Application of Mineral Resource Management in South African Mining Companies (MRM): Which elements of it have contributed significant Strategic Competitive Advantage?

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A research submitted to the Gordon institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Business Administration

11 November 2009

ABSTRACT

The question of how mining companies compete is a not a new question. The study looked at the elements of corporate strategy in general but also with specific emphasis to the mining business, the elements of mineral resources management (MRM), and how the business of mining is assisted by such work. The research tapped into the experiences of people at the forefront of MRM work, through a qualitative study of their opinions on the research questions, to contribute to formulation of improved ways of application of MRM as a source of strategic advantage anchored of RBV aligned theory of strategy

The research sort to understand whether MRM application over the years has led to strategic competitive advantages for mining companies in South Africa, specifically the following;1.) What are the most important elements of MRM? and 2.) How is MRM used to obtain strategic competitive advantage in the mining business in South Africa?

A proposal was made of the key areas of MRM and which elements of it offer strategic advantage to mining business.

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DECLARATION

I declare that this research work is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business of Science, University of Pretoria. It has not been submitted before for any degree or examination in any university. I further declare that I have obtained the necessary authorization and consent to carry out this research.

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Mack William

Date _____

ACKNOWLEDGEMENTS

A number of people assisted me much to complete the project whom I would like to acknowledge and thank sincerely. I wish express my gratitude to;

- My wife Dame, for the consistent support through the entire project. My girls Phumi and Sandi were also very supportive.
- Kerry Chipp for guidance on qualitative studies
- My supervisor Joe Aspinall for guidance and feedback
- My supervisor and leader Monty Mphathi for allowing me time even as our business was facing real challenges

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ACRONYMS

MRM - Mineral Resources Management

RBV - resources Based View of strategy

1. INTRODUCTION OF THE RESEARCH PROBLEM

1.1. Introduction

The question of how mining companies compete is a not a new question. It has always existed and remains valid to this day. The research was prompted by a desire to understand how, if any, the application of Mineral Resources Management (MRM) practices in the mining industry has assisted mining companies achieve strategic competitive advantage.

The discussion was started with a look at the elements of corporate strategy in general but also with specific emphasis to the mining business, the elements of MRM, and how the business of mining is assisted by such work.

1.2. Cooperate Strategy in the Mining Business

- **Uniqueness of strategy as a basis for sustainable strategic competitive advantage**

Porter (1996) says that "strategy is a creation of a unique and valuable position, involving a different set of activities". Porter (1996) continues

that “Strategy is creating fit among a company’s activities”. According to Porter (1996) there is difference between good strategy and operational effectiveness, with both being important but different in impact. He notes “Operational effectiveness and strategy are both essential to superior performance, which is the primary goal of any enterprise”.

“Ultimately, all differences between companies in cost or price derive from the hundreds of activities required to create, produce, sell, and deliver their products or services, such as calling on customers, assembling final products, and training employees. Cost is generated by performing activities, and cost advantage arises from performing particular activities more efficiently than competitors. Similarly, differentiation arises from both the choice of activities and how they are performed. Activities then are the basic units of competitive advantage. Overall advantage or disadvantage results from all a company’s activities, not only a few.” (Porter, 1996)

“A company can outperform rivals only if it can establish a difference that it can preserve. It must deliver greater value to customers or create comparable value at a lower cost, or do both” (Porter, 1996)

1.2..1. Tools of strategic management in mining companies

Given the above discussion, it was sort to evaluate possible tools for strategy in mining businesses. Runge (1998) concurs with Porter, positing that the "easiest way that long term competitive advantage can be sustained is via some unique input to the process", arguing further that "mining companies always have one unique input, the ore body." Runge (1998) warns however that there is a limit to this argument, citing two "difficulties";

1. "Unique inputs lose value over time. Orebodies that were once rich and shallow become deep and low grade". Further that "a long term strategy is not built on holding of unique inputs, but on ability to continually discover new unique inputs or enhance value of existing ones", this ability being "characteristic of an exploration focused company, not a mining company"

2. "Newly discovered orebodies, patents and copyrights can be sold or licensed. If these inputs indeed underpin long term profitability, the present value of them, the extra value they add to any process, can be captured by the discoverer from the start". Runge (1998) argues

that when the discoverer sells to the "highest bidder, then there is no "surplus" to underpin long term operational competitiveness"

Having noted the challenges of just depending on the orebody uniqueness, Runge (1998) proceeds to say that "for an enterprise to sustain itself for the long term, then unique inputs are still required - but they must be inputs that are a feature of the organization itself. These inputs cannot be sold except by selling the organization". The notion that uniqueness of inputs that has do with the organization itself, extends to encompass mechanisms for "updating, expanding and extending these unique characteristics" (Runge, 1998), is what Prahalad and Hamel (1990) have called core competences.

The issue of what core competencies mining companies choose to have became relevant. Competitive advantage obtained from sustained organizational learning was found to be relevant to how MRM could assist strategic advantage. It was important to review the use of MRM use to develop unique capability.

1.3. Mineral Resources Management: Background

"MRM is an integrated activity which identifies, evaluates and provides an optimal extraction plan of the mineral resource, to produce a quality product which satisfies the business objectives of the company, and the requirements of the customer, in a dynamic environment. It performs an audit and quality assurance function to ensure compliance to the business plan, and customer satisfaction in terms of quality and quantity. Overall, effective MRM is an essential component of Operational Excellence along the value chain" (Macfarlane, 2006). The MRM model provides "horizontal integration, along the value chain (Porter, 1998)" based on the notion of supplier/customer relationships" (Macfarlane, 2006), but also vertical integration "recognizing the levels of work (Jacques, 1992)" (Macfarlane, 2006). Refer to figure 1 below, for model of MRM.

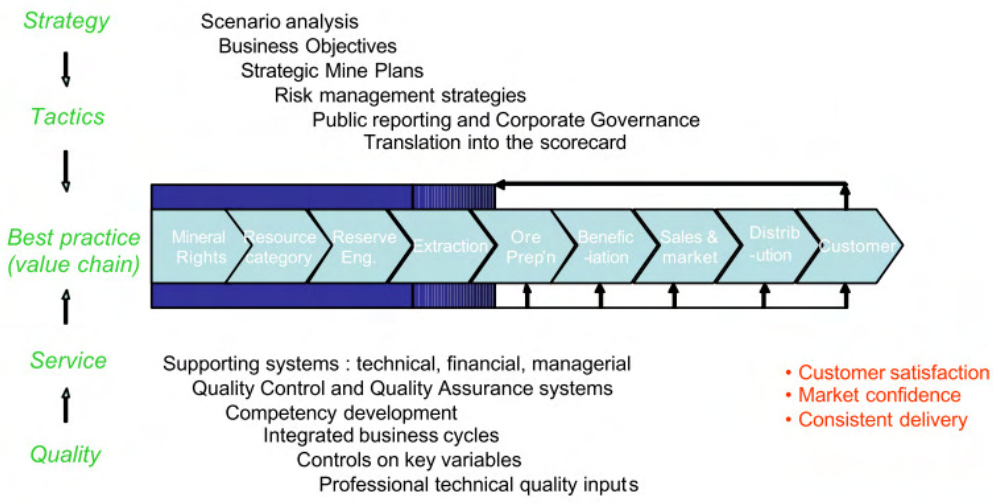

Figure 1 Basic MRM Model (A Macfarlane, 2007)

- **Key Elements and Issues, MRM**

The basic model of MRM (A Macfarlane, 2007) was used to a guide to review views of MRM experts as to which areas assisting companies achieve strategic competitive advantage. The model indicates the process of MRM management, from its link to strategy; scenarios analysis, derivation of business objectives, strategic mine planning, and governance, to execution; systems, control, business cycles, and competency development. MRM in its wide ranging impact to the mining business lends itself to use for derivation of strategic competitive advantage.

The MRM model also clearly shows the role MRM throughout the value chain from exploration to resources. It was noted that whereas all of the elements of MRM are important, it was necessary to review those which areas assist strategic advantage that is not easily imitated, as opposed to just operational effectiveness which can be copied. Using the above basic MRM model but also work by Macfarlane (2006), it the following areas of MRM would be reviewed for possible contribution to uniqueness of activities and hence strategic competitive advantage.

The model indicates that process elements of MRM from exploration through the value chain to final product. There are also organizational aspects to the model like organizational structure and capability. Below key elements of MRM, in line with model, are outlined.

- Exploration
- Acquisitions (buying) of mineral rights
- Evaluation of mineral deposits
- Disposal of mineral rights
- Linking mechanisms to corporate strategy

- Mine planning systems, policies and calendar routines,
- Feasibility studies, reserve engineering and extraction plans
- Risk management
- Capital projects implementation
- Mining and plant operations execution
- Reporting, reconciliations and controls
- Functional integration
- IT platform and standardization
- Organizational structure
- MRM training
- Organizational learning and continuous improvement
- Skill and competency development
- Development of unique organizational capability

- **Some challenges with MRM**

Since the application of MRM has been implemented over the years, there have been "criticisms of the mining industry in general and the South African one in particular" (Macfarlane, 2007). Macfarlane lists the following concerns about MRM application, which he calls "CEO's worry list";

- Excellent plans being created, but not delivering results
- Projects being financed and constructed, but not delivering to expectations
- CEO's having difficult accounting for unsatisfactory year end or quarterly results, therefore having to constantly think up new excuses for non-performance
- Loss of confidence by analysts and investors in company announcements, and the company in general.
- Having to take shock announcements about material changes in resource estimates, plans, designs or production levels attainable
- Markets discovering a non-compliance issue in a public report on resources, reserves or valuations
- Share weakening as a result of market discounts to the extent you become subject to a hostile takeover

These challenges, it the author's view, are an indication that MRM application, has to be looked at again with the view to isolate the advantage generating aspects of it.

1.4. The Contribution of Mining industry to the South African Economy

The work of MRM, if properly implemented could enhance further the value that the mining industry contributes to the South African economy. For a mining company that does not seek to improve, the potential value that can be achieved by reconfiguring organisational processes, will be noted by other competitors, exposing such inefficient mining companies to takeovers. Given the value as seen in table in fig2 below) 140 billion, inefficiency is undesirable, hence the motivation of this project in part.

• GDP	Accounts for 7% of National GDP, 18.4% multiplier effect (related industries)
• Total fixed investment	6.5% of total,
• investment in South Africa	1.6 trillion (31.% of JSE)
• Dividend payout	15.6 billion Rands
• Contribution to exports	140 billion Rands (32.3% total Merchandise exports)
• Taxes	16.2 billion Rands (12% to total company tax)
• World largest producer of;	Platinum Group Metals (PGM's), gold, chromium, ferrochrome, vanadium, manganese and vermiculite

Figure 2 Economic statistics for Mining Industry in South Africa (summarised from Chamber of Mines Annual Report 2007-8)

1.5. Motivation for the Research

The motivation for the research was that it would assist in tapping into the experiences of people at the forefront of this work, contributing to formulation of improved ways of application of MRM as a source of strategic advantage anchored of RBV aligned theory, especially that mining companies generally have little leverage with the external factors like commodity price and exchange rates. Mining is a fairly mature industry; meaning efforts to seek truly unique strategies have to continue.

