential Projects - in the Definition (Feasibility Study) Phase			
Bakhuis	Aluminium	Alcoa	Suriname
Worsley Efficiency & Growth	Aluminium	BHP Billiton	Australia
Douglas Middleburg Optimisation	Energy Coal	BHP Billiton	South Africa
Mount Arthur Underground	Energy Coal	BHP Billiton	Australia
Navajo South Mine Extension	Energy Coal	BHP Billiton	USA
Newcastle 3rd Port Expansion	Energy Coal	BHP Billiton	Australia
Kipper Wet Gas Development	Petroleum	Esso	Australia
NWS North Rankin B	Petroleum	Woodside	Australia
NWS Western Flank Gas	Petroleum	Woodside	Australia
Pyrenees	Petroleum	BHP Billiton	Australia
Cliffs Nickel	Stainless Steel	BHP Billiton	Australia
Kalgoorlie Nickel Smelter Upgrade	Stainless Steel	BHP Billiton	Australia
Perseverance Deeps	Stainless Steel	BHP Billiton	Australia

Source: BHP Billiton internal project management news letter, April 2007, Issue 43

The BHP Billiton project pipeline list indicates that the Douglas-Middelburg Optimisation Project is currently the only major project in South Africa that is at the end of definition (feasibility) phase (refer to **Table 3**).

2.5.5. The Douglas / Middelburg Optimisation (DMO) project

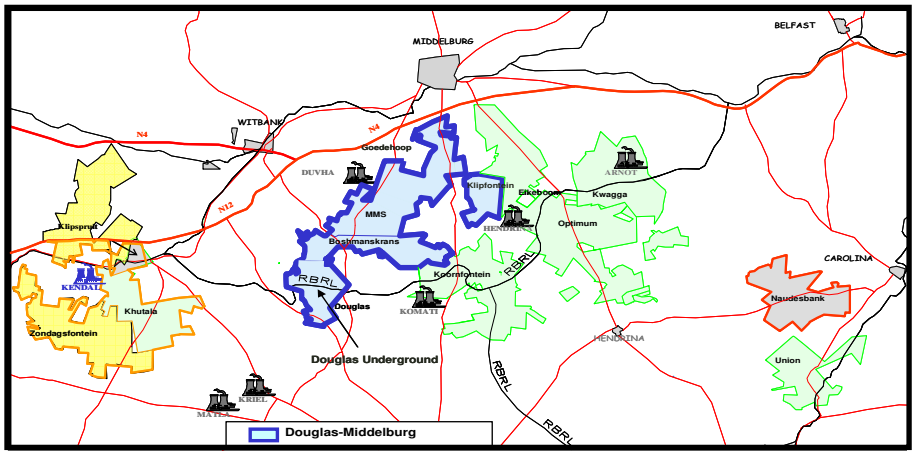
The Douglas and Middelburg Mine complexes currently produce approximately 32 million run of mine tonnes of coal per annum. Douglas Colliery is a predominantly underground mine, producing an export quality thermal coal, with

a limited life as economic underground reserves will be depleted over the next 2 years. Middelburg Mine is an opencast operation, contiguous with Douglas Colliery and produces coal for both the thermal export market and the local adjacent Duvha Power Station operated by the national utility Eskom. Douglas Colliery has been in existence at various locations since 1896, however the area bounded by the current operations has been operating principally since 1976. Middelburg Mine was formed in 1995 with the amalgamation with the adjacent Duvha Opencast Services which produced coal solely for the local power station.

An opportunity exists to extend the production of the export quality coal at Middelburg Mine and also to replace the underground production at Douglas using the same fleet of equipment that is currently in use at Middelburg Mine. This is possible due to the availability of lower strip ratio areas of unmined coal at Douglas Colliery and through the optimisation of the remaining resources. The project designated as the Douglas Middelburg Optimisation (DMO) Project was formed in 2004 to address the optimisation of these resources.

The location of the project in relation to the other Ingwe operations in the Witbank Coalfield is shown below (refer to **Figure 5**).

Figure 5: The DMO project coal reserves



Source: BHP Billiton, DMO project feasibility report, 04/04/2007

Feasibility study recommendation

The recommendation resulting from the detailed work undertaken as part of the feasibility study is that the DMO project be approved for execution and that a capital expenditure of US$415mil (BHPB Share nominal) be approved to implement the recommended project case over a 2 ½ year period from the approval of the project.

Recommended project case

The Recommended Project Case consists of the opening of the new unmined opencast properties classified as Steenkoolspruit and Kleinkopje on the property of Douglas Colliery. These properties will be developed using one of the existing draglines from Middelburg Mine operating in conjunction with the two existing truck and shovel fleets from Boschmanskrans. As these machines will be transferred from high to low strip ratio areas a substantial increase in coal exposure will result.

The coal will be transported via a new high capacity overland conveyor to a new 2000 tonne per hour double stage coal processing plant situated at Middelburg South. This plant will replace the current life expired, labour intensive and inefficient single stage plant at Vandyksdrift. The export product from the plant will be conveyed to the existing Middelburg Mine load-out facility situated approximately 5km from the new plant.

The project requires a capital expenditure of US$415 nominal BHPB share and will take 22 months from project approval to the commissioning of the new coal processing facility. Coal from the Kleinkopje and Steenkoolspruit properties will initially supplement the coal mined from the declining underground sections at Douglas Colliery. The project will be completed with the transferring of a dragline from the existing Middelburg Mine operational area to Steenkoolspruit on the western portion of Douglas in the second quarter of calendar year 2009. The transfer of mining equipment in 2008 from Boschmanskrans Pillar Mining area will substantially reduce the exposure that the complex will have to pillar mining

over the next 8-10 years as the volume mined from pillars will reduce to less than 5% of the total.

The overall DMO Complex consists of two distinct investment phases. Phase 1 which comprises the detailed work undertaken as part of the feasibility study and will be augmented by additional stripping capacity post 2016 to cater for the increasing strip ratios and exhaustion of the mining areas at Middelburg Mine. This second phase of capital is not being applied for at present and will be motivated separately closer to 2016. In the recommended project case, optimised without case and no investment in phase 2 the contractual requirements to the power station are met.

Project case financial evaluation

The recommended project case generates an expected NPV of US$479 mil over the "Optimised Without Case".

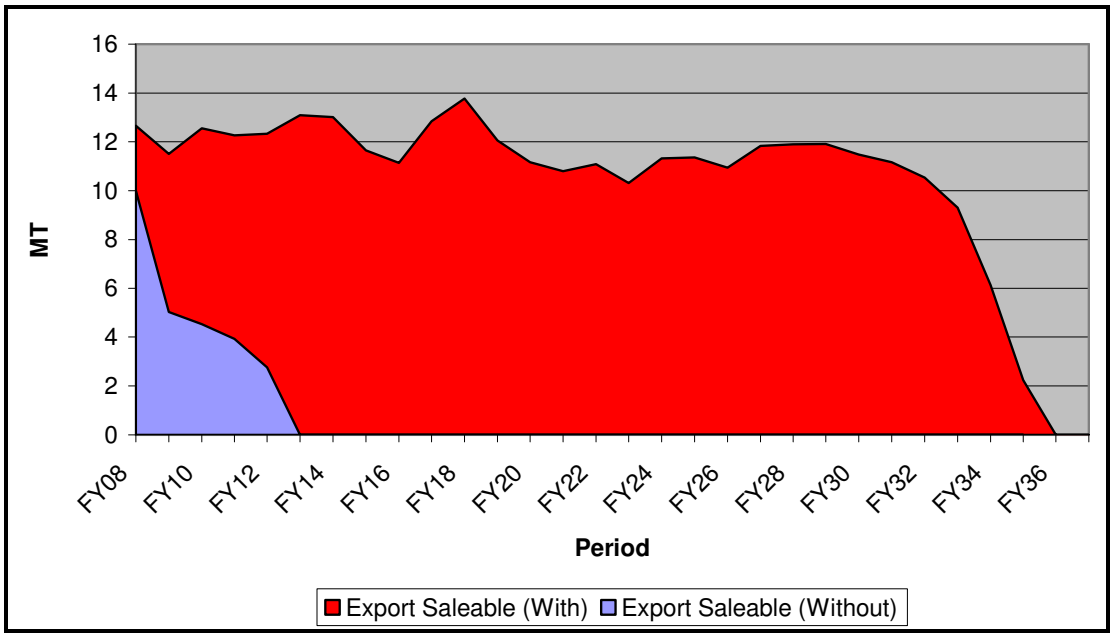
The investment evaluation conclusion for the project is as follows:

- The DMO project is a high quality investment in a tier 1 resource,
- The incremental expected NPV for the project is US$479 mil,
- The NPV range from P10 to P90 is from US$57 mil to US$908 mil,
- The incremental IRR is 27% real (31% nominal),
- The capital efficiency ratio is high at 0.68 (>1 for Phase 1) as would be expected on a brownfields development,
- The implementation risk is categorised as low and there is a high level of confidence that the operation will achieve the expected performance, and
- The largest risks to the project revolve around the exposure to both exchange rate and export price.

The "Optimised Without" Case which the project was compared with will result in the early termination of export coal from the complex with the first major reduction commencing in 2008 coinciding with the end of the underground

operations at Douglas Colliery. The export output will reduce down to zero by 2013. Thereafter Middelburg Mine operates as a fixed price mine supplying coal to Duvha Power Station until the end of the contractual obligations on December 31st 2034. The level of the fixed price is such that the cash flows will tend towards best neutral and turn negative once the export coal sales have terminated. It will be necessary to terminate the export coal sales by 2013 to ensure sufficient coal remains in the resource at Middelburg Mine to satisfy the remaining Eskom contractual commitments. The comparison between the saleable export tonnage is shown in **Figure 6** below. In both cases the annual tonnage to the power station remains at the contractual 10 million tonnes.

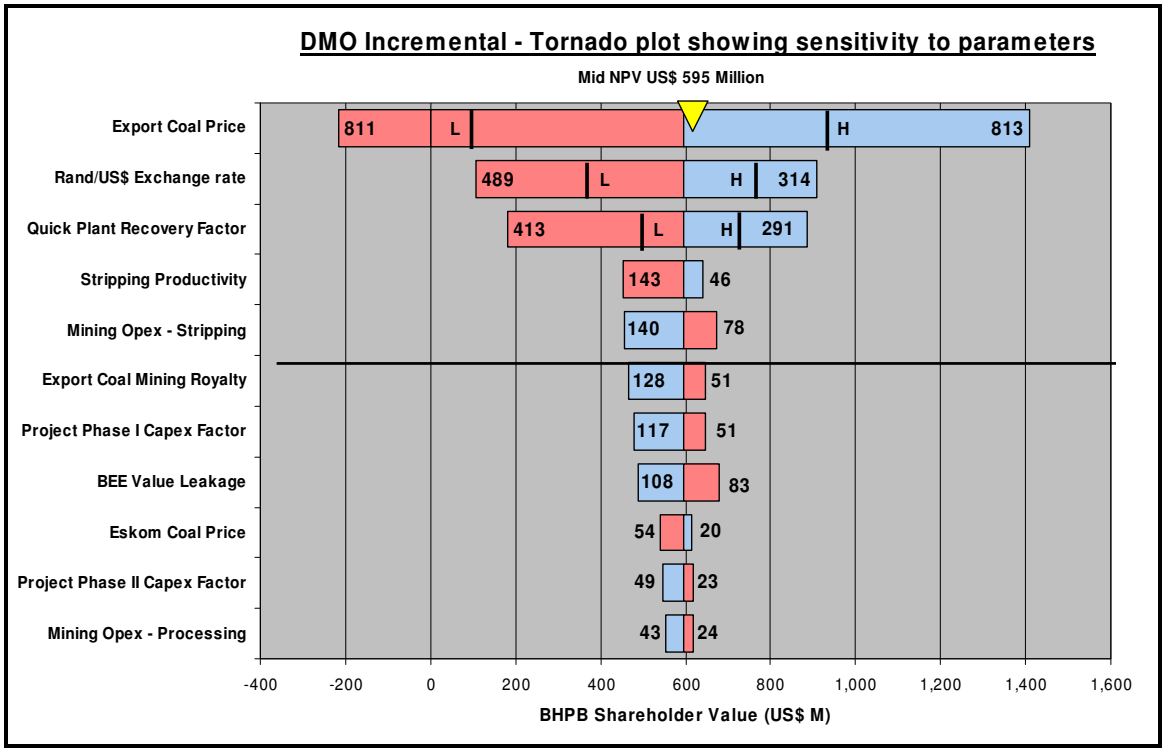
Figure 6: Comparison between saleable export tonnages (with and without the project)



Source: BHP Billiton, DMO project feasibility report, 04/04/2007

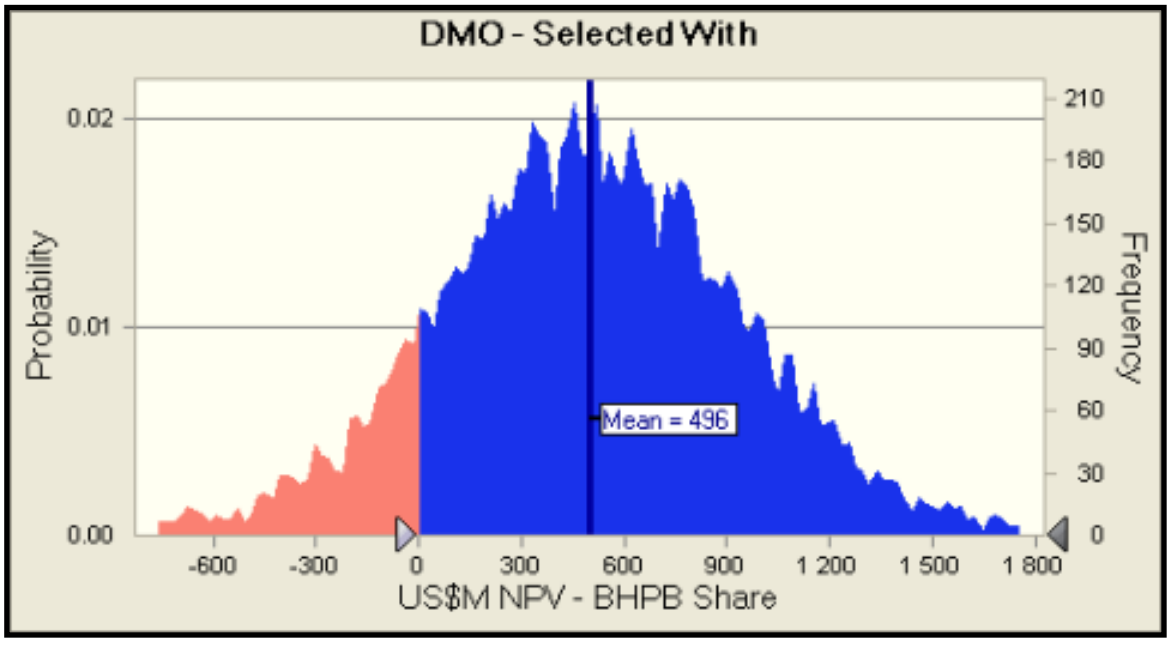
The incremental value of the project relative to the "Optimised Without Case" can be observed in **Figures 7 to 9** which are shown below.

Figure 7: Tornado plot showing sensitivity to parameters



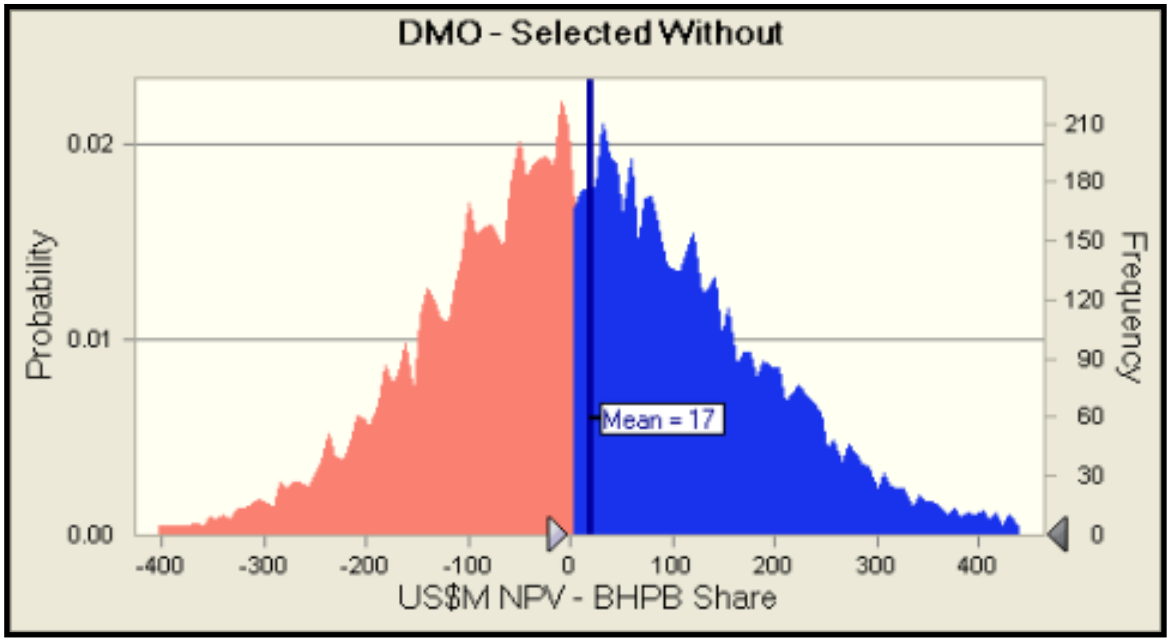
Source: BHP Billiton, DMO project feasibility report, 04/04/2007

Figure 8: Forecast incremental probabilistic value – "With Case"



Source: BHP Billiton, DMO project feasibility report, 04/04/2007

Figure 9: Forecast incremental probabilistic value – "Without Case"



Source: BHP Billiton, DMO project feasibility report, 04/04/2007

Project attributes

The following attributes can be identified with each of the major areas of the project.

- **Coal processing plant**
  - Significantly reduced operating cost as a result of modern proven technology,
  - Increase reliability as a result of 2 modules vs. 5+3 modules,
  - Improved recovery through substantially improved blending facilities,
  - Produces a second stage product for the power utility releasing additional coal for the export market,
  - Eliminates the risks associated with the existing life expired plant,
  - Eliminates the risks associated with the undermining that has occurred in the vicinity of the existing plant, and
  - Allows operational synergies and cross blending of coals through a common load-out at Middelburg Mine.

❖ **Low strip ratio mining areas**

- Existing equipment is transferred from high to low strip ratio areas,
- Pit length is increased from the current overly cramped pits increasing dragline productivity, and
- Effectively replaces the entire Douglas underground with no additional MMS equipment or staff until 2016. This process will result in the retrenchment of virtually the entire current labour force at Douglas although key skills may be transferred to fill vacancies elsewhere in the group.

❖ **High capacity overland conveyors**

- Replaces existing double handling and long haul distances experienced at Middelburg with short hauls from the pit to the run of mine tip facility, and
- Haul distance is unchanged throughout the life of the mine.

❖ **Optimisation of coal**

- The production of a secondary product from the export discards permits the processing export quality coal which otherwise would be required to be sent to Eskom to meet contractual requirements,
- The revised mining plan and additional plant capacity permits seams which are currently unmined and are discarded into the spoils to be upgraded for the Eskom market. This also allows additional export quality coal to be generated, and
- The reclamation and reprocessing of the exiting discard dumps at Middelburg and Vandyksdrift provides a source of low cost coal to Eskom and thereby releases additional coal for the export market.

Project description

The scope of the DMO Project is defined as follows:

- The construction of a new 2000 tonne per hour double stage coal processing plant at Middelburg Mine to replace the current single stage life expired facility at Vandyksdrift. The plant will be located at Middelburg South approximately 1000 metres south of the existing south plant facilities. The plant will be provided with a circular stacker reclaimer on the ROM side and a longitudinal facility for the product situated adjacent to the loadout. The plant will process coal from the southern areas of the combined resource including the coal emanating from the Boschmanskrans Pillar Area. Construction of the plant will take 22 months from the decision to proceed with the project to a projected commissioning date of December 2008. Ramp up to full production will take approximately 3 months thereafter.
- The development of the new mining areas in the western portion of Douglas Colliery designated as Steenkoolspruit and Kleinkopje. The development of the new properties will incorporate the associated environmental infrastructure including storm water protection facilities, affected water dam and clear water cut-off facilities. A large number of grave sites were identified on the site and over 95% have been relocated with the remainder scheduled for the coming months. The initial boxcut have been undertaken by a contractor since February 2007 until the first Boschmanskrans shovel is relocated to the pit in July 2008.
- A coal transportation system comprising of a run of mine (ROM) tip, primary and secondary crushing facilities and a 12km overland conveyor system to the new processing plant. The conveyor will carry coal destined for both the export and power station processing facilities although the tonnage throughout the life will be predominantly destined for the export plant.

