



**Investigating the value of integrated
risk management strategies at a South
African opencast colliery**

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ABSTRACT

Economic markets continue to become more complex, creating challenges for many mines. The scope, complexity, and interdependencies of emerging risks necessitate the need for a more robust and integrated strategy to risk management. To this effect, integrated risk management (RM) or Enterprise Risk Management (ERM) has been the topic of increased attention in the coal mining industry. It is critical to understand RM because of the high-risk environment that coalmining intrinsically is. Not reaching higher RM maturity levels poses an immense risk to the mine in terms of potential revenue losses (millions of Rands), legal implications to the mine, job insecurity and thus livelihoods of personnel, value delivered to stakeholders as well as ultimately the sustainability of the mine. The very real danger to life and limb faced by miners is also a fundamental risk of modern coal mining. The need for the implementation of a formal RM strategy/framework is growing, as mines become more competitive and threats become greater with every passing year. While safety, health and environmental risks are subject to tighter controls every year, coalmines face a rising tide of various other risks, which will be discussed in this study.

The primary research objective of the study is to investigate if integrated RM is perceived to be a value adding strategic function to the mine with specific reference to site managers, employees and contractors as well as if it is an effective tool to the mine. The study also evaluated whether RM affects productivity and it furthermore highlighted the critically high ranked risks for the mine to address. Finally, the study aimed to determine if there was a change in RM perception especially from a safety RM mind-set to an integrated RM or ERM focus after knowledge about integrated RM has been gained via the questionnaire.

An empirical study was conducted on 151 participants at an opencast colliery in South Africa. The majority of the participants agree (77.5%) that RM is valuable and is thus effective at the colliery to mitigate the various risks it is exposed to. Managers, employees and contractors strongly agree (88.0%) that RM is effective at the colliery to mitigate these various risks. The participants agree (71.3%) that the risks listed in the questionnaire are risks that must be addressed by the mine because these risks are critical and must to be mitigated as much as possible. The

risk that was ranked as the most serious current risk is the recent financial credit rating downgrade because this affects the future of the mine. Ranked in second place is political influence and instability especially in Eskom tied coalmines with the third most critically ranked risk being safety. Most personnel initially thought that RM was mostly about safety whereby 61.59% of individuals believed safety accounts for 90% of RM and the other risks the remaining 10% of RM. However, Participants agree (66.8%) that their risk perception has to a certain extent changed after going through sections B1, B2 and B3 of the questionnaire, thus the ranking of safety RM in third place and not first place (evaluated in section C). The participants also agree (75.3%) that the productivity of the mine is affected by integrated RM strategies.

Managers, employees and contractors tend to have different views on the extent of RM implementation or adoption at the mine. Managers feel that RM is in order and under control whereas employees and contractors beg to differ. Managers and employees in general believe that contractors are a higher risk and thus need to be managed with more caution. Managers see mechanisation as the future whereas employees and contractors feel that it is a threat to their jobs and are therefore not in support of it. Another key problem facing majority of mining companies is the skillset deficiency in the industry. One significant risk discussed is the threat of substitution of coal via greener and cleaner non-carbon based fuels for energy e.g. renewables.

The researcher recommends that the mine implement an integrated RM strategy such the ISO 30001 or the COSO framework that is aligned with effective internal controls. The intense focus on 'only' safety needs to be changed to accommodate an integrated RM mind-set. Therefore, RM training about the various risks that affect the mine and the coal mining industry must be given to all personnel. There must also be a feedback system in place in order to ensure the effective management and communication of the RM strategy to the entire workforce. The mine also needs to appoint a chief risk officer or a senior manager (for the time being) for this purpose. Full 'Board' and 'top management' support of RM is vital and must be attained because it is pertinent to the achievement of the mine's strategic RM objectives.

KEYWORDS: Integrated risk management, Enterprise risk management, Coal mining, Value and Effectiveness.

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TABLE OF CONTENTS

ABSTRACT	ii
ACKNOWLEDGEMENTS	iv
LIST OF TABLES.....	xi
LIST OF FIGURES.....	xiii
LIST OF ABBREVIATIONS.....	xv
 CHAPTER 1: NATURE AND SCOPE OF THE STUDY	1
1.1 Introduction	1
1.2 Problem Statement	2
1.3 Research Questions.....	5
1.3.1 Primary Research Question.....	5
1.3.2 Secondary Research Questions	5
1.4 Objectives of the Study	6
1.4.1 Primary Objective	6
1.4.2 Secondary Objectives.....	6
1.5 Scope of the Study.....	7
1.5.1 Field of the Study.....	7
1.5.2 Geographical Demarcation of the Study.....	7
1.6 Research Methodology	8
1.6.1 Literature Review.....	11
1.6.2 Empirical Investigation.....	13
1.6.2.1. Research Design – Quantitative Study.....	13
1.6.2.1.1 Research Approach.....	13
1.6.2.1.2 Research Participants	14
1.6.2.1.3 Measuring Instruments.....	16
1.6.2.1.4 Statistical Data Analysis	16
1.6.2.2. Research Design – Qualitative Pilot Study	18
1.6.2.2.1 Research Approach and Data Collection	18
1.6.2.2.2 Research Strategy	19
1.6.2.2.3 Research Setting.....	20

1.6.2.2.4 Sampling	20
1.6.2.3 Strategies Employed to ensure Quality Data	21
1.6.2.4 Ethical Considerations	22
1.7 Limitations of the Study	23
1.8 Contribution of the Study	23
1.9 Layout of the Study	24
1.9.1 Chapter 1: Nature and Scope of the Study	25
1.9.2 Chapter 2: Literature Review	26
1.9.3 Chapter 3: Empirical Investigation	26
1.9.4 Chapter 4: Conclusion and Recommendations	26
1.10 Chapter Summary	27
CHAPTER 2: LITERATURE REVIEW	28
2.1 Introduction	28
2.2 The Value of Risk Management	28
2.3 The International Mining Industry	29
2.4 The South African Mining Industry	32
2.4.1 Risks facing the South African Mining Industry	35
2.5 The Coal Mining Industry of South Africa	36
2.6 Current RM Strategies Utilised by South African Mining Companies	39
2.6.1 The Assessment Process and Key Assumptions	40
2.7 Risks and Uncertainties	41
2.7.1 Risk	41
2.7.1.1 Hazard Risks	43
2.7.1.2 Financial Risks	43
2.7.1.3 Operational Risks	44
2.7.1.4 Strategic Risks	44
2.8 Risk Management (RM)	45
2.8.1. Risk Management in Operations	46
2.9 Risk Management Communication	47
2.10 Risk Management Frameworks and Strategies	48
2.10.1 Frameworks	48
2.10.2 ISO 31000 Strategy Implementation in Mining	50

2.10.3 COSO ERM: An Integrated Risk Management Strategy.....	50
2.11 Enterprise Risk Management (ERM)	52
2.12 The Evolution of Enterprise Risk Management	54
2.13 The Strategic Adoption of ERM.....	56
2.14 Traditional Risk Management (TRM) versus Enterprise Risk Management (ERM)	57
2.15 The Value of Enterprise Risk Management.....	59
2.16 Defining Internal Control and its Role in the Company	60
2.16.1 Significance of Risk Management in the Internal Control System.....	61
2.17 ERM Maturity	62
2.17.1 ERM Strategy in the Mining Industry	64
2.17.1.1 ERM Strategy in a Complex South African Mining Industry.....	65
2.18 ERM Strategy Implementation In Coal Mining	66
2.19 Typical Risks Facing the Coal Mining Industry.....	68
2.20 Chapter Summary	73
CHAPTER 3: EMPIRICAL INVESTIGATION	75
3.1. Introduction	75
3.2. Research Methodology	76
3.2.1. Questionnaire Development and Construction	76
3.2.1.1 Section A: Demographic Information and Baseline on RM.....	77
3.2.1.2 Section B1: Risk Management Value	77
3.2.1.3 Section B2: Current Typical Risks	78
3.2.1.4 Section B3: Risk Management Effects on Productivity	78
3.2.1.5 Section B4: Revised Risk Management Perception	78
3.2.1.6 Section C: General Risk Management Information.....	78
3.2.2. Data Collection and Study Population	78
3.2.3. Confidentiality	79
3.2.4. Statistical Analysis	79
3.3. Response Rate to the Questionnaire	80
3.4. Results: Section A - Demographical Information.....	81
3.4.1. Statistical Analysis of the Role of the Respondents at the Colliery: Manager, Employee and Contractor	81

3.4.2. Statistical Analysis of the Work Department of the Respondents at the Colliery.....	82
3.4.3. Statistical Analysis of the Gender of the Respondents at the Colliery	83
3.4.4. Statistical Analysis of the Age of the Respondents at the Colliery	84
3.4.5. Statistical Analysis of the Preferred Language of the Respondents at the Colliery.....	85
3.4.6. Statistical Analysis of the Race of the Respondents at the Colliery	86
3.4.7. Statistical Analysis of the Level of Education of the Respondents at the Colliery.....	87
3.4.8. Statistical Analysis of the Work Experience of the Respondents at the Colliery.....	88
3.4.9. Statistical Analysis of the Initial Risk Management Perception of the Respondents at the Colliery.....	89
3.4.10. Section C: C2 Statistical Analysis of the Revised Risk Management Perception of the Respondents at the Colliery.....	91
3.5. Results: Section B1 - Statistical Analysis of the Value and Effectiveness of RM at the Colliery	93
3.6. Results: Section B2 - Statistical Analysis of the Typical Current Risks at the Colliery	95
3.7. Results: Section B3 - Statistical Analysis of the Effects of RM on Productivity at the Colliery	97
3.8. Results: Section B4 - Statistical Analysis of the Revised RM Perception at the Colliery	99
3.9. Results: Section C – Statistical Analysis of General RM at the Colliery	101
3.9.1 Section C3: Risk Ranking at the Colliery	101
3.10. Exploratory Factor Analysis on RM at the Colliery	103
3.10.1 Application of Factor Analysis.....	104
3.10.2 Steps in Factor Analysis	105
3.10.3 Kaiser’s Measure of Sample Adequacy (MSA)	105
3.10.4 Section B1: Risk Management Value	105
3.10.4.1 Factor Grouping for B1	106
3.10.5 Section B2 - Current Typical Risks	107
3.10.5.1 Factor Grouping for B2	107
3.10.6 Section B3 - Risk Management effects on Productivity	109
3.10.6.1 Factor Grouping for B3	109
3.10.7 Section B4 - Revised Risk Management Perception	110