MRM as a strategy tool was seen by the author as ripe for revisiting by industry, to review what has been achieved with view reformulate implementation and alignment. Further, it would assist in efforts to close the loop on this effort over the years, so that gaps as regards strategic management are closed. Also it was thought, it may be possible to separate work that assists operational effectiveness from true strategic competitive advantage. Whereas there is no doubt of the positive contribution by the MRM practices and applications, at improving operational effectiveness, it is not clear what strategic advantage has been obtained by its application by mining companies in South Africa. In fact it is true that there has been a lot of similarity in its

application, inviting the questions about its contribution as strategic tool.

1.6. Research Aim

Over the last decade the development and application of mineral resource management in mining business in South Africa has been unprecedented. Mineral Resource Management, essentially an integrated business planning system, has been implemented widely and in general thought to have enhanced value extraction in the business of mining.

The matter of operational effectiveness not being a sufficient differentiator over time, prompted the author to seek to build a discussion of what people in the field may think are the salient drivers of strategy uniqueness using MRM, by extension possible strategic advantage. The research sort to understand whether MRM application over the years has led to strategic advantages for mining companies in South Africa, specifically the following;

1. What are the most important elements of MRM?

2. How is MRM used to obtain strategic competitive advantage in the mining business in South Africa?

In this research, it was sort to gain insight into what has been the experience of application and practice of MRM in the South Africa mining industry. The research further sort to evaluate if there have been differences in such applications by the various companies and what may explain the differences. This understanding is important to inform the way forward for the mining business in the continued application of these MRM practices, with specific emphasis on how to contribute to strategic competitive advantage based on resource based view (RBV) aligned theory of strategy.

The MRM review based on the RBV of strategy will assist improved application of the various RBV aligned theories in the mining industry, especially along the lines of acquisition of unique capabilities through MRM.

2. LITERATURE REVIEW

2.1. Introduction to literature review

The challenges in the mining industry between the areas of strategy formulation and execution have to be understood in the broader context of theory on strategy. The literature review will highlight aspects of the resource based view of strategy and elements of it in the business of mining. The roles of dynamic capabilities, management of strategy and organizational learning are examined. Some aspects of MRM are then discussed with the view to link them to the general theory of strategy. The review of the literature is aimed at assisting in improved understanding of how aspects of MRM can be used to gain strategic competitive advantage in the mining business.

2.2. The Resource Based View of strategy and sustainable advantage

The resource based view (RBV) of strategy is a widely diffused theory that really started in the fifties, generally seeking to highlight the need to look inside the organization for advantage. Penrose in 1959 initially argued of heterogeneity and a firm's resources giving the firm uniqueness, with Andrews (1971) later contributing with the notion of internal appraisal. Wernerfelt (1984) suggested looking at firm

resources (tangible and intangible) and later Barney (1991) proposed characteristics of a company's resources that would give it sustainable competitive advantage, namely that they; valuable, rare, inimitable and non substitutable. Due to the faster changing environment and inability to fix the external, looking internally is now a very important lever of strategy. Later, the notion of capabilities was developed, generally meaning the use of company processes to apply resources for a desired outcome (Amit and Shoemaker, 1993; Prahalad and Hamel, 1990). Below is a framework of RBV (Kostopoulos, Spanos, & Prastacos, 2002), which indicates how firm resources and capabilities can lead to sustainable advantage.

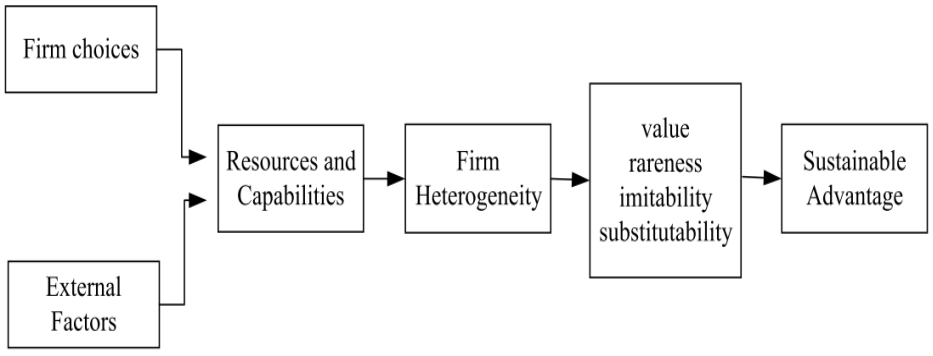

Figure 3, A framework of RBV and Sustainable Advantage (Kostopoulos, Spanos, & Prastacos, 2002)

2.3. Uniqueness of strategy as a basis for sustainable strategic competitive advantage

Porter (1996) says that "strategy is a creation of a unique and valuable position, involving a different set of activities". Porter (1996) continues that "Strategy is creating fit among a company's activities". According to Porter (1996) there is difference between good strategy and operational effectiveness, with both being important but different in impact. He notes "Operational effectiveness and strategy are both essential to superior performance, which is the primary goal of any enterprise".

"Ultimately, all differences between companies in cost or price derive from the hundreds of activities required to create, produce, sell, and deliver their products or services, such as calling on customers, assembling final products, and training employees. Cost is generated by performing activities, and cost advantage arises from performing particular activities more efficiently than competitors. Similarly, differentiation arises from both the choice of activities and how they are performed. Activities, then are the basic units of competitive advantage. Overall advantage or disadvantage results from all a company's activities, not only a few." (Porter, 1996)

"A company can outperform rivals only if it can establish a difference that it can preserve. It must deliver greater value to customers or create comparable value at a lower cost, or do both" (Porter, 1996)

2.3.1. Strategic Heterogeneity in the Mining Industry

Seth and Thomas (1994) have argued that under similar conditions firms make independent decisions that are similar to each other. DiMaggio and Powell (1983) in a similar argument posit that due to interconnectedness of firms that face environmental conditions that are alike, the organisations become similar in structure, practices and strategic behaviours. These matters lead to homogeneity in their strategies.

The opposite of strategic homogeneity is a phenomenon where companies seek to differentiation from other companies in the same industry, strategic heterogeneity. The notion of seeking space where there is less competition for survival (Deephouse, 1999) by pursuing unique strategies, if correct, can be rewarded by the market. The views

espoused by the resource based view of strategy, as discussed earlier anchor this thinking.

Strategic heterogeneity declines with industry maturity (Miles, Snow and Sharfman, 1993). Shapiro, Russell and Pitt (2007) note that whereas the mining industry is becoming increasingly concentrated (PricewaterHouseCoopers, 2005), “the largest mining companies originate in so many different countries, with different socio-economic environments and different resources”, indicating “some strategic heterogeneity”. Shapiro *et al* (2007) conclude of the mining industry that “a certain degree of strategic heterogeneity can be observed”.

2.4. Concept of Business Model

Business model has been defined as, “An architecture for the products, service and information flows including a description of the various business activities and their roles” (Timmers, 1998) and “A description of the roles of and relationships among a firm’s consumers, allies and suppliers that identifies the major flows of product, information, and money, and the major benefit to participants (Weill and Vitale, 2001).

Hedman and Kallings (2002) propose that a business model "integrates a firm's internal aspects that transform factors to resources, through activities, in a structure, to products and offerings to market". Hedman and Kalling (2002) adopt the following elements of a business model;

- Industry
- Product offering
- Activities
- Activities and Organization
- Resources and competencies
- Factor markets and competencies

2.5. Dynamic Capabilities

This concept is building on the notion of core competencies (Prahalad, 1990) but looking more at building and adapting "competencies to address rapidly changing environments" (Eisenhardt and Martin, 2000). Leveraging competencies and assets becomes more important with rapidly changing environment. "Dynamic capabilities help a firm sense

opportunities and then to seize them" (Harreld, O'Reilly III, & Tushman, 2007).

Having noted the dynamism of organizations Mintzberg (2005) notes the aspect of strategy being to "improve fit between capabilities and opportunities available and thereby make the business more successful".

2.6. The IBM Business leadership model

The challenges of translating strategy into reality remain real. The IBM case of strategy implementation offers a guide as to how to develop and implement strategy in a dynamic fashion, without fixating on any one aspect of the business at time.

Harreld *et al* (2007), in their paper on dynamic capapilties at IBM, state that the "IBM Business Leadership Model emphasizes the role of the general manager and the interdependence between strategy and execution. Strategy is stimulated by leaders' dissatisfaction, the perception of a gap between current and desired

performance." Below (Figure 4 the IBM business leadership model), is the business leadership model used at IBM. Each elements of the model is discussed briefly below.

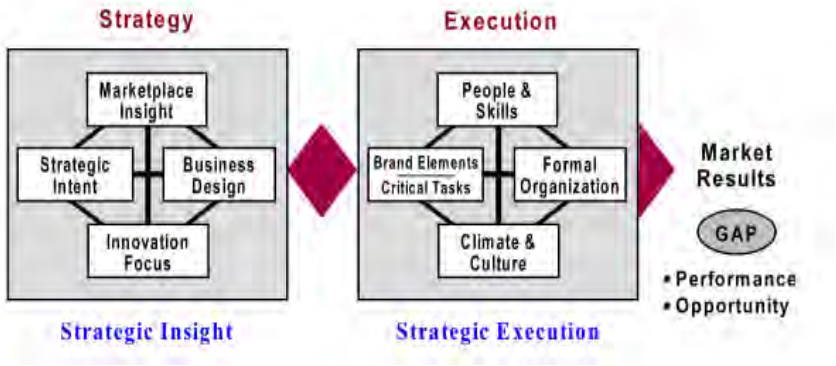

Figure 4 the IBM business leadership model. (Harreld, O'Reilly III, & Tushman, 2007)

There are two sides to the model, the strategy insight and the strategy execution side.

Strategic Insight

On the side of strategy insight the four elements are: strategic intent, market insight, innovation focus, and business design. The four elements are related to each other. At IBM, the difference has been that IBM "emphasizes the interdependence among these elements as a key to successful strategy formulation" (Harreld,

O'Reilly III, & Tushman, 2007). They continue, outlining the elements of the strategic insight side of the model as the follows;

- **Strategic Intent**-sets the overall direction and goal for the organization. In the case of IBM this became an “on demand” company.

- **Market Insight**-involves a focus on understanding customer needs, competitor moves and market economics. This led to IBM’s realization that its customers wanted solutions to their problems, not IT infrastructure

- **Innovation focus**-challenges managers to actively experiment and challenge current thinking in the design and execution of strategy.