Key performance indicators

The project performance will be measured on three main areas which include Safety, Financial performance and Schedule. A threshold, target and a stretched target for each of the performance indicators were defined (refer to **Table 4**).

Table 4: The DMO project key performance indicators

Key Performance Indicator	Threshold	Target	Stretch
Safety			
Fatalities	0	0	0
Classified Injury Frequency Rate	2	1.0	0.5
Level 4 Incidents	1	0	0
Financial Performance			
Capital Cost	P90	P50	P10
Schedule			
Commencement on site (after approval)	3 months	2 months	1 month
ROM Tip Complete	21 months	17 months	16 months
Process plant cold commissioning	25 months	22 months	21 months

Source: BHP Billiton, DMO project feasibility report, 04/04/2007

Key issues

The key risks related to the DMO Project are detailed within the report and are summarised as follows:

- The construction environment which is placing pressure on both design and construction resources as well as cost escalation,
- Integration of the project into the existing MMS Operation,
- Management of the rundown of underground operations and the matching of boxcut production as replacement tonnage, and
- The current performance at Middelburg Mine.

Project benchmarking

The key measures of performance for the various areas have been fully benchmarked against comparable operations both locally and offshore.

2.5.6. BHP Billiton Capital Investment Policy

Source: BHP Billiton investment policy, version 5.1, May 2007

2.5.6.1. Purpose of the BHP Billiton Investment Policy

The BHP Billiton investment system is designed to assist in making good investment decisions and to ensure investments:

- Are aligned with company values, ethics, priorities, strategies and policies,
- Achieve optimal shareholder value with an acceptable degree of risk,
- Have an acceptable probability of success, and
- Are based on a consistent decision framework.

The ultimate goal is to have BHP Billiton invest consistently in opportunities that achieve returns in excess of an investment's cost of capital, thereby increasing BHP Billiton shareholder wealth and company reputation.

Independent Peer Review (IPR)

Independent Peer Reviews support the progression of investment proposals through the investment process while assisting with BHP Billiton's governance requirements. For each investment decision above the Group Approval Threshold, an IPR Leader is appointed and a fit-for-purpose IPR team formed.

The IPR Leaders are allocated to a 'pool' of resources and are rated (into one of three groups) according to capability (not organisational level), experience and training. Projects are similarly classified (into one of three groups) according to size, complexity, risk, phase and whether BHPB is operator. The grouping of projects determines whether the IPR leader is to be sourced externally to the relevant Group President's CSGs, external to the relevant CSG or may be

sourced from within the CSG. IPR Leaders are selected from the 'pool' by the relevant CSG President and jointly appointed by the CSG President and the IRC.

The IPR Leader's key responsibilities are to:

- Work with the relevant CSG (customer sector group) to prepare the Terms of Reference for the IPR. The Terms of Reference should be developed in consultation with the Project Leader and the Investment Office, and agreed with the CSG President prior to submission to the IRC (via the IRC Secretary) for approval,
- Engage early in the each phase and support the project team to ensure issues are raised and resolved as soon as practical,
- Review the Investment Approval Request and relevant supporting documentation (study report and Investment Evaluation Model) against the relevant BHP Billiton Standard, and other relevant industry standards, and
- Prepare an IPR Summary Report outlining recommendations, key findings and any material issues. The IPR Summary report (supported by appropriate IPR Functional reports) should be discussed with the CSG President and submitted to the IRC for consideration.

Investment Review Committee (IRC)

The role of the Investment Review Committee (IRC) is to oversee and monitor the investment processes across the organization and endorsement of major investment decisions. The IRC operates under powers delegated by the CEO, and is chaired by the BHP Billiton Chief Financial Officer.

The responsibilities of the IRC are outlined in the Investment Review Committee Charter, Investment Review Committee Charter, and are summarised below:

- To ensure that a fit-for-purpose, rigorous Independent Peer Review has been undertaken for all investments exceeding the Group Approval Threshold,
- To ensure investments are aligned with the Group's values, ethics, priorities, strategies and policies,
- To ensure that the key risks and opportunities are understood and where possible appropriately quantified, and action plans are in place to deal with those risks/opportunities,
- To satisfy itself that shareholder value has been maximized,
- To ensure the Investment Approval Request is correctly presented, and
- To ensure that there is a process in place for the Post Investment Review of investments, to assess investment performance and to capture and institutionalise project learning's and improvements to the investment process.

Overview of the BHP Billiton Capital Investment Policy

The BHP Billiton investment process commences with identifying the original business concept in the Identification Phase, and concludes with the Operation Phase where learning's are captured and post investment analysis is conducted.

The investment process has five phases:

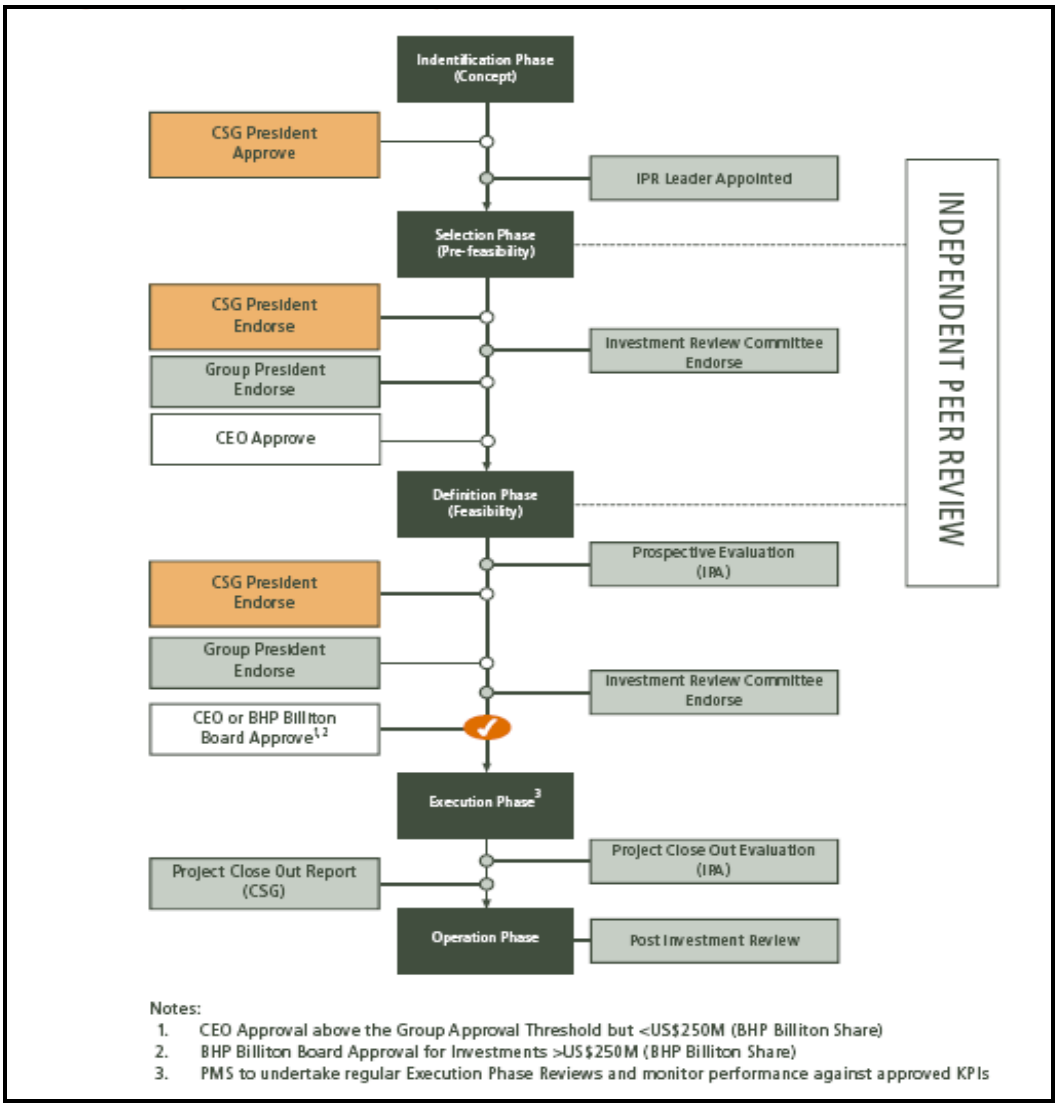
- Identification (Concept),
- Selection (Pre-Feasibility),
- Definition (Feasibility),
- Execution, and
- Operation.

Figure 10: BHP Billiton capital investment procedure

Source: BHP Billiton investment policy, version 5.1, May 2007

The following figure represents the BHP Billiton capital investment process map (refer to **Figure 11**).

Figure 11: BHP Billiton capital investment process map



Source: BHP Billiton investment policy, version 5.1, May 2007

Table 5: Key activities and questions to be answered for each of the phases of the BHP Billiton capital investment process phases

Phase Objectives	Activities	Key Questions to be Addressed
IDENTIFY Identify potentially value-creating investment alternatives to be assessed in further detail during the Selection Phase. Plan for the next phase.	• Identify a potentially value-creating investment. • Identify major alternatives for investment capture to be evaluated in the Selection Phase. • Determine the potential value of the various alternatives. • Confirm alignment with the business strategy. • Define what work needs to be done to assess the investment opportunity. • Plan for the Selection Phase.	•Is this the right investment for BHP Billiton? If so, why? •Is there sufficient potential value associated with the investment to justify further investigation? •Does the investment fit with the current business strategy? • What are the potential material issues (if any) or major risks that could negate all investment value? •Have a broad range of alternatives been identified for study in the Selection Phase? •Is there an adequate plan for the Selection Phase?
SELECT Select the single most valuable investment alternative (configuration) to be studied further & optimised in the Definition Phase. Plan the next phase.	• Evaluate various alternatives and select the preferred alternative. • Demonstrate that the single most valuable alternative has been recommended for further study in the Definition Phase. • Ensure technical and commercial viability of the investment. • Ensure there are no material issues that could negate all investment value. • Plan for the Definition Phase.	•Does the investment still fit with the current business strategy? •Have all reasonable alternatives been properly considered and reviewed equally? •What criteria were used to select the single most valuable alternative? •Are the major risks and possible controls identified? •Does the potential value of the investment continue to justify further investigation? •Have counterparties been assessed for risks and their ability to meet our requirements? •Is there an adequate plan for the Definition Phase?
DEFINE Define the selected single investment alternative. Plan the execution of the project.	• Based on the selected alternative, optimise total life cycle costing and NPV for the investment. • Complete any outstanding optimisation selections or tradeoff studies. • Complete a full evaluation of the investment including the risk profile. • Finalise scope, cost, schedule and other KPIs. • Include any upside alternatives that may accrue to the investment outside the scope of the IAR. • Plan for the Execution Phase. • Obtain funding approval.	•Does the investment still fit with the current business strategy / BHP Billiton portfolio? •Is there an accurate understanding of the value and risks of the investment prior to moving to project execution? •Have all reasonable optimization opportunities been pursued? •Has shareholder value been maximised? •Are the risks understood? •Have counterparties been assessed for risks and their ability to meet our requirements? •Are the risk control action plans in place? •Are statutory approvals being obtained (or pending)? •Is there a detailed optimal Project Execution Plan? •Is approval recommended?
EXECUTE Deliver or execute the project to achieve the KPIs agreed in the Investment Approval Request.	• Deliver the investment consistent with business and project KPIs, including safety, scope, cost and schedule. • Complete Project Close-Out Report.	•Are the risks (including HSEC) being satisfactorily controlled? •Is the investment being delivered in accordance with the approved scope, cost and schedule? If not, what corrective actions are required? •Have internal or external conditions changed materially, such that Cost and/or Schedule forecasts are at risk of breaching KPI Thresholds? •What is the Execution Phase Watchlist status and is a Supplementary Approval Request required? •Have the lessons learned been communicated throughout the organisation?
OPERATE Capture key learning's from the investment decision. Operate the assets and ensure the investment produces maximum returns for shareholders.	• Complete Post Investment Review. • Operate the assets to ensure performance to specification and maximum return to shareholders.	•What were the key learning's for BHP Billiton from the original investment decision and from the execution of the project? •Is the value that was expected when the investment was approved being achieved? If not, what actions are required to ensure that the full benefits are achieved?

Source: BHP Billiton investment policy, version 5.1, May 2007

2.5.6.2. Identification Phase (Concept Phase)

The primary objective of the Identification Phase is to identify whether, at a high level, a business opportunity is likely to exist and identify a broad range of possible alternatives (e.g. size, technology, processing, products, transport, infrastructure, etc) to be assessed during the Selection Phase, should the investment opportunities warrant further investigation.

This phase is designed to ensure proposals that progress to the next phase satisfy CSG and Group strategy, have a good prospect of being economically attractive and where it is expected that risks are capable of being managed to an acceptable level.

The company will only fund opportunities that fit with the broader BHP Billiton strategic direction and it is assumed that the CSG strategy is aligned with the broader BHP Billiton strategy via the CSG appraisal process. The aim is to seek high-level identification of conceptual solutions rather than focus too quickly on existing “tried and proven” solutions. The results of the Identification Phase should comprise a number of potentially valuable alternatives that warrant further investigation during the subsequent Selection Phase.

Deliverables

The deliverables from the Identification Phase are:

- An Identification Phase study report,
- A work plan including a budget and schedule, and
- Following the CSG President’s approval to proceed to the Selection Phase, an Investment Review Committee Notification requesting the appointment of an Independent Peer Review Leader is to be submitted via the IRC Secretary

2.5.6.3. Selection Phase (Pre-Feasibility Phase)

The primary objective of the Selection Phase is to select the single most valuable investment alternative to be further studied and optimised in the Definition Phase. The IPR Leader works with the relevant CSG to prepare the Terms of Reference for the IPR. The Terms of Reference should be developed in consultation with the Project Leader and the Investment Office, and agreed with the CSG President prior to submission to the IRC (via the IRC Secretary) for approval.

The IPR Leader coordinates an Independent Review of the investment opportunity and provides guidance and advice to the Project Leader. The IPR process is an iterative one, ensuring that major issues are identified and addressed (where possible) prior to submission to the CSG President at the end of the phase. Early in the Selection Phase the IPR team is to review the Identification Phase study report and the scope of work, plan and schedule for the Selection Phase to ensure that it is appropriate and realistic. Prior to the appointment of the Project Manager and the direct line reports to the Project Manager for the Definition phase, the Vice President - Project Management Services is to endorse the proposed organisation structure and the nominations. The endorsement or otherwise must be documented and communicated with the CSG President and the IRC, and must include any reasoning for not supporting the CSG's proposal.

If the Selection study results warrant proceeding to the Definition Phase a draft Investment Approval Request (IAR) in conjunction with a draft IPR Summary Report is to be submitted to the CSG President for discussion and endorsement. The CSG President is to consider the input of the IPR team prior to advancing projects to the Group President. If the CSG President proposes to proceed to the Definition Phase then Group President endorsement is required prior to submission of the IAR to the IRC. The IPR Leader should submit the IPR Summary Report and IPR Functional Reports to the IRC for consideration at the same time.

The Project Leader and the IPR Leader are to attend the relevant CSG and/or IRC meetings where the IAR and the IPR reports are considered. The CSG President and where possible, the relevant Group President are expected to attend the IRC meeting. The CEO will attend the IRC meeting. The CEO will consider the endorsement of the IRC and will approve (or otherwise) the progression to the Definition Phase.

Deliverables

The deliverables from the Selection Phase are:

- A Selection Phase Study Report, and
- An Investment Approval Request (IAR).

2.5.6.4. Definition Phase (Feasibility Phase)

The primary objective of the Definition Phase is to better define and optimise the single investment alternative selected in the previous phase.

Figure 12 in this section shows the flow of information to the various approval bodies and the documentation requirements for each approval body.

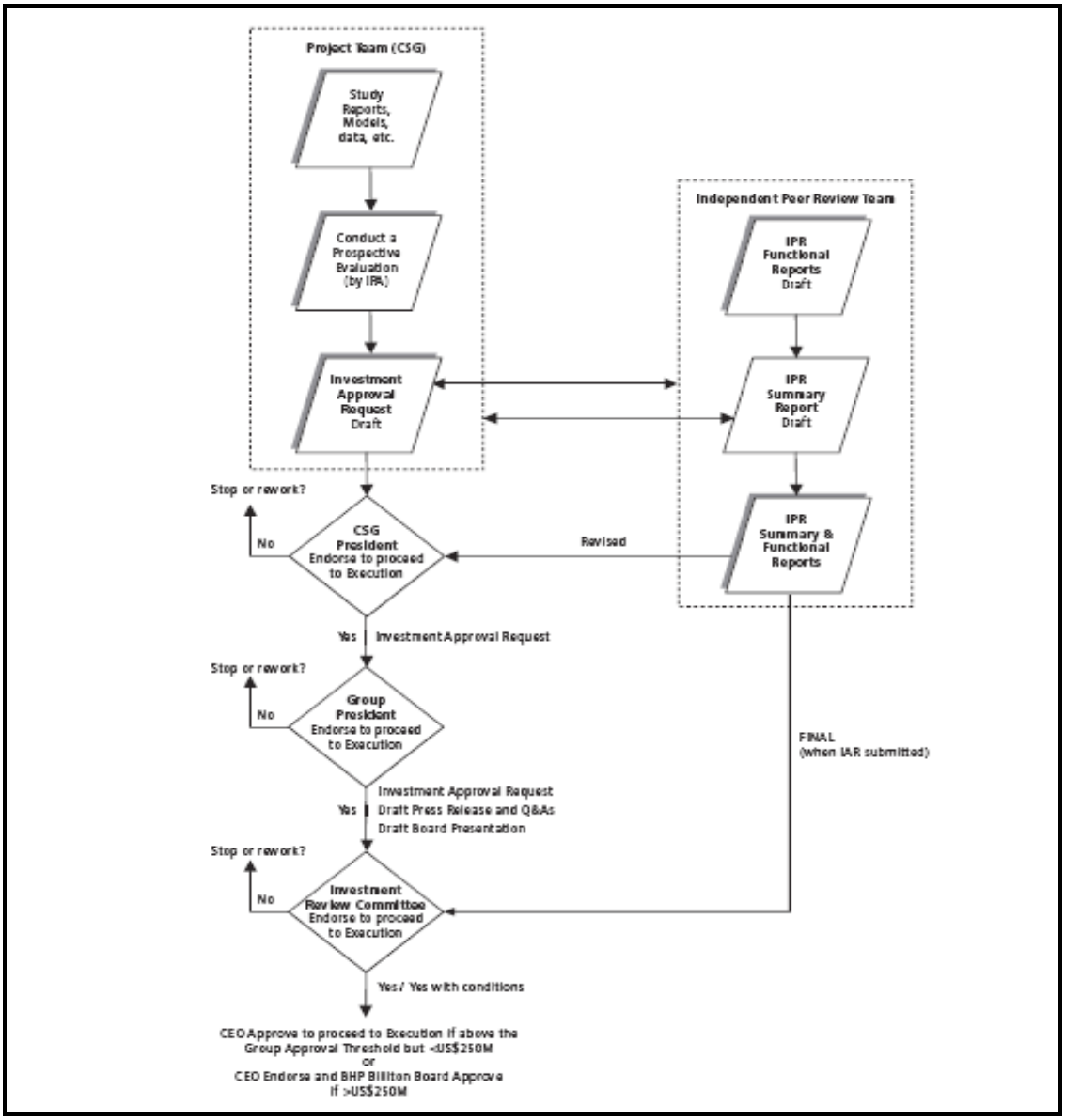
Prior to the completion of the Definition Study and prior to the final IPR, the Project Leader is to engage Independent Project Analysis Inc (IPA) to undertake a Prospective Evaluation. IPA will prepare a Prospective Evaluation report which is to also be provided to the IPR Leader.