3.10.7.1 Factor Grouping for B4	110
3.11. Reliability of the Measuring Instrument	111
3.12 Statistical Correlations between the Factors at the Colliery	113
3.13 Statistical Comparison of Managers, Employees and Contractors Perceptions against all Factors in B1, B2, B3 & B4	117
3.13.1 Factor 1 (B1 – Value and Effectiveness).....	117
3.13.2 Factor 2 (B1 – Contractors)	117
3.13.3 Factor 3 (B2 – Risk Set ‘1’ - Internal and External risks)	118
3.13.4 Factor 4 (B2 – Risk Set ‘2’ - Labour related risks)	118
3.13.5 Factor 5 (B2 – Risk Set ‘3’ - Performance Delivery risks)	118
3.13.6 Factor 6 (B3 – General Productivity).....	118
3.13.7 Factor 7 (B3 – Internal Productivity)	118
3.13.8 Factor 8 (B4 – Revised RM Perception)	119
3.14 Multiple Linear Regression Analysis at the Colliery	121
3.14.1 Multiple Linear Regression 1: RM Value and Effectiveness.....	121
3.14.2 Multiple Linear Regression 2: Change in RM Perception	124
3.15 Further Statistical Analysis at the Colliery	127
3.15.1 Value	127
3.15.2 Effectiveness	128
3.15.3 Safety.....	129
3.15.4 Productivity	131
3.15.5 Selected Typical Risks.....	132
3.15.6 RM Perception Change.....	134
3.15.7 Extent of RM Adoption	136
3.16 Chapter Summary	139
 CHAPTER 4: CONCLUSION AND RECOMMENDATIONS.....	140
4.1 Introduction	140
4.2 Main Conclusions regarding the Study	140
4.2.1 Conclusions on the Literature Study	140
4.2.2 Conclusions on the Empirical Study	141
4.2.2.1 Conclusions regarding the Demographic Information.....	141
4.2.2.2 Conclusions on the Reliability and Validity of the Study	143

4.2.2.3 Conclusions regarding the Value of Integrated RM Strategies at a South African Opencast Colliery	144
4.2.2.4 Conclusions regarding whether Integrated RM is Effective at the Colliery	144
4.2.2.5 Conclusions regarding the Current Typical Critically High Risks facing the Colliery	145
4.2.2.6 Conclusions regarding how RM Strategies affects Productivity.....	148
4.2.2.7 Conclusions regarding the Initial RM Perception	148
4.2.2.8 Conclusions regarding whether RM Perception can change from mainly Safety RM to Integrated RM.....	149
4.2.2.9 Conclusion regarding the Extent to which RM has been Adopted by Managers, Employees and Contractors	151
4.2.2.10 General Conclusions	152
4.3 Conceptual Framework	154
4.4 Contribution of the Study.....	155
4.5 Recommendations and Managerial Implications.....	155
4.6 Evaluation of the Achievement of the Study Objectives	159
4.6.1. Primary Objective	159
4.6.2. Secondary Objectives	159
4.6.3. Other Findings	161
4.7 Recommendations for Future Research	161
4.8 Conclusion	163
LIST OF REFERENCES	166
ANNEXURES.....	177
APPENDIX A: QUANTITATIVE QUESTIONNAIRE.....	177
APPENDIX B: QUALITATIVE INTERVIEW SCHEDULE	183

LIST OF TABLES

Table 2.1: High-level overview of the ISO 31000 and COSO framework	52
Table 2.2: TRM vs ERM Summary.....	59
Table 2.3: ERM Maturity	63
Table 2.4: Summary of typical risks facing the coal mining industry	68
Table 3.1: Response to the survey questionnaire	80
Table 3.2: Summary of the participant's Role within the colliery	82
Table 3.3: Summary of the Department of the respondents within the colliery	83
Table 3.4: Summary of the Gender of the respondents	84
Table 3.5: Summary of the Age of the respondents	85
Table 3.6: Summary of the Preferred language of the respondents	86
Table 3.7: Summary of the Race of the participants	87
Table 3.8: Summary of the Level of education of the respondents	88
Table 3.9: Summary of the Work experience of the respondents	89
Table 3.10: Initial RM perception of the respondents	90
Table 3.11: Revised RM perception of the respondents	92
Table 3.12: Summary of the descriptive statistics for Section B1 – Value	94
Table 3.13: Summary of the descriptive statistics for Section B2 – Typical Risks ...	97
Figure 3.14: Percentage breakdown of results Section B3 – RM effects on Productivity	99
Table 3.15: Summary of the descriptive statistics for Section B4 – Revised RM perception	100
Table 3.16: Summary of the descriptive statistics for Section C – Risk Ranking	103
Table 3.17: MSA Score Interpretation	105
Table 3.18: MSA Scores for each question of section B1	106
Table 3.19: Rotated Factor Pattern (Standardized Regression Coefficients) of section B1	106
Table 3.20: MSA Scores for each question of section B2	108
Table 3.21: Rotated Factor Pattern (Standardized Regression Coefficients) of section B2	108
Table 3.22: MSA Scores for each question of section B3	109
Table 3.23: Rotated Factor Pattern (Standardized Regression Coefficients) of section B3	110

Table 3.24: MSA Scores for each question of section B4	111
Table 3.25: Rotated Factor Pattern (Standardized Regression Coefficients) of section B4	111
Table 3.26: Cronbach's alpha coefficients	112
Table 3.27: Summary of the Factor Analysis Statistics	113
Table 3.28: p-value meaning	114
Table 3.29: Summary of the Correlations: Spearman's rho.....	115
Table 3.30 Conclusions from effect sizes – Cohens d	119
Table 3.31: Summary of the comparison of the factors with the respondents' role..	120
Table 3.32: Summary of the Regression Model	123
Table 3.33: Anova Table for the Regression Model	123
Table 3.34: Model Coefficient Data of the Regression Model	124
Table 3.35: Summary of the Regression Model	125
Table 3.36: Anova Table for the Regression Model	126
Table 3.37: Model Coefficient Data for the Regression Model	126
Table 4.1: Summary of the Risk Ranking	146

LIST OF FIGURES

Figure 1.1: Geographical location of the mine	8
Figure 1.2: Research data collection process flow diagram	10
Figure 1.3: Layout of the research study	25
Figure 2.1: Market capitalisation of the Global Top 40 mining companies versus the adjusted price index	29
Figure 2.2: Global mining commodities and countries	31
Figure 2.3: Production by mining methods	32
Figure 2.4: Rand priced index of commodities	33
Figure 2.5: Production per commodity indexed annually	34
Figure 2.6: Mining revenue per commodity annually (R' Billions)	35
Figure 2.7: Safety data for mining commodities in South Africa	36
Figure 2.8: Current location of South African collieries	37
Figure 2.9: Picture of mined coal from a colliery	39
Figure 2.10: ISO 31000 Risk Management Standard Process Flow	49
Figure 2.11: COSO ERM cube	51
Figure 2.12: The evolution of RM into ERM	54
Figure 2.13: The evolution of RM Model	55
Figure 3.1: Summary of Statistical Analysis and Layout of Chapter 3	76
Figure 3.2: A Pareto Chart to summarise the role of the respondents	81
Figure 3.3: A Pareto Chart to summarise the work department of the respondents..	82
Figure 3.4: Percentage breakdown of the gender of the respondents	83
Figure 3.5: A Pareto Chart to summarise the age of the respondents	84
Figure 3.6: A Pareto Chart to summarise the language of the respondents	85
Figure 3.7: A Pareto Chart to summarise the race of the respondents	86
Figure 3.8: A Pareto Chart to summarise the education of the respondents	87
Figure 3.9: A Pareto Chart to summarise the work experience of the respondents .	89
Figure 3.10: A Waterfall Chart to summarise the respondents' old initial RM perception	90
Figure 3.11: A Waterfall Chart to summarise the respondents' new revised RM perception	92
Figure 3.12: Percentage breakdown of results for Section B1 – Value of RM	94
Figure 3.13: Percentage breakdown of results for Section B2 – Typical Risks	96

Figure 3.14: Percentage breakdown of results Section B3 – RM effects on Productivity	98
Figure 3.15: Percentage breakdown of results for Section B4 – Revised RM perception	100
Figure 3.16: Percentage breakdown of results for Section C – Risk Ranking	102
Figure 3.17: Mean and SD for the factors against the respondents' roles	117
Figure 3.18: Scoring of selected RM Value questions	128
Figure 3.19: Scoring of selected RM Effectiveness questions	129
Figure 3.20: Scoring of selected RM Safety questions	130
Figure 3.21: Scoring of selected RM Productivity questions	131
Figure 3.22: Scoring of selected Typical Risk questions	133
Figure 3.23: Scoring of selected RM Perception change questions	134
Figure 3.24: Scoring of selected RM Adoption questions	136
Figure 4.1: The Conceptual Framework to RM at a Opencast Colliery	153

LIST OF ABBREVIATIONS

ABET	Adult Basic Education & Training
COSO	Committee of Sponsoring Organizations
ERM	Enterprise Risk Management
ISO	International Organization for Standardization
Max	Maximum
Min	Minimum
MSA	Kaiser's Measure of Sample Adequacy
N	Number
NWU	North-West University
RM	Risk Management
SA	South Africa
SARS	South African Revenue Services
SD	Standard Deviation
TRM	Traditional Risk Management
USD	United States Dollar

CHAPTER 1: NATURE AND SCOPE OF THE STUDY

1.1 INTRODUCTION

Every company is exposed to some form of risk and thus could be a population of study however for this research; focus will be on the mining industry in particular the coal mining industry. In an opencast colliery, there are many risks involved and if not appropriately addressed, it can put the business in serious risk of failure (Ahmada & McManus, 2014:541). Thus, integrated RM strategies are of paramount importance in a high-risk environment such as a mine.

For clarification purposes, a '*colliery*' is a mining term for a coalmine and the buildings and equipment associated with it. An '*opencast mine*' simply means an open pit or surface mine utilising surface mining techniques to extract rocks and minerals (contrary to an underground mine). A '*manager*' in this context means an individual who is in charge of a certain group of tasks or a certain division at the colliery. An '*employee*' means an individual who works part-time or full-time under a contract of employment at the colliery (excludes managers). Finally, a '*contractor*' means a person or company that performs work on a contract basis at the colliery.

This research will unveil whether managers, employees and contractors are just undertaking RM for the sake of doing so or if they do it because it is perceived to be of value to them. In addition, through the study, it will be determined that if proper RM principles are adhered to, then the effectiveness of RM strategies at the colliery will be demonstrated. The study will also evaluate the extent to which RM has been adopted by managers, employees and contractors including whether RM does affect productivity. The research furthermore aims to highlight the critically high ranked risks for the mine to address or look into. Finally, the study will declare if there was a change in RM perception especially from a safety RM mind-set to an integrated RM or ERM focus after knowledge about integrated RM has been gained via the questionnaire.

This study is business and management related and is therefore suitable for a MBA qualification. It is also very relevant to ERM and in particular the mining industry

because the risks in mining are significant and they need to be properly addressed. For any mining company, the proper management of risk is essential at all times and this therefore suggests suitability of the topic. It is essential for management to have these research questions answered because the mine and the field of study will benefit considerably from this research. The mine will benefit from the study because the research will evaluate the value of RM at the colliery and simultaneously identify any anomalies which may exist that the mine can use to better manage their risk profile thus affecting their triple bottom line.