- **Business Design**- based on above three, specifies how the business will go to market. It involves customer value proposition, value capture, scope of activities and sustainability

Harreld *et al* (2007) having outlined the four areas of strategic insight above, highlight that there is nothing unique about the individual areas of the model, except the "emphasis on complementarity-ensuring that they are aligned and they work together" (Harreld, O'Reilly III, & Tushman, 2007).

Strategic Execution

According to (Harreld, O'Reilly III, & Tushman, 2007), the right side of the model speaks to what managers require to implement strategy. The four areas are;

- **Critical tasks and processes** - these are the key success factors required to deliver the value proposition and activities as specified in the business design.
- **Formal Organization**-These are the explicit structures, metrics, and rewards required to direct, control and motivate individuals and groups to perform the unit's critical tasks. It is important to realize that sometimes complex structure can hinder strategy execution; in the case of IBM it was loss of speed.

- **People and Skills** - this area talks to the unit having the "requisite human resource characteristics, capabilities, and competencies needed to execute the critical tasks?"
- **Culture**-the existing culture (expectations about how people need to behave) should be aid the execution of the "critical tasks"

Having described the four elements of strategy execution (Harreld, O'Reilly III, & Tushman, 2007) reflect that "whenever a strategy is changed, it is almost always the case that the existing organizational alignment will also need to be changed", saying that the "existing organizational architectures reflect old strategies".

2.7. Strategy Management

Kaplan and Norton (2008) define Management system as "the integrated set of processes and tools that a company uses to develop its strategy, translate into operational actions, and monitor and improve the effectiveness of both". They further note that it is good to have "a closed loop management system" with five steps of, 1) Strategy

development, 2) Translation of strategy, 3) Planning operations, 4) Monitoring and learning and testing and 5) Adapting strategy.

The model below, (Figure 5, How the closed loop system links strategy and operations?, indicates the value of a closed loop system, especially to prevent a “breakdown between strategy and operations” (Kaplan & Norton, 2008). In mining, MRM is a key management system to creating this link. However it remains an open question how various companies use this link between strategy and operations to gain unique strategic advantage?

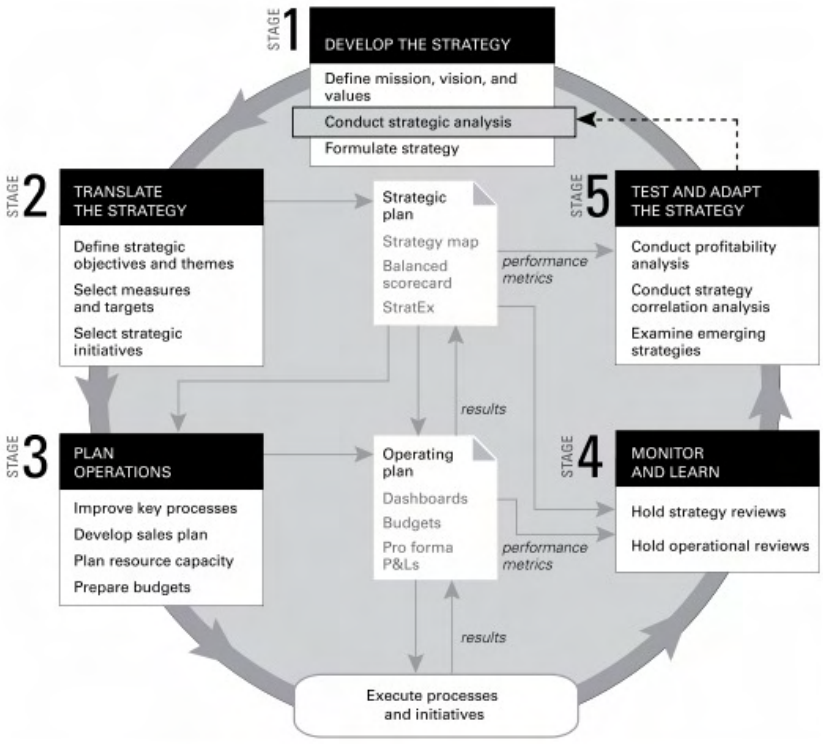

Figure 5, How the closed loop system links strategy and operations? (Kaplan & Norton, 2008)

Kaplan and Norton (2008) note that the "failures to balance strategy and operations is pervasive", illustrating the need for a "closed loop system" (2008) so that failure is prevented. The stages of strategic management as suggested by Kaplan and Norton (2008) are described below in short

- Stage 1: Develop the Strategy

Stage 1 involves "articulating the company's strategy" (Kaplan & Norton, 2008), which normally takes the form of a when a company "incrementally improves an existing strategy or, on occasion, introduces an entirely new one" (Kaplan & Norton, 2008). Kaplan and Norton (2008) highlight that the strategy must deal with to the following questions:

- Which customers or markets will the company target?
- What is the value proposition that distinguishes the company?
- What key processes give the company competitive advantage?
- What are the human capital capabilities required to excel at these key processes?
- What are the technology enablers of the strategy?
- What are the organizational enablers required for the strategy?

- Stage 2: Translate the Strategy

The next stage of the process is to translate the strategy into "objectives and measures" (Kaplan & Norton, 2008)

- Stage 3: Plan Operations

At this stage "the company next develops an operational plan that lays out the actions that will accomplish its strategic objectives" (Kaplan & Norton, 2008)

- Stage 4: Monitor and Learn

As companies implement their strategic and operational plans, they "review the performance of operating departments" (Kaplan & Norton, 2008)

- Stage 5: Test and Adapt the Strategy

"From time to time managers will discover that some of the assumptions underlying their strategy are flawed or obsolete in which case they must be reviewed" (Kaplan & Norton, 2008).

2.8. Learning organization

In their paper "Is yours a learning organization" Garvin, Edmondson and Gino, (2008) outline elements of a learning organization as consisting of

mainly three building block; a supportive learning environment, concrete learning processes and practices, and leadership behaviour that provides reinforcement. The building blocks of a learning organization as described by Garvin, Edmondson and Gino (2008) are outlined below.

2.8.1. A supportive learning environment

A supportive learning environment has four categories. The four categories are psychological safety, appreciation of differences, openness to new ideas and time for reflection. Below, each element of a supportive learning is described.

Psychological safety; *E*mployees learn better when there is not fear of "being belittled or marginalised when they disagree with peers or authority figures, ask naive questions own up to mistakes, or present a minority viewpoint" (Garvin, Edmondson, & Gino, 2008).

Appreciation of differences; According to Garvin *et al* (2008), learning occurs when people become aware of opposing ideas with recognition

of competing functional outlooks and alternative world views increasing energy and motivation.

Openness to new ideas; Garvin Garvin *et al* (2008) posit that beside*s* correcting mistakes and solving problems, learning is also about "crafting novel approaches", with employees being encouraged to "take risks and exploring the untested and unknown".

Time for reflection; Garvin *et al* (2008) say supportive learning environments allow time for a pause in the action and encourage thoughtful review of the organization's processes.

2.8.2. Concrete learning processes and practices

Garvin *et al* (2008) describe learning processes as involving the generation, collection, interpretation, and dissemination of information. Learning organization they say experiment to develop and test new products and services; gather intelligence to keep track of competitive, customer, and technological trends; do disciplined analysis and interpretation to identify and solve problems; and educate and train to develop both new and established employees.

2.8.3. Leadership that reinforces learning

"Organizational learning is strongly influenced by the behaviour of leaders" (Garvin, Edmondson, & Gino, 2008). When leadership encourages learning in organization people must feel empowered to identify problems and are able to raise alternative views, according to Garvin *et al* (2008).

2.8.4. Tacit Knowledge

Runge (1998) highlights tacit knowledge as driver of competitive advantage. Runge leans on Drucker's position on "a post capitalist society based on knowledge" (1995).

Runge writes in his book Mining economics and strategy (1998) "Within mining enterprises, it is this tacit knowledge that is a vital contributor (perhaps the main contributor)" to the business of mining. This may explain whether the market values a mining company low or higher, their ability to derive more value from the mineral assets by working together. Runge (1998) continues that, "It is in the institutionalized procedures that allow hundreds of people to work together. It is in the

short-form jargon and culture that is understood by the people in each work environment, pertaining only to that environment or a narrow set of similar work situations."

2.9. Tools of strategic management in mining companies

Runge (1998) concurs with Porter, positing that the “easiest way that long term competitive advantage can be sustained is via some unique input to the process”, arguing further that “mining companies always have one unique input, the orebody.” Runge (1998) warns however that there is a limit to this argument, citing two “difficulties”;

1. “Unique inputs lose value over time. Orebodies that were once rich and shallow become deep and low grade”. Further that “a long term strategy is not built on holding of unique inputs, but on ability to continually discover new unique inputs or enhance value of existing ones”, this ability being “characteristic of an exploration focused company, not a mining company”

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present value of them, the extra value they add to any process, can be captured by the discoverer from the start." Runge (1998) argues that when the discoverer sells to the "highest bidder, then there is no "surplus" to underpin long term operational competitiveness"

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The issues of what core competencies, how actively managed is the strategic process and organizational learning become very relevant in mining companies. Competitive advantage obtained from sustained organizational learning in not easy to imitate, hence longer lasting.

2.10. Mineral Resources Management, Application in South Africa

2.10.1. MRM concepts

"MRM is an integrated activity which identifies, evaluates and provides an optimal extraction plan of the mineral resource, to produce a quality product which satisfies the business objectives of the company, and the requirements of the customer, in a dynamic environment. It performs an audit and quality assurance function to ensure compliance to the business plan, and customer satisfaction in terms of quality and quantity. Overall, effective MRM is an essential component of Operational Excellence along the value chain" (Macfarlane, 2007). The MRM model provides "horizontal integration, along the value chain (Porter, 1998)" based on the notion of supplier/customer relationships" (Macfarlane, 2007), but also vertical integration "recognizing the levels of work (Jacques, 1992)" (Macfarlane, 2007). Refer to figure 1 below.