If the Definition study results warrant proceeding to the Execution Phase a draft Investment Approval Request (IAR) in conjunction with a draft IPR Summary Report is to be submitted to the CSG President for endorsement. The CSG President is to consider the input of the IPR team prior to advancing projects to the Group President. If the CSG President proposes to proceed to the Execution Phase then Group President endorsement is required prior to submission of the IAR to the IRC. The IPR Leader should submit the IPR Summary Report and IPR Functional Reports to the IRC for consideration at the same time.

The CEO will attend the IRC meeting. If the request for approval is greater than the Group Approval Threshold but less than the CEO approval limit (as defined by the Approvals Framework), the CEO will consider the endorsement of the IRC and will approve (or otherwise) the progression to the Execution Phase.

Approval of projects greater than the CEO approval limit rests with the BHP Billiton Board after CEO endorsement.

Figure 12: Definition phase approval process



Source: BHP Billiton investment policy, version 5.1, May 2007

Appointment of a Project Auditor (Health Check)

During the Definition Phase and prior to approval to proceed to the Execution Phase, the relevant CSG Chief Financial Officer in conjunction with the Vice President – Risk Management & Assurance is to decide on the appointment (or not) of a dedicated Project Auditor (from Group Audit Services). Criteria relevant to the decision will include – materiality of the investment, complexity, geographic location, contracting environment, risk profile and potential business conduct challenges. If a dedicated project auditor is not appointed, Group Audit Services will continue to conduct audits in conjunction with the Execution Phase Reviews conducted by Project Management Services.

Deliverables

The deliverables from the Definition phase are:

- A Definition Phase Study Report,
- A Prospective Evaluation report prepared by Independent Project Analysis Inc,
- An Investment Approval Request (IAR), and
- Drafts of the following: Board presentation, press release and 'Question & Answers'.

2.5.6.5. Execution Phase

Progress & Status Reporting

The primary objective of the Execution Phase is to deliver or execute the project to achieve the objectives stated in the Investment Approval Request. During the Execution Phase the progress of the project is to be monitored and reported against the cost and schedule KPIs as approved in the Investment Approval Request. The Project Manager is to prepare a Project Monthly Report which is to also be uploaded into the Investment Tracking System on a monthly basis.

Execution Phase Close-out & Learning Capture

Prior to the completion of the Execution Phase and before the key project team members have disbanded, a Close-Out Evaluation is to be conducted and a Project Close-Out Report is to be produced. The purpose of these reviews is to capture the key project learning's (both positive and negative) that had a significant impact on the final outcome of the project and to collect benchmark data related to the project. Independent Project Analysis Inc (IPA) currently undertakes the Close-Out Evaluation and the Project Close-Out Report is produced by the project team with the assistance of Project Management Services as necessary. On completion of the reviews, a copy of the Close-Out Evaluation Report from IPA, and the Project Close-Out Report should be loaded into the Investment Tracking System and these reports will be used for the subsequent Post Investment Review.

Deliverables

The deliverables for Execution Phase status monitoring and reporting are:

- A Project Monthly Report,
- Supplementary Approval Request Report (if necessary), and
- A Project Close-Out Report toward the end of the phase.

2.5.6.6. Operation Phase

Post Investment Review

A Post Investment Review (PIR) is to be completed and submitted to the IRC no later than 18 months after Project Completion, to capture key learning's during the Execution Phase and communicate a retrospective analysis of the investment decision.

PIRs are to be independently led and the PIR Leader should not come from the CSG concerned. The PIR Leader, in consultation with the CSG President is to

develop the Terms of Reference for the PIR. The PIR Summary Report is to be endorsed by the CSG President and approved by the IRC. The Executive Committee (ExCo) is to be informed of the outcomes of the PIR with the intention of disseminating and sharing the learning's. On an annual basis the IRC will advise the ExCo of the Post Investment Reviews undertaken during the year and provide a summary of the key learning's and recommendations.

Deliverables

On completion of the PIR, the PIR leader is to submit to the IRC Secretary:

- A 2 page PIR Summary report, and
- If requested by the CSG President, a PIR Detail Report which as a minimum should include the following: (a) executive summary; (b) background (c) analysis of the key performance indicators; (d) key learning's from review and approval of the investment as well as the execution of the project; (e) recommendations including improvements to the investment process and/or standards; (f) a record the process undertaken, documents reviewed and people interviewed to support the PIR; (g) a reference to the Project Close-Out Report and IPA Close-Out Evaluation Report.

CHAPTER 3: FOUNDATION OF THE STUDY

3. Theoretical foundation

3.1. Scope of body of knowledge

The study will focus on project management and project status evaluation on a strategic level.

The evaluation method will be derived from the project health check model as described in the book “The Interactive Project Workout” (Buttrick 2000). The evaluation criteria will include: Project Plan, Resources, Ownership, Justifiable Case, Expertise, Clear Specification and Top Level Support. Additional evaluation criteria may be added if necessary.

3.2. Theories to be used

Project health check model (Buttrick 2000).

3.3. Hypothesis statement

No hypothesis statements need to be tested for this case study.

CHAPTER 4: LITERATURE REVIEW

In order to be more competent in today's market place, companies are looking to improve their systems and processes to be more competitive. One way of doing this is by establishing project management as a core competency throughout the organisation. Companies see proper project management as a competitive advantage in maximising the return on invested capital and thus the increase in shareholders value. According to the Project Management Body of Knowledge (PMBOK 2004), a project is a temporary endeavour undertaken to create a unique product service or result. Temporary means that every project has a definite beginning and a definite end, and products, services or results refer to the creation of unique deliverables. Shenhar (2004) defines a project from a strategic point of view, "A temporary organisation and process setup to achieve a certain goal under constrains of time, budget and other resources". The following are some more common definitions of a project presented by literature:

- A project is an endeavour to accomplish a specific objective through a unique set of interrelated tasks and the effective utilisation of resources (Gido & Clements, 1999);
- In the broadest sense, a project is a specific, finite task to be accomplished (Meredith & Mantell, 1985); and
- A project may be defined as a beneficial change which uses special project management techniques to plan and control the scope of work in order to deliver a product to satisfy the client's and stakeholders needs and expectations (Burke, 2003).
- A practical definition of a project include: A project is a complex, non-routine, one-time effort limited by time, cost and quality constraints to meet either a customer's requirement or a strategic goal.
    - It has a clear and pre-determined end objective,
    - It has a clear start and end date,
    - It has an approved budget and allocated funding,

- Responsibility, accountability and authority are clearly assigned up-front,
- Quality specifications, control systems and procedures are clearly defined upfront,
- Success and exit criteria clearly determined up-front,
- Its role within overall business strategy clearly defined and understood, and
- The project manager, project sponsor and client have signed off on the same terms of reference and overall work breakdown schedule willingly (Coetzee, 2007).

Project management on the other hand could be defined as the application of knowledge, skills, tools and techniques to project activities to meet project requirements (PMBOK 2004). Project management is accomplished through the application and integration of the project management processes of initiating, planning, executing, monitoring, controlling and closing.

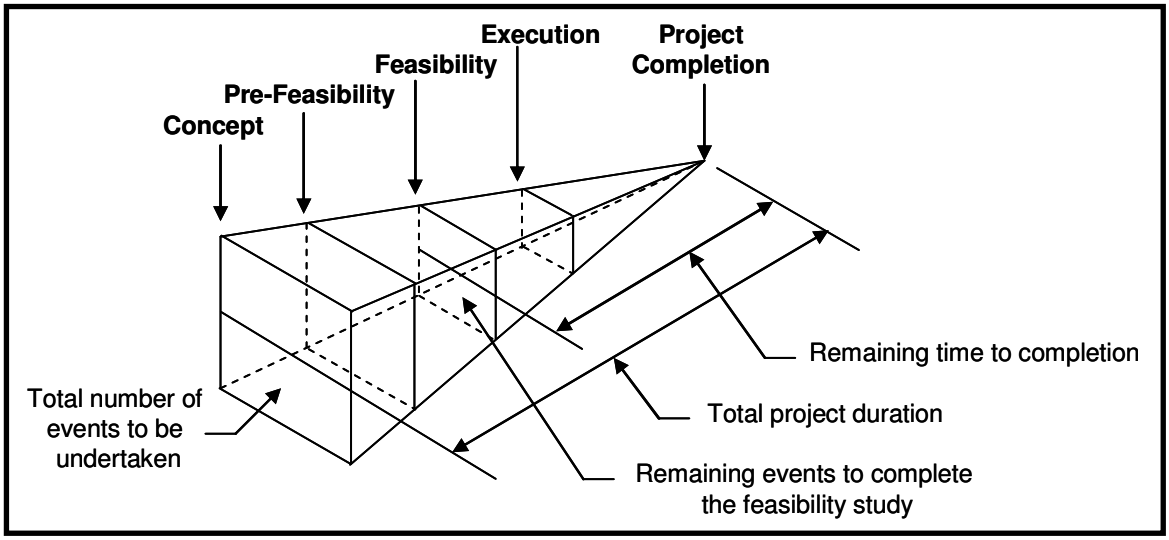
Projects and project management are becoming so important that they are utilised as a means of achieving an organisations strategic plan. Projects are typically authorised as a result of one or more of the following strategic considerations: market demand, organisational need, customer request, technological advance or a legal requirement (PMBOK 2004).

Projects are usually divided into phases / stages for better management control. The collection of these phases forms a project lifecycle. The project life cycle thus defines the phases that connect the beginning of the project to the end. Typical phases as described by Buttrick (2000) include: proposal, initial investigation stage, detailed investigation stage, develop and test stage, trial stage, release stage and the post implementation review. The description of the phases differs from company to company, but essentially they all refer to a concept stage, a pre-feasibility stage, a feasibility stage and an execution stage.

The definitions of the stages are convention specific to each company or industry.

In order for a project to advance from one phase of the project life cycle to the next, a company should ensure that the project comply with the requirements of that phase, as specified by the company standards. The following figure is a representation of a typical project lifecycle with the total number of events that need to take place for each project life cycle phase, in comparison to the total duration time of the project (refer to **Figure 13**).

Figure 13: Project phase vs. project duration vs. events to complete



Source: Conroy et al (1998)

Typical methods of determining the status of a project in order to make the decision of advancing to the next phase includes audits, a project health checks or review sessions.

The need to undertake any audit or review sessions is usually self evident, i.e. in order to ensure that the reported status of the project is in fact a true and accurate reflection of the actual condition or shape of the project.

Project reviews have the advantage of creating a good relationship between the project manager and the project sponsor (Englund 2006). Reviews force the project manager to review the project status and pending tasks. At the same time, they force the project sponsor to know more about the project, the customer and other project stake holders. The project review process may consist of various types of reviews, depending on the project stage. According to Englund (2006), there are four typical review types:

- Initiation review (IR),
- Planning and proposal review (PPR),
- Procurement review (PR), and
- Quality assurance review (QAR).

He also identified four main objectives of project reviews:

- Determining the feasibility of the project to make the go/no go decision,
- Checking if all necessary activities were done before presenting a customer proposal or solution,
- Checking if all agreements and procedures were formally accepted and reviewed between the customer and the project delivery organisation, and
- Tracking deviations and variances and allowing room for improvements and action plans.

Audits could be done at any stage of the project life cycle, i.e. pre project, in project and post project. Duffy et al (1989) highlights the benefits of conducting audits. These benefits include:

- Anticipate problems rather than react to them,
- Manage risks and problems, so as to reduce or eliminate their impact,
- Evaluate opportunities to increase or decrease participation in the project,

- Gain an independent view of the performance of the project team in contributing to the success of the project,
- Confirm that users requirements are well understood, defined and achievable within the restraints imposed on the project, and
- Be reassured that effective planning and cost control methods are being used on the project.

However, audits have the ability to give a snapshot of the status of the project at the time and as such may not fully identify key aspects of the soft skill issues, such as personality clashes, low productivity, dysfunctional bureaucratic behaviour or discontentment within the project group. Other problems with audits according to Conroy et al (1998) include:

- The data presented for an audit can be developed purely for the audit exercise rather than as a management tool,
- Audits are usually only done at certain project stages. Damage to projects as a result of oversight may be too great to repair within the remaining life of the project,
- Audits are by nature esocentric as they are often seen as challenges to the project manager rather than as an aid. The audit should identify the clear distinction between monitoring and controlling,
- Interim audits are of limited value as a forecasting tool unless the project management software is applying regularly updated risk management techniques such as a Monte Carlo simulation package,
- The audits are temporal. Any scope changes after the audit has been done, could “cloudy” the audit result, and
- Availability of competent auditors, especially in remote locations, could pose a risk for proper project status evaluation.

Traditionally there exist a variety of project tracking systems, for project status purposes, which could be both computer driven or manual to keep track of variables that must be accounted for to help ensure project success. Well

established monitoring aides include systems such as PERT, Gantt Charts and Critical Path Methodologies (Pinto 1990). Typically these systems track costs, schedules, performance of project sub assemblies, subcontractors and so forth. The information gained from these processes could be of high value for project tracking purposes, but, for actual project stats evaluation it may not provide enough information on all the critical project success criteria to determine if a project should be approved to advance to the next phase in the project life cycle. The information could be used as basis for decisions regarding project performance but not necessary strategic project evaluation.

There limited literature available on proper project health checks, to decide whether projects could advance to the next phase of the project life cycle. Literature is more concerned with project evaluation for selecting the right project from the start. The evaluation models and evaluation criteria discussed for project selection could however be transposed onto project status evaluation against a predetermined criteria or benchmark.

The literature concerning project status evaluation will be discussed under four main categories. These categories include: the different project status models available, financial aspects of project status evaluation, project management and the role of the project manager and the strategic viewpoint of project evaluation.

Project status evaluation models

In his textbook “The Interactive Project Workout“ Buttrick (2000) gives an overview of project methodology and typical process steps developed from both theory and experience. Buttrick explains tools and techniques that could be applied to projects to ensure that they are kept under control and are likely to deliver the promised benefits. One of the tools to be used to evaluate the status of a project at a certain time or phase is the Project Health Check model. This tool is a useful analytical device to assess the current health of a project. It looks

at the full project environment and using a set of key questions result in an assessment of the overall risk associated with the project. The Project Health Check model is based on seven critical project success factors. These include:

1. **Project Plan**: Is there a detailed project plan which includes costs, personnel accountabilities and contingency plans?
2. **Resources**: Is there sufficient man power, appropriate technology available and does the project team personnel understand their roles?
3. **Ownership**: Where stake holders involved, do they understand limitations of the project and which of their requirements are included?
4. **Justifiable Case**: Project has been fully costed and budgeted, project shows a clear return on investment and adequate funding is available?
5. **Expertise**: All project team members possesses the appropriate level of expertise, project roles have been written out and adequate training has been built into the project schedule?
6. **Clear Specification**: The objectives of the project are clear to all stake holders and there is adequate documentation of the requirements of the project?
7. **Top Level Support**: Top management shares responsibility, authority levels and accountabilities have been agreed upon and the project sponsor is fully committed to the project's success.

Each one of these critical success factors are analysed with regards to the project at hand to determine the risk status of the project.

Another author that used critical project success factors to evaluate the status of a project is Jeffery K Pinto (1990). In his article "Project Implementation Profile: a tool to aid project tracking and control" Pinto points out that the project manager should not just track the "harder" technical aspects of a project, but should also assess the "softer" side. Softer side refers to the behavioural issues which include the project team personnel, top management support and client

acceptance. The softer side thus determines the status of a project in relation to its human elements and strategic issues of project development. Pinto identified ten critical project success factors for project implementation. These factors include:

1. **Project Mission**: Initial clarity of goals and general direction.
2. **Top Management Support**: Willingness of top management to provide the necessary resources and authority/power fro project success.
3. **Project schedule** / **plans**: A detailed specification of the individual action steps required for project implementation.
4. **Client consultation**: Communication, consultation and active listening to all impacted parties.
5. **Personnel**: Recruitment, selection and training of the necessary personnel for the project team.
6. **Technical tasks**: Availability of the required technology and expertise to accomplish the specific technical action steps.
7. **Client acceptance**: The act of selling the final project to its ultimate intended users.
8. **Monitoring and feedback**: Timely provision of comprehensive control information at each stage in the implementation process.
9. **Communication**: The provision of an appropriate network and necessary data to all key actors in the project implementation.
10. **Trouble shooting**: Ability to handle unexpected crises and deviation from plan.

There is quite a resemblance between the critical project success factors as was highlighted for the “Project Implementation Profile” presented by Pinto (1990) and the “Project Health Check” model presented by Buttrick (2000).

Project reviews should be done whenever something could contribute to performance improvement or at every milestone (Englund 2006). Depending on

the length and size of the project, monthly reviews should be adequate. He focuses on nine key evaluation criteria in the review session. These areas include:

1. Scope management
2. Time management
3. Cost management
4. Quality management
5. Human resource management
6. Communication management
7. Risk management
8. Procurement
9. Customer satisfaction

Performing readiness checks on projects is similar to checking a car before you start off a long trip. It doesn't keep bad things from happening, but it does provide some comfort and reduces the risk of things going wrong (Bolles 2002). Project readiness check could be seen by project managers as a waist of time. It is important to point out to project managers that readiness checks are not performed to evaluate performance (there are no good or bad grades assigned). They are done to help project teams ensure that it is properly prepared to achieve success before work begins, which saves time and money in the end. Bolles (2002) in his book "Building Project Management Centres of Excellence" focuses on twelve key project success factors. These include:

1. Project status update cycle
2. Change control process
3. Issue resolution process
4. Steering / project team established
5. Baseline plan
6. Project budget
7. Scope statement
8. RRAA* matrix
9. Communication plan
10. Risk assessment
11. Metrics plan
12. Management plan

Typically during a project readiness review, the full project team, a project customer representative and the project sponsor should be represented. Having

* Role, responsibility, accountability, authority

the customer and the project sponsor attend the readiness review communicates the importance of being prepared to every one.

The WS Atkins Project Performance Auditing Methodology as described by Duffy et al (1989) is based on nine key project success factors, which include:

1. Organisation and management
2. Project definition
3. Time
4. Money
5. Procurement Strategy
6. Communication
7. Site (site related problems)
8. Restraints
9. Commissioning and operation

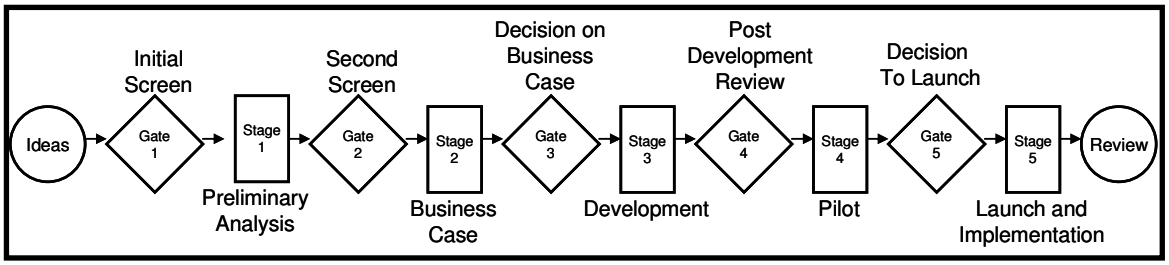
Quality assurance should be applied to every project that is going through the project life cycle. Torp et al (2005) suggest that the quality assurance be done through the identification of critical success factors (CSF) and Potential Pitfalls (PP). He found that evidence from case studies showed that lack of critical success factors are considered potential pitfalls and visa versa. The following key project success factors were identified:

1. Project organisation
2. Contract strategy
3. Project planning and controlling
4. Stable framework conditions
5. Stakeholder management
6. Technical factors
7. Nature and market condition
8. Objective management
9. Top management support
10. Interface surrounding projects
11. Management of design

The Stage-Gate™ process described by Cooper et al (2002) shows the use of a score card method at gates to rate and prioritises projects, engaging senior management in the decision process and improving the efficiency of gates through such means as virtual gates and self-managed gates. The gates represent Go/Kill decision points. The Stage-Gate™ process is a risk

management model and is divided into three versions: Significant Customer Request (SCR) process for low risk projects, The Fast Track process for medium risk projects and The Full Process for high risk projects. The following is a representation of the full five stage process (refer to **Figure 14**):

Figure 14: The Stage-Gate™ process



Source: Cooper et al (2002)

At each gate the project is checked to a "Must Meet" and "Shall Meet" criteria. These criteria include strategy, product advantage, market attractiveness, synergies, technical feasibility and Risk vs. Return. The projects are rated according to the criteria and a decision is made whether to stop (kill) or go ahead with the project.