Overall, the study is business related, the support of the mine management has been obtained and management is interested in the results acquired from the study thus this assists in better implementation. The data obtained through this study via the measuring instruments was reliable and valid, hence it contributes to executability because the study can be implemented in practice.

The structure of the rest of the Chapter is as follows: Firstly, the Chapter will begin with a problem statement, then the research questions and objectives, and then the scope of the study. Thereafter the research methodology, limitations, and finally the layout of the study will be discussed. The Chapter will conclude with further research direction.

1.2 PROBLEM STATEMENT

Global and local economic markets are in constant change and this change translates into business risk (Berenger *et al.*, 2016:403). Internal business operational changes also create substantial risk, thus integrated risk management (RM) is integral to every business irrespective of the type of product or service offered and therefore operational risks needs to be managed appropriately (Canhoto *et al.*, 2015:204). There are various strategies that one can adapt to a mine to deal with risks such as financial, compliance, health and safety, human resources and legal. It is however critical to determine if it is adding value to the mine and if it is effective enough to deal with the business risks of today (Vijayakumar & Nagaraja, 2012:4). This study aims to determine how valuable integrated RM is at the operational level by site management, employees and contractors. An article by

Deloach (2015:1) suggests that there is a false sense of security amongst mines on the value and effectiveness of RM due to persistent gaps that always appear due to the constantly changing environments.

The study is of great academic and practical importance because through this research the mine and the field of study will benefit considerably which will ultimately be seen in the mine's triple bottom line. There is also a lack of previous research within this topic especially when dealing with opencast collieries. This was confirmed via a thorough database search via databases such as EBSCOhost, Google Scholar, SAePublications and ScienceDirect.

This research primarily aims to unravel whether managers, employees and contractors are performing integrated RM because it is of value to them. Also, secondary to the study, it will be determined if proper RM principles are adhered to, which in turn will demonstrate the effectiveness of the RM strategies applied at the colliery (Arnold *et al.*, 2015:3). The study will also indirectly evaluate whether integrated RM affects productivity as well as the extent to which RM has been adopted by managers, employees and contractors. The research also aims to highlight the critically high risks for the mine to address. Finally, any changes in RM perception especially from a safety RM mind-set to an integrated RM or ERM focus will then be evaluated. It is critical to understand these RM aspects because of the high-risk environment that mining intrinsically is and thus will aid in ensuring that focus is paid to the areas needed most. A fundamental gap identified can be witnessed through the lack of staff training in terms of the preparation and the management of risks (Razali *et al.*, 2011:205).

There is a reasonable quantity of previous research that focuses on several aspects of RM such as the importance, types, determinants and even impact however; they are mostly focused around the finance and medical industries (Heyneke, 2010:1; Kganakga, 2013:2). As a result, there is very limited research on the actual value and effectiveness of RM strategies at an operational level for opencast collieries, thus there is no existing study that will be replicated through this research (Southern Cross University, 2013:1). The need for this research is illustrated by many articles such as the internal control of RM (Kganakga, 2013:4) and making RM a value-

adding function (Razali *et al.*, 2011:206). These articles stress the need for understanding the value that RM plays at board level and also the need for effective RM implementation.

Other research articles published examines the relationship between ERM and the internal controls of an organisation as well as risk based impacts on the company (Pergler, 2012:1; Ferkolj, 2010:1). The research articles discussed thus far looks more into the corporate nature of RM and only touches slightly on RM at an operational level. It was suggested by Arnold *et al.* (2015:4) that further research is required in the perceived value of RM at operational level. This can be done via feedback from managers, employees and contractors on their perceived value of RM at the colliery of study.

Pergler (2012:2) states that RM at an operational level originally involved just the health and safety risk aspect, however there was a need to expand beyond this and to include a risk register to track and mitigate all risks e.g. financial, talent and political. This RM strategy is partially implemented by many companies (Pergler, 2012:2), but they unfortunately still underestimate other critical risks such as energy security, climate change and cybercrime because their value may not be understood and thus the effectiveness of risk mitigation is reduced (Florio & Leoni, 2016:5). Although there is a fair amount of literature about RM in terms of the principles and application, there is nevertheless a gap in the research as there is limited studies dealing with the value of RM at the operational level (Pergler, 2012:3). Consequently, there is an incomplete picture of the value of RM at opencast collieries in South Africa with no studies focusing on site management, the employees and contractors.

Most of the other literature focuses a lot on the application of corporate RM strategies (Heyneke, 2010:3) however; this study is focused on the operational RM strategies with particular attention devoted to the perceived value and thus effectiveness at an opencast colliery. This study will thus be of great value to the RM field and the organisation once completed. The study does have some limitations in that it is focused on a specific colliery in the Free State province of South Africa and thus the sampling will be limited to this constraint.

The findings of this research will assist site management, employees and contractors as well as Head Office personnel to better manage risks on site and to ensure that effective RM is maintained at the operation thus creating value to the organisation by preventing serious disasters that can cause permanent damage to the organisation and its reputation. The field of study will benefit from this research because this type of study has not been undertaken at a colliery before and there is limited literature on RM value in the mining industry, thus it will add to the existing literature in the RM field (Deloach, 2015:1).

1.3 RESEARCH QUESTIONS

1.3.1 Primary Research Question

The primary research question of the study is to investigate if integrated RM is perceived to be a value adding strategic function to the mine with specific reference to site managers, employees and contractors.

1.3.2 Secondary Research Questions

The following secondary research questions were investigated with the aim of achieving all of the objectives:

- i. Is integrated RM an effective tool to the mine?
- ii. To what extent has RM been adopted by managers, employees and contractors?
- iii. Does RM affect productivity?
- iv. What are the critically high ranked risks for the mine to address or look into?
- v. Is it possible to have a change in RM perception of managers, employees and contractors after becoming more knowledgeable about integrated RM (especially from a safety RM mind-set to an integrated RM or an ERM focus)?

1.4 OBJECTIVES OF THE STUDY

1.4.1 Primary objective

The primary objective of the study is to determine whether RM strategies is a value-adding function to an opencast colliery in South Africa with specific reference to site management, employees and contractors.

1.4.2 Secondary objectives

The secondary objectives of this research are:

- i. To determine whether integrated RM is an effective tool to the mine,
- ii. To determine the extent to which RM has been adopted by managers, employees and contractors,
- iii. To determine whether RM affects productivity,
- iv. To determine the critically high risks for the mine to address or look into and to rank these risks,
- v. To determine if there was a change in RM perception by managers, employees and contractors after becoming more knowledgeable about integrated RM (especially from a safety RM mind-set to an integrated RM or an ERM focus).

Addressing this research problem is vital because if the value of RM is not understood by management, employees and contractors, then the effectiveness of the applied RM techniques will be minimal (Deloach, 2015:1).

1.5 SCOPE OF THE STUDY

1.5.1 Field of the study

The field of study is Risk Management because every company is exposed to some form of risk and thus could be a study population however, for this study focus will be on the mining industry in particular the coal mining industry. The study will be conducted at a colliery with approximately 600 personnel in the Vaal Triangle and thus the study population will be personnel from this colliery. The specific individuals of the study population can be broken down into groups of site management, employees and contractors. Through this study population, the value-adding aspects of integrated risk management strategies will be investigated. There are no conflicts of interest or special permission requirements needed from the ethics committee, because all aspects of this study are within the North-West University's code of ethics.

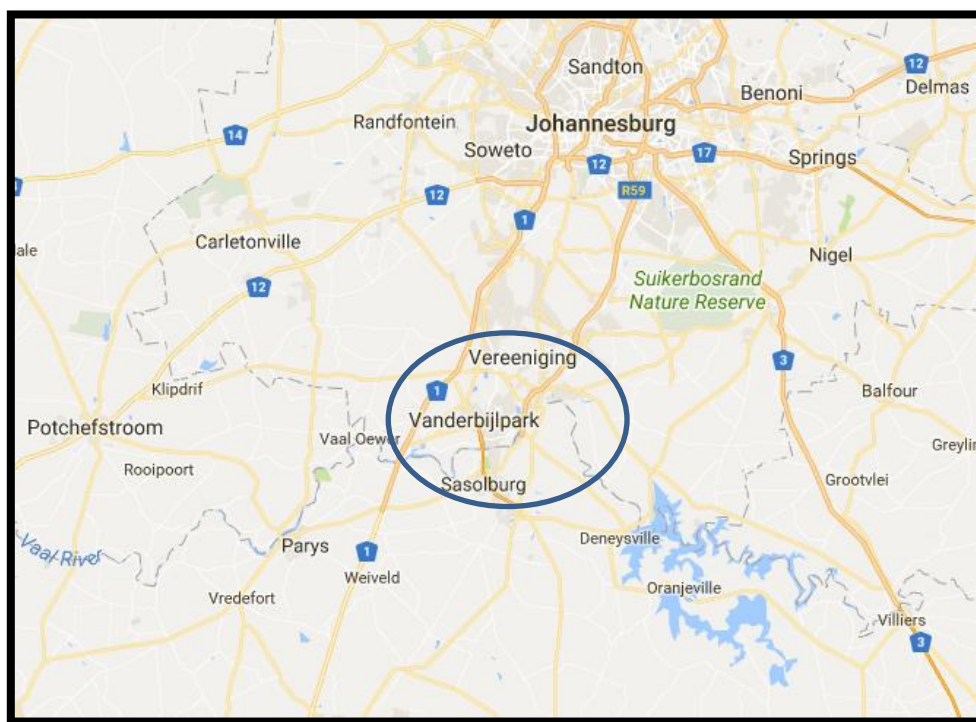
1.5.2 Geographical demarcation of the study

The data will be gathered from site management, employees and contractors from a colliery in the coal mining industry, which is situated in the Free State Province in the vicinity of Deneysville, bordering the Vaal River (Vaal Triangle). The study population (unit of analysis) will be the site management, employees and contractors of the opencast colliery in the Free State province.

In terms of site management, the General Manager, Head of Departments and Section Heads will be involved. In terms of employees, any employee working on the mine will be involved and thus will include operators, artisans, assistants, specialists and office staff. In terms of contractors, companies such as Barloworld, Komatsu and Hitachi will be used. For systems and reports, Ellipse, Enablon and Ramesys can be utilised for such data if required. The population of study at the colliery is approximately 600 personnel and the sample of study will be 200 personnel of this population.

This unit of analysis will be most suitable because firstly the population and sample are all working at this colliery. Secondly, the mine is an opencast operation. Thirdly, there are various risks throughout the mine such as health and safety, finance, labour, economic and environmental. Finally, it is most suitable because the unit of analysis is diverse in terms of management, employees and contractors. The colliery also does address risk to some extent, which will allow for the evaluation of whether risk is being correctly addressed and if it is adding value to the mine and the employees working there. With this in mind, one will be able to evaluate the effectiveness of the RM strategies applied at the colliery.