- **MRM Model**

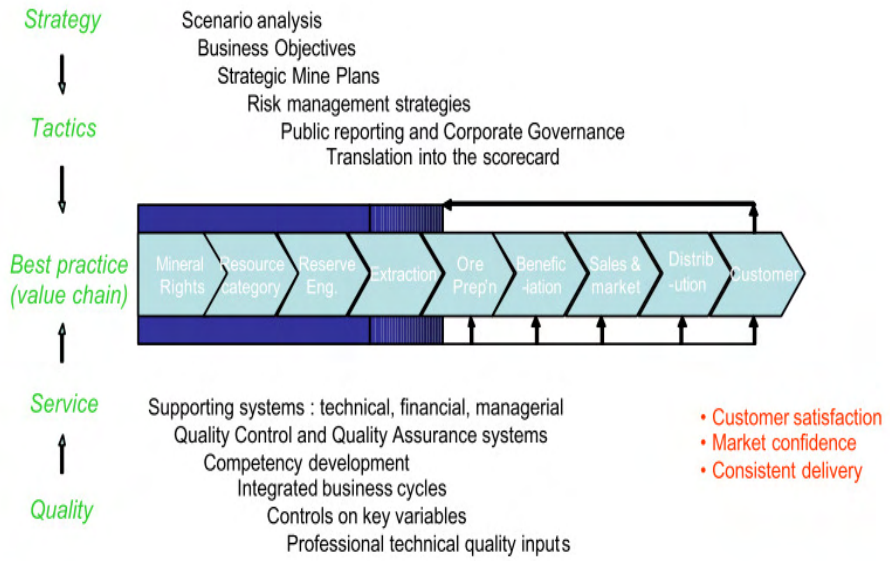

Figure 6 The Basic MRM model (Macfarlane A. , 2007)

2.10.2. Key elements of MRM

The basic model of MRM (Macfarlane, 2007) was used to a guide to review views of MRM experts as to which areas assisting companies achieve strategic competitive advantage. The model indicates the process of MRM management, from its link to strategy; scenarios analysis, derivation of business objectives, strategic mine planning, and governance, to execution; systems, control, business cycles, and competency development. MRM in its wide ranging impact to the

mining business lends itself to use for derivation of strategic competitive advantage.

The MRM model also clearly shows the role MRM thought the value chain from exploration to resources. It was noted that whereas all of the elements of MRM are important, it was necessary to review which areas assist strategic advantage that is not easily imitated, as opposed to just operational effectiveness which can be copied. Using the above basic MRM model but also work by Macfarlane (2006), it the following areas of MRM would be reviewed for possible contribution to uniqueness of activities and hence strategic competitive advantage.

The model indicates that process elements of MRM from exploration through the value chain to final product along the horizontal line. There are also organizational levels of work aspects to the model that are vertical line. Below key elements of MRM, in line with model, are outlined.

- Exploration
- Acquisitions (buying) of mineral rights
- Evaluation of mineral deposits

- Disposal of mineral rights
- Linking mechanisms to corporate strategy
- Mine planning systems, policies and calendar routines,
- Feasibility studies, reserve engineering and extraction plans
- Risk management
- Capital projects implementation
- Mining and plant operations execution
- Reporting, reconciliations and controls
- Functional integration
- IT platform and standardization
- Organizational structure
- MRM training
- Organizational learning and continuous improvement
- Skill and competency development
- Development of unique organizational capability

2.10.3. Strategic mine planning

"Strategic mine planning deals with those components and decisions that largely affect the business over the long term. Central to this, is the

development of a business model, and a plan to maximise value from exploitation of the entire mineral resource available to the organization" (Smith and Ballington, 2005). Several concepts have been applied to strategic mine planning, including strategic planning as a prediction tool (van der Heijden, 2004) and scenario planning (Porter,2005, Swartz,1996, Selin,2006). "Developing an understanding of the uncertainty inherent in the external and future environments, and testing the robustness of any strategies against a set of possible futures, is a critical component of long term and strategic planning" (Smith, Suruhlal and Manyuchi, 2008). Smith *et al* (2008) conclude that a key part of the mining business is "the ability to effectively manage capital investment so as to ensure acceptable stakeholder returns with the overall strategic context.

2.11. Conclusion

The literature review covered has given the context of mining strategy proceeding from the resource based view of cooperate strategy. The notion that increasing organizational capability "form the basis of a difficult to imitate competitive advantage" (Harreld, O'Reilly III, & Tushman, 2007), needs more application in mining business strategy. The literature on strategy management indicates tight management of

strategic action as a possible driver of advantage. The technical aspects of MRM were only reviewed at a high level to give context without seeking to outline unnecessary detail. The literature was used to review contribution of MRM to strategic competitive advantage in mining companies in South Africa.

3. RESEARCH QUESTIONS

3.1. Introduction

Leaning on the theory on strategy and strategic management, questions seeking to understand link between the MRM application in South African mining companies and the broader cooperate strategy. The aim is proceeding from the view that MRM has strategic application, to assess how it is used to achieve strategic advantage. The literature review clearly indicates that increasingly, organizational capabilities and management of strategy are used as on basis for seeking advantage that is sustainable.

In this research, it was sort to gain insight into what has been the experience of application and practice of MRM in the South Africa mining industry. The research further sort to evaluate if there have been differences in such applications by the various companies and what may explain the differences. This understanding is important to inform the way forward for the mining business in the continued application of these MRM practices, with specific emphasis on how to contribute to strategic competitive advantage based on resource based view (RBV) aligned theory of strategy.

3.2. Research Question 1

What are the most important elements of MRM in South African Mining Industry?

MRM being an application that covers the whole spectrum of the mining business value chain, it was important to capture expert views on which elements of MRM are most important. This is important in assisting mining businesses in making choices about future application of MRM, but also evaluating its current performance as a strategic tool.

3.3. Research Question 2

How is MRM used to obtain strategic competitive advantage mining businesses in South Africa?

The various elements would contribute differently to obtaining strategic competitive advantage. Yet some elements may not necessarily give strategic advantage, even if as they contributed operational effectiveness. It was sort to understand which elements of MRM assist strategic uniqueness. The impact of MRM on three key areas of the mining business, acquisition of minerals, developing new mines and

operating existing ones, and managing mining business was reviewed with the view to assist understand how MRM contributes to strategic competitive advantage in south African mining industry.

4. RESEARCH DESIGN

4.1. Introduction

This chapter details the research design and method which has been used to explore the research questions in chapter 3, and notes the basis which applies to such research design method.

4.2. Research design

4.2.1. Background

Initially a review of relevant theory on general strategy and mineral resource management was done to assist guide the research. Two key areas were looked at;

- General strategy in a generic fashion but also as it relates to the mining business. The resource based view of strategy which encourages an inward looking approach to business strategy and management is reviewed.

- Elements of MRM were reviewed to form basis of interviews

The author's opinion was that whereas these generic strategic approaches are fairly understood, it is not clear which areas of MRM contributes more to strategic competitive advantage, especially in the South African mining case. The application of MRM can be summarised as being relevant to three key areas mining competitive strategy; acquiring minerals, obtaining capital for mine development and sustained operation of existing mines, but also organisational capability, linked skills development and organisational learning. If this is not understood, a situation will arise where mining companies just spend money on MRM initiatives, without any focus. It is proposed that a better understanding of the elements of MRM that contribute more significantly to strategic competitive advantage, if the research succeeds, will assist managers of business strategy in the mining industry with their decisions as to which MRM initiatives can be emphasised to gain competitive advantage.

Once the literature review was done, one to one expert interviews were conducted, with people considered experts in aspects MRM application. People with not less than 5 years experience in the MRM field, alternatively managers of business strategy in mining companies in

South Africa were targeted. The interviews mainly sort to understand how MRM is applied to gain strategic competitive advantage.

4.3. Research Method

4.3.1. Qualitative research

According to de Ruyter and Scholl (1998), qualitative research typically utilizes small samples to understand the way in which people think about a certain subject. Further, according to Yin (2003,) qualitative research is the most appropriate method when the research seeks to understand the components and characteristics of a phenomenon and trying to theorize around it.

A qualitative research was chosen as most appropriate for the research. The view taken was that the constructs involved are fairly unspecific and not easy to reduce to an air tight measurable, making a quantitative approach undesirable. For example strategic competitive advantage cannot be easily measured, with only proxy measures being possible. Qualitative methods suit such scenarios better as the value of the observation is more important than its accuracy and repeatability.

The research also seeks to capture experiences and insights that have come over years of practice, which are not directly observable but come with high subjectivity and ambiguity. The insights however should reveal patterns that should indicate the impact of MRM application to strategic management in South African mining companies.

Expert Interviews

One-on-One interviews were conducted with South African MRM practitioners and mining executives accountable for mining strategy, to gain insights into the interviewees' views about the elements of MRM that assist mining companies to have strategic competitive advantage. The participants would use both their experiences and whatever public available data they may have to assist their arguments.

To gain further insights, with increased validity of conclusions, it would be necessary to do focus groups and even questionnaires. It was decided however that the scope of this project be limited to expert interviews.

Description of research method

Primary data consisting of the opinions of MRM practitioners/experts was collected using a qualitative study. This was done by using one on one expert interviews. Where it was necessary, telephone interviews were also used.

The unit of analysis is an application of MRM at corporate level in mining company. The population is persons who have practiced in the field of MRM for not less than 5 years, and operating at not less than level 2, according to levels of work (Jacques, 1992). Alternatively persons actively involved in mining strategy with accountabilities for MRM application.

Non probability sampling, described by Zikmund (2003) to mean that the probability of choosing any particular member of the population is unknown, was used to select participants for the one on one interviews. Four areas non probability sampling are described by Zikmund (2003) as the following;

- Convenience sampling (also called haphazard or accidental sampling), essentially involving use of “units or people who are most conveniently available”(Zikmund,2003)
- Judgement/purposive sampling, where experience is used to select sample based on judgement
- Quota sampling, ensuring that certain characteristics of the population are not left out of sample
- Snowball sampling, techniques were initial respondents are selected by probability methods and additional respondents are selected on the basis of information obtained in the initial respondents.

Given the nature of the research problem, probability sampling was not appropriate to the study. As a result, potential participants were identified through non-probability sampling, using both convenience and judgment sampling (Zikmund, 2003). The selection also sort to ensure that the people interviewed are not limited to one company (moderate elements of quota sampling). However a convenience sample was used since the people were accessed largely through industry networks.

A sample of 10 MRM experts were interviewed, currently employed at or previously worked at the following companies LONMIN(4), AngloGold Ashanti(1), Anglo Platinum(1), ASTGigima(2), RandUranium(1) and Harmony(1). It was acknowledged that the sample size was low; however the depth of experience was expected to compensate for that. Further it was noted that the experts interviewed have experience beyond their current employer, moderating against bias to exposure to only one company. The interviews of two experts were not successful, with only the experts on the chapter 5 interviewed, 8 of them. This was deemed not expected to impact the research too negatively to invalidate the results.

Data Collection

The data was collected through one to one interviews, with experts on MRM. The interviews are conducted in an exploratory fashion, such that biases are avoided in what the interviewees' views are regarding strategic competitive strategy in South African mining companies. Leading questions have the effect of influencing the outcome interviews.

Data Management

Interviewees were provided with a consent form (attached in application as appendix 1. The experts had the option to opt out at any stage of the interview or reserve opinions where in their judgment confidentiality could be compromised. Permission was sort to record the interviews to allow for later transcription into a written format.

A written note after the interview, which was sent back to interviewee for any corrections, was then analysed for themes and patterns, in light of the literatures review.

Data Analysis

An analysis of themes and patterns from the one on one interviews was done. Emerging patterns with regard to groups of responses (Zikmund, 2003), were captured.

Data Validity and Reliability

Minimal interference of thought patterns and opinions of the interviewees was emphasised. The interview therefore took the

unstructured exploratory approach, however guided by the research questions.