The scorecard evaluation method is further supported by Germain (2000) in his article "Balance Your Project". The project must follow the normal project life cycle, but at each phase the project should be evaluated by means of a balance scorecard approach. The balanced scorecard should include a financial perspective, internal process perspective, customer perspective and a learning and growth perspective. The advantages of using a score card approach include:

- Aligns performance measures with business strategy through cause/effect,
- Clearly communicates strategy to all levels of the organisation,
- Establish a foundation for budgeting and individual performance planning,
- Allows management to monitor achievement of the strategic plan and enable them to adjust the plan for internal and external conditions, and
- Provides and indicates future results.

Attempts have been made to automate the project evaluation procedure. The concurrent simultaneous engineering resource view (ConSERV) concept presented by Conroy et al (1998) is a very useful method for evaluating the project risks on a continual basis throughout the project life cycle. Conroy specifies ten key project specific dimensions in order to generate a unique set of project specific risks. The dimensions include: type of industry, location, client and design influence, main plant items, interfaces, cost, focus, resources, end date and contingency. The ConSERV enables project specific data to be handled via a knowledge based system and thereby be continually analysed, assessed and audited against project specific issues and organisational procedures. This is a very good concept but would need the full dedication of the project team in order to update the system on a continual basis. This could have the risk that the project team members are so involved in continually updating the tracking system that they loose the focus of the project. Another risk identified is that project manager becomes so reliant on the automated system that if a system failure occurs, the project is at risk of "collapsing" without any backup systems in place.

According to Shenhar (2004) project managers should follow a strategic project leadership (SPL) approach to project management. This new SPL approach focuses on projects, to create a competitive advantage for companies and winning the market place. This approach consists of five major components, Project Strategy, Spirit and Vision, Organisation, Processes and Tools. These five elements are hierarchical, and during project initiation, planning, executing and reviewing, they must be addressed sequentially from the highest to the lowest. Shenhar identified seven key principles (key project success factors) for project success, which include:

1. **Leadership**: Turn project managers into leaders. Make them responsible for business results.

2. **Strategic project portfolio management**: Group your projects based on their strategic impact and form a policy for project selection. Operational projects, strategic projects, external projects and internal customers.
3. **Project strategy**: Define the competitive advantage of your product and articulate a detailed project strategy to win in the market place. Project strategy involves business perspective, objective, product definition, competitive advantage / value, success and failure criteria, project definition and strategic focus.
4. **Spirit**: Articulate an inspiring project vision and develop an appropriate project spirit, which will support the strategy and create energy, excitement and commitment.
5. **Adoption**: Assess the product environment and task. Classify your project, and select the right project management style to fit the project type.
6. **Integration**: Create an integrated hierarchical plan. Start with strategy, and include spirit, organisation, process and tools.
7. **Learning**: Create a project learning organisation. Every monitoring and controlling activity will include lessons learned. Summarise your project in a lessons learned event and report.

Project managers are faced with limited resources and careful selection of the right pool of projects should be done. Gabriel et al (2005) looked at multi objective, integer-constrained optimisation model. The important evaluation criteria look at the value the project will add to the company, labour requirements and average cost of the project. What gives this model an advantage is the incorporation of the Monte Carlo simulation of the project variable. It is thus possible to quantify the impact of risk variable on the project outcome.

Vandersluis (2001) reminds us that capacity in terms of skills, space, money, materials, equipment and support system for the size of the project should be considered during project evaluation. In terms of cost, the focus should be placed

on return on investment, cost vs. benefit and the opportunity cost (what else could be done with the resources that might have deliver an even greater benefit).

Another author that addresses the resources and capacity constraints, Crawford et al (2006), insists that a project characterisation system should be used to ensure that resources are available and ensure that a company possesses of the required capability to deliver projects. The characterisation system is thus used to do strategic alignment, capability specialisation and determines the project approach.

Messner et al (2001) presents organisation based information architecture (OBIA) that defines a structure for information needed to address the strategic decision process of evaluating and selecting project to pursue. The information in the OBIA was separated into five main categories: organisation, commitment, process environment and facility. After the information was entered into the OBIA structure, a Project Analysis Diagram was constructed that identifies the information elements that require additional investigation. Although the OBIA model gave a good layout of the information needed for project evaluation, it does not give a rating method to compare the quality of information between projects. The OBIA structure could however be used to ensure that all the required information are available and in a standardised format to be able to do project status evaluation against a predetermined benchmark.

The identification and management of project risk is extremely important in evaluating the project status. Eben-chaime (2000) used a parametric weighing approach for project selection. A simple Single Period Project Selection (SPPS) model was used to show that a parametric weighing approach could be used to be risk averse. It was proven that while upgrading the conduct of risk in project selection, the SPPS model is conceptually simple, has strong intuitive appealing and is well solved in terms of computing effort.

In the article “A fuzzy stochastic technique for project selection” Wong et al (1999) highlights the challenges faced when comparing two or more projects. He uses the fuzzy stochastic dominance (SFD) aid intended to provide a new tool for multiple attribute decision making. The aggregate utility function for an individual project is derived as a fuzzy number (interval) which in tern, yields probabilistic information for stochastic dominance tests. Multi-attribute utility theory is used frequently to select a project from a feasible set of alternatives, given a set of attributes that are important to the decision maker. This method could be applied to project status evaluation by applying the test to projects at a certain phase of a project and comparing them to benchmark figures / ratings of typical historical successful projects at the same phase. The method provides a reasonable compromise between probabilistic risk analysis and the expected utility approach.

The following is a summary table of the project critical success factors that were identified by each of the authors (refer to **Table 6**):

Table 6: Summary table of Key Project Success Factors presented by literature

	Authors										
# of Critical Project Success Factors	**Bolles (2002)**	**Buttrick (2000)**	**Conroy et al (1998)**	**Cooper et al (2002)**	**Englund (2006)**	**Gabriel et al (2005)**	**Germain (2000)**	**Pinto (1990)**	**Shenhar (2004)**	**Torp et al (2005)**	**Vandersluis (2004)**
1	Project status update cycle	Project Plan	Type of industry	Strategy	Scope management	Value added by project to the company	Financial perspective	Project mission	Leadership	Project organisation	Resources
2	Change control process	Resources	Location	Product advantage	Time management	Labour requirements	Internal process perspective	Top management support	Project portfolio management	Contract strategy	Return on investment
3	Issue resolution process	Ownership	Client and design influence	Market attractiveness	Cost management	Cost of project	Customer perspective	Project schedule / plan	Project strategy	Project planning & controlling	Cost vs. Benefit
4	Steering / Project team established	Justifiable case	Main plant items	Synergies	Quality management	Risk associated with project outcome	Learning and growth perspective	Client consultation	Spirit	Stable framework conditions	Opportunity cost
5	Baseline plan	Expertise	Interfaces	Technical Feasibility	Human resource management			Personnel	Adoption	Stakeholder management	
6	Project budget	Clear specification	Cost	Risk vs. Return	Communications management			Technical tasks	Integration	Technical factors	
7	Scope statement	Top level support	Focus		Risk management			Client acceptance	Learning	Nature and market conditions	
8	RRAA matrix*		Resources		Procurement			Monitoring and feedback		Objective management	
9	Communication plan		End date		Customer satisfaction			Communication		Top management support	
10	Risk assessment		Contingency					Trouble shooting		Interface toward surrounding projects	
11	Metrics plan									Management of design	
12	Management plan										

* RRAA - Role, responsibility, accountability, authority

In a literature study done by Mengasha (2004) it could be seen that there was a shift of focus towards organisational and management issues from the historical technical issues for key project success factors. Technical issues are still important, but there are other issues like top management support, organisational issues, stakeholder management, coordination and human relation issues, that are just as important, as can be seen in **Table 6**.

Financial aspects of project status evaluation

One of main focus points of projects must be the total capital requirements of the project and the return on investment. The most common and realistic financial approach to project evaluation is the Net Present Value (NPV) analysis. NPV analysis has the advantage over other financial metrics e.g. Payback period (PP), Return on assets (ROA) and Return on investment (ROI), of taking time value of money into account. Flaig (2005) however suggest that projects should

use the Expected Net Present Value analysis (ENPV) during project evaluation. ENPV has an advantage over classical NPV calculation due to the fact that it includes factors like quality cost, yield and probability of completion of a project at a certain time. During project status evaluation it will be advised to include all the possible influences on the NPV calculation. The calculated project NPV will be compared to a company project required NPV and based on this comparison, will the go-ahead be given for a project to proceed to the next phase.

With so much attention on the bottom line, executives want hard-line numbers that show project management return on investment. According to an article "Proving the Value" by Bigelow (2004), only 51% of organisations measure the value of implementing project management improvement initiatives, and these metrics are focused primary on meeting delivery dates and budgets. Metrics is a new "buzz" word in company performance measurement today. It is not surprising that most of the literature concerning metrics include the catch phrase: "If you can't measure it, you can't manage it". In short, project implementation metrics is the tool to making the project manager fully accountable. Metrics provide the yardstick to project performance. The metrics used for evaluating project management performance really depend on the initiative's goals, the project management maturity level and the company culture. Improved scope- and project management, developing project charter, improved project selection, leveraging information across business units and support form senior management should all be align with corporate strategy and the project portfolio. It is suggested to use established quantitative impact metrics for each project, with those metrics then being used as indicators for alignment and prioritisation. This should give a good indication of the status of the project at a specific time.

Project Management and the role of the Project Manager

The catch phrase "The sooner a bad project is terminated, the better, however the sooner the best projects are completed the better" was used by Tomkinson (2004). He stresses the fact that executive involvement in projects is critically

important in optimising returns, lowering cost and risks and maximising the shareholders value. On a strategic level, execs and managers should define and analyse project alignment with company objectives, interdependencies, key schedule milestones, resources (human, equipment, capital) and project performance. Executive involvement should be done through constantly reviewing of detained plans, schedules and project status summaries.

Project management auditors / reviewers are normally at or above the level of project manager, have technical and managerial experience associated with the project, and are not in the position to influence any team member's performance evaluation directly. In this way the audit team is like a group of expert consultants, but with the experience on projects in the organisation (Graham et al 2004).

A project management point of view, taken by Longman et al (2004), defines key focus points for successful installation of project management. With installing project management, he expresses the need to ensure each of following elements are aligned and integrated into coherent project framework:

- **Strategy**: Sets the boundaries and goals fro the project,
- **Goals**: The project manager must know which operational goals makes a difference,
- **Leadership**: To keep a tight rein on organisational project portfolio,
- **Business process**: The system to gather, analyse and disseminate information must support project based framework,
- **Human capabilities**: This enquires the right people and skills for the project,
- **Culture and performance system**: Consist of norms, values and beliefs of the project environment,
- **Issue resolution systems**: To make ground rules clear,
- **Team structure**: Matrixing, intact or central pool project teams, and

- **External factors**: Changes in way projects are sold, delivered, reported e.g. government.

The role of project management in reviewing and evaluating projects is of critical importance for project success. Typically a project manager, according to Gillard (2005) should consist of the following core competencies with associated behaviours:

1. **Goal and action management**: This include diagnostic use of concepts, efficiency orientation and proactive,
2. **Leadership**: Including self-confidence and use of oral presentation,
3. **Human resource management**: Managing group process and the use of socialised power,
4. **Directing subordinates**: Developing others and the use of unilateral power, and
5. **Focus on others**: Stamina and Adaptability.

Lefley (2006) pointed out the possibility that a project champion can bias project selection. He used the Financial Appraisal Profile (FAP) model on project selection and proved his theory that the project champion could indeed bias project selection. It is assumed that this theory could also be true for a project champion to bias the status of a project at a certain project lifecycle phase in order to proceed into the next phase. The bias effect from the project champion could be minimised in the FAP protocol through the using of a Quasi-Delphi approach in the evaluation and justification of exceptionally high or exceptionally low project rating values in comparison to the other team members. Each team member in the evaluation process was given equal weighting and average scores were used.

Executive compensation should be coupled to the choices that the executives have that could influence the value of the firm. This was tested by Barron et al (2001) by the use of the principal-agent model. The quality of information on

which to base a decision on as well as well as the decision criteria are set by executives. The decision by the executive to go ahead or stop a project could have a huge influence on the value of a firm. A project selection framework is shown to introduce endogenous uncertainty into compensation that can influence the executive's effort choices. A simulation of the model indicates increased probability of a good project would lead to reduction in the optimal level of effort and a reduced proportion of compensation that is incentive based.

Within R&D project evaluation through a rank-order heuristic approach, there is always the danger of ignoring the technical interdependencies between projects. According to Raynor et al (2004) Strategic Flexibility mitigate any of the risk associated with portfolio deficiencies, selection criteria, projects interdependencies and resource allocation.

Throughout the project life cycle the project manager should always keep in mind the importance of how the project will help deliver the companies corporate objectives (Black 2004). Project approval must be a well oiled process. The project approval or rejection should be decisive, fast and painless based on the determination if the project will deliver on the anticipated return on investment.

Strategic viewpoint of project status evaluation

A strategy should distil a vision into critical business issues. These issues then get translated into projects, with discrete deliverables and backup plans. According to Longman et al (2004) there are seven essential criteria for project success:

1. **Make a compelling business case for project management**: Project managers must communicate clearly to each team member the value the project is expected to add to the organisation,
2. **Make project management practical, relevant and beneficial from day one**: The project team members need to know the intent of the concepts and tools to be used in the project and how to apply them effectively,

3. **Building bridges to on-the-job applications**: Applying of newly acquired skills and supporting with expert coaching and feedback,
4. **Make systems and procedures user-friendly**: The project processes must be documented and visible. It must be supported by procedures, forms, workflows and org structures,
5. **Make project management a win for team members and managers**: Applying the project management concepts must not add more work or consume more time than necessary,
6. **Make project management a ongoing learning experience**: This could be done through the practice of practical destructive questioning e.g. through tough-minded self appraisal at the end of every project, and
7. **Trumpet success**: Make project successes visible and communicate it widely.

Case studies have shown that the processes, practices and people issues involved in moving from corporate strategy to programs, and projects is done in a much more systematic way than is generally recognised (Morris et al 2005).Projects are important ways for strategy to be implemented in the enterprise. It is because of this reason that it is important to do careful project evaluation before the Go / No Go decision. Project management processes are incorporated as key businesses management processes. Processes having a high interconnectivity between corporate, business and project level are an important means of translating corporate goals, objectives and strategy into programs and projects, and ensuring the continuity of strategy is achieved in a systematic and structured way. Project management approaches are now being used by organisations at all stages of the project life cycle with project strategy development, review and optimisation occurring at specific points. Project resources and capabilities are key factors in creating deploying and maintaining program and project strategies.

CHAPTER 5: RESEARCH METHODOLOGY

5.1. Research methodology

5.1.1. Outline of type field work

The field work will consist of the following two phases:

Phase1: Evaluation of the current Buttrick (2000) project health check model.

The current Buttrick (2000) project health check model will be evaluated and adapted to meet the requirements to evaluate the current health of projects within the coal mining environment within BHP Billiton according to the BHP Billiton project management standards. The evaluation will be done through a team workshop. The workshop team members will consist of a sample of project management representatives for the DMO project. Each of the current Buttrick (2000) health check model evaluation criteria will be evaluated separately to determine their applicability to coal mining projects. Additional evaluation criteria will be brainstormed and evaluated to identify the full scope of evaluation criteria applicable to coal mining projects within BHP Billiton.

Phase 2: Applying the "New" Project Health Check model to the DMO Project.

The "New" project health check model will be applied to the DMO Project through a structured questionnaire to be completed by all relevant stake holders to the project. This questionnaire will be constructed to evaluate all the criteria of the "New" project health check model. The results will be analysed by using statistical methods and entering the questionnaire results into a data based model to calculate the health of the project according to a predetermined evaluation criteria. The results will also be displayed on a spider web diagram to visually display the health of the project according the evaluation criteria.

5.1.2. Three step process to getting consensus on evaluation criteria

The project health check model will be applied by making use of an adjusted three step process as was done by Pinto (1990) with the Project Implementation Profile questionnaire. The three steps include:

Step 1: Monitor the key project success factors

The significant stakeholders involved with the project must each fill out the project health check questionnaire. Collecting data from as many people from the project team as possible provides a wide range of perspectives of the status of the project.

Step 2: Use consensus to develop a collective picture of the project

Review the results obtained from step one and discuss the likely causes of disagreement among project team members.

Step 3: Pay close attention to low factors

Determine the root causes for low scoring numbers on key project success factors. Those low score numbers may have an adverse effect on the project success. Develop action plans to improve the low scoring numbers.

5.2. Sample size and data collection methodology

The sample will consist of all of the members of the DMO Project team (refer to **Appendix 1** for a profile of the research participants).

5.3. Measuring instruments

A survey study will be used as measuring instrument for the evaluation criteria of the project health check model.

5.4. The (Buttrick 2000) project health check model

The project health check model consists of seven critical evaluation criteria. These criteria include:

1. **P** roject Plan
2. **R** esources
3. **O** wnership
4. **J** ustifiable Case
5. **E** xpertise
6. **C** lear Specification
7. **T** op Level Support

Five questions are asked in a structured questionnaire on each of the evaluation criteria. The participants will use a 9-point Lickert scale to evaluate each of the evaluations criteria. The following table is a typical representation of a 9-point Lickert scale (refer to **Table 7**).

Table 7: 9-Point Lickert scale

Scoring rules	Score
Strongly disagree or don't know	(4)
Disagree	(2)
Neutral	0
Agree	2
Strongly agree	4

Source: Buttrick (2000)

The following table (refer to **Table 8**) shows the typical questions that must be asked according to the Buttrick model. The first column shows the evaluation criteria and the second column lists the questions to be asked for each criteria.

Table 8: The Buttrick (2000) project health check evaluation criteria and questions

Criteria	Buttrick Questions to be Asked
Project Plan	• There is a detailed plan (including critical path, time, schedules, milestones, manpower requirements etc.) for the completion of the project? • There is a detailed budget for the project? • Key personnel needs (who, when) are understood and specified in the project plan? • We know which activities contain slack time or resources that can be used in other areas during emergencies? • There are contingency plans in case the project is off schedule or off budget?
Resources	• There is sufficient manpower to complete the project? • The appropriate technology is available throughout the project lifecycle? • The technology to be used to support the project works and is fully supported? • Specific project tasks are well managed? • Project team members understand their role?
Ownership	• The stakeholders were given the opportunity to provide input early in the project? • The stakeholders accept ownership of the project actions? • Conditions of satisfaction have been agreed with the Project Sponsor? • Stakeholders understand the limitations of the project (what the project is not supposed to do)? • Stakeholders understand which of their requirements are included in the project?
Justifiable Case	• The project has been fully costed and budgets agreed with the sponsor • Estimates of the financial and commercial value of the project have been made • The project promises benefit to the organisation and a clear return on investment • Business measures of success have been identified and measurement processes planned • Adequate funding is available for the lifecycle of the project
Expertise	• All members of the project team possess the appropriate levels of expertise • Owners and users understand the project and are capable of implementing it • People on the project team understand how their performance will be evaluated • Accountabilities for team members have been written, understood and agreed • Adequate training (and time for training) is available within the project scope and schedule
Clear Specification	• The objectives of the project are clear to all stakeholders and members of the project team • The goals of the project are in line with corporate goals and corporate standards • I am enthusiastic about the chances of success of this project • There is adequate documentation of the project requirements and operational performance needs • An adequate presentation of the project aims and objectives has been given to stakeholders
Top Level Support	• The Project Sponsor shares accountability with the project team for ensuring the project's success • Management will be responsive to requests for additional resources, if the need arises • Terms of reference, authority and responsibility levels have been agreed • I am confident I can call upon management to help where necessary • The Project Sponsor is fully committed to the project's success

Source: Buttrick (2000)

The scoring results from the questionnaire are then entered into an excel model to give a total average result. According to this result, the project is rated as either impossible, high risk project, medium risk project or low risk project (refer to **Table 9**).