Figure 1.1: Geographical location of the mine



(Google Maps, 2017:1)

1.6 RESEARCH METHODOLOGY

This study was principally conducted in two phases. First, a literature review was conducted of the different academic studies on RM in the mining industry. This was followed by an empirical study via a qualitative pilot study and then a quantitative empirical study. It was preferable to use the quantitative research method approach with a supplementary qualitative pilot study as well as factor analysis and multiple

linear regression. This assisted in ensuring a multiple angle argument (triangulation), hence an enhanced method that will validate the acceptability of the results. Generally, the more evidence the better the research argument, thus this method will be valuable and fit for purpose. This will therefore provide for a better understanding of the research problem (Bryman *et al.*, 2014:62) and the research problem will be able to fit to the research method approach.

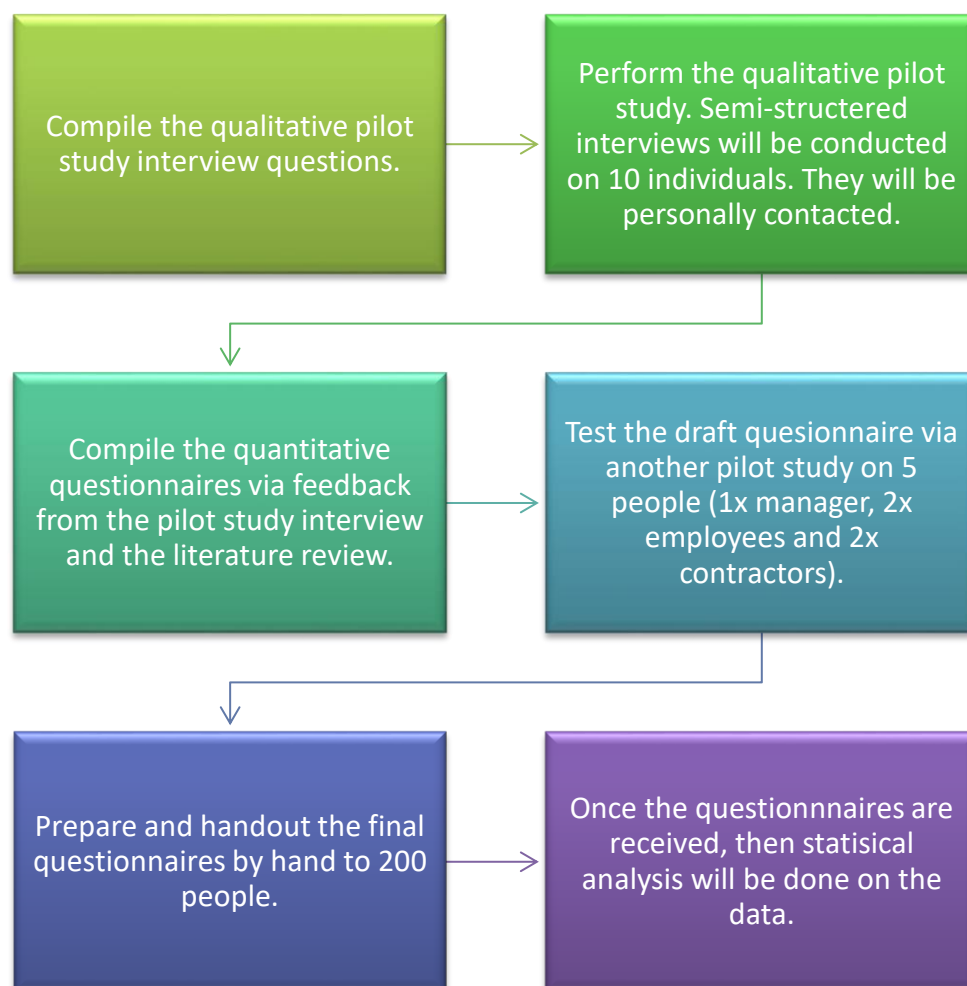
To add to the point above, the qualitative pilot study results will assist to explain the quantitative research results as well as to fine-tune the quantitative measuring instrument. The study will start with a purposive convenience sample for the pilot qualitative study. Then another purposive convenience sample will be used for the quantitative statistical study because the data and resources will be easily accessible. The nature of the data for the pilot qualitative study will involve non-numeric characters whilst the nature of the data for the quantitative study will consist of mostly numeric data due to the Likert scales used which represents counts or measurements, which will be in a discrete, nominal or ordinal form.

The research study will make use of the cross-sectional method. A cross-sectional study is one that takes place at a single point in time and is appropriate for use with both the qualitative and quantitative research method. In effect, one is taking a slice or cross-section of the data being observed or measured (Welman *et al.*, 2011:143). According to Bryman *et al.* (2014:106) “A cross sectional design entails the collection of data at a single point in time in order to collect a body of quantitative and quantifiable data in connection with two or more variables which are then examined to detect patterns of association.” Thus, cross-section analysis is also suitable for this study due to the time constraints in order to complete the research.

In terms of measuring instruments, a questionnaire and a pilot interview will be used and thus primary data will be collected. Primary data refers to original data collected by the researcher for the purpose of their own study at hand. Secondary data refers to information collected by individuals, agencies or institutions other than the researcher (Welman *et al.*, 2011:149). The data will be of primary nature because it will be collected directly from the participants of the research. There will thus be no secondary data used.

There are no existing quantitative research questionnaires for this study so it will have to be self-developed based on the specific requirements for this study. A pilot study on the final draft questionnaire will be completed by 5 mine personnel (managers, employees and contractors included) to ensure that the questionnaire is fit for purpose and that all errors are identified and removed. For the qualitative interviews, some of the questions were adapted from a study done by Kganakga (2013:34). Through this process, replication will be possible. Consequently, the data will be collected via quantitative questionnaires as well as from some qualitative pilot semi-structured interviews through the data collection process below:

Figure 1.2: Research data collection process flow diagram



(Source: Own Compilation)

Saunders and Lewis (2012:257) propose that researchers need to pilot their questionnaires and interviews with a few individuals who are comparable to those who will be partaking in the research. Thus, pilot studies were used to check if the questions included in the questionnaire and the interview were likely to be comprehended by the participants and would provide the vital data required to answer the research questions. In terms of ethical aspects, the questionnaire will be directly distributed to the participants chosen and will also be collected directly from them as well. An introduction letter from the researcher was approved by the General Manager and the Study Leader and was therefore also distributed with the questionnaire and the interview consent letter. Replication of the study will be achieved by minimising contamination from researcher biases, clear description of procedures and control of the conditions of the study.

1.6.1 Literature Review

The purpose of the literature review is to demonstrate to the reader what existing literature is present on RM as well as the perceptions of its value adding effects in a South African opencast colliery. It also provides context to the problem, shows why the problem exists and why it needs to be addressed. Finally, it is used to shape the background for this research in showing where there is a need for further research, and where gaps exist in the literature. In this study, a comprehensive and broad literature review was completed to determine if integrated RM is of value to the mine of study. The review also aims to highlight the critically high risks for the mine to address. It is critical to understand these RM aspects because of the high-risk environment that mining intrinsically is and thus will aid in ensuring that focus is paid to the areas needed most.

Addressing this research problem is vital because if the value of RM is not understood by operational personnel and contractors including site management, then the effectiveness of the applied RM techniques will be minimal. This study aims to prove that if a mine values RM, then the true effectiveness of RM will be achieved (Deloach, 2015:1). The findings of this research will assist site management, employees and contractors as well as Head Office personnel to better manage risk on site and to ensure that effective RM is maintained at the operation thus creating

value for the company by preventing serious disasters that can cause permanent damage to the company and its reputation.

The field of study will benefit from this research because this type of study has not been undertaken at a colliery before and there is limited literature on RM value in the mining industry, thus it will add to the existing literature in the RM field. Most mining related risk research is based on underground mining operations, however this research will be examining an opencast operation. It is a major difference and therefore of great importance as majority of the mines around the world are opencast. RM strategies are being implemented at the mine of study but the question remains if it is really adding value to the operation via the managers, employees and contractors (Deloach, 2015:1).

The literature review comprised of the following key concepts regarding RM at the colliery of study:

- RM Value;
- The Mining Industry;
- The Coal Mining Industry;
- Risk Management;
- Risk Management Frameworks;
- Enterprise Risk Management (ERM);
- Differentiating Traditional Risk Management (TRM) and Enterprise Risk Management (ERM);
- Value of ERM;
- ERM in the Mining Industry;
- ERM Implementation in Coal Mining;
- ISO 31000 Implementation in Mining;
- Strategy Currently Utilised by South African Mining Companies;
- Typical Risks Facing the Mining Industry.

The search engines used for the literature review included EBSCOhost, Google Scholar, SAE Publications and ScienceDirect. In addition to the researcher, Librarians

from the North-West University were utilised to complete a thorough database search with regards the research theme at hand. The following source areas provided further insight into the topic:

- Journals;
- Research articles;
- Risk management books and articles;
- Internet search engines;
- Online articles;
- Magazines;
- Libraries;
- Company data library;
- Mining related policies;
- Dissertations, mini-dissertations and other papers on the theme;
- Internet articles;
- News articles;
- Textbooks and e-Books.

1.6.2 Empirical Investigation

1.6.2.1. Research Design – Quantitative Study

1.6.2.1.1 Research Approach

A self-administered questionnaire was utilised whereby the respondents answered questions by completing the questionnaires independently. The questionnaires were personally handed out to the respondents to answer and were also personally collected in order to ensure a high probability of a good response rate (no pressure was put on respondents to complete the questionnaire). Emailed questionnaires were only used in special circumstances due to the low response rates achieved.

For this study, in terms of the levels of measurement, the questionnaires utilised nominal and ordinal measurement. In terms of nominal measurement, the data

allocated to the participants only served to differentiate them with regards to their biographical information being measured. In terms of ordinal measurement, the figures allocated did not only reflect differences among the participants on the variables being measured but it also ranked some of the items of study. The questionnaire was used to collect primary data. With regards to the questionnaires, they do not involve direct observations of the behaviour of the subjects but instead individuals' opinions and perceptions of RM. These measuring instruments are consequently vulnerable to measurement reactivity, the consequences of which may vary from the concealment of information to deliberate dishonesty by participants. The questionnaire was used to obtain the following types of information from the respondents (Welman *et al.*, 2011:150):

- Biographical details;
- Typical behaviour with respect to RM;
- Perceptions, opinions, beliefs, and convictions about RM;
- Attitudes on RM;

The raw data delivered via the questionnaires was subjected to validity and reliability tests so that the accomplished research objectives are not disputed. The use of the raw data permitted the researcher to identify any potential statistical errors or failure to reach a reasonable conclusion.

1.6.2.1.2 Research Participants

The study was conducted at a colliery with approximately 600 employees in the Free State Province (Vaal Triangle area) and thus the study population was personnel from this colliery. There was no conflict of interests and permission from the ethics committee, management and the participants themselves was gained before the study commenced.