4.4. Research Limitation

The following limitations are noted as having limited the research.

- The interviewees are limited to South African experts in MRM and Mining strategy. Views by the wider community of practice internationally in the mining industry would have enhanced the value of the research.

- It is unlikely that the researcher was not able totally remove his opinions from the conversations during the interviews, meaning that the results may be biased.

- The non probability sample that is taken limits the research for generalization, due to lower in repeatability.

- It is possible that interviewees' opinions and backgrounds unduly affected the outcome of the research (somewhat similar mining industry introduces possible bias).

5. RESULTS

5.1. Introduction

Each interviewee was selected on the basis of experience in MRM, using industry networks. The interviewees were recorded and views from the interviews summarised in results section. The notes followed the same sequence as the questions. It was attempted to capture the views in short phrases to capture the opinion without compromising the context. It some cases phrases used by interviewees are used to capture the context and the phrases were put in quotation marks without a referencing to them.

5.2. Interviewee Dave Borman

Position:	Mining Consultant GMSI
Company	GMSI, ASTGigima, Mining IT Solutions Company
Experience in MRM	34 years experience in MRM
Consent use of personal details	Yes

Key elements of MRM

Linking previously separate disciplines together, taking away “silos”.

Incorporation of mining design criteria early in mine design

How MRM is used for strategic competitive advantage

- Assist in investor relations, as shareholders like mines archiving what they said they would achieve. MRM assists **planning integrity**. This takes away sudden and material changes to reserve statements on which financial decisions are made.
- “Helps CEO” keep promises to market, and avoid questions like “why did they not know”. Therefore it improves confidence in mine plan, banks can loan money on the basis of such plans or market buy the company’s share. It is no use spending time talking to market analysts if your MRM does to back you up with information integrity and consistence.
- To gain advantage one has to go beyond the IT systems, people systems are as important.
- MRM assists “operations people believe the business plan”, which improves confidence and execution

Comments on application of MRM that is common of industry wide or unique per company

Common

- Most system are generic but with customization

Unique

- Acquisition policies are different. For example Harmony buys old mines from AngloGold and runs them at cheaper unit cost.
- People will also dispose on mineral rights differently, with the bigger mining companies letting go of old rights sooner.

MRM contribution Acquisition and securing mineral rights

- Sufficient "proving" of the mineral resource through good exploration budget is very important.
- Good modelling of geological structures and grade

MRM contribution to new mines/existing mines

- Standard IT platform coupled with good organisational discipline for compliance to these systems, aids speed, which in fast changing environment can be basis for competition.

MRM contribution to organizational capability

- Standard IT platform coupled with good organisational discipline for compliance to these systems, aids speed, which in fast changing environment can be basis for competition.

5.3. Interviewee Jeremy Witley

Position:	Senior Manager; Mineral Resources
Company	LONMIN (listed in JSE and LSE
Experience in MRM	More that 15 years, SAMREC CODE competent person for resources declaration for LONMIN
Consent use of personal details	Yes

Key elements of MRM

MRM essentially is an information provider, it enables to optimization of the orebody

There are two main things;

- Understanding the orebody, which is linked understanding the geology.
- Opening your depleting reserves to build future flexibility, increase proved reserves

How MRM is used for strategic competitive advantage

- Orebody link to mining operations through to plants

For Lonmin, it is most important to look at strategic linkages to metallurgical processing capability and mining operations. This ultimately links to the orebody. One needs to look at the whole value chain.

"For example acquisition of mineral rights just would be made without due consideration of plant capacity"

- **It is important to understand your orebody**

"If a mining company can't understanding their orebody, they can't have advantage over anybody"

Comments on application of MRM that is common of industry wide or unique per company

Common

- Resource estimation
- Generally the way Short term reserves are managed

Unique

- Different definition of reserves, particularly, proved reserves, classification of reserves, "another person's indicated may another's inferred resource" and this linked to mining method. **Reserves**; economically minable mineral resources.

- Orebody mineral accounting, for example Lonmin mining method of use up dip or down dip layout, allows more upfront sampling leading to better understanding of the geology.

MRM contribution Acquisition and securing mineral rights

- Acquisition of minerals is fairly strategic but is done for different reasons. It could be for growth, or replacement of depleting resources, or it could just be opportunity.
- MRM can't assist you if one "doesn't have a good business strategy" on acquisitions. In fact you may destroy value. So different company do different things.

MRM contribution to new mines/existing mines

- The right information on the mineral resources is "everything to good operation of a mine". Companies should not be mining if they don't have good information.
- Good database, integrity of information that comes with good systems.

MRM contribution to organizational capability

- The Combination of mining operations and the understanding to the orebody helps develop organisational capacity. Operations

must be tailored made the orebody, to local situation. This improves predictability, because risk is removed earlier on.

- Software systems, the entry level standard software systems ("they call them vanilla") are useless if not customised. So over time, the systems become divergent from one company to company. When these standard software systems are customised they can serve the intent of the company strategy. The software has to be changed to suit the organisational process flow. "We don't do things different because we like it is through years of learning and experience" is the argument. "People do what you think is right for unique situation"

5.4. Interviewee Dennis Hoffman

Position:	Senior Manager; Mineral Resources
Company	LONMIN (listed in JSE and LSE
Experience in MRM	More that 15 years Manager Resources Evaluation
Consent use of personal details	Yes

Key elements of MRM

- Understanding Geological Variability

Biggest risk in the mining business is **geological variability**. With production plans other things can be done to manage the risk once the mining project has started, for example, giving it focus or accelerating production. "If orebody does not play game, you will be battle."

- Producing believable mine plans

One risk is producing unrealistic plans which not only mislead markets.

How MRM is used for strategic competitive advantage

- Manage Ore grade at highest level

One has to look sensitivity analysis on for various scenarios mixes of orebodies, linked to financial modelling and operational practicalities

- Financial modelling anchored on NPV

Whereas financial modelling is done at some level, it is not nearly enough, given the potential. Some people are now looking at small changes technical impact the business at a higher level.

- Integration of MRM work

Bringing all the disciplines together, geological, evaluation, geotechnical risk, mine planning and ventilation constraints, linking all that "what is underground"

- Management leadership

Management leadership should manage for true and real integration. Generally integration is not observable practically on the ground.

Comments on application of MRM that is common of industry wide or unique per company

Common

- Increasingly common platforms for MRM management

Unique

MRM contribution Acquisition and securing mineral rights

- It is the expertise to that helps in understanding the geology.
- Culture of management of spending money on exploration before investing in mining operations needs to be inculcated.

- Technology is increasing and playing a big part in exploration for example the "use of such like helium balloons to explore for diamonds"

MRM contribution to new mines/existing mines

- To have the competitive edge, a company has to **"understand the risk"** and this is linked to skills, core specialists. The **core specialists** must have a voice. It is pointless to have the expertise if company executives won't listen to them. Specialists through **professional fraternity**, share information and tend to learn from their networks.

MRM contribution to organizational capability

- This again is related to "understanding through competent people", the orebodies you mine.

5.5. Interviewee Mike Woodwall

Position:	Mining Executive GMSI, ASTGigima, IT Solutions Company
Company	GMSI is mining IT Solutions Company

Experience in MRM	Mining software solution design and implementation, since 1996
Consent use of personal details	Yes

Key elements of MRM

- Integrated information flow

A Single data base, with inputs that are cross discipline, hence forcing people from different backgrounds to use same tools, will hopefully help people have the same conversation.

- Process view of mining

Understanding mining business as a process through a value chain, therefore assisting in the “Breakdown of functional silos” that are so “embedded in the industry”.

- IT platforms

MRM in its form could not be done 15years, 3D modelling be aided to a large extent by recent computer power.

How MRM is used for strategic competitive advantage

Advantage comes if you apply **process view** to mine planning process throughout the value chain

- Concept Risk and value

MRM gives advantages if risk is understood and managed. Value in contrast to risk is captured in decision making and design. “It is all very well saying I have got a plan, how are confident are you of that plan”. The concept of **Mineral asset management** incorporates risk and value. **This links capital with operations or strategy with tactics**

- Integrity of information and investor relations

MRM helps information integrity due to systems. Information integrity leads to good investor relations. “If you communicate with analysts, your story has to be straight and tight”. One communicates value, by demonstrating understanding of risk, leading to higher confidence in mine plans. “The expression we use at GMSI is we create feasible believable and achievable mine plans” not plans that are made to “make a manager happy”

Comments on application of MRM that is common of industry wide or unique per company

Common

- It platform
- Functional integration
- Basic training

- Everybody does that

Unique

- Centralization versus decentralization; different companies have different structuring, however there must be a close and live conversation between centre and individual mines, regardless of structure. Organisational structure should suit strategy which is why it will be different.

MRM contribution Acquisition and securing mineral rights

- Functional integration and skill development

One needs an integrated understanding of the orebody, through dynamic combination of skills

MRM contribution to new mines/existing mines

- Development of organizational capability, embedding integrated information management practice
- Skill and competency development, MRM training
- Functional integration
- It platform standardization, a lot of customization is happening to standardize for the various companies.

MRM contribution to organizational capability

- Development of organizational capability, embedding integrated information management practice
- Sustained momentum in various MRM areas at strategic level, in the process of that, one develops unique organisational capability, “part of the way you do things”.

5.6. Interviewee Theo Pegram

Position:	Left Anglo Platinum last quarter of 2009 where he was MRM executive
Company	Anglo Platinum is biggest platinum produce in the world
Experience in MRM	more than 15 years experience in MRM
Consent use of personal details	Yes

Key elements of MRM

- MRM needs all the functional disciplines; geology, resource estimation, survey and reconciliation, mine planning, rock engineering and mine ventilation. A key component of MRM is the **full functional integration.** The organizational structure must support for the strategy- there is no one answer. However

MRM activities must cover the full spectrum of the various mining technical functions must cover the

- Systems, both software and management systems, form a key part of MRM.

How MRM is used for strategic competitive advantage

- The advantage starts right at the beginning when people do what required, upfront **exploration spending.** For example Anglo platinum spent billions in exploration, over the last 5 yrs. From this work they learned that what the company knew 10yrs does not apply today and won't apply in the future. The same can be said with Merensky versus UG2 orebodies. The point is you can't infer between two orebodies, hence the need to do full exploration upfront.
- **Effective mine planning** based on first principles and a robust business planning process is a driver of competitive advantage. For example one must go through the mechanics in a disciplined fashion, of the following; scoping pre feasibility study, full feasibility and implementation. The linking between long-term versus short term has to be robust. **Iteration** should be done at

every level of planning, to ensure that earlier assumption hold true.

- At the end of it all **good integrated systems** give companies advantage.

Comments on application of MRM that is common of industry wide or unique per company

Common

- Most systems are generic

Unique

Whereas everybody does exploration, **scale of exploration** is through exploration spend is different with some spending much more than others

MRM contribution Acquisition and securing mineral rights

No view expressed

MRM contribution to new mines/existing mines

- **Capital expenditure** provision is a big differentiator. Those that have upfront capital honour capital expenditure requirements,

setting up more cost efficient operations through optimal design and hence maximum value extraction.