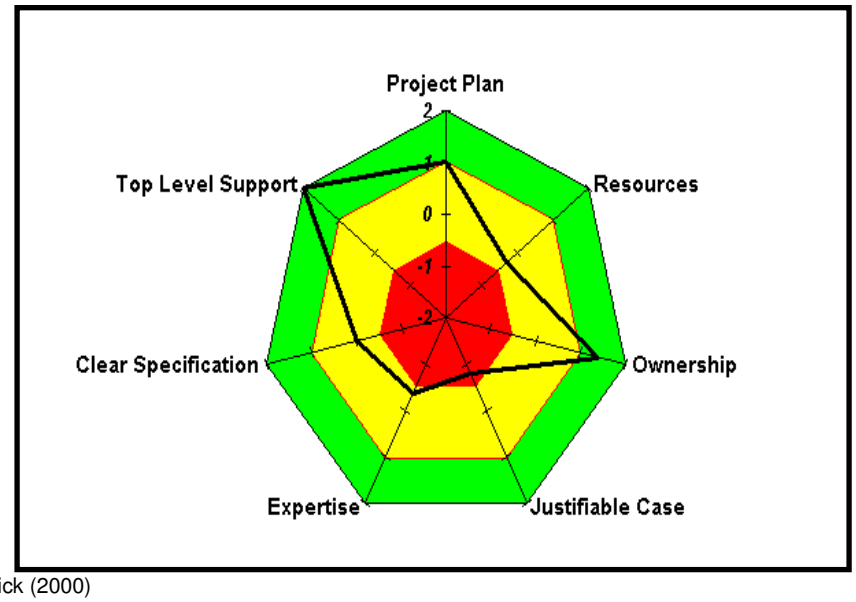
Table 9: Project risk rating scale

Resultant Scoring from Questionnaire	Project Rating
-14 to -7	Impossible
-6 to 0	High Risk Project
1 to 7	Medium Risk Project
8 to 14	Low Risk Project

Source: Buttrick (2000)

The results are displayed on a spider web diagram. The following is an example of a project that has been rated and displayed on the spider web diagram:

Figure 15: Typical risk rating spider web diagram



Source: Buttrick (2000)

It could be seen that this particular project performed very well on the criteria Top Level Support, Ownership and Project Plan. The project manager should however be more focused on Clear Specification, Resources and Expertise which had a medium (yellow) rating. What is of concern is the very low (red) rating of Justifiable case.

The total project had a medium risk rating. This means that the project should go a head, but with caution. More resources and expertise should be assigned to the project and careful consideration should be given to see if there is a Justifiable Case for the project.

CHAPTER 6: RESEARCH RESULTS AND DISCUSSION

6.1. Phase 1: Evaluation of the current Buttrick (2000) project health check model

A workshop was held to evaluate the current Buttrick (2000) project health check model. The workshop team consisted of a selection of DMO Project team members with project experience. The following people attended the workshop:

1. DMO Project Manager
2. Process Manager
3. Engineering Manager
4. HSEC Manager
5. Workshop Facilitator

During the workshop a mission statement was developed to clearly define the project team's expectations and requirements for the "New" project health check model. The mission statement included the following:

"The New Project Heath Check Model must:

- Comply to the BHP Billiton Capital Investment Standards and BHP Billiton Feasibility Standard Report,
- Cover all project chapter of the feasibility study,
- Be user friendly,
- Questionnaire must take less than 15 minutes to complete,
- Interpretation of the results must be accurate, and
- Results must be available to every stakeholder for review."

The BHP Billiton feasibility standard report and relevant literature, as was described in the literature study regarding project health check criteria and project key success factors, were reviewed. With this information as background

the following fifteen project health check evaluation criteria were established (refer to **Appendix 2** for full description in the consistency matrix) that complied to the BHP Billiton Capital Investment Standards:

1. Project Mission / Clear Specification
2. Top Level / Management Support
3. Project Schedule / Project Plan
4. Project Personnel and Expertise
5. Ownership
6. Resources
7. Justifiable Case
8. Technical Tasks
9. Monitor and Feedback
10. Communication
11. Finance (CAPEX and OPEX)
12. Risk Management and HSEC
13. Mining and Geology
14. Processing and Engineering
15. Environmental

Evaluation criteria **1** to **10** were obtained from a combination of literature presented by Buttrick (2000) and Pinto (1990). Criteria **11** to **15** were included as project specific evaluation criteria relevant to the DMO Project as was dictated by the BHP Billiton Feasibility Standard report.

The DMO project feasibility report consists of seventeen chapters (refer to Column one of **Table 10** for chapter reference). It was necessary to determine if the total project was covered by the "New" project health check model. The chapters were evaluated to determine which of the chapter could be combined or rejected in the evaluation criteria for the "New" model. It could be seen, from **Table 10**, that the total project was indeed covered with the "New" project health check.

Table 10: Adapted evaluation criteria for the DMO Project

DMO Project Feasibility Study Report Chapters	"New/adapter" Project Health Check Evaluation Criteria
1. Executive summary	Not applicable
2. Strategy	Done as part of the Concept and Pre-feasibilty phases however still covered in the Project mission / Clear specification
3. Market analysis	Done as part of the Concept and Pre-feasibilty phases
4. Risk Management	Risk management and HSEC
5. Mineral Specific	
5.1. Geology and mineral processing	Mining and Geology
5.2. Mining	Mining and Geology
5.3. Metallurgical processing	Processing and Engineering
5.4. Infrastructure	Processing and Engineering
5.5. Engineering development	Processing and Engineering
6. Human resources	Project pesonnel and expertise
7. Project execution	Project schedule / project plan
8. Operations management	Project schedule / project plan
9. Information management	Comminication, Monitor and Feedback
10. HSEC	Risk management and HSEC
11. External relations	Not covered
12. Capital cost estimate	Finance (CAPEX and OPEX)
13. Operational cost	Finance (CAPEX and OPEX)
14. Ownership, legal, contractual	Environmental
15. Investment evaluation	Finance (CAPEX and OPEX)
16. Work plan	Project schedule / project plan
17. Project status and reviews	Outcome of the Project Health Check

In order to perform the “New” project health check, a questionnaire was constructed with 5 key questions per criteria to determine the current health of the project (refer to **Appendix 3** for the Project Health Check Questionnaire).

The questions for criteria 1 to 10 were adopted from the combined literature presented by the Buttrick (2000) model and the Pinto (1990) model. The questions for criteria 11 to 15 were developed during the evaluation workshop by the representative project team members. The following table shows the evaluation questions for each evaluation criteria (refer to **Table 11**):

Table 11: "New" Project Health Check Model evaluation criteria questions

"New" Criteria	Questions relating to the "New" Project Health Check Evaluation Criteria
Project Mission / Clear Specification	• The goals and objectives of the project are clear to all stakeholders and members of the project team • The goals of the project are in line with corporate goals and corporate standards • I am enthusiastic about the chances for success of this project • There is adequate documentation of the project requirements and operational performance needs • I am aware of and can identify the beneficial consequences to the organisation of the success of the project
Top level / management support	• Upper management will be responsive to requests for additional resources, if the need arises • Upper management shares responsibility with the project team for ensuring the project's success • I agree with upper management on the degree of my authority and responsibility for the project • I am confident I can call upon management to help where necessary and they will provide support in crisis • Upper management is fully committed to the success of the project
Project schedule / project plan	• There is a detailed plan (including critical path, time, schedules, milestones, manpower requirements etc.) for the completion of the project • There is a detailed budget for the project • Key personnel needs (who, when) are understood and specified in the project plan • We know which activities contain slack time or resources that can be used in other areas during emergencies • There are contingency plans in case the project is off schedule or off budget
Project personnel and expertise	• All members of the project team possess the appropriate levels of expertise • Project team personnel understand their role on the project team • People on the project team understand how their performance will be evaluated • Accountabilities for team members have been written, understood and agreed • Adequate training (and time for training) is available within the project scope and schedule
Ownership	• The stakeholders were given the opportunity to provide input early in the project • The stakeholders accept ownership of the project actions • Conditions of satisfaction have been agreed with the Project Sponsor • Stakeholders understand the limitations of the project (what the project is not supposed to do) • Stakeholders understand which of their requirements are included in the project
Resources	• There is sufficient manpower to complete the project • The appropriate technology is available throughout the project lifecycle • The technology to be used to support the project works and is fully supported • Specific project tasks are well managed • Project team members understand their role
Justifiable case	• The project has been fully costed and budgets agreed with the sponsor • Estimates of the financial and commercial value of the project have been made • The project promises benefit to the organisation and a clear return on investment • Business measures of success have been identified and measurement processes planned • Adequate funding is available for the lifecycle of the project
Technical tasks	• Specific project tasks are well managed • The project engineers and other technical people are competent • The technology that is being used to support the project works well • The appropriate technology (equipment, training programs, etc.) has been selected for project success • The people implementing this project understand it
Monitor and feedback	• All important aspects of the project are monitored, including measures that will provide a complete picture of the project's progress (adherence to budget and schedule, manpower and equipment utilisation, team morale, etc.) • Regular meetings to monitor project progress and improve the feedback to the project team are conducted • Actual progress is regularly compared with the project schedule • The results of project reviews are regularly shared with all project personnel who have impact upon budget and schedule • When the budget or schedule requires revision, input is solicited from the project team
Communication	• The results (decisions made, information received and needed, etc.) of planning meetings are published and distributed to applicable personnel • Individuals/groups supplying input have received feedback on the acceptance or rejection of their input • When the budget or schedule is revised, the changes and the reasons for the changes are communicated to all members of the project team

	• The reasons for the changes to existing policies/procedures have been explained to the members of the project team, other groups affected by the changes, and upper management • All groups affected by the project know how to make problems known to the project team
Finance (CAPEX and OPEX)	• The CAPEX and OPEX cost estimate are within a 10-15% accuracy level • Escalations and Foreign Exchange provisions have been made and the basis for calculation thereof can be justified • There is a WBS in place at the work package level representing all the contracts and elements in line with the final understanding of the project execution strategy • The cost estimate includes a separate contingency component which could be justified • A capital despersment schedule (procurement) schedule has been developed in conjunction with the project schedule
Risk management and HSEC	• Thorough risk assessments have been done to determine all business and HSEC (health, safety, environmental and community) risks • The risks have been consolidated into risk registers e.g. EWRM (Enterprise Wide Risk Management for business risks) and HSEC Risk Register • The risks in the risk register have been evaluated and rated. Risk control action plans have been added to mitigate the risk or manage the risk to a tolerable level • The safety risk assessments include the BHP Billiton fatal risk protocols • There is a detailed EWRM and HSEC management and monitoring plan in place
Mining and Geology	• The geological report includes a reliable resource estimation and geological data base • The geological report includes a full characterisation of the ore and waste rock type to be encountered in order to relate them to metallurgical processes and environmental characterisation • There is a detailed mining schedule based on sound mining practices and the machine capacity meet the mining schedule requirements • The mining plan has been modelled with BHP Billiton approved mine planning software (e.g. XPAC) and reconcile to benchmarking figures • An ore reserve statement has been developed from the final mine layout and the mine able resource model as per BHP Billiton ore reserve policy
Processing and Engineering	• The metallurgical characterisation of the ore has been fully understood and used as a base for the process and equipment selection • There exists a complete set of PCD's (Process Control Diagrams) and P&ID's (Piping and Instrumentation Diagrams) for the process plant • All relevant Engineering Design Standards (e.g. SABS and SANS) have been included in the Engineering Design Criteria and applied in the process plant design • All infrastructure requirements e.g. utilities, disposal and drainage, transportation, temporary facilities, communication, security and fire protection systems have been included in the project • There is a proper quality control management plan in place to control the quality of equipment to be purchased and work to be preformed
Environmental	• The project complies to all legal requirements and has evidence of the following studies: EMP (Environmental Management Plan), Water use license and an EIA (Environment Impact Assessment) • All heritage resources have been identified and all necessary approvals for exhumation (grave relocation) and/or demolition (e.g. building) have been obtained • There is a proper construction EMP (environmental management plan) in place which include: Hazardous Materials Management, Waste Management and Rehabilitation Plan • There is an EMP monitoring and auditing program in place • There is a water balance and a water management plan in place for execution and beyond

6.1.1. Difference between the "New" project health check model and the Buttrick (2000) project health check model

The "New" project health check model in concept had the same structure as the Buttrick (2000) project health check model, however the following minor differences were incorporated into the "New" model:

1. **Five additional evaluation criteria's that are project specific to the DMO Project.** These criteria's included:

- Finance (CAPEX and OPEX),
- Risk Management and HSEC,
- Mining and Geology,
- Processing and Engineering, and
- Environmental

2. **Weighted scoring for different team members according to their accountability to that specific evaluation criterion.**

Evaluation criteria 1 to 10 are project generic evaluation criteria and all project team members should be able to give their opinions on them. Criteria 11 to 15 however are project specific to the DMO Project. It was required to build a weighting factor into the model based on the team members' accountability. Each questionnaire participant had to rate themselves according to the following accountability to the evaluation criteria (refer to **Table 12**):

Table 12: Participant Weighting Scale

Weighting Scale	Accountability Level
0%	No Accountability / Not Affected
25%	Indirectly Affected
50%	Directly Affected
75%	Functional Accountability
100%	Direct Accountability

This means that a participant with "No Accountability / Not Affected" to the evaluation criteria will have a weight contribution of 0%. Their answers will not influence the results for that specific criterion. A participant with a "Direct Accountability" to the specific evaluation criteria will have a 100% contribution. Their rating to the questions will have a direct impact on the evaluation criteria result. All other accountability levels will have an influence on the evaluation criteria results, but to a lesser extent as the accountability level reduces.

3. **Individual participant assessment spider web diagrams, graphs and individual question analysis.**

A project evaluation model feature of being able to see the spider web diagram for each participant as well as a graph comparing the participants individual results compared to the rest of the participants were built into the "New" model. The average result for each question was also displayed on a bar chart to identify the "leased liked" and "most liked" evaluation criteria question.

4. **Health check scoring system for the "New" project health check model**

The project health check scoring system for the "New" project health check was changed to accommodate multiple participant (20 in this case) entries.

The following rating system was used to rate the total project score (refer to **Table 13**):

Table 13: Project Score Rating

Resultant Scoring from Questionnaire	Project Rating
60 to 30	Low Risk Project
29 to 1	Medium Risk Project
0 to -29	High Risk Project
-30 to -60	Impossible

The following rating system was used to rate the individual evaluation criteria (refer to **Table 14**):

Table 14: Evaluation Criteria Rating

Evaluation Criteria Average Score	Rating
4 to 2	Good
<2	Caution
<0	Warning

6.2. Phase 2: Applying the "New" project health check model to the DMO Project.

A questionnaire was constructed to evaluate the health of the DMO Project by means of the "New" project health check model (refer to **Appendix 3** for the Project Health Check Questionnaire). The questionnaire is just an example due to the fact that the actual questionnaire was in electronic format and distributed via e-mail.

The questionnaire data received from each participant was checked for completeness and the data was entered into the "New" project health check model (refer to **Appendix 4** for the data base of the questionnaire results).

6.2.1. The DMO Project health

The following average results were calculated from the questionnaire results received from the project team members:

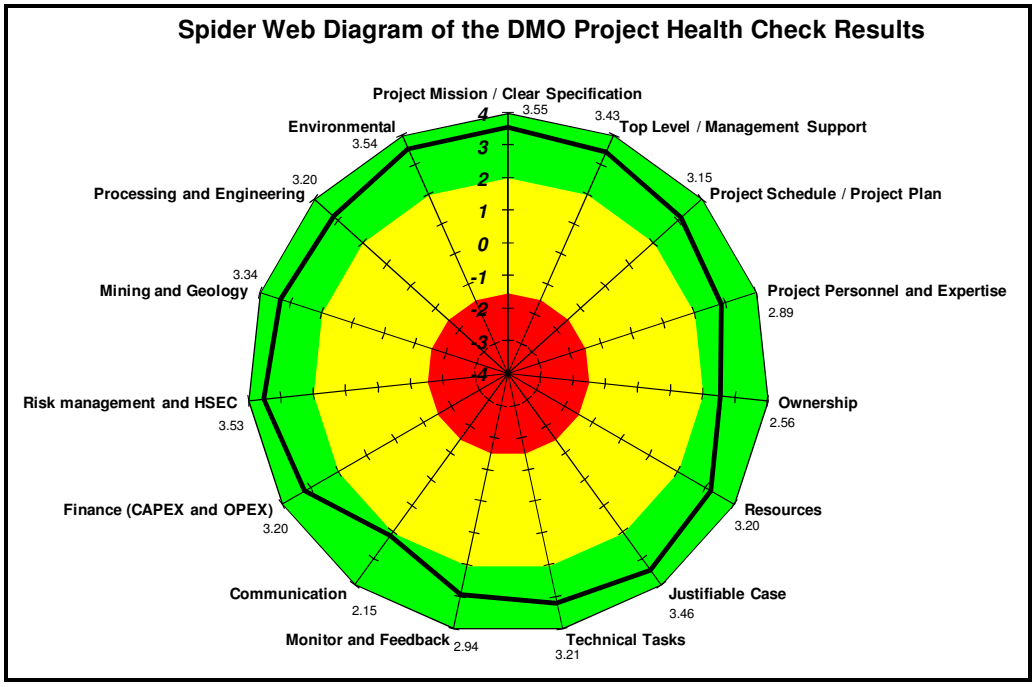
Table 15: DMO Project Health Check results

Date Health Check Performed:	**18-Jul-07**	
Risk/health check score	**47.33**	**LOW RISK**
Individual Risks (Scores from -4 to +4)	**Score**	**Remark**
Project Mission / Clear Specification	3.55	***GOOD***
Top Level / Management Support	3.43	***GOOD***
Project Schedule / Project Plan	3.15	***GOOD***
Project Personnel and Expertise	2.89	***GOOD***
Ownership	2.56	***GOOD***
Resources	3.20	***GOOD***
Justifiable Case	3.46	***GOOD***
Technical Tasks	3.21	***GOOD***
Monitor and Feedback	2.94	***GOOD***
Communication	2.15	***GOOD***
Finance (CAPEX and OPEX)	3.20	***GOOD***
Risk management and HSEC	3.53	***GOOD***
Mining and Geology	3.34	***GOOD***
Processing and Engineering	3.20	***GOOD***
Environmental	3.54	***GOOD***

With reference to Table 15, the DMO Project score of **47.33** is a very high score, which indicates that the DMO Project is very healthy in terms of the rating criteria (refer to **Table13**). All of the evaluation criteria had a score of between 2 and 4 indicating that the DMO Project is performing very well on all of the evaluation criterias (refer to **Table 14**).

The average evaluation criteria scores were displayed on a spider web diagram to obtain a visual overview of the DMO Project's health (refer to **Figure 16**).

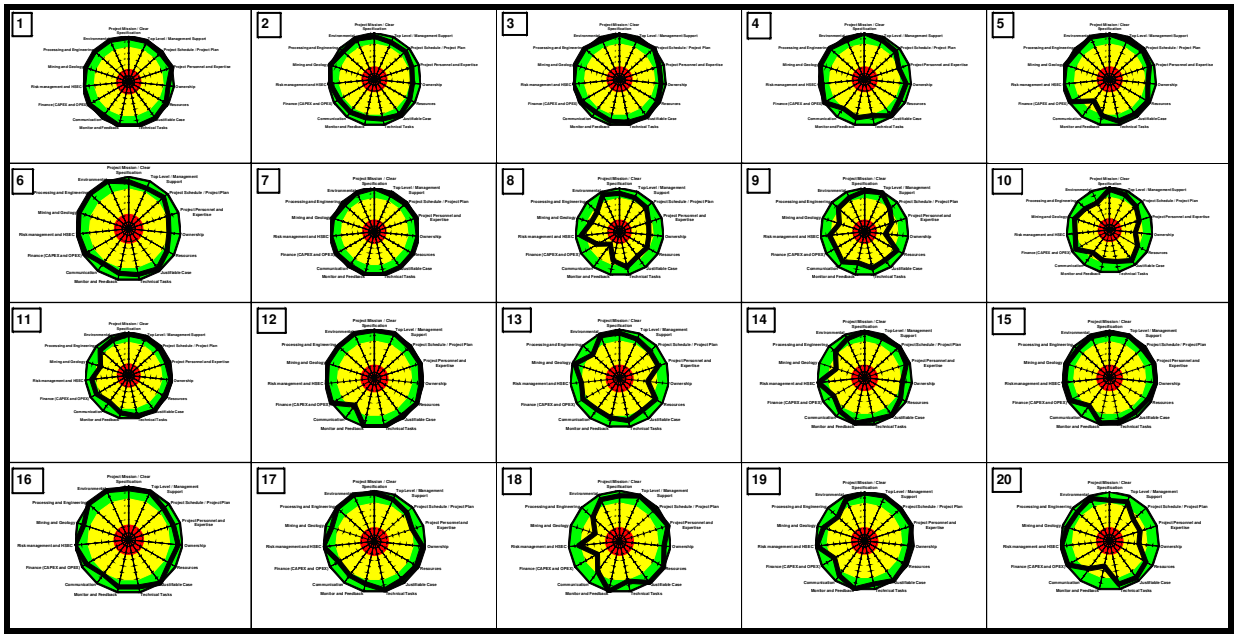
Figure 16: Spider web diagram of the DMO Project health check results



All the evaluation criteria displayed in **Figure 16** are located within the green zone of the graph. This indicates that the DMO Project is in very good health and the project could proceed to the next phase of the BHP Billiton project process, which is construction.