The level of analysis outlines what the importance of the study is and helps one to identify the unit of analysis for the research. The unit of analysis refers to the level of collection of the data used during the analysis and for reporting of the results. The

unit of analysis can be individuals, groups or organisations, an industry or a geographical or a political region. Being clear about the unit of analysis is imperative because it will affect how and where the data is collected, how the analysis will be carried out and how to report the findings (Canhoto *et al.*, 2015:31).

Cooper and Schindler (2011:280) states that there are five different types of unit of analysis that are shared in research design. They include organisations, divisions, departments, groups and individuals. Based on this, the study population for this research will therefore be individuals and groups within the organisation. The specific individuals of the study population can be broken down into groups of site management, employees and contractors. Through this study population, the effectiveness and value-adding aspects of integrated risk management strategies was investigated.

Thus, the study population (unit of analysis) was the site management, employees and contractors of the opencast colliery in the Free State province. Systems, programmes and financial reports was also used when necessary. The sample size used was 200 (from a population of 600) via the purposive convenience sampling process and was broken down as follows:

- 30 site managers;
- 100 employees;
- 70 contractors.

This unit of analysis was most suitable because firstly the population and sample are all working at this colliery. Secondly, the mine is an opencast operation. Thirdly, there are various risks throughout the mine such as health and safety, finance, labour, economic and environmental to name a few. Finally, it is most suitable because the unit of analysis is diverse in terms of management, employees and contractors in fair proportions.

1.6.2.1.3 Measuring Instruments

In terms of data collection, the initial qualitative pilot study was done first (and will be discussed in section 1.6.2.2 below) and interviews was utilised. For the quantitative study, a questionnaire was utilised after fine-tuning via a second pilot study. For the questionnaires, the Likert scale (4 options: *strongly agree*: '4', *agree*: '3', *disagree*: '2' and *strongly disagree*: '1') was employed because it is well suited to this type of study. There are reverse scored questions in the questionnaire to minimize extreme response bias and acquiescent bias. Their score allocation was opposite to the normal questions (*strongly agree*: ' - 1', *agree*: ' - 2', *disagree*: ' - 3' and *strongly disagree*: ' - 4').

The results of the questionnaires and interviews was thereafter examined to see the respondent's perspective of RM at the colliery. A pilot study was used to check if the questions included in the questionnaire were likely to be comprehended by the participants and would provide the vital data required to answer the research questions. A pilot study on the final draft questionnaire was also completed with 5 mine personnel (managers, employees and contractors) to ensure that the questionnaire was fit for purpose and that all errors were identified and removed. Replication of the study will be achieved by minimising contamination from the researcher biases, a clear description of procedures used and control of the conditions of the study. The quantitative study questionnaires and the qualitative pilot interview schedules can be seen in Appendix A and Appendix B respectively.

1.6.2.1.4 Statistical Data Analysis

The descriptive analysis was exhibited via tables, pie charts, column charts and Pareto charts and was based on the data collected. Descriptive statistics simply describes the characteristics of the sample, summarising huge volumes of data into a few summary statistics (Welman *et al.*, 2011:154). Further analysis was conducted to conclude consistency of the results and consensus of the respondents surveyed. The means and standard deviations together with the confidence intervals and statistical significance was analysed.

Validity is the extent to which a test measures what is actually required to be measured. Reliability has to do with the accuracy and precision of a measurement procedure. Measurements are reliable to the extent that they are repeatable and is the degree to which a test consistently measures what it is supposed to measure. Practicality is concerned with a wide range of factors including economy, convenience and interpretability (Cooper & Schindler, 2011:281). These are all key facets that was taken into consideration in this research study.

In terms of the approach for data analysis, the statistical analysis was carried out in conjunction with the North-West University Statistical Consultation Services Department by using the IBM SPSS statistics software (2016) version 23, SAS 9.4 (2016) and MS Excel software. The SPSS and SAS statistics software was used for the more complex statistical calculations and MS Excel was used more for the more descriptive statistical aspects. Cronbach alpha coefficients was utilised to determine the reliability of the scale and the internal consistency of the test and refers to how closely related a set of items are as a group. Cronbach's Alpha can take on any value less than or equal to one, including negative values, although only positive values are deemed sensible, thus greater values of alpha are more appropriate. Generally the requirement of reliability is a value of 0.70 or higher for alpha (Levine *et al.*, 2011:556). Spearman's rho correlation was calculated in order to determine the associations between the category scores. Multiple linear regression analyses and exploratory factor analysis was also used in order to predict and validate the value of integrated RM at the mine.

Cohen's d coefficients were calculated to show an indication of the relationship between category scores (Bryman *et al.*, 2014:321). A cut-off point of 0.3 (medium effect) will be set for practically visible significant correlations and a cut-off point of 0.5 (large effect) will be set for significant correlations (Bryman *et al.*, 2014:322). The use of raw data allowed the researcher to recognise any possible statistical errors or failure to reach a reasonable conclusion. Further analysis was conducted to determine the consistency of the results and the consensus of the respondents surveyed. Questionnaires with missing information were removed so that they were not can be taken into account during the data analysis. In terms of reliability, it is believed that the research will show replicability fairly easily.

1.6.2.2. Research Design – Qualitative Pilot Study

1.6.2.2.1 Research Approach and Data Collection

For the qualitative pilot study, the semi-structured interview process was utilised. Although, the interviewer had a list of questions about the research topic (interview guide), the interviewees were allowed flexibility in their replies. The questions did not need to follow the precise order in the interview guide and the word phrasing was changed by the interviewer when required. In addition, questions that were not included in the guide were asked when the interviewer probed on the responses of the interviewees (Bryman *et al.*, 2014: 221). Audio recordings were taken for use to fine-tune the quantitative measuring instrument and to validate the results obtained. Transcriptions were not required and were thus not done because this was only a pilot study. The language used was comprehensible to the interviewees and further explanations were done when required. The place of the interview was in a comfortable, silent and reserved setting.

The research instrument was thus a semi-structured interview. Saunders and Lewis (2012:151) define a semi-structured interview as *“a method of data collection in which the interviewer asks a set of themes using some predetermined questions but varies the order in which the themes are covered and questions asked.”* This style of interviewing enables the interviewer to enquire with a view to clarifying any ambiguous responses or to request explanation when unfinished responses are provided. This particular amount of freedom makes semi-structured interviews very applicable to the nature of this research study.

The duration of the interview fluctuated between 20-30 minutes per interviewee. The interviewer recorded the interviews after the introductions were complete and the purpose of the study was clarified. Some rephrasing and summarising was used to allow the interviewer to test his/her own comprehension and to focus on ambiguous remarks. Kganakga (2013:41) outlines several critical features of semi-structured interviews and the researcher adhered to the guidelines as follows:

- The layout of the interview will be semi-structured with some pre-planned questions, while permitting the free flow of discussion and questions;
- An interview guide will be prepared based on the themes from the literature review and the research questions;
- Questions will be open-ended, allowing interviewees to expand on the topic and not just answer by simply saying yes or no;
- The interviewer must understand and interpret what was heard. The interviewer must search for a deeper understanding and clarity from the interviewees throughout the interview;
- The researcher must perform audio recordings of the responses and use a note pad if required.

1.6.2.2.2 Research Strategy

Since the data to be collected is also qualitative in nature; inductive reasoning was used during the analysis and interpretation of the data. Canhoto *et al.* (2015:54). emphasizes that qualitative researchers frequently discover certain findings and then draw conclusions on the grander phenomena and this is called inductive reasoning. All research studies should ensure that its results are both valid and reliable. Saunders and Lewis (2012:142) uses the terms 'validity' in relation to the integrity of research findings and conclusions whilst 'reliability' is concerned with the extent to which data collection methods and analysis procedures can be repeated to achieve the same results. Thus, validity and reliability were verified in this study.

In order to preserve anonymity of the mine and the interviewees throughout the research process, the audio recordings of the interviews will be kept confidential by limiting access to the data to as few individuals as possible. The name of the colliery and the participants in both the quantitative and qualitative study will not be disclosed during the study. A pilot study was first completed as explained above via the interview to fine tune the measuring instrument (questionnaire) and a second pilot study on the actual draft questionnaire itself was done thereafter. This was to ensure that the questions prepared were likely to be understood by the participants and provides the data needed to answer the research questions.

1.6.2.2.3 Research Setting

The interviews were completed on the mine during working hours. The setting for the interviews was in a comfortable, reserved and silent meeting room. The distinctive characteristic was for the interviewees to feel comfortable and free to answer the questions posed. The researcher made the research setting as comfortable as possible for the interviewees so that quality data can be obtained from the interviewees and thus integrity of the data will be maintained.

1.6.2.2.4 Sampling

Sampling practices provide a range of methods that enable one to reduce the amount of data one will need to collect by considering only data from a sub-group of a population rather than the whole population (Saunders & Lewis, 2012:150). The necessity for selecting a sample develops from the significance of saving time and money in terms of the collection of useable and informative data.

The sampling procedure used was a purposive convenience sample due to the areas in which further research is required on a sample of 10 personnel. Purposive sampling is a non-probability form of sampling because the researcher does not seek to sample the participants randomly. The aim of purposive sampling is to sample participants in a strategic way so that those sampled are appropriate to the research questions (Bryman *et al.*, 2014:165). This sample was most suitable because firstly the population are all employed at this colliery. Secondly, the mine is an opencast operation. Thirdly, there are various risks throughout the mine such as health and safety, finance, labour, economic, environmental, and so forth. Finally, it is most suitable because the unit of analysis is diverse in terms of management, employees and contractors.

The sample size for the qualitative pilot study will be 10 via the purposive convenience sample process and will be broken down as follows:

- 2 site managers;
- 5 employees;
- 3 contractors.

In a worst-case scenario if the sample is for some reason not accessible anymore, an alternative unit of analysis can also be utilised to answer the research questions for both the qualitative and quantitative designs. As a backup plan the management, employees and contractors of other opencast collieries can be used. There are a lot of collieries in the Mpumalanga province that can be used. There are also some opencast mines in the Limpopo and North-West provinces. Another option in terms of an absolute worst case scenario is to perform this study on an underground mine which could also work well should there be a sample access problem.

1.6.2.3 Strategies employed to ensure quality data

In order to maintain the integrity of the research data, a thorough literature review was completed which included the most recent studies and models for this research study. Only approved and validated sources was used in the literature review. The research setting was appropriate and this aided in ensuring integrity of the research data as well as quality of the study. In terms of entrée and establishing researcher roles, the data was collected from the appropriate people under suitable conditions because permission has been gained from management and this lead to integral and quality data.

To ensure data quality, a pilot qualitative study was initially performed and then a quantitative study to delve into the required details and ensure quality and validity of data because this ensures creditability of the findings (a pilot study of the questionnaire was done as well). Other strategies for quality and validity of data and analysis comprises of triangulation, respondent validation, application of critical thinking to analysis and data collection, and critical approaches to the status of data collected (Canhoto *et al.*, 2015:109).