- Efficiency is assisted a lot by a good focus of **reserve reconciliation and management controls**

MRM contribution to organizational capability

Training and continuous learning in MRM is very important.

5.7. Interviewee Jurgens Visser

Position:	Head of MRM, RandUranium
Company	RandUranium is gold company mining company in the East Rand
Experience in MRM	34 years with Anglogold Ashanti, also was head of MRM, MEng in MRM(Wits)
Consent use of personal details	Yes

Key elements of MRM

- **Alignment of people** from different backgrounds especially clarifying roles and responsibilities

- **Developing a skills-set**, specifically to take MRM to a new approach, in the past they were separate functions, now part one. Jurgens calls these “tools of the trade”
- **Skills** issues are critical to all the MRM effort. Understanding of geological model, facies model, 3 D models require specialised skills. For example AngloGold Ashanti, they trained all MRM managers to post graduate in MRM at Wits.
- **MRM managers** must be **empowered** not bullied by operations managers. In Jurgens view if “if MRM manager is not empowered, then is no MRM application in place”

How MRM is used for strategic competitive advantage

“If people don’t drive things then there you lost the plot”. Therefore focus must on the people processes, not the mechanics of technology.

- Development of unique organisational capacity
- Skills development and MRM training
- Organisational structure

IT systems offer no real advantage on their own, as they can be copied and really easily available. It is rather how they are used, through people skills and organisational systems.

Optimal plans through many scenarios and budgets that cover whole spectrum of MRM can be a source of advantage. Again it is about skills and training than technology.

Comments on application of MRM that is common o industry wide r unique per company

Common

Most MRM systems are similar but ….

Unique

There is Nuances with MRM which explain subtle differences, where at first glance MRM application may all seem to be common.

- Organisational structures differ slightly from company to company.
- Some organizations “talk MRM”, some “think MRM”, yet some “do MRM” with the full spectrum of the value chain from exploration to final product. Different levels of effort generate differences or uniqueness.

For Jurgens the key issue is that operations must feel confident of MRM, they must know that they will guide them.

MRM contribution Acquisition and securing mineral rights

- Applications for all this technology would have possible even 5yrs ago, “would been physically impossible, to do this things”, better modelling is making exploration less expensive

MRM contribution to new mines/existing mines

- Systems, technology enablers, and skills are a potent combination which brings about efficiency.
- Better modelling and information management is aiding improved decision making, monitoring critical few, not everything.

MRM contribution to organizational capability

- The key remains skills development that is aligned to MRM.

5.8. Interviewee John Hudson

Position:	Senior Manager; Mining Engineering
Company	LONMIN (listed in JSE and LSE
Experience in MRM	More that 7 years, SAMREC CODE competent person for reserve declaration for LONMIN

Consent use of personal details Yes

Key elements of MRM

- Mineral Resource definition, which includes geological drilling and sampling
- Mine design especially the modifying factors that guide the mine design
- Mine production scheduling
- Financial modelling, which determines if it is economic to mine, so that it can be declared reserve according to SAMREC code.

How MRM is used for strategic competitive advantage

- Creating new minerals reserves

Getting people to do the right thing at right time through **quality planning** is important. This way the company delivers what it says it is going to deliver, generating market trust because forecasting is critical

- Good ore grade management (ore quality),which the company can do through reporting, systems
- Successful capital projects depend on good MRM work

Comments on application of MRM that is common of industry wide or unique per company

Common

Systems and MRM processes are similar.

Unique

- However organizational structures are different per company. Different levels centralization/ decentralization
- Different mineral product accounting through various ore tracking methodologies and reconciliation

MRM contribution Acquisition and securing mineral rights

- Quality drilling program
- Industry networking scanning the external environment
- Good Evaluation though **quality systems and good analysis** for interpretation

MRM contribution to new mines/existing mines

- MRM organisational structure should - follow your process, your capability is you process,
- Companies must build good team

MRM contribution to organizational capability

- A **reputation on MRM**, will attract people to your company, therefore good MRM is a skill attracter
- It is just not proper systems or organisational structure but critical, it is also **MRM leadership** that is important.
- The link with **financial modelling from MRM** is not strong enough and more of it could add more value to bottom-line.

5.9. Interviewee Hennie Boshoff

Position:	Mine Planning Manager
Company	LONMIN (listed in JSE and LSE
Experience in MRM	more than 30 years experience in MRM mine planning, spanning Goldfields, Notharm Platinum and Lonmin recently.
Consent use of personal details	Yes

Key elements of MRM

- Sound and credible database-boreholes and sampling data, wrong base then everything is wrong.

- **IT systems** (software) that a company uses to assist model generation and evaluation of resources
- **Skills**, qualified people who know what they are looking at in the analysis
- A **company's mine design** which includes, dilution, optimum extraction, mining methods, costs/financials modelling(NPV's
- **Proper controls** in the mining extraction, which should include policing operations to optimize extraction through systems, "mining cuts, don't over break, it costs you mine to get waste out of mine, they must mine correctly".

How MRM is used for strategic competitive advantage

- Proper systems, "your systems get you answers quicker"

He says "you can run scenarios to determine optimal extraction to minimize cost".

Further that "you can do analysis, you do it quicker, watch the markets, if prices go up, you open cut, take more volume, un-constraining face efficiency"

Live systems aid response to market **with speed and integrity,** and therefore capture value with opportunity horizon.

- Right **skills**

- Communications between MRM and mine operations is very important. “People must listen to the man on the ground, the people at the top don’t know everything”
- Grade control and interfacing with plant can be live.

Comments on application of MRM that is common of industry wide or unique per company

Common

Most systems are common

Unique

The application is different, especially organisational structure

MRM contribution Acquisition and securing mineral rights

- Good 3 D models to assist interpretation of geological information.

MRM contribution to new mines/existing mines

- Communications between MRM and mine operations is very important. “People must listen to the man on the ground, the people at the top don’t know everything”

- Developing people, as “people are the biggest asset”. They must also be experienced.
- **Communication across functional**, structured data allows resolution of disagreement, having all involved to be similarly sighted of all technical information. “The structures must be right but they must respected”

5.10. Conclusion

The key themes coming from the conversations are what were captured. No attempt was made to give any further meaning to the statement in this chapter.

6. DISCUSSION OF RESULTS

6.1. Introduction

The discussion of results was done in the context the research aim, the literature review and the results themselves. The research aim of seeking to understand how MRM assists strategic competitive advantage in South African mining industry can be achieved by first determining which elements of MRM are considered important by experts of MRM. This matter allows that, should trends emerge, the mining industry's effort be concentrated in areas considered most important. The matter of how MRM is used to obtain strategic competitive advantage can then be understood.

6.2. Research Question 1; Discussion of Results

What are the most important elements of MRM in South African Mining Industry?

6.2.1. Introduction

The key elements of MRM, as observed by the sampled experts, were derived from analyzing results from each interviewee carefully in line with MRM model by Macfarlane (2007). Those key elements were outlined in a summary below. The responses indicated agreement with model in general. The model has a horizontal line along the value chain from exploration on the left to markets on the far right. The model also has a vertical component along which execution of work at different level happens. (Refer to fig7 below)

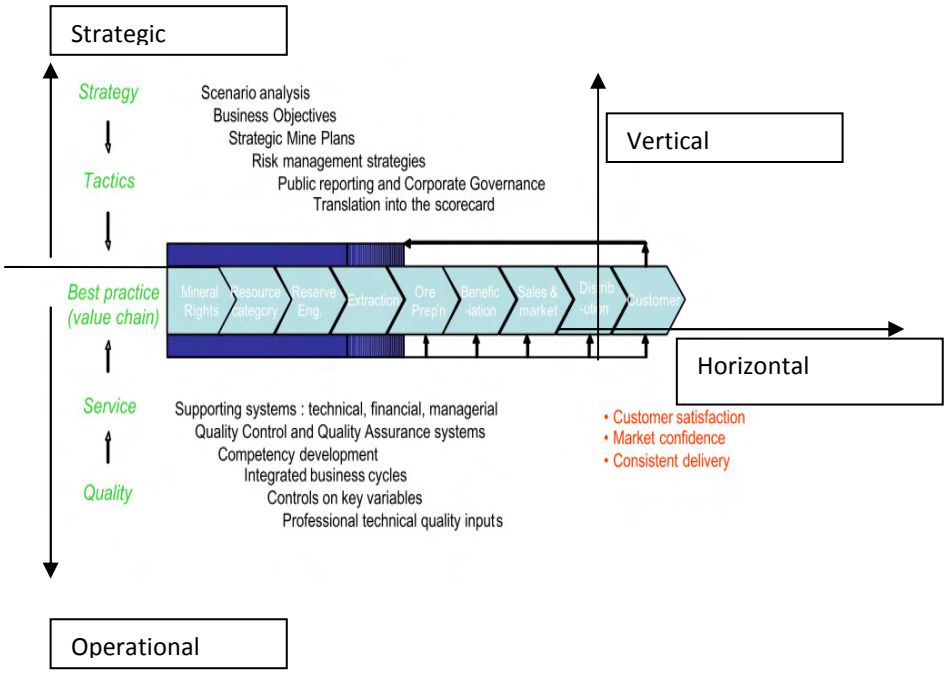

Figure 7 MRM Model for analysis of results

The research was especially interested in the link between levels lower that level3 (Jacques, 1992) and the upper levels, linking to strategy. This divide was categorised as operational and strategic respectively. The operational elements of MRM along the value chain were clearly reflected in the responses. To a lesser extent the vertical dimension was reflected in the responses, especially the link to higher business level strategy but also quality controls to lower levels.

There was a third dimension, that of a clear articulation of the matter that it is not only the physical execution of these elements of MRM, it is also the climate, the organisational setting and the strategic context under which these key elements are implemented.

6.2.2. MRM; Key elements

6.2.2.1. Understanding the Geology

The results indicated that an important input to the mining business is the full understanding of the orebody characteristics. This outcome was in line with expectation; given the MRM model (Macfarlane, 2007), puts exploration at the start. However there was indication that the

individuals sampled are in general, of the view that there is insufficient understanding of orebodies, resulting in difficulty is achieving competitive efficiencies. D Hoffman in this research expert interview asserted that "the biggest risk in the mining business is **geological variability".**

6.2.2.2. Process View of Mineral Extraction

The results indicated that MRM is viewed as guided by the process of mineral extraction, along the value chain. Emphasis was placed on all the elements of the value chain, with data and information exchange across the horizontal line being particularly critical.

6.2.2.3. IT Platform and software

Most interviewees mentioned the importance of MRM systems, especially backed by computer systems. The issue that MRM software makes possible several iterations at speed, that modelling and simulating what if scenarios improves understanding of the orebody and mineral extraction processes hence decision making, was strongly articulated on. In fact it was said that MRM in its current form largely because of computer systems and their processing power and speed.