One of the features built into the “New” project heath check model is the ability to display each questionnaire participant’s results separately on a spider web diagram.

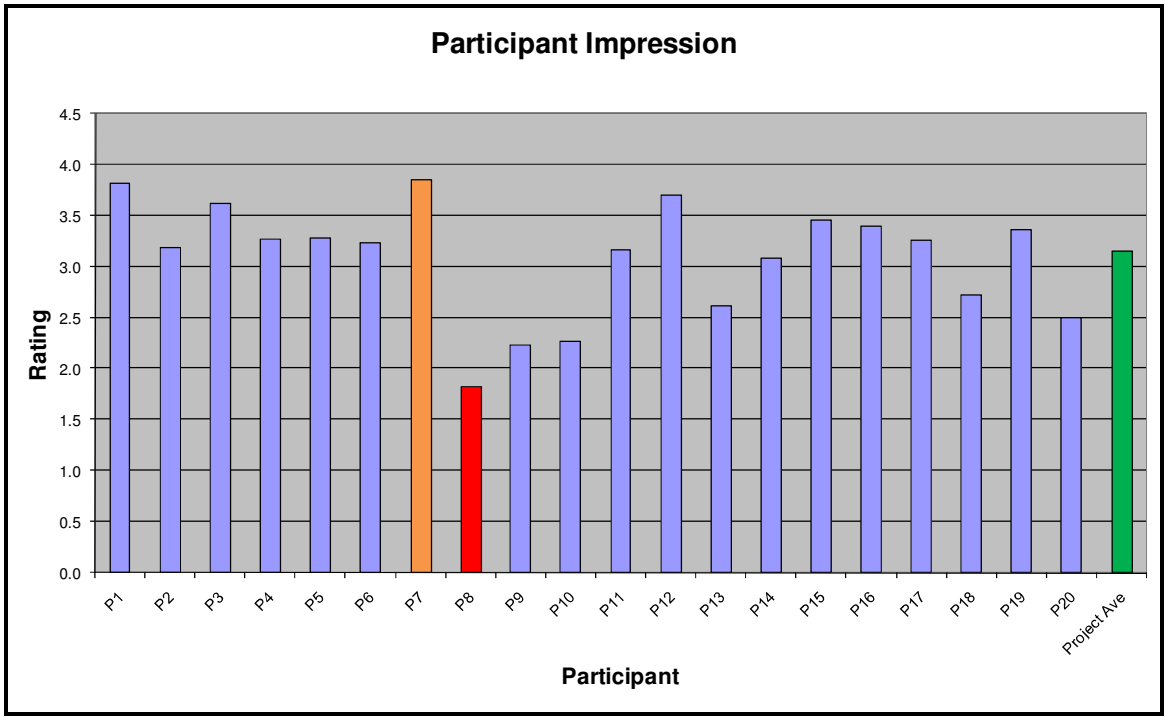
Figure 17: Spider Web diagram for individual participant results



It was of interest to see from **Figure 17**, that not all the participants had the same project health perception. There were a few participants displaying evaluation criteria results that were located in the yellow (caution) zone of the graphs. Due to the high average scores, these individual negative scores were cancelled out to give a total project average score in the green area (**low risk project**).

The participant's individual impression of the health of the DMO project was captured in **Figure 18**:

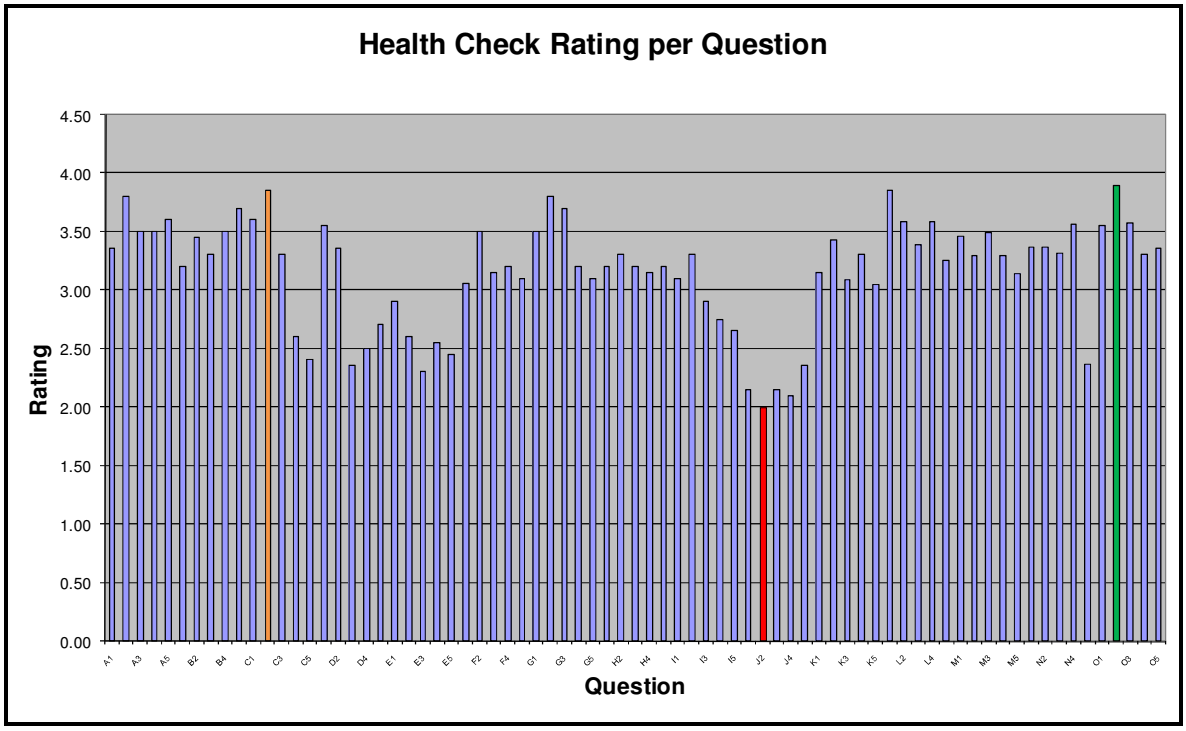
Figure 18: Bar chart of individual participant impression



There exists a good correlation between the visual results displayed in the spider web diagram (refer to **Figure 17**) for each individual participant and the bar chart (refer to **Figure 18**) displaying the individual average scores on the evaluation criteria. With reference to **Figure 18**, it could be seen that participant no. 8 (red column) had the worst rating for the DMO Project with an average criteria score of 1.8. Participant no. 7 had the highest average criteria rating of 3.9 (orange column). The green column indicates the project average of 3.2.

The following graph (refer to **Figure 19**) displays the participants' perceptions on the "most liked" question and "least liked" question. "Least liked" refer to the question with which the group most strongly disagreed where as "most liked" refer to the question with which the group most strongly agreed to.

Figure 19: Bar chart of project team member impression of the questionnaire questions



With reference to **Figure 19**, it could be seen that the "most liked" questions was question O2 (green bar) with an average question score of 3.90, concerning the evaluation criteria Environmental. The question reads as follow:

"All heritage resources have been identified and all necessary approvals for exhumation (grave relocation) and/or demolition (e.g. building) have been obtained".

This result could however be skewed due to the fact that only 1 participant had a 100% accountability weighting to this criteria, five participants had a 75% accountability weighting and the rest of the participants had accountability weightings of 25% or less.

The highest rated question where all of the participants had a 100% weighted contribution was question C2 (orange bar) with a score of 3.85. The question relates to the criteria "Project Schedule / Project Plan" and reads as follow:

"There is a detailed budget for the project".

The "least liked" question was question J2 concerning the evaluation criteria Communication (green bar) with a score of 2.00. The question reads as follows:

"Individuals/groups supplying input have received feedback on the acceptance or rejection of their input".

6.2.2. Project Management vs. Project Team Member perception of the DMO Project health

The results obtained form the questionnaires were split into management level project team members and team members (refer to **Appendix 5 and 6**). Management were defined as team members that were in a HOD (Head of Department) level or higher.

Table 16: DMO Project health check results – project management vs. project team members

Individual Risks (Scores from -4 to +4)	HOD Team		Project Team Members	
	Score	Remark	Score	Remark
Project Mission / Clear Specification	3.26	***GOOD***	3.46	***GOOD***
Top Level / Management Support	2.91	***GOOD***	3.49	***GOOD***
Project Schedule / Project Plan	3.03	***GOOD***	2.97	***GOOD***
Project Personnel and Expertise	2.77	***GOOD***	2.77	***GOOD***
Ownership	2.66	***GOOD***	2.34	***GOOD***
Resources	2.97	***GOOD***	3.11	***GOOD***
Justifiable Case	3.26	***GOOD***	3.29	***GOOD***
Technical Tasks	2.91	***GOOD***	3.12	***GOOD***
Monitor and Feedback	2.77	***GOOD***	2.80	***GOOD***
Communication	2.26	***GOOD***	1.89	***CAUTION***
Finance (CAPEX and OPEX)	3.25	***GOOD***	2.74	***GOOD***
Risk management and HSEC	3.35	***GOOD***	3.28	***GOOD***
Mining and Geology	3.58	***GOOD***	2.63	***GOOD***
Processing and Engineering	3.35	***GOOD***	2.51	***GOOD***
Environmental	3.09	***GOOD***	3.36	***GOOD***
Risk/health check score	**45.42**	**LOW RISK**	**43.76**	**LOW RISK**

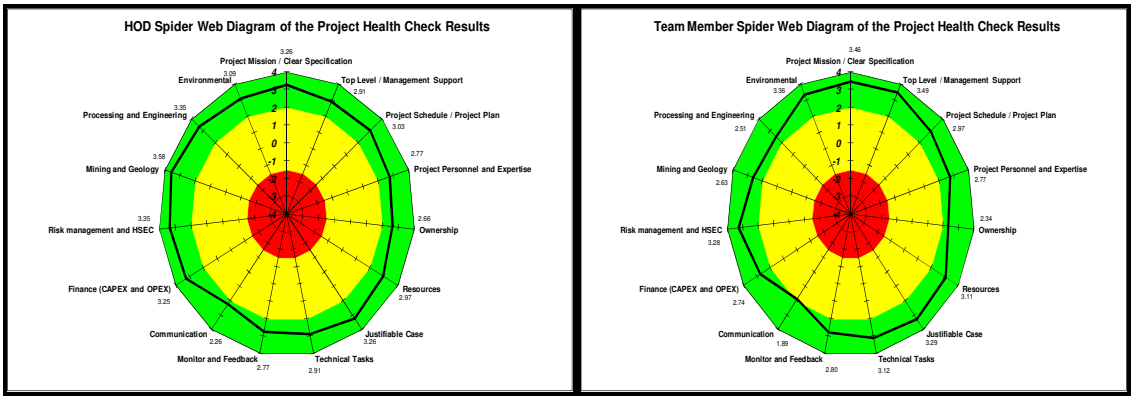
With reference to **Table 16**, the results revealed the same trend with the project health check score for the management team at 45.42 versus the team members score of 43.76. Although the score for the project team members were slightly

lower than for the management team, the project rating in both cases were still a **low risk project**.

The only evaluation criteria that should be highlighted are that of Communication. The management perception of communication within the project was higher that that of the project team. The management score of 2.26 on communication falls within the 2-4 rating scale, resulting in a “good’ score. The project team score of 1.89 on communication falls within the 0-2 rating scale, resulting in a “caution” score. It could be concluded from these results that management’s impression of communication within the DMO project was higher than that of the project team members’ impression. Management should thus make an effort to improve the communication systems and channels within the DMO project.

The following spider web diagrams (refer to **Figure 20**) of the management and project teams heath check scores were constructed to visually observe that there exists a good correlation between the project health check results of the project management team versus the project teams perception. The only area where the team members gave a noticeably lower score than the management team was on Communication. Two other areas that may need to be highlighted were “Processing / Engineering” and “Mining / Geology”, where the team members also gave a lower score than management.

Figure 20: Spider web diagrams of the project management health check scores vs. the team member scores



CHAPTER 7: CONCLUSION

The Buttrick (2000) project health check model was successfully adapted to be able to evaluated projects within the coal mining industry within BHP Billiton. The "New/Adapted" health check model evaluates coal mining projects on fifteen evaluation criteria's, which include:

1. Project Mission / Clear Specification
2. Top Level / Management Support
3. Project Schedule / Project Plan
4. Project Personnel and Expertise
5. Ownership
6. Resources
7. Justifiable Case
8. Technical Tasks
9. Monitor and Feedback
10. Communication
11. Finance (CAPEX and OPEX)
12. Risk Management and HSEC
13. Mining and Geology
14. Processing and Engineering
15. Environmental

Five questions are asked in a structured questionnaire on each of the evaluation criteria. The answers obtained from the participants are then entered into a health check model to determine the project health check score. The score is then rated to a predetermined criterion to be either a:

- Low risk project,
- Medium risk project,
- High risk project, or
- Impossible to achieve project.

The DMO project scored very well, with a project health check score of 47.33. According to this score, the DMO project is rated as a **low risk project**.

The DMO Project health impression between the project management and the project team members were essentially the same, with the management team scoring the project marginally higher at 45.42 compared to 43.76. However the

project team's perception of communication effectiveness within the project was lower than that of the management team. This was highlighted as an area where management should focus and improve on.

Suggested future studies:

It is suggested that the "New" project health check model be applied to more coal mining projects. Not just within BHP Billiton, but also in other companies. The model could also be applied to mining projects within other commodities.

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Appendix 1: Research Participant Profile

Position	Position Level	Approximate Years Experience	Connection to Project
Project Manager	Top Management	28	Team Member
Financial Manager	Head of Department	22	Team Member
Mining Manager	Head of Department	24	Team Member
Engineering Manager	Head of Department	18	Team Member
Process Manager	Head of Department	17	Team Member
Human Resource Manager	Head of Department	28	Team Member
Construction Manager	Management Level	25	Team Member
Contracts Consultant	Middle Management Level	31	Contractor
Cost Controller	Employee Level	18	Team Member
Cost Controller	Contractor	35	Contractor
Document Controller	Employee Level	18	Team Member
Mechanical Engineer	Middle Management Level	35	Team Member
HR Superintendent	Middle Management Level	20	Team Member
HR Superintendent	Middle Management Level	22	Team Member
Personal Assistant	Employee Level	22	Team Member
Process Engineer	Middle Management Level	8	Team Member
Mining Engineer	Middle Management Level	10	Team Member
Environmentalist	Contractor	18	Contractor
Scheduler	Contractor	15	Contractor
Communication Specialist	Employee Level	18	Team Member

Appendix 2: Consistency Matrix

Research Question: To what extent can the Buttrick (2000) Project Health Check be adapted to evaluate coal mining projects on a strategic level?

Sub-Problem	Proposition Number	Proposition	Source of Proposition	Source of data	Analysis
Project mission / Clear specification	1	The objectives of the project are clear to all stake holders and there is adequate documentation of the requirements of the project?	Buttrick (2000); Pinto (1990)	Quantitative measurement instrument	Statistical analysis on quantitative data
Top level / management support	2	Top management shares responsibility, authority levels and accountabilities have been agreed upon and the project sponsor is fully committed to the project's success?	Buttrick (2000); Pinto (1990)	Quantitative measurement instrument	Statistical analysis on quantitative data
Project schedule / project plan	3	Is there a detailed project plan which includes costs, personnel accountabilities and contingency plans?	Buttrick (2000); Pinto (1990)	Quantitative measurement instrument	Statistical analysis on quantitative data
Project personnel and expertise	4	All project team members possesses the appropriate level of expertise, project roles have been written out and adequate training has been build into the project schedule?	Buttrick (2000); Pinto (1990)	Quantitative measurement instrument	Statistical analysis on quantitative data
Ownership	5	Where stake holders involved, do they understand limitations of the project and which of their requirements are included?	Buttrick (2000)	Quantitative measurement instrument	Statistical analysis on quantitative data
Resources	6	Is there sufficient man power, appropriate technology available and does the project team personnel understand their roles?	Buttrick (2000)	Quantitative measurement instrument	Statistical analysis on quantitative data
Justifiable case	7	Project has been fully costed and budgeted, project shows a clear return on investment and adequate funding is available?	Buttrick (2000)	Quantitative measurement instrument	Statistical analysis on quantitative data
Technical tasks	8	Availability of the required technology and expertise to accomplish the specific technical action steps?	Pinto (1990)	Quantitative measurement instrument	Statistical analysis on quantitative data
Monitor and feedback	9	Timely provision of comprehensive control information at each stage in the implementation process?	Pinto (1990)	Quantitative measurement instrument	Statistical analysis on quantitative data
Communication	10	The provision of an appropriate network and necessary data to all key actors in the project implementation?	Pinto (1990)	Quantitative measurement instrument	Statistical analysis on quantitative data
Finance (CAPEX and OPEX)	11	The financial estimate is accurate and include variable like escalation, foreign exchange and contingency?	BHP Billiton Feasibility study standard: April 2004	Quantitative measurement instrument	Statistical analysis on quantitative data
Risk management, health and safety	12	The project consist of a proper risk register with applicable action plans for risk mitigation	BHP Billiton Feasibility study standard: April 2005	Quantitative measurement instrument	Statistical analysis on quantitative data
Mining and Geology	13	The mineral resource has been well estimated and characterised. Mining will be done through proven mining practices according to a well defined mining schedule.	BHP Billiton Feasibility study standard: April 2006	Quantitative measurement instrument	Statistical analysis on quantitative data
Processing and Engineering	14	The process and equipment is chosen according to ore characteristics and all applicable engineering standards have been applied to the plant design	BHP Billiton Feasibility study standard: April 2007	Quantitative measurement instrument	Statistical analysis on quantitative data
Environmental	15	There is a detailed Environmental Management Plan in place.	BHP Billiton Feasibility study standard: April 2008	Quantitative measurement instrument	Statistical analysis on quantitative data

Appendix 3: Project Health Check Questionnaire

DMO Project Health Check Date: _____/_____/2007 Connection to Project? Team Member / Stake Holder (Circle Correct Option)		Strongly disagree or don't know		Disagree		Neutral		Agree		Strongly agree
Criteria A	**Project Mission / Clear Specification**									
A1	The goals and objectives of the project are clear to all stakeholders and members of the project team	-4	-3	-2	-1	0	1	2	3	4
A2	The goals of the project are in line with corporate goals and corporate standards	-4	-3	-2	-1	0	1	2	3	4
A3	I am enthusiastic about the chances for success of this project	-4	-3	-2	-1	0	1	2	3	4
A4	There is adequate documentation of the project requirements and operational performance needs	-4	-3	-2	-1	0	1	2	3	4
A5	I am aware of and can identify the beneficial consequences to the organasiation of the success of the project	-4	-3	-2	-1	0	1	2	3	4
Criteria B	**Top level / management support**									
B1	Upper management will be responsive to requests for additional resources, if the need arises	-4	-3	-2	-1	0	1	2	3	4
B2	Upper management shares responsibility with the project team for ensuring the project's success	-4	-3	-2	-1	0	1	2	3	4
B3	I agree with upper management on the degree of my authority and responsibility for the project	-4	-3	-2	-1	0	1	2	3	4
B4	I am confident I can call upon management to help where necessary and they will provide support in crisis	-4	-3	-2	-1	0	1	2	3	4
B5	Upper management is fully committed to the success of the project	-4	-3	-2	-1	0	1	2	3	4
Criteria C	**Project schedule / project plan**									
C1	There is a detailed plan (including critical path, time, schedules, milestones, manpower requirements etc.) for the completion of the project	-4	-3	-2	-1	0	1	2	3	4
C2	There is a detailed budget for the project	-4	-3	-2	-1	0	1	2	3	4
C3	Key personnel needs (who, when) are understood and specified in the project plan	-4	-3	-2	-1	0	1	2	3	4
C4	We know which activities contain slack time or resources that can be used in other areas during emergencies	-4	-3	-2	-1	0	1	2	3	4
C5	There are contingency plans in case the project is off schedule or off budget	-4	-3	-2	-1	0	1	2	3	4
Criteria D	**Project personnel and expertise**									
D1	All members of the project team possess the appropriate levels of expertise	-4	-3	-2	-1	0	1	2	3	4
D2	Project team personnel understand their role on the project team	-4	-3	-2	-1	0	1	2	3	4
D3	People on the project team understand how their performance will be evaluated	-4	-3	-2	-1	0	1	2	3	4
D4	Accountabilities for team members have been written, understood and agreed	-4	-3	-2	-1	0	1	2	3	4
D5	Adequate training (and time for training) is available within the project scope and schedule	-4	-3	-2	-1	0	1	2	3	4
Criteria	**Ownership**									