1.6.2.4 Ethical Considerations

Ethical considerations have to be taken into account during the whole research procedure and be addressed specifically with regards to informed consent, confidentiality and consequences. There were no conflicts of interest and permission from the ethics committee, management and the participants themselves was gained. Behaving ethically means (Bryman *et al.*, 2014:120):

- No harm should come to research participants;
- They should agree to participate and know what the research is about;
- Their privacy should not be invaded;
- They should not be lied to or cheated.

An introduction letter from the researcher was approved by the General Manager and the Study Leader and was distributed during the interviews together with the questionnaires and the consent letter. The introduction letter described the purpose of the study and promised anonymity and confidentiality as well as highlighting the concept of voluntary participation. The questions were developed in a way that all participants will understand making use of common English vocabulary. There will be no use of ethnography and observations. All of the data obtained from the research will be of a primary nature obtained directly from the personnel working at the colliery of study, thus secondary data (other sources) will not be required.

For the study, the collected data was reported in such a way that the participants cannot be recognised. Respecting the rights of the participants and the colliery as the host institution was given adequate attention and all research deductions was supported by evidence and all restrictions of the research design was reported as well. In order to preserve anonymity of the mine and the participants throughout the research process, the audio recordings of the interviews and the questionnaires was kept confidential by limiting access to the data to as few individuals as possible. The name of mine and the participants in both the quantitative and qualitative study will not be disclosed during the study.

1.7 LIMITATIONS OF THE STUDY

The study does have some limitations in that it is focused on a specific colliery in the Free State province of South Africa (Vaal Triangle), thus the sampling will be limited to this constraint. Due to time constraints for this research, data was collected from the participants at only one period in time. If time was not a constraint, a longitudinal research study would be preferable due to its ability to study longer term change and development over time. In order to gain a better understanding of the constructs being explored, there could have been a risk of interviewer bias where the interviewer may have asked leading questions that may have influenced the respondents answers in both the pilot qualitative and the empirical quantitative studies.

1.8 CONTRIBUTION OF THE STUDY

This is a business and management related topic and is therefore suitable to contribute to the economic and management sciences academic literature. It is also very relevant to ERM and in particular the mining industry because the risks in mining are huge and they need to be properly addressed. For any mine, manager, employee or contractor, the proper management of risk is essential at all times and this study therefore highlights its importance for the colliery.

It is essential for management to have the research questions of this study answered because the mine will benefit substantially from this research via its triple bottom line. The mine will profit from the study because the research will evaluate the value of RM at the colliery and simultaneously identify any irregularities that may exist that the mine can use to better manage their risk profile. By having a proper RM strategy in place, the mine will have a competitive advantage against its competition. The study is of great academic, managerial and practical importance because the findings of this research will assist site management, employees and contractors as well as Head Office personnel to better manage risks on site and to ensure that effective RM is maintained at the operation, thus creating value by preventing serious disasters that can cause permanent damage to the mine, its reputation and its sustainability.

The field of study will benefit from this research because this type of study has not been undertaken at a colliery before and there is limited literature on RM value in the mining industry, thus it will add to the existing literature in the RM field. Most mining related risk research is based on underground mining operations, however this research will be examining an opencast operation, thus it is of great importance.

The study is executable because firstly, access to information at the opencast colliery is obtainable and approval from the colliery to conduct this research has been acquired. The colliery also addresses risk to some extent, which will allow for the evaluation of whether risk is being correctly addressed and if it is adding value to the mine and the employees working there. The researcher also has some experience with prior research that was completed and this will aid in the successful execution of the study. The research was feasible because the data was gathered from site management, employees and contractors at the colliery, so the cost was minimal. Transportation costs was negligible because the research was conducted at the site of employment. There was some administration costs for the printing, statistical consultants and the language editor; however, it was at a feasible rate.

Overall, the study is business related, the support of the mine management was obtained and management is interested in the results acquired from the study thus this assists in better implementation. Finally, the study can be employed in practice thus, it is executable and therefore can contribute a great deal to the colliery and to academic literature.

1.9 LAYOUT OF THE STUDY

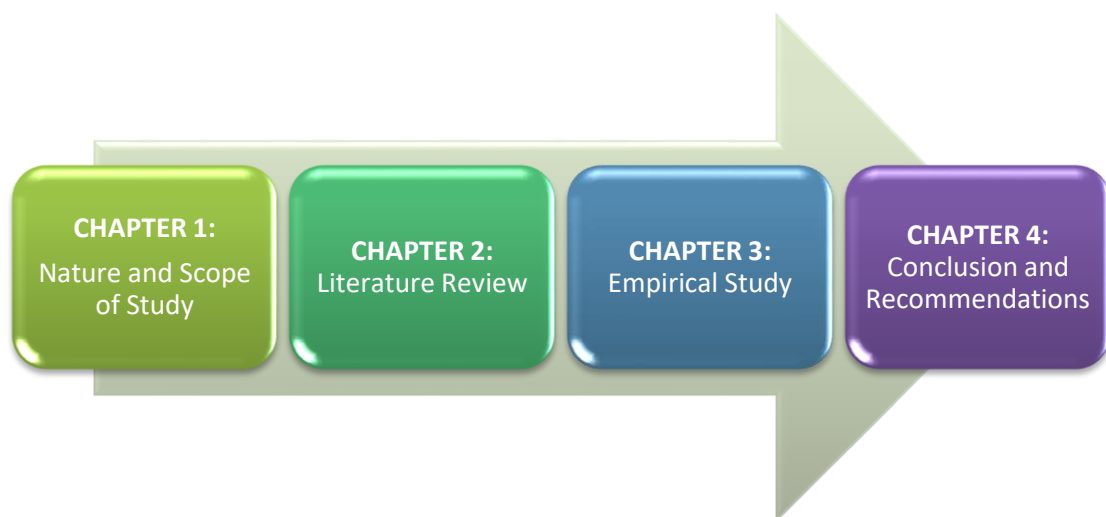
The mini-dissertation format is of the North-West University Master's Degree format. This report is for academic purposes and included all technical aspects, full documentation and detail. The primary audience is the examiner, research supervisor as well as other academic lecturers. The secondary audience is the mine management because the report has managerial implications and will thus be shared with management. The study aims to aid in demonstrating an understanding of existing theory and research in which the topic of study is based. The research paper

consists of four Chapters as seen in the graphical representation of the study layout in Figure 1.3 below. Thus, the report format comprises of:

- Nature and scope of the study (Chapter 1 – current reading);
- Literature review of risk management (Chapter 2);
- The empirical study and results (Chapter 3);
- Conclusion and recommendations (Chapter 4).

The report also includes an abstract, acknowledgements, table of contents, lists of figures and tables, references and appendixes.

Figure 1.3: Layout of the research study



(Source: Own Compilation)

1.9.1 Chapter 1: Nature and Scope of the Study

This is the current Chapter being read and it guided the reader by explaining the nature and the scope of the study. The Chapter comprised of an introduction, problem statement, research questions, research objectives, scope of the study, research methodology, limitations of the study, contribution of the study and finally the layout of the study.

1.9.2 Chapter 2: Literature Review

This Chapter acquaints with the reader to the topic of Risk Management and its value adding function in coal mining. It scrutinizes key theoretical and practical strategies/frameworks and offers a background to the nature of the study and the need for further investigation. This section reviews existing literature of Risk Management globally and in South Africa including the mining industry and provides insights, characteristics and descriptions. The Chapter also supports the design of the study and research instrument used from an academic perspective and also reviews literature concerning risk management challenges. This Chapter also discusses the coal mining industry, RM strategies, Value of RM, ERM, Implementation of ERM, Risk Strategies of South African mining companies as well as typical risks facing the mining industry.

1.9.3 Chapter 3: Empirical Investigation

This Chapter deliberates on the methodology used and describes the research model and the data that was captured and analysed (quantitative statistics). This section also explains the nature of the research participants via the demographics section. It further interprets the data and describes the analysis and results of the study. The main sections deal with RM value, current typical risks, RM productivity, revised RM perception and general RM information.

1.9.4 Chapter 4: Conclusion and Recommendations

This Chapter provides a summary of the research findings and makes conclusions about the research problems. Based on the results from the empirical and the literature studies, recommendations were made on the value of integrated RM strategies at a South African opencast colliery. This section also discusses the achievement of the study objectives and makes recommendations for future research.

1.10 CHAPTER SUMMARY

This Chapter introduced the topic of study, which is Risk Management in the coal mining industry. The Chapter included the problem statement that was formulated and a discussion of the research questions and objectives of the study. The scope of the study was explained and the research methodologies detailed. The limitations of the study was made clear, and the contribution of the study as well as the study layout was discussed. The next Chapter entails a detailed literature review on Risk Management in the mining industry with specific reference to coal mining.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The literature review presented in this Chapter details the relationships between integrated Risk Management (RM) and the effect it has on mining, more specially opencast coal mining. The Chapter begins with an introduction of RM, the international and the South African mining industries and then briefly discusses the coal mining industry, which deliberates on some of the risks faced. It then goes into RM and gives information into the theory regarding integrated RM strategies and internal control in companies. This Chapter also discusses the evolution of RM into Enterprise Risk Management (ERM), its differences from traditional RM, its adoption in companies including the mining industry. An overview of the role of internal controls and then the various mining related risks are then discussed including the challenges faced by both internal control and integrated RM strategy implementation. Conclusions are then drawn which assisted in a successful empirical study as discussed in Chapters 3 and 4.

2.2 THE VALUE OF RISK MANAGEMENT

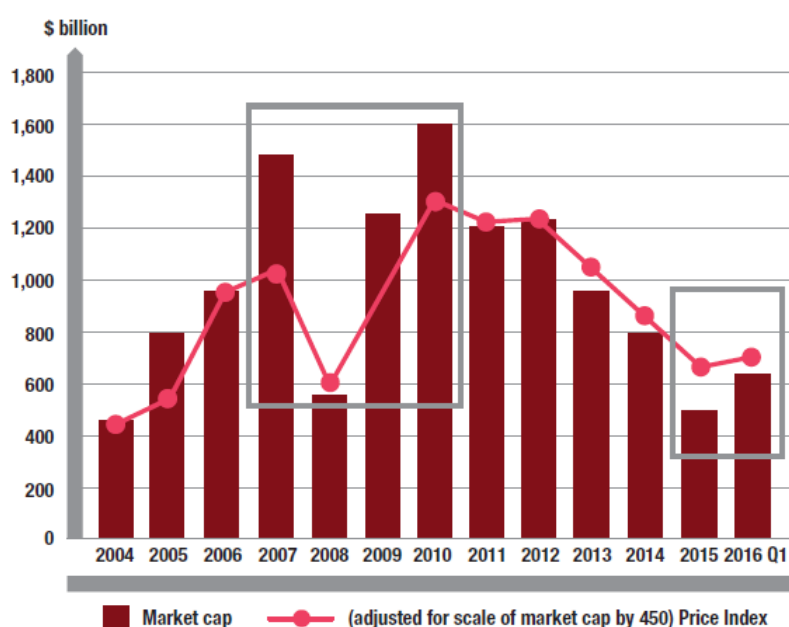
With a rise in uncertainty and increasing complexity, effective RM has become critical to the success of companies. An effective RM program can empower companies to get ahead of risks before they become catastrophes. However, it can often be challenging for mining companies to gain adequate support from internal and external stakeholders to provide the commitment necessary to establish an effective RM Program (Harvard, 2011:2). One reason for this is that it can be difficult to articulate the value of RM. Articulating the value of RM and ERM has long been a challenge due to the difficulty of measuring the value of ERM through typical financial metrics, such as return on investment (Manab *et al.*, 2010:239). This is only compounded by the fact that there are only a few mature and formal RM programs in the mining industry. In addition, the operation of RM strategies/frameworks requires sustained organisational focus and commitment, dedicated resources and structured change management. To advance RM, it is important for mining companies to

convey the value of RM or ERM to its stakeholders, both internal and external, in order to build a business case for it (PricewaterhouseCoopers, 2014:1).