6.2.2.4. Functional Integration

The notion that MRM consists of several functional professional disciplines that used to function separately and that now they have to function as a unit to be called a full MRM application was represented strongly in the views captured in the research. In fact some expressed the view that the functional integration is so important, without it there cannot be an MRM application.

6.2.2.5. Skills and Competency

The results show a widely held view that MRM application only yields significant results if backed by skilled and competent people. MRM was said to be heavily information based, hence requiring high skill. Also that, experience played an important role in the quality of the analysis of such data and information.

6.2.2.6. The Third Dimension

It was made clear that the above key elements of MRM application don't operate in a vacuum. Mention of "empowerment" of MRM professionals, disciple to comply with computer systems", cross factional communication, MRM leadership, indicate that other factors

are necessary for successful application of MRM. The role management for creating environment that is conducive was said to critical

6.2.3. Conclusion

There was convergence of views on the key elements of MRM. It can be concluded from the results that this areas form the base of MRM application.

6.3. Research Question 2 Analysis

How is MRM used to obtain strategic competitive advantage mining businesses in South Africa?

6.3.1. Introduction

This question aimed to evaluate how MRM is used to obtain strategic competitive advantage? The literature review about uniqueness of strategy as a source of possible advantage was used to guide this analysis. The view by Porter (1996) that “strategy is a creation of a unique and valuable position, involving a different set of activities” anchored the analysis.

In line with the paper by Harreld *et al* (2007), that the IBM Business Leadership Model emphasised the "the interdependence between strategy and execution", with strategy being stimulated by "the perception of a gap between current and desired performance", the space between strategy and operations is critical space to look at for review.

The views of the sampled experts on which elements offer competitive advantage, were summarised. Then an analysis was done against the literature review on whether those aspects of MRM as suggested by the sampled experts would truly offer strategic advantage.

6.3.2. Basis for Competitive Advantage

6.3.2.1. Introduction

It was important to outline the basis for competitive advantage. It was put forward that a combination of uniqueness of strategy, dynamic capabilities linking strategy with execution and closer strategy management based on organisational learning would assist strategic

competitive advantage. The elements of MRM were assessed against the proposed basis for advantage. On that basis it was deducted from the results but also on the basis of the literature, how MRM is used to obtain strategic advantage by mining companies in South Africa.

6.3.2.2. Uniqueness of strategy as a Basis for Sustained Advantage

The analysis for this research question was anchored on uniqueness as a barrier to imitation, as in model for sustainable advantage by Kostopoulos *et al* (2002) in figure 8 below. A review was done of the sampled experts' views on the advantage generating elements of MRM application, to assess for uniqueness. This was done in light of the notion that if nothing prevents a competitor from taking the same action, then in all likelihood they would respond with similar action, hence no real advantage being derived from taking the action in first place. Some proposed advantage generating elements of MRM as proposed by the sampled experts were rejected on account that if they can be replicated, at best they offer operational effectiveness, not strategic competitive advantage.

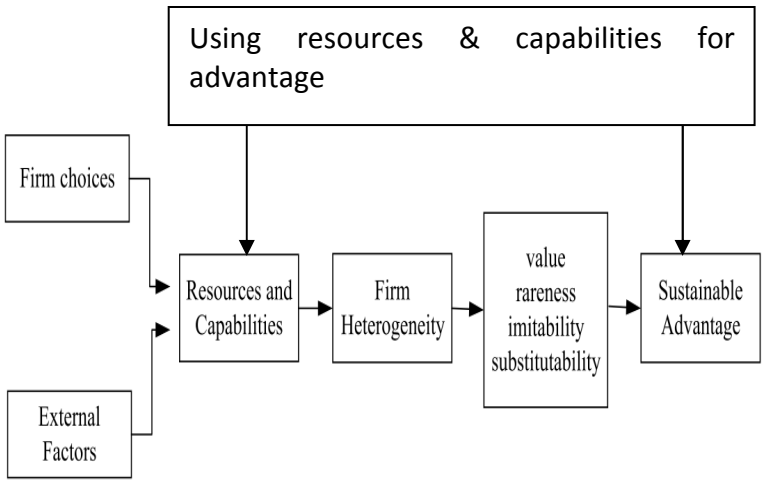

Figure 8, A framework of RBV and Sustainable Advantage (Kostopoulos, Spanos, & Prastacos, 2002)

6.3.2.3. Strategic Insight versus Execution

The IBM model for dynamic capabilities in figure 9 below indicates that the space between strategy formulation and execution, presents an opportunity to deal with the performance gap at the market. It was proposed that the two way interaction between the strategy execution interface at corporate level and MRM application at the mines, would present a similar opportunity. The elements presented by interviewees as assisting strategic advantage were reviewed with the view to assess if they assist in linkages between strategy and execution, developing dynamic capabilities. The notion that the changes in technology and knowledge are so rapid that the strategy execution interface has to be active all the time, was deemed very important.

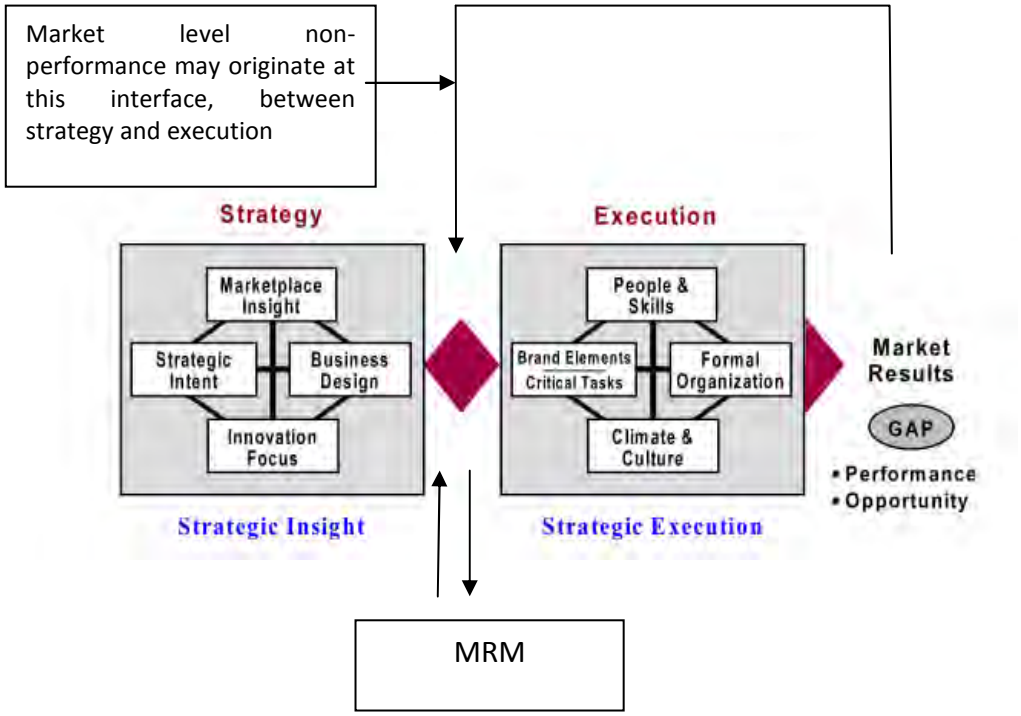

Figure 9, IBM Model of Dynamic Capabilities

6.3.2.4. Strategy Management as Learning

Proceeding from the point of view that, to stay dynamic, dynamic capabilities have to be reviewed on an ongoing basis, two issues became very important. First, it was deemed important that the process of strategy management be managed closely. Secondly, managing strategy more closely would be greatly assisted by conditions that support organizational learning as described by Garvin *et al* (2008). The Kaplan and Norton (2008) model on strategy management was used

parallel to organizational learning to review is elements of MRM offer real learning, hence strategic insight by extension(see fig.10)

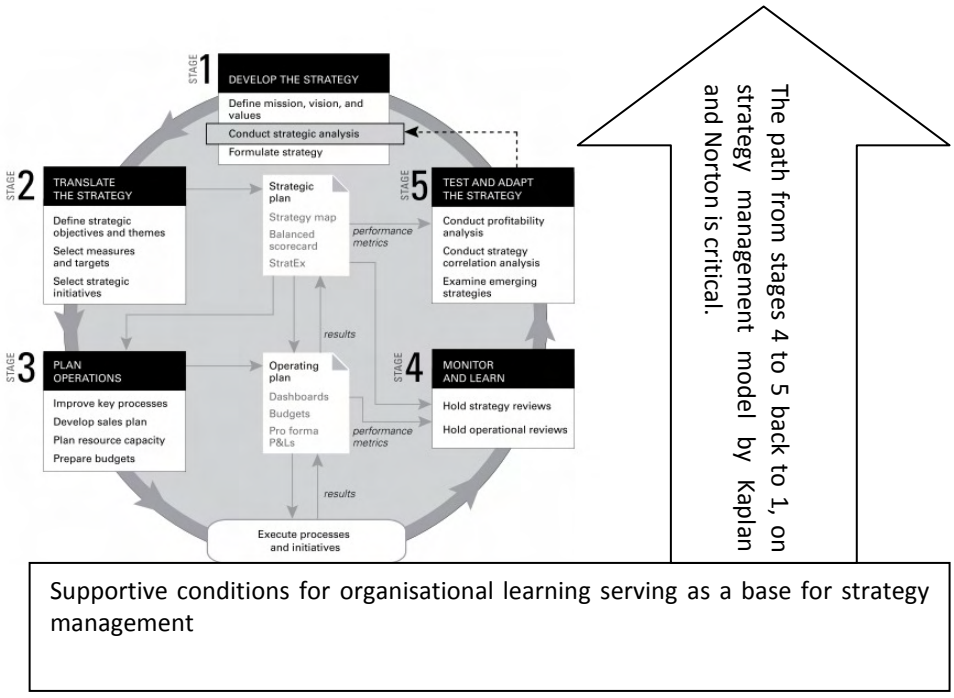

Figure 10 Strategy Management

The interviews indicated that not sufficient interaction takes place around observed patterns from the execution level. The conversations, it was said, are mainly top down. The execution space at operations, observes the mineral resource much more by proximity to it, therefore

the insights would be profound, and hence the arrow point back to the strategy formulation leg of the model on figure 10.

6.3.3. Elements of MRM that give strategic advantage

6.3.3.1. Optimizing mine mineral extraction at corporate level for mineral processing capabilities

It was observed that most mining houses already did central planning, to varying degrees. In fact the tension between the centre and operations was palpable in some interviews. It was felt by some Interviewees that it did not really matter what level of decentralization or centralization there was, what mattered was what the corporate strategy requires to be centralised, and the same corporate strategy says must decentralised. An example was given where sometimes it is not increased volumes that give you advantage, it is rather optimization around current capacity, this in a dynamic, real time basis. This approach, it was said, required organizational and technical systems with high levels of efficiency on information processing.