E										
E1	The stakeholders were given the opportunity to provide input early in the project	-4	-3	-2	-1	0	1	2	3	4
E2	The stakeholders accept ownership of the project actions	-4	-3	-2	-1	0	1	2	3	4
E3	Conditions of satisfaction have been agreed with the Project Sponsor	-4	-3	-2	-1	0	1	2	3	4
E4	Stakeholders understand the limitations of the project (what the project is not supposed to do)	-4	-3	-2	-1	0	1	2	3	4
E5	Stakeholders understand which of their requirements are included in the project	-4	-3	-2	-1	0	1	2	3	4
Criteria F	**Resources**									
F1	There is sufficient manpower to complete the project	-4	-3	-2	-1	0	1	2	3	4
F2	The appropriate technology is available throughout the project lifecycle	-4	-3	-2	-1	0	1	2	3	4
F3	The technology to be used to support the project works and is fully supported	-4	-3	-2	-1	0	1	2	3	4
F4	Specific project tasks are well managed	-4	-3	-2	-1	0	1	2	3	4
F5	Project team members understand their role	-4	-3	-2	-1	0	1	2	3	4
Criteria G	**Justifiable case**									
G1	The project has been fully costed and budgets agreed with the sponsor	-4	-3	-2	-1	0	1	2	3	4
G2	Estimates of the financial and commercial value of the project have been made	-4	-3	-2	-1	0	1	2	3	4
G3	The project promises benefit to the organisation and a clear return on investment	-4	-3	-2	-1	0	1	2	3	4
G4	Business measures of success have been identified and measurement processes planned	-4	-3	-2	-1	0	1	2	3	4
G5	Adequate funding is available for the lifecycle of the project	-4	-3	-2	-1	0	1	2	3	4
Criteria H	**Technical tasks**									
H1	Specific project tasks are well managed	-4	-3	-2	-1	0	1	2	3	4
H2	The project engineers and other technical people are competent	-4	-3	-2	-1	0	1	2	3	4
H3	The technology that is being used to support the project works well	-4	-3	-2	-1	0	1	2	3	4
H4	The appropriate technology (equipment, training programs, etc.) has been selected for project success	-4	-3	-2	-1	0	1	2	3	4
H5	The people implementing this project understand it	-4	-3	-2	-1	0	1	2	3	4
Criteria I	**Monitor and feedback**									
I1	All important aspects of the project are monitored, including measures that will provide a complete picture of the project's progress (adherence to budget and schedule, manpower and equipment utilisation, team morale, etc.)	-4	-3	-2	-1	0	1	2	3	4
I2	Regular meetings to monitor project progress and improve the feedback to the project team are conducted	-4	-3	-2	-1	0	1	2	3	4
I3	Actual progress is regularly compared with the project schedule	-4	-3	-2	-1	0	1	2	3	4
I4	The results of project reviews are regularly shared with all project personnel who have impact upon budget and schedule	-4	-3	-2	-1	0	1	2	3	4
I5	When the budget or schedule requires revision, input is solicited from the project team	-4	-3	-2	-1	0	1	2	3	4
Criteria J	**Communication**									
J1	The results (decisions made, information received and needed, etc.) of planning meetings are published and distributed to applicable personnel	-4	-3	-2	-1	0	1	2	3	4
J2	Individuals/groups supplying input have received feedback on the acceptance or rejection of their input	-4	-3	-2	-1	0	1	2	3	4
J3	When the budget or schedule is revised, the changes and the reasons for the changes are communicated to all members of the project team	-4	-3	-2	-1	0	1	2	3	4

J4	The reasons for the changes to existing policies/procedures have been explained to the members of the project team, other groups affected by the changes, and upper management	-4	-3	-2	-1	0	1	2	3	4
J5	All groups affected by the project know how to make problems known to the project team	-4	-3	-2	-1	0	1	2	3	4
Criteria K	**Finance (CAPEX and OPEX)**									
K1	The CAPEX and OPEX cost estimate are within a 10-15% accuracy level	-4	-3	-2	-1	0	1	2	3	4
K2	Escalations and Foreign Exchange provisions have been made and the basis for calculation thereof can be justified	-4	-3	-2	-1	0	1	2	3	4
K3	There is a WBS in place at the work package level representing all the contracts and elements in line with the final understanding of the project execution strategy	-4	-3	-2	-1	0	1	2	3	4
K4	The cost estimate include a separate contingency component which could be justified	-4	-3	-2	-1	0	1	2	3	4
K5	A capital despersment schedule (procurement) schedule has been developed in conjunction with the project schedule	-4	-3	-2	-1	0	1	2	3	4
Criteria L	**Risk management and HSEC**									
L1	Thorough risk assessments have been done to determine all business and HSEC (health, safety, environmental and community) risks	-4	-3	-2	-1	0	1	2	3	4
L2	The risks have been consolidated into risk registers e.g. EWRM (enterprise wide risk management for business risks) and HSEC risk register	-4	-3	-2	-1	0	1	2	3	4
L3	The risks in the risk register have been evaluated and rated. Risk control action plans have been added to mitigate the risk or manage the risk to a tolerable level	-4	-3	-2	-1	0	1	2	3	4
L4	The safety risk assessments include the BHP Billiton fatal risk protocols	-4	-3	-2	-1	0	1	2	3	4
L5	There is a detailed EWRM and HSEC management and monitoring plan in place	-4	-3	-2	-1	0	1	2	3	4
Criteria M	**Mining and Geology**									
M1	The geological report include a reliable resource estimation and geological data base	-4	-3	-2	-1	0	1	2	3	4
M2	The geological report include a full characterisation of the ore and waste rock type to be encountered in order to relate them to metallurgical processes and environmental characterisation	-4	-3	-2	-1	0	1	2	3	4
M3	There is a detailed mining schedule based on sound mining practices and the machine capacity meet the mining schedule requirements	-4	-3	-2	-1	0	1	2	3	4
M4	The mining plan has been modeled with BHP Billiton approved mine planning software (e.g. EXPAC) and reconcile to benchmarking figures	-4	-3	-2	-1	0	1	2	3	4
M5	An ore reserve statement has been developed from the final mine layout and the mine able resource model as per BHP Billiton ore reserve policy	-4	-3	-2	-1	0	1	2	3	4
Criteria N	**Processing and Engineering**									
N1	The metallurgical characterisation of the ore has been fully understood and used as a base for the process and equipment selection	-4	-3	-2	-1	0	1	2	3	4
N2	There exist a complete set of PCD's (process control diagrams) and P&ID's (piping and instrumentation diagrams) for the process plant	-4	-3	-2	-1	0	1	2	3	4
N3	All relevant engineering design standards (e.g. SABS and SANS) have been included in the engineering design criteria and applied in the process plant design	-4	-3	-2	-1	0	1	2	3	4
N4	All infrastructure requirements e.g. utilities, disposal and drainage, transportation, temporary facilities, communication, security and fire protection systems have been included in the project	-4	-3	-2	-1	0	1	2	3	4

N5	There is a proper quality control management plan in place to control the quality of equipment to be purchased and work to be preformed	-4	-3	-2	-1	0	1	2	3	4
Criteria O	**Environmental**									
O1	The project complies to all legal requirements and has evidence of the following studies: EMP (environmental management plan), Water use license and an EIA (environment impact assessment)	-4	-3	-2	-1	0	1	2	3	4
O2	All heritage resources have been identified and all necessary approvals for exhumation (grave relocation) and/or demolition (e.g. building) have been obtained	-4	-3	-2	-1	0	1	2	3	4
O3	There is a proper construction EMP (environmental management plan) in place which include: Hazardous materials management, waste management and rehabilitation plan	-4	-3	-2	-1	0	1	2	3	4
O4	There is an EMP monitoring and auditing program in place	-4	-3	-2	-1	0	1	2	3	4
O5	There is a water balance and a water management plan in place for execution and beyond	-4	-3	-2	-1	0	1	2	3	4

Appendix 4: Research Results for the DMO Project

Questionnaire Answers

	Questionnaire Participant																				
Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Average**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**2000**
A1	3	3	3	4	3	2	4	2	4	3	4	4	3	4	4	4	4	2	3	4	**3.4**
A2	4	3	4	4	4	3	4	3	4	4	4	4	4	4	4	4	4	4	4	3	**3.8**
A3	4	4	4	4	4	3	4	3	4	4	3	4	4	4	4	4	2	4	4	-1	**3.5**
A4	4	3	4	4	4	4	4	4	1	3	4	4	3	4	3	2	4	4	4	3	**3.5**
A5	4	4	4	4	4	4	4	3	4	4	3	3	3	3	3	4	4	2	4	4	**3.6**
Average	**3.8**	**3.4**	**3.8**	**4.0**	**3.8**	**3.2**	**4.0**	**3.0**	**3.4**	**3.6**	**3.6**	**3.8**	**3.4**	**3.8**	**3.6**	**3.6**	**3.6**	**3.2**	**3.8**	**2.6**	**3.6**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**2000**
B1	3	3	3	3	3	2	3	2	3	2	4	4	3	3	4	4	3	4	4	4	**3.2**
B2	4	3	3	3	3	4	3	4	4	3	4	4	3	3	4	4	4	3	4	2	**3.5**
B3	4	3	4	3	4	2	3	4	4	3	3	4	3	4	3	3	3	4	4	1	**3.3**
B4	4	3	3	4	4	2	4	2	4	4	3	4	4	3	4	4	2	4	4	4	**3.5**
B5	4	3	4	4	3	4	4	2	4	4	4	4	2	4	4	4	4	4	4	4	**3.7**
Average	**3.8**	**3.0**	**3.4**	**3.4**	**3.4**	**2.8**	**3.4**	**2.8**	**3.8**	**3.2**	**3.6**	**4.0**	**3.0**	**3.4**	**3.8**	**3.8**	**3.2**	**3.8**	**4.0**	**3.0**	**3.4**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**2000**
C1	4	4	4	3	4	4	3	3	4	3	4	4	3	4	3	3	3	4	4	4	**3.6**

C2	4	4	4	4	4	4	4	4	3	4	4	4	3	4	4	4	3	4	4	4	**3.9**
C3	3	3	4	3	4	2	4	4	2	4	3	4	2	4	3	4	3	4	4	2	**3.3**
C4	3	3	4	3	4	3	3	2	0	2	4	3	4	3	4	2	2	3	3	-3	**2.6**
C5	4	2	4	3	2	3	4	0	2	0	3	3	1	4	3	2	3	2	4	-1	**2.4**
Average	**3.6**	**3.2**	**4.0**	**3.2**	**3.6**	**3.2**	**3.6**	**2.6**	**2.2**	**2.6**	**3.6**	**3.6**	**2.6**	**3.8**	**3.4**	**3.0**	**2.8**	**3.4**	**3.8**	**1.2**	**3.2**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**2000**
D1	4	3	4	3	4	3	4	3	3	3	4	4	4	4	4	4	2	4	4	3	**3.6**
D2	4	3	2	2	4	3	4	1	2	4	4	4	4	3	4	4	4	4	4	3	**3.4**
D3	4	2	3	2	3	2	4	0	2	1	3	3	2	3	3	3	2	4	4	-3	**2.4**
D4	4	3	4	2	2	2	4	2	-1	1	3	4	2	3	4	2	0	4	4	1	**2.5**
D5	4	3	3	2	3	2	4	2	0	0	3	4	1	4	4	2	3	4	4	2	**2.7**
Average	**4.0**	**2.8**	**3.2**	**2.2**	**3.2**	**2.4**	**4.0**	**1.6**	**1.2**	**1.8**	**3.4**	**3.8**	**2.6**	**3.4**	**3.8**	**3.0**	**2.2**	**4.0**	**4.0**	**1.2**	**2.9**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**2000**
E1	4	3	4	3	3	3	4	1	-2	2	4	4	3	3	4	4	3	3	4	1	**2.9**
E2	3	3	2	3	2	3	4	2	2	1	4	4	1	4	3	4	4	0	4	-1	**2.6**
E3	2	2	4	3	2	1	4	0	-2	3	3	3	0	0	4	3	4	4	3	3	**2.3**
E4	3	3	3	4	3	2	4	2	2	-1	4	4	-1	2	4	3	4	4	3	-1	**2.6**
E5	3	2	3	3	3	2	4	2	-1	-1	4	3	0	3	4	3	3	4	3	2	**2.5**
Average	**3.0**	**2.6**	**3.2**	**3.2**	**2.6**	**2.2**	**4.0**	**1.4**	**-0.2**	**0.8**	**3.8**	**3.6**	**0.6**	**2.4**	**3.8**	**3.4**	**3.6**	**3.0**	**3.4**	**0.8**	**2.6**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**2000**
F1	2	4	4	3	4	2	4	2	3	0	4	4	3	2	3	3	4	4	4	2	**3.1**
F2	4	3	4	3	4	4	4	2	4	3	4	4	3	2	3	3	4	4	4	4	**3.5**
F3	4	3	4	3	4	4	4	2	1	3	3	4	2	3	4	2	2	4	3	4	**3.2**
F4	4	3	3	3	3	2	4	2	4	2	3	4	4	4	3	3	4	4	3	2	**3.2**

F5	4	2	3	3	3	2	4	1	2	2	4	4	2	4	4	4	4	4	4	2	**3.1**
Average	**3.6**	**3.0**	**3.6**	**3.0**	**3.6**	**2.8**	**4.0**	**1.8**	**2.8**	**2.0**	**3.6**	**4.0**	**2.8**	**3.0**	**3.4**	**3.0**	**3.6**	**4.0**	**3.6**	**2.8**	**3.2**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**2000**
G1	4	3	4	3	3	4	4	3	2	4	4	3	2	4	4	4	3	4	4	4	**3.5**
G2	4	4	4	4	4	4	4	3	2	4	4	4	3	4	4	4	4	4	4	4	**3.8**
G3	4	4	4	4	4	4	4	2	4	4	4	4	3	4	3	4	3	4	4	3	**3.7**
G4	4	3	4	4	4	3	4	0	0	2	4	4	2	4	3	4	4	4	4	3	**3.2**
G5	4	4	4	4	2	3	4	0	4	1	4	3	2	3	2	4	3	4	4	3	**3.1**
Average	**4.0**	**3.6**	**4.0**	**3.8**	**3.4**	**3.6**	**4.0**	**1.6**	**2.4**	**3.0**	**4.0**	**3.6**	**2.4**	**3.8**	**3.2**	**4.0**	**3.4**	**4.0**	**4.0**	**3.4**	**3.5**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**2000**
H1	4	3	3	2	3	3	4	2	4	2	3	4	3	3	4	3	3	4	4	3	**3.2**
H2	4	3	4	3	4	3	4	3	2	2	4	4	3	4	4	4	4	0	4	3	**3.3**
H3	4	3	4	2	4	4	4	3	2	0	3	4	3	3	3	2	4	4	4	4	**3.2**
H4	4	3	4	2	4	3	4	2	2	2	4	4	2	3	4	3	4	4	2	3	**3.2**
H5	4	3	3	3	2	3	4	3	4	4	4	4	4	3	3	4	4	0	2	3	**3.2**
Average	**4.0**	**3.0**	**3.6**	**2.4**	**3.4**	**3.2**	**4.0**	**2.6**	**2.8**	**2.0**	**3.6**	**4.0**	**3.0**	**3.2**	**3.6**	**3.2**	**3.8**	**2.4**	**3.2**	**3.2**	**3.2**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**2000**
I1	4	3	4	3	4	2	4	2	2	2	4	4	3	3	4	3	4	4	4	-1	**3.1**
I2	4	2	4	3	4	3	4	1	2	2	4	4	3	4	4	4	4	4	4	2	**3.3**
I3	4	3	4	3	3	4	4	2	1	1	2	4	4	4	4	2	3	4	4	-2	**2.9**
I4	4	3	3	2	2	3	4	0	2	3	3	4	1	4	4	3	3	4	4	-1	**2.8**
I5	4	3	2	3	-1	3	4	2	2	1	2	4	2	4	3	4	0	4	4	3	**2.7**
Average	**4.0**	**2.8**	**3.4**	**2.8**	**2.4**	**3.0**	**4.0**	**1.4**	**1.8**	**1.8**	**3.0**	**4.0**	**2.6**	**3.8**	**3.8**	**3.2**	**2.8**	**4.0**	**4.0**	**0.2**	**2.9**
Weighting	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**2000**

%																					
J1	4	3	2	3	2	3	4	-2	3	1	2	-1	2	3	2	3	1	3	2	3	**2.2**
J2	3	3	3	2	0	2	3	-1	2	2	2	3	2	4	2	1	3	-1	3	2	**2.0**
J3	4	3	3	2	-1	3	4	-1	3	1	3	0	3	3	3	3	2	4	3	-2	**2.2**
J4	4	3	3	2	0	2	3	0	3	2	3	2	0	2	0	2	4	2	3	2	**2.1**
J5	2	3	4	2	2	3	4	-2	3	0	0	3	4	3	2	3	3	1	4	3	**2.4**
Average	**3.4**	**3.0**	**3.0**	**2.2**	**0.6**	**2.6**	**3.6**	**-1.2**	**2.8**	**1.2**	**2.0**	**1.4**	**2.2**	**3.0**	**1.8**	**2.4**	**2.6**	**1.8**	**3.0**	**1.6**	**2.2**
Weighting %	100	75	100	75	75	75	75	25	75	75	50	75	75	25	25	25	75	25	25	75	**1225**
K1	4	3	3	4	3	4	4	2	2	4	0	4	3	2	4	3	2	0	4	4	**3.1**
K2	4	3	4	4	4	3	4	0	2	4	4	4	3	2	4	4	3	0	4	4	**3.4**
K3	4	3	4	4	4	4	4	0	0	2	3	4	2	2	3	3	4	0	0	4	**3.1**
K4	4	3	4	4	4	4	4	0	4	4	4	4	3	2	3	3	0	0	0	4	**3.3**
K5	4	3	3	4	4	3	4	1	2	2	3	4	3	2	4	3	3	0	0	3	**3.0**
Average	**4.0**	**3.0**	**3.6**	**4.0**	**3.8**	**3.6**	**4.0**	**0.6**	**2.0**	**3.2**	**2.8**	**4.0**	**2.8**	**2.0**	**3.6**	**3.2**	**2.4**	**0.0**	**1.6**	**3.8**	**3.2**
Weighting %	75	75	100	75	75	75	100	75	75	25	50	25	75	100	25	100	50	25	25	75	**1300**
L1	4	4	4	3	4	4	4	3	4	2	4	4	4	4	4	4	4	4	4	4	**3.8**
L2	4	4	4	3	4	4	4	4	2	3	2	3	3	4	4	4	4	0	4	4	**3.6**
L3	4	3	4	3	4	4	4	2	2	1	2	4	2	4	3	4	4	4	4	4	**3.4**
L4	4	4	4	4	4	4	4	3	2	4	4	4	1	3	4	4	4	4	4	4	**3.6**
L5	4	3	4	4	4	3	4	3	2	2	2	4	1	4	3	4	4	0	3	3	**3.3**
Average	**4.0**	**3.6**	**4.0**	**3.4**	**4.0**	**3.8**	**4.0**	**3.0**	**2.4**	**2.4**	**2.8**	**3.8**	**2.2**	**3.8**	**3.6**	**4.0**	**4.0**	**2.4**	**3.8**	**3.8**	**3.5**
Weighting %	50	100	75	75	75	50	50	25	50	25	0	25	100	25	25	25	25	25	25	75	**925**
M1	4	4	4	4	4	4	4	1	2	2	3	4	4	0	4	3	3	0	3	4	**3.5**
M2	4	4	4	4	4	4	4	-1	2	2	2	4	3	1	3	3	3	0	3	4	**3.3**