2.3 THE INTERNATIONAL MINING INDUSTRY

As was in the mining super cycle, most people thought that coal, iron ore and other metal and minerals prices would go up and up but it did not, and today most people believe that these prices will not recover from the losses suffered in 2015/16. This is simply not true because this is a commodity cycle furthermore; these cycling times are unfortunately lengthening which implies it will take longer to adjust to these current market forces, which adds another dimension to RM. The graph in Figure 2.1 below shows the average Global Top 40 mining companies adjusted price index for the commodity basket of coal, nickel, copper, gold, PGMs, iron ore, zinc and silver from the years 2014 to Q1 of 2016. The commodity cycles can be clearly seen especially the 2008 and 2015 commodity price crashes.

Figure 2.1: Market capitalisation of the Global Top 40 mining companies versus the adjusted price index



(PricewaterhouseCoopers, 2016a:7).

The year 2015 seemed to be the ‘race to the bottom’ with many new records set by the global Top 40 mining companies. The Top 40 experienced their first ever collective net loss, their lowest return on capital employed, unprecedented capex containment and the tag team effect of prevailing debt levels plus impairments, sending leverage to new heights. Sporadic rallies in early 2016 built expectations, with many poised to herald a gradual but sustained return to prosperity. However, most aspirations have since been snuffed, dismissed as unfortunate interpretations of increased volatility. Some industry leaders have taken the opportunity to reinforce their expectations of subdued conditions persisting through 2016 and beyond (PricewaterhouseCoopers, 2016a:6). All this change plays a significant part in integrated RM and ERM on a wider global scale.

Of all the commodities, coal has been the most criticised over the past few years. One would be hard pressed to find a near-term prognosis of prosperity anywhere within the mining and energy sectors. Although the emerging economies, particularly the Indian sub-continent and Southeast Asia, may drive future demand, it is highly unlikely that they will replace the unprecedented demand from China witnessed over the past decade. Although China’s waning demand has occupied the spotlight, it is one component of a broader social and geopolitical trend that has been referred to by some as a ‘war on coal’ (Deloitte, 2016:12).

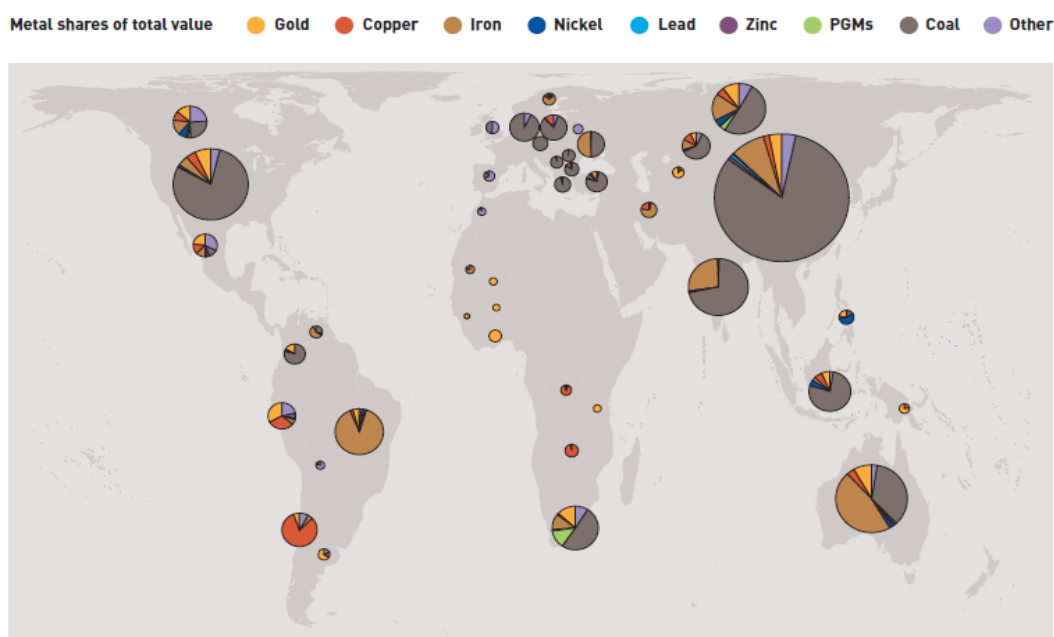
The coal industry has also been under pressure owing to technological advancements and the reduced cost of less carbon-intensive energy sources, particularly renewables and Liquefied Natural Gas (LNG). Solar installations and solar adoption have moved at a pace faster than many predicted as a result of reduced costs and improved battery storage. These developments thus offer new opportunities and markets for mining companies so that they can adapt to the changing energy mix. Nevertheless, in the short to medium-term, coal remains the most economical energy source there is and there are 1.2 billion people on Earth without access to electricity. Although the movement to “phase-out” coal is real, the commodity will continue to play a critical and significant role in the energy mix of many world economies (PricewaterhouseCoopers, 2016a:7). All countries need some base generation such as coal and nuclear, and with many countries not

favouring nuclear, the only other form of base generation at the moment is coal, thus it cannot be phased out easily.

The most important mining countries in terms of mineral production today are shown in Figure 2.2 below. The circles are proportional to the total value of all metals, industrial minerals and coal at the mine stage in all countries. Many of the countries are emerging economies consequently, the largest mines are now found in developing countries. In recent years huge investments have taken place in Latin America, Africa and parts of Asia and these are likely to escalate in the next ten years. Growth in exploration and mining interest in Africa, Latin America, and parts of Asia has been spurred by (ICMM, 2015:5):

- The depletion of easily accessible mineral deposits in Europe and the US;
- Technological advancements that led to the enhanced feasibility of mining of previously inaccessible deposits in remote less developed regions;
- The development of huge ocean going vessels in the late 20th century, initially for oil transport, which facilitated trade of bulk mineral commodities such as iron ore, coal and bauxite.

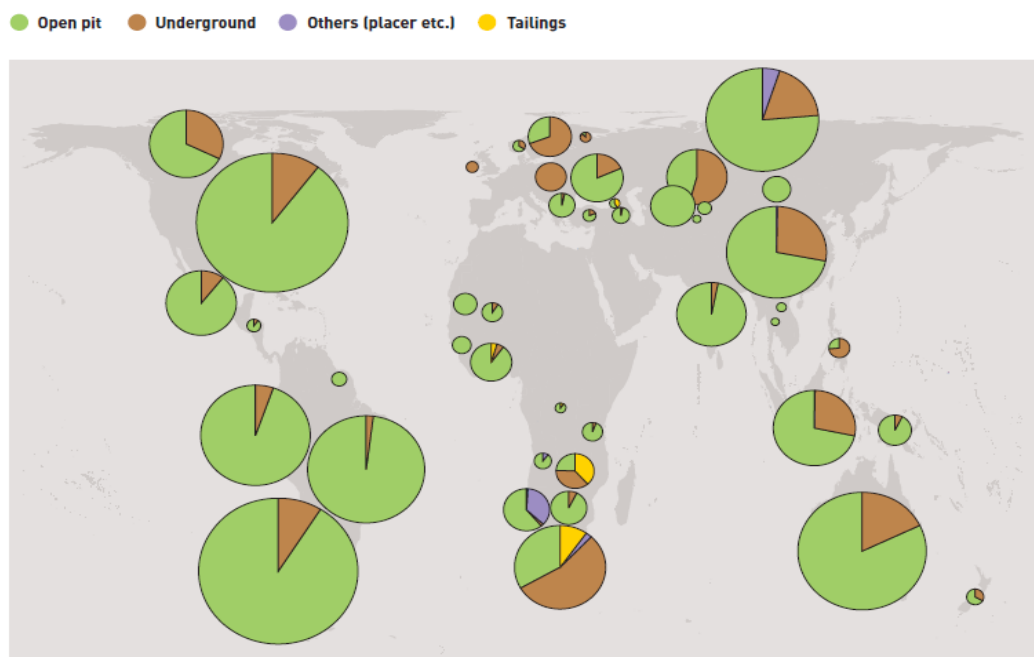
Figure 2.2: Global mining commodities and countries



(ICMM, 2015:5)

The mine of study is opencast therefore the researcher thought it would be interesting to discuss the trend in mining extraction throughout the world, which is now the opencast or open pit method as seen in Figure 2.3. Mine production has undergone important changes during the 20th century with a shift from underground to open pit mining techniques. Early in the century, underground mining dominated in developed countries, and as mining evolved in emerging economies, open-pit mining became more common. The majority of the industrial mine operations of the world are now open pit (Figure 2.3). Most productivity increases in the past century have been achieved through the ability to process lower grade ores through more efficient mineral processing and the use of ever-larger equipment ICMM (2015:8).

Figure 2.3: Production by mining methods



(ICMM, 2015:8)

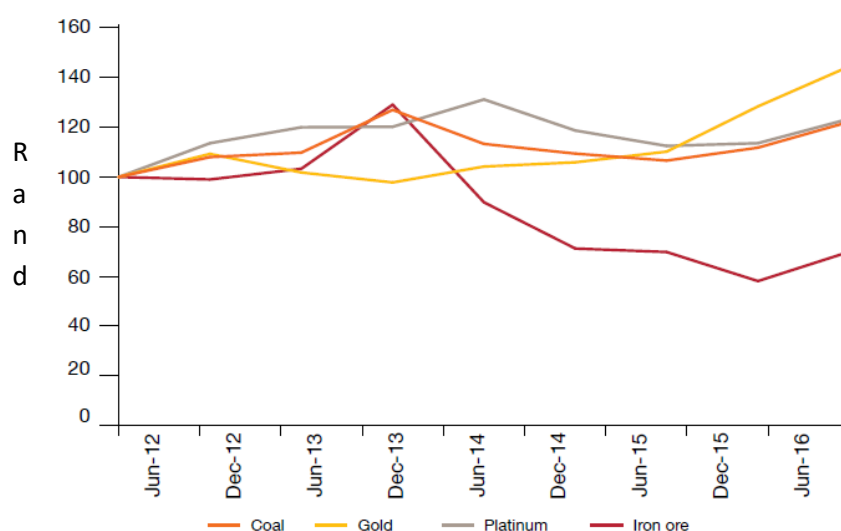
2.4 THE SOUTH AFRICAN MINING INDUSTRY

The 2017 financial year was another tough one for stakeholders in the South African mining sector. Investors in aggregate saw a decrease in dividends and market capitalisation after a cautiously optimistic view on a recovery in 2016. Despite the improved financial performance, regulatory announcements in June 2017 resulted in market capitalisation dropping to June 2015 levels. The subsequent recovery was

aided by improved USD prices and hope by investors that the new Mining Charter would be revised before final implementation (PricewaterhouseCoopers, 2017:1).