6.3.3.2. Embedding MRM practices through organizational discipline and intensive training

The organizational and technical systems require some time coupled with consistent effort over years, some respondents emphasised. This they said required organisational discipline, especially for large organizations to act in synchrony, and do at all times. Therefore discipline of honouring time schedules, the discipline of complying with all not some rules of the systems, but also the discipline of staying power and persistence, were said to be very important for successful MRM implementation. It can then be said that a company does not find that it suddenly has a powerful MRM centred organisational capacity. The discipline and persistent over years effort should be backed up by ongoing education and training. It was remarked that training just a few people is not sufficient; one needs an organisation wide training effort to assist the embedment

6.3.3.3. Continually investing in technology enablers to have edge advantage

Several interviewees made the point that MRM in its current form would not have happened 15 years ago. The technology enablers that have come over the last decade are said to have powered the MRM applications to its current levels. The point was made however that this

technology is not inaccessible to industry players. Therefore on its own it could not represent strategic advantage. However it was pointed out that keeping at the technology frontier line gives edge advantage, meaning at any pint the business is executing faster.

6.3.3.4. Integration of systems for information flow to facilitate speed in execution and insight generation(learning)

It was remarked that MRM, is to a large extent an information system, although not entirely true. MRM application becomes more powerful for strategic purposes it was highlighted, when information from all elements of the business are integrated seamlessly, to aid analysis. However the notion that system can do analysis was dismissed, with emphasis being made that ultimately, it is highly skilled people who analyse and generate insight. The point was made though, that integrated information assists greatly analysis by experienced people.

6.3.3.5. Management Leadership

If MRM is going to be a strategic tool; it was made clear, leadership at all levels is important. It was noted that ultimately to have things done, companies need good leadership. The results indicate an idea that application of MRM will succeed to the extent that it is led.

6.3.4. Conclusion research question 2

It turned out that in fact advantage would derive from unique combination of the various elements of MRM, not the individual components of MRM itself. It was clear however that MRM success rests on human systems of the MRM, being at par with technical systems. The use of strategy development and MRM, offer the real opportunity.

6.3.5. Conclusion

The research question on obtaining strategic competitive advantage using MRM as defined by literature review has been has been reasonably answered, given that it is a qualitative study. The discussions held during the interviews attempted in various ways to seek the answers to how MRM assist strategic advantage in mining. Quantitative studies to further validate the assertions in research empirically are beyond the scope of this research.

7. CONCLUSION

7.1. RBV and mining strategy

It is concluded that use of RBV aligned strategies will assist mining companies achieve strategic competitive advantage. The review of how MRM assists in achieving the same, has added to that discussion. On the basis that superior efficiency at mineral extraction leads to superior capital deployment by investors in a company, it was concluded that improved application of MRM would improve strategic competitive advantage.

7.2. Research method

MRM covers a broad area of the mining value chain. This study was limited to a high level understanding of the key issues driving strategic advantage in MRM. Using opinions of experts in the field of MRM, it determined, what would be the key elements to drive strategic advantage. Being a qualitative study, it was conceded that the result may not be sufficiently repeatable. However the results were accepted as indicating sufficiently mining industry could focus effort going forward.

7.3. Research results

7.3.1. MRM - Key Elements

It was concluded that the key area of MRM are geological evaluation, mineral extraction planning functional integration and IT systems. The model in fig 11 below indicates that the geological evaluation is tightly connected to mineral extraction planning. On either side is functional integration and IT systems that support application of MRM. The three base of the pyramid hold up the mineral extraction planning. However, the conclusion reached that the successful implementation of MRM is depended on skills was reflected by use of the skill and competency component of the model as a base. These key MRM components are essential and without any one of them, the application would be insufficient.

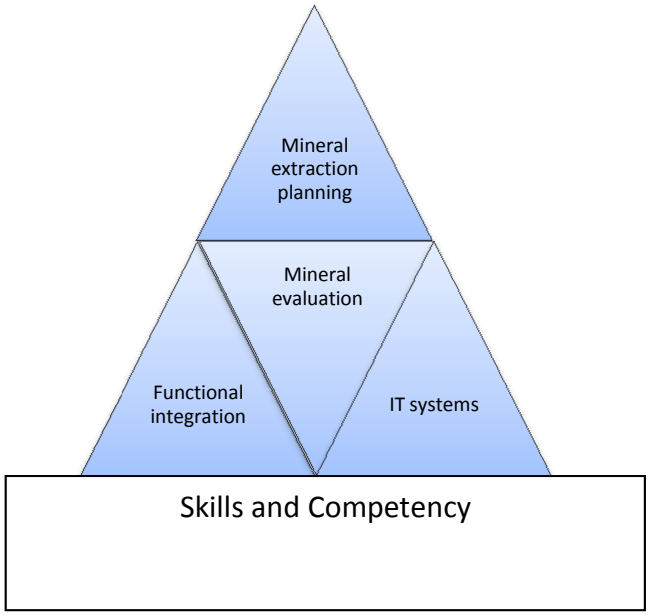

Figure 11 Model for key elements of MRM

7.3.2. MRM, Elements Giving Strategic Advantage

It was concluded that the following aspects of MRM give strategic competitive advantage.

- Optimizing mine level mineral extraction at corporate level for mineral processing capabilities of whole business.
- Embedding MRM practices through organizational discipline and intensive training
- Continually investing in technology enablers to have edge advantage
- Integration of systems for information flow to facilitate speed in execution and insight generation(learning)

- Management Leadership

The model below in fig 12, illustrates that MRM was deemed to be the centre of mining business strategy, to reduce risk, but also to maximise value. Value capture due to the good fortune of a rich orebody was rejected as not sustainable going forward. It was put forward that increasingly, advantage will derive from generating unique MRM and other capabilities in a dynamic fashion, this through a combination of learning and active management of strategy supported by good leadership.

Figure 12 Driving mining strategy through MRM capability

7.4. Proposals for future Research

It can be concluded that MRM should be at the centre of corporate strategies for mining businesses. In evaluating elements of MRM it was

noted, there are those that are immediately observable. On deeper enquiry there were clearly under the water elements of the MRM iceberg. Any further work needs to look to seek more understanding. The under the water issues are soft issues yet it may be that they are responsible for lack of success of some MRM applications.

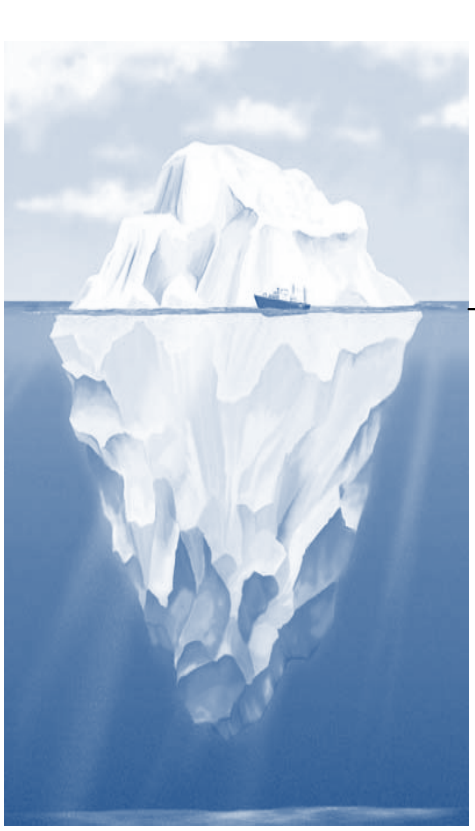

Figure 13 MRM Iceberg

Further empirical studies can be undertaken on the issues put forward as giving strategic competitive advantage, to prove or disprove the assertions of this research.

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Appendices

Appendix A

RESEARCH QUESTIONAIRE

Consent form

I am conducting research in my private capacity on the application of MRM in South African mining companies, evaluating contribution strategic competitive advantage of the various elements of MRM. It is sort to capture the views of the people who are practitioners or experts in the field of MRM and mining strategy regarding which elements of MRM contribute significant strategic competitive advantage.

The research results will be submitted to the Gordon Institute of Business Science (GIBS), University of Pretoria, in partial fulfillment of the requirements for the degree of Master of Business Administration (MBA) which I am presently pursuing

All data and responses will remain confidential and should you prefer that your identity not be disclosed please indicate so. This survey is

voluntary and you may withdraw at any time without penalty. The results will be made available after the research report has been marked and released by GIBS.

Please sign below to indicate consent for the interview to proceed

---

Name *Signature*

Researchers Name: Mr. Mack William

Email Address: mwilliam@bcl.bw

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GIBS Research Supervisor Name: Mr. Joe Aspinall

Email Address: joe@pharmabooks.co.za

Phone: +27 824906526

1. RECORD OF INTERVIEWEE DETAILS (NAME, POSITION, MRM EXPRIENCE.)

_____

_____

_____

2. PLEASE GIVE A BRIEF DESCRIPTION COMPANY DETAILS, TYPE OF MINING, SIZE, NUMBER OF MINES WORKED FOR.

_____

_____

_____

3. HAVE YOU BEEN DIRECTLY INVOLVED IN MRM OVER THE LAST 7 YEARS?

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4. WHAT WOULD YOU SAY THE KEY ELEMENTS OF MRM ARE FOR YOUR COMPANY, BUT ALSO IN GENERAL?

_____

_____

_____

5. PLEASE EXPLAIN HOW YOU HAVE USED MRM TO OBTAIN STRATEGIC COMPETITIVE ADVANTAGE IN THE MINING BUSINESS. NOTES BELOW CAN BE USED AS A GUIDE

_____

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_____

Exploration

Acquisitions (buying) of mineral rights

Evaluation of mineral deposits

Disposal of mineral rights

Linking mechanisms to corporate strategy

Mine Planning Systems Policies and Calendar Routines,

Feasibility Studies, Reserve Engineering and Extraction Plans,

Risk Management

Capital Projects Implementation

Mining and Plant Operations Execution

Reconciliation and Controls

Functional integration

ITS Platform and Standardization

Organizational Structure

MRM training

Organizational Learning and Continuous Improvement

Skill and Competency development

Development of Unique Organizational Capability

6. Which aspects of MRM described above are common industry wide and which ones tend to differ from company to company?

Common MRM practices in different mining companies (similar, no significant differences)

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_____

Significant Difference in MRM application in South African mining companies

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7. Which elements of MRM practices and application discussed above in your view contribute more to superior achievement (compared to others) of acquiring and securing of mineral rights?

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8. Which elements of MRM practices and application discussed above, in your view contribute more to superior achievement (compared to others) of Superior performance in the development of new mines and operations of existing mining businesses?

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9. Which elements of MRM practices and application discussed above, in your view contribute more to superior achievement (compared to others) of acquiring skills and developing unique organizational capability for efficient operations on mining businesses?

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