M3	4	4	4	4	4	4	4	2	0	4	0	4	4	3	3	3	3	0	3	4	**3.5**
M4	4	4	4	4	4	4	4	3	0	3	2	4	4	1	4	3	3	0	3	2	**3.3**
M5	4	4	4	4	4	4	4	2	0	3	0	4	3	0	4	3	3	0	3	2	**3.1**
Average	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**1.4**	**0.8**	**2.8**	**1.4**	**4.0**	**3.6**	**1.0**	**3.6**	**3.0**	**3.0**	**0.0**	**3.0**	**3.2**	**3.3**
Weighting %	50	50	100	100	100	50	100	25	100	25	0	25	50	25	25	25	25	25	25	100	**1025**
N1	4	4	4	4	4	4	4	0	2	3	3	4	3	2	3	4	4	0	0	4	**3.4**
N2	4	3	4	4	4	4	2	2	4	3	3	4	3	2	3	4	4	0	0	4	**3.4**
N3	4	3	4	4	3	4	3	2	4	2	3	3	1	3	4	4	3	0	3	4	**3.3**
N4	4	3	4	4	3	4	4	3	4	2	3	4	1	3	3	4	4	4	3	4	**3.6**
N5	4	3	4	4	3	4	4	0	-2	0	3	4	1	3	3	4	4	4	3	-1	**2.4**
Average	**4.0**	**3.2**	**4.0**	**4.0**	**3.4**	**4.0**	**3.4**	**1.4**	**2.4**	**2.0**	**3.0**	**3.8**	**1.8**	**2.6**	**3.2**	**4.0**	**3.8**	**1.6**	**1.8**	**3.0**	**3.2**
Weighting %	50	75	75	75	75	75	50	100	75	25	0	25	75	25	25	25	25	25	25	75	**1000**
O1	4	4	3	4	4	4	3	3	3	-1	4	4	4	4	4	4	4	4	3	4	**3.6**
O2	4	4	4	4	4	4	4	3	4	4	3	4	4	4	4	4	4	4	4	4	**3.9**
O3	4	3	4	3	4	4	4	4	1	2	3	4	4	4	4	4	4	4	4	4	**3.6**
O4	4	4	3	3	4	4	4	4	3	0	3	4	3	4	3	4	4	0	3	2	**3.3**
O5	4	3	3	3	4	4	4	3	3	3	3	4	3	0	3	4	4	4	3	4	**3.4**
Average	**4.0**	**3.6**	**3.4**	**3.4**	**4.0**	**4.0**	**3.8**	**3.4**	**2.8**	**1.6**	**3.2**	**4.0**	**3.6**	**3.2**	**3.6**	**4.0**	**4.0**	**3.2**	**3.4**	**3.6**	**3.5**
Total Project	**3.8**	**3.2**	**3.6**	**3.3**	**3.3**	**3.2**	**3.9**	**1.8**	**2.2**	**2.3**	**3.2**	**3.7**	**2.6**	**3.1**	**3.5**	**3.4**	**3.3**	**2.7**	**3.4**	**2.5**	**3.2**

Appendix 5: Research Results for the Management of the DMO Project

Questionnaire Answers

	Questionnaire Participant							
Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Average**
Weighting %	100	100	100	100	100	100	100	**700**
A1	3	3	3	4	3	2	4	**2.9**
A2	4	3	4	4	4	3	4	**3.3**
A3	4	4	4	4	4	3	4	**3.4**
A4	4	3	4	4	4	4	4	**3.3**
A5	4	4	4	4	4	4	4	**3.4**
Average	**3.8**	**3.4**	**3.8**	**4.0**	**3.8**	**3.2**	**4.0**	**3.3**
Weighting %	100	100	100	100	100	100	100	**700**
B1	3	3	3	3	3	2	3	**2.6**
B2	4	3	3	3	3	4	3	**2.7**
B3	4	3	4	3	4	2	3	**3.0**
B4	4	3	3	4	4	2	4	**3.1**
B5	4	3	4	4	3	4	4	**3.1**
Average	**3.8**	**3.0**	**3.4**	**3.4**	**3.4**	**2.8**	**3.4**	**2.9**
Weighting %	100	100	100	100	100	100	100	**700**
C1	4	4	4	3	4	4	3	**3.1**
C2	4	4	4	4	4	4	4	**3.4**
C3	3	3	4	3	4	2	4	**3.0**
C4	3	3	4	3	4	3	3	**2.9**
C5	4	2	4	3	2	3	4	**2.7**
Average	**3.6**	**3.2**	**4.0**	**3.2**	**3.6**	**3.2**	**3.6**	**3.0**
Weighting %	100	100	100	100	100	100	100	**700**
D1	4	3	4	3	4	3	4	**3.1**
D2	4	3	2	2	4	3	4	**2.7**
D3	4	2	3	2	3	2	4	**2.6**
D4	4	3	4	2	2	2	4	**2.7**
D5	4	3	3	2	3	2	4	**2.7**
Average	**4.0**	**2.8**	**3.2**	**2.2**	**3.2**	**2.4**	**4.0**	**2.8**
Weighting %	100	100	100	100	100	100	100	**700**
E1	4	3	4	3	3	3	4	**3.0**
E2	3	3	2	3	2	3	4	**2.4**
E3	2	2	4	3	2	1	4	**2.4**
E4	3	3	3	4	3	2	4	**2.9**
E5	3	2	3	3	3	2	4	**2.6**
Average	**3.0**	**2.6**	**3.2**	**3.2**	**2.6**	**2.2**	**4.0**	**2.7**
Weighting %	100	100	100	100	100	100	100	**700**
F1	2	4	4	3	4	2	4	**3.0**
F2	4	3	4	3	4	4	4	**3.1**
F3	4	3	4	3	4	4	4	**3.1**

F4	4	3	3	3	3	2	4	**2.9**
F5	4	2	3	3	3	2	4	**2.7**
Average	**3.6**	**3.0**	**3.6**	**3.0**	**3.6**	**2.8**	**4.0**	**3.0**
Weighting %	100	100	100	100	100	100	100	**700**
G1	4	3	4	3	3	4	4	**3.0**
G2	4	4	4	4	4	4	4	**3.4**
G3	4	4	4	4	4	4	4	**3.4**
G4	4	3	4	4	4	3	4	**3.3**
G5	4	4	4	4	2	3	4	**3.1**
Average	**4.0**	**3.6**	**4.0**	**3.8**	**3.4**	**3.6**	**4.0**	**3.3**
Weighting %	100	100	100	100	100	100	100	**700**
H1	4	3	3	2	3	3	4	**2.7**
H2	4	3	4	3	4	3	4	**3.1**
H3	4	3	4	2	4	4	4	**3.0**
H4	4	3	4	2	4	3	4	**3.0**
H5	4	3	3	3	2	3	4	**2.7**
Average	**4.0**	**3.0**	**3.6**	**2.4**	**3.4**	**3.2**	**4.0**	**2.9**
Weighting %	100	100	100	100	100	100	100	**700**
I1	4	3	4	3	4	2	4	**3.1**
I2	4	2	4	3	4	3	4	**3.0**
I3	4	3	4	3	3	4	4	**3.0**
I4	4	3	3	2	2	3	4	**2.6**
I5	4	3	2	3	-1	3	4	**2.1**
Average	**4.0**	**2.8**	**3.4**	**2.8**	**2.4**	**3.0**	**4.0**	**2.8**
Weighting %	100	100	100	100	100	100	100	**700**
J1	4	3	2	3	2	3	4	**2.6**
J2	3	3	3	2	0	2	3	**2.0**
J3	4	3	3	2	-1	3	4	**2.1**
J4	4	3	3	2	0	2	3	**2.1**
J5	2	3	4	2	2	3	4	**2.4**
Average	**3.4**	**3.0**	**3.0**	**2.2**	**0.6**	**2.6**	**3.6**	**2.3**
Weighting %	100	75	100	75	75	75	75	**575**
K1	4	3	3	4	3	4	4	**3.0**
K2	4	3	4	4	4	3	4	**3.3**
K3	4	3	4	4	4	4	4	**3.3**
K4	4	3	4	4	4	4	4	**3.3**
K5	4	3	3	4	4	3	4	**3.2**
Average	**4.0**	**3.0**	**3.6**	**4.0**	**3.8**	**3.6**	**4.0**	**3.3**
Weighting %	75	75	100	75	75	75	100	**575**
L1	4	4	4	3	4	4	4	**3.3**
L2	4	4	4	3	4	4	4	**3.3**
L3	4	3	4	3	4	4	4	**3.2**
L4	4	4	4	4	4	4	4	**3.5**
L5	4	3	4	4	4	3	4	**3.3**
Average	**4.0**	**3.6**	**4.0**	**3.4**	**4.0**	**3.8**	**4.0**	**3.3**
Weighting %	50	100	75	75	75	50	50	**475**
M1	4	4	4	4	4	4	4	**3.6**

M2	4	4	4	4	4	4	4	**3.6**
M3	4	4	4	4	4	4	4	**3.6**
M4	4	4	4	4	4	4	4	**3.6**
M5	4	4	4	4	4	4	4	**3.6**
Average	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**3.6**
Weighting %	50	50	100	100	100	50	100	**550**
N1	4	4	4	4	4	4	4	**3.6**
N2	4	3	4	4	4	4	2	**3.2**
N3	4	3	4	4	3	4	3	**3.2**
N4	4	3	4	4	3	4	4	**3.4**
N5	4	3	4	4	3	4	4	**3.4**
Average	**4.0**	**3.2**	**4.0**	**4.0**	**3.4**	**4.0**	**3.4**	**3.3**
Weighting %	50	75	75	75	75	75	50	**475**
O1	4	4	3	4	4	4	3	**3.1**
O2	4	4	4	4	4	4	4	**3.4**
O3	4	3	4	3	4	4	4	**3.1**
O4	4	4	3	3	4	4	4	**3.1**
O5	4	3	3	3	4	4	4	**2.9**
Average	**4.0**	**3.6**	**3.4**	**3.4**	**4.0**	**4.0**	**3.8**	**3.1**
Total Project	**3.8**	**3.2**	**3.6**	**3.3**	**3.3**	**3.2**	**3.9**	**3.0**

Appendix 6: Research Results for the Team Members of the DMO Project

Questionnaire Answers

	Questionnaire Participant													
Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**Average**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	**1300**
A1	2	4	3	4	4	3	4	4	4	4	2	3	4	**3.5**
A2	3	4	4	4	4	4	4	4	4	4	4	4	3	**3.8**
A3	3	4	4	3	4	4	4	4	4	2	4	4	-1	**3.3**
A4	4	1	3	4	4	3	4	3	2	4	4	4	3	**3.3**
A5	3	4	4	3	3	3	3	3	4	4	2	4	4	**3.4**
Average	**3.0**	**3.4**	**3.6**	**3.6**	**3.8**	**3.4**	**3.8**	**3.6**	**3.6**	**3.6**	**3.2**	**3.8**	**2.6**	**3.5**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	**1300**
B1	2	3	2	4	4	3	3	4	4	3	4	4	4	**3.4**
B2	4	4	3	4	4	3	3	4	4	4	3	4	2	**3.5**
B3	4	4	3	3	4	3	4	3	3	3	4	4	1	**3.3**
B4	2	4	4	3	4	4	3	4	4	2	4	4	4	**3.5**
B5	2	4	4	4	4	2	4	4	4	4	4	4	4	**3.7**
Average	**2.8**	**3.8**	**3.2**	**3.6**	**4.0**	**3.0**	**3.4**	**3.8**	**3.8**	**3.2**	**3.8**	**4.0**	**3.0**	**3.5**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	**1300**
C1	3	4	3	4	4	3	4	3	3	3	4	4	4	**3.5**
C2	4	3	4	4	4	3	4	4	4	3	4	4	4	**3.8**
C3	4	2	4	3	4	2	4	3	4	3	4	4	2	**3.3**
C4	2	0	2	4	3	4	3	4	2	2	3	3	-3	**2.2**
C5	0	2	0	3	3	1	4	3	2	3	2	4	-1	**2.0**
Average	**2.6**	**2.2**	**2.6**	**3.6**	**3.6**	**2.6**	**3.8**	**3.4**	**3.0**	**2.8**	**3.4**	**3.8**	**1.2**	**3.0**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	**1300**
D1	3	3	3	4	4	4	4	4	4	2	4	4	3	**3.5**
D2	1	2	4	4	4	4	3	4	4	4	4	4	3	**3.5**
D3	0	2	1	3	3	2	3	3	3	2	4	4	-3	**2.1**
D4	2	-1	1	3	4	2	3	4	2	0	4	4	1	**2.2**
D5	2	0	0	3	4	1	4	4	2	3	4	4	2	**2.5**
Average	**1.6**	**1.2**	**1.8**	**3.4**	**3.8**	**2.6**	**3.4**	**3.8**	**3.0**	**2.2**	**4.0**	**4.0**	**1.2**	**2.8**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	**1300**
E1	1	-2	2	4	4	3	3	4	4	3	3	4	1	**2.6**
E2	2	2	1	4	4	1	4	3	4	4	0	4	-1	**2.5**
E3	0	-2	3	3	3	0	0	4	3	4	4	3	3	**2.2**
E4	2	2	-1	4	4	-1	2	4	3	4	4	3	-1	**2.2**
E5	2	-1	-1	4	3	0	3	4	3	3	4	3	2	**2.2**

Average	**1.4**	**-0.2**	**0.8**	**3.8**	**3.6**	**0.6**	**2.4**	**3.8**	**3.4**	**3.6**	**3.0**	**3.4**	**0.8**	**2.3**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	**1300**
F1	2	3	0	4	4	3	2	3	3	4	4	4	2	**2.9**
F2	2	4	3	4	4	3	2	3	3	4	4	4	4	**3.4**
F3	2	1	3	3	4	2	3	4	2	2	4	3	4	**2.8**
F4	2	4	2	3	4	4	4	3	3	4	4	3	2	**3.2**
F5	1	2	2	4	4	2	4	4	4	4	4	4	2	**3.2**
Average	**1.8**	**2.8**	**2.0**	**3.6**	**4.0**	**2.8**	**3.0**	**3.4**	**3.0**	**3.6**	**4.0**	**3.6**	**2.8**	**3.1**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	**1300**
G1	3	2	4	4	3	2	4	4	4	3	4	4	4	**3.5**
G2	3	2	4	4	4	3	4	4	4	4	4	4	4	**3.7**
G3	2	4	4	4	4	3	4	3	4	3	4	4	3	**3.5**
G4	0	0	2	4	4	2	4	3	4	4	4	4	3	**2.9**
G5	0	4	1	4	3	2	3	2	4	3	4	4	3	**2.8**
Average	**1.6**	**2.4**	**3.0**	**4.0**	**3.6**	**2.4**	**3.8**	**3.2**	**4.0**	**3.4**	**4.0**	**4.0**	**3.4**	**3.3**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	**1300**
H1	2	4	2	3	4	3	3	4	3	3	4	4	3	**3.2**
H2	3	2	2	4	4	3	4	4	4	4	0	4	3	**3.2**
H3	3	2	0	3	4	3	3	3	2	4	4	4	4	**3.0**
H4	2	2	2	4	4	2	3	4	3	4	4	2	3	**3.0**
H5	3	4	4	4	4	4	3	3	4	4	0	2	3	**3.2**
Average	**2.6**	**2.8**	**2.0**	**3.6**	**4.0**	**3.0**	**3.2**	**3.6**	**3.2**	**3.8**	**2.4**	**3.2**	**3.2**	**3.1**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	**1300**
I1	2	2	2	4	4	3	3	4	3	4	4	4	-1	**2.9**
I2	1	2	2	4	4	3	4	4	4	4	4	4	2	**3.2**
I3	2	1	1	2	4	4	4	4	2	3	4	4	-2	**2.5**
I4	0	2	3	3	4	1	4	4	3	3	4	4	-1	**2.6**
I5	2	2	1	2	4	2	4	3	4	0	4	4	3	**2.7**
Average	**1.4**	**1.8**	**1.8**	**3.0**	**4.0**	**2.6**	**3.8**	**3.8**	**3.2**	**2.8**	**4.0**	**4.0**	**0.2**	**2.8**
Weighting %	100	100	100	100	100	100	100	100	100	100	100	100	100	**1300**
J1	-2	3	1	2	-1	2	3	2	3	1	3	2	3	**1.7**
J2	-1	2	2	2	3	2	4	2	1	3	-1	3	2	**1.8**
J3	-1	3	1	3	0	3	3	3	3	2	4	3	-2	**1.9**
J4	0	3	2	3	2	0	2	0	2	4	2	3	2	**1.9**
J5	-2	3	0	0	3	4	3	2	3	3	1	4	3	**2.1**
Average	**-1.2**	**2.8**	**1.2**	**2.0**	**1.4**	**2.2**	**3.0**	**1.8**	**2.4**	**2.6**	**1.8**	**3.0**	**1.6**	**1.9**
Weighting %	25	75	75	50	75	75	25	25	25	75	25	25	75	**650**
K1	2	2	4	0	4	3	2	4	3	2	0	4	4	**2.8**
K2	0	2	4	4	4	3	2	4	4	3	0	4	4	**3.2**
K3	0	0	2	3	4	2	2	3	3	4	0	0	4	**2.4**
K4	0	4	4	4	4	3	2	3	3	0	0	0	4	**2.8**

K5	1	2	2	3	4	3	2	4	3	3	0	0	3	**2.6**
Average	**0.6**	**2.0**	**3.2**	**2.8**	**4.0**	**2.8**	**2.0**	**3.6**	**3.2**	**2.4**	**0.0**	**1.6**	**3.8**	**2.7**
Weighting %	75	75	25	50	25	75	100	25	100	50	25	25	75	**725**
L1	3	4	2	4	4	4	4	4	4	4	4	4	4	**3.8**
L2	4	2	3	2	3	3	4	4	4	4	0	4	4	**3.3**
L3	2	2	1	2	4	2	4	3	4	4	4	4	4	**3.1**
L4	3	2	4	4	4	1	3	4	4	4	4	4	4	**3.2**
L5	3	2	2	2	4	1	4	3	4	4	0	3	3	**2.9**
Average	**3.0**	**2.4**	**2.4**	**2.8**	**3.8**	**2.2**	**3.8**	**3.6**	**4.0**	**4.0**	**2.4**	**3.8**	**3.8**	**3.3**
Weighting %	25	50	25	0	25	100	25	25	25	25	25	25	75	**450**
M1	1	2	2	3	4	4	0	4	3	3	0	3	4	**2.9**
M2	-1	2	2	2	4	3	1	3	3	3	0	3	4	**2.6**
M3	2	0	4	0	4	4	3	3	3	3	0	3	4	**2.9**
M4	3	0	3	2	4	4	1	4	3	3	0	3	2	**2.6**
M5	2	0	3	0	4	3	0	4	3	3	0	3	2	**2.2**
Average	**1.4**	**0.8**	**2.8**	**1.4**	**4.0**	**3.6**	**1.0**	**3.6**	**3.0**	**3.0**	**0.0**	**3.0**	**3.2**	**2.6**
Weighting %	25	100	25	0	25	50	25	25	25	25	25	25	100	**475**
N1	0	2	3	3	4	3	4	2	3	4	4	4	0	**2.2**
N2	2	4	3	3	4	3	4	2	3	4	4	3	0	**2.7**
N3	2	4	2	3	3	1	4	3	4	4	3	3	0	**2.4**
N4	3	4	2	3	4	1	4	3	3	4	4	3	4	**3.4**
N5	0	-2	0	3	4	1	4	3	3	4	4	3	4	**1.8**
Average	**1.4**	**2.4**	**2.0**	**3.0**	**3.8**	**1.8**	**4.0**	**2.6**	**3.2**	**4.0**	**3.8**	**3.2**	**1.6**	**2.5**
Weighting %	100	75	25	0	25	75	25	25	25	25	25	25	75	**525**
O1	3	3	-1	4	4	4	4	4	4	4	4	3	4	**3.4**
O2	3	4	4	3	4	4	4	4	4	4	4	4	4	**3.8**
O3	4	1	2	3	4	4	4	4	4	4	4	4	4	**3.5**
O4	4	3	0	3	4	3	4	3	4	4	0	3	2	**3.0**
O5	3	3	3	3	4	3	0	3	4	4	4	3	4	**3.2**
Average	**3.4**	**2.8**	**1.6**	**3.2**	**4.0**	**3.6**	**3.2**	**3.6**	**4.0**	**4.0**	**3.2**	**3.4**	**3.6**	**3.4**
Total Project	**1.8**	**2.2**	**2.3**	**3.2**	**3.7**	**2.6**	**3.2**	**3.4**	**3.3**	**3.3**	**2.9**	**3.5**	**2.4**	**2.9**