Decreases in the metal prices have put a lot of pressure on conventional deep-level platinum and gold mines' profitability and sustainability which resulted in SARS receiving marginal taxes; employees experiencing further retrenchments with the prospect of more to come and communities around some mines still desperate for improved service delivery and employment. Mining companies that have repositioned themselves within the current low-price environment (as seen in Figure 2.4 below) have started to see the benefits of cost saving initiatives reflected in lower operating cost increases.

Figure 2.4: Rand priced index of commodities

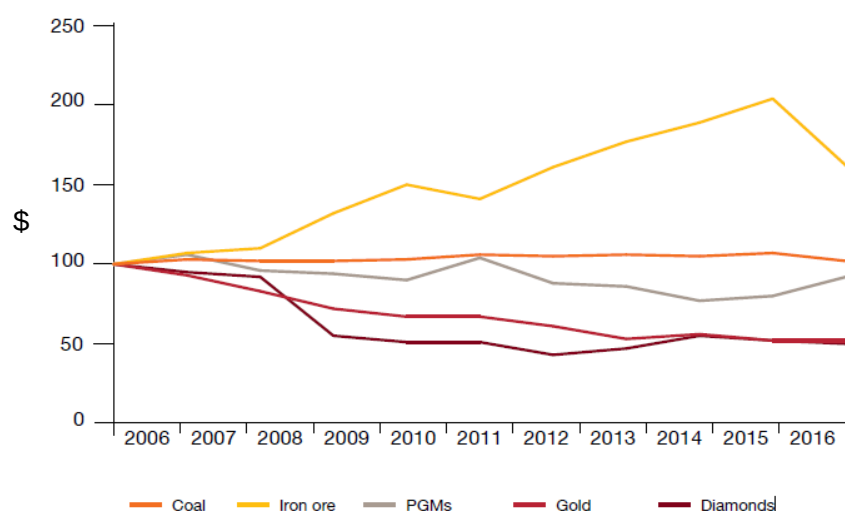


(PricewaterhouseCoopers, 2016b:9)

Companies had no choice but to cut back on new developments, refocus on profitable production rather than maximum production (seen in Figure 2.5 below) and reduce costs. Reduction in capital expenditure is evident. With the general outlook for the industry remaining subdued at best, 2016 marked another challenging year for miners. Performance was impacted by a slower than expected rate of economic growth, a prolonged and continuing downswing in commodity prices, an increase in short-term volatility, increased pressure on operating models and regulatory uncertainty. Adding to the challenge is the increased difficulty in raising capital due to

a loss of confidence by investors and capital markets being seen as a last resort. South Africa's credit ratings downgrade has also created some uncertainty within the market (PricewaterhouseCoopers, 2016b:10). The slowdown in growth in the world's second-largest economy, China, which is a significant importer of commodities, has had a negative impact on demand from other economies, including South Africa.

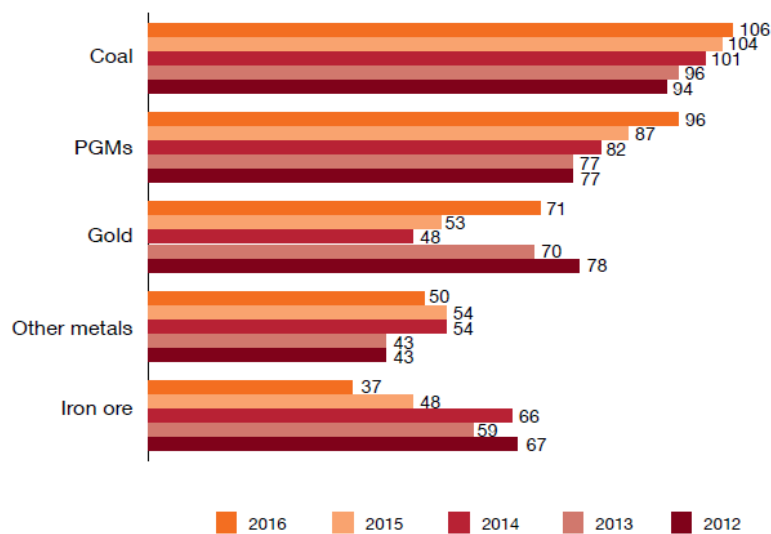
Figure 2.5: Production per commodity indexed annually



(PricewaterhouseCoopers, 2016b:10)

The South African mining industry continued to face a myriad of challenges as a result of subdued commodity prices and a growing cost base despite positive efforts to reduce costs and focus on profitable production. In addition, socio economic pressures in the country and labour challenges have put pressure on many mines' operating environment. The BMI (2016a:20) report indicated that South Africa has the highest cost of labour as a percentage of total costs among the major producers, averaging around 60%, whereas peers such as the United States and Australia average around 30-40%. The high proportion of labour cost is as a result of labour-intensive deep level conventional mining prevalent in South Africa. The political system in South Africa has lost credibility and the political risk index, as reflected in the BMI (2016b:35) report, indicates that factors such as the country's high degree of unionisation, the threat of industrial action and disruption to economic activity are a constant concern to investors. Coal has been the main contributor to mining revenue in the last five years for South Africa (Figure 2.6).

Figure 2.6: Mining revenue per commodity annually (R' Billions)

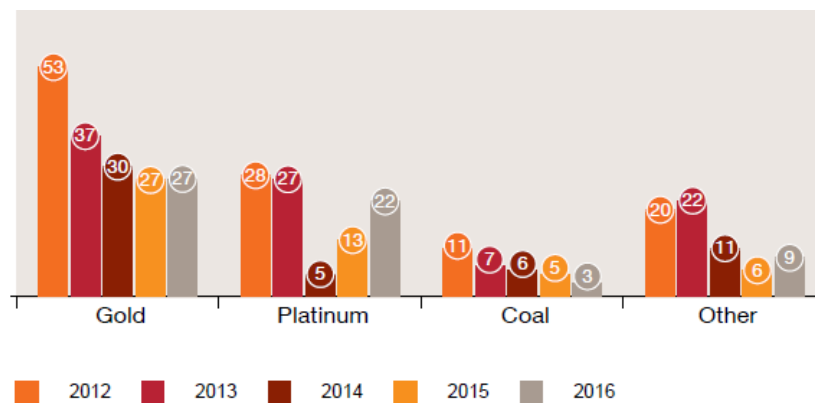


(PricewaterhouseCoopers, 2016b:9)

2.4.1 Risks facing the South African mining industry

Given the current economic downturn and slump in commodity prices, coupled with negative investor sentiment, the mining industry is faced with many related challenges and risks that need to be effectively addressed to ensure survival of the companies and the industry. In the current period, it is noted that companies are increasingly focused in more significant detail on their risks, mainly due to the impact of the changing environment forcing management to make tough operational and financial decisions to ensure sustainability (PricewaterhouseCoopers, 2016b:13). The highest-ranking risks included labour relations; sustainable business plans; budgets; the volatility of metal prices and exchange rates; infrastructure access and capacity; the regulatory, political and legal environments; high operating costs; and skills availability. Most companies' top exposures also include liquidity and capital management, climate change and cyber security as top risks. Safety, health and the environment are also key risks and if not kept under control can yield major problems for companies. Safety has generally seen an improvement in most mining sectors especially in the Coal industry as seen in Figure 2.7 below.

Figure 2.7: Safety data for mining commodities in South Africa



(PricewaterhouseCoopers, 2016b:23)

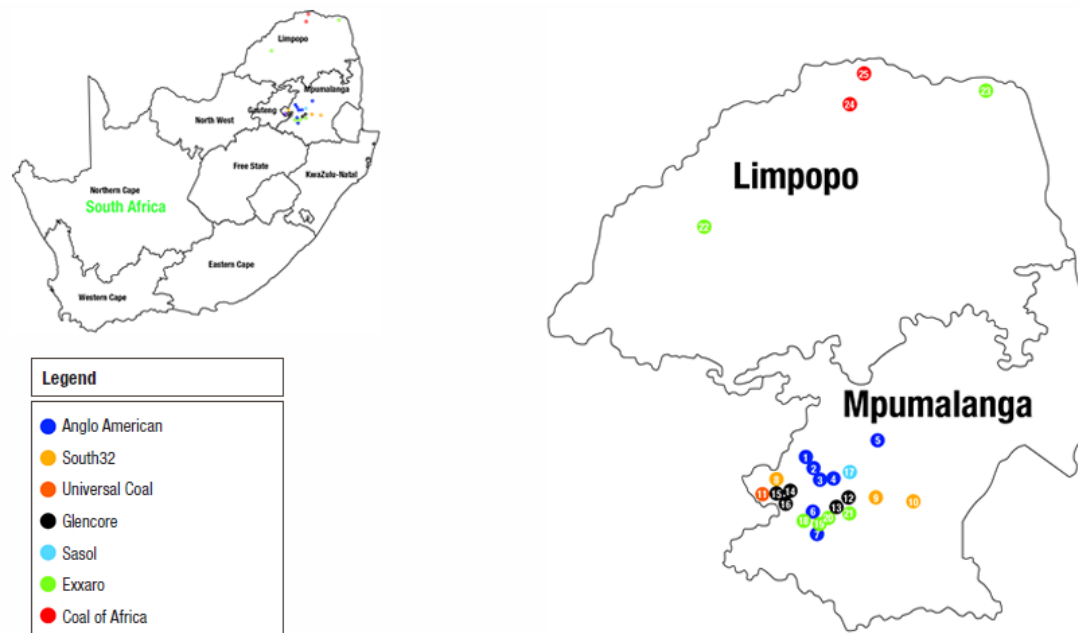
2.5 THE COAL MINING INDUSTRY OF SOUTH AFRICA

Coal mining's arrival in South Africa can best be traced to the start of gold mining in the late 19th century, particularly on the Witwatersrand, with the first coal in appreciable tonnages being extracted on the Highveld coalfield close to the Witwatersrand gold mines. Following the democratic election of 1994, ownership was transferred increasingly into the hands of historically disadvantaged South Africans, in many cases exceeding the 26% black-ownership level specified by the then mining charter. The new mining charter was published in June 2017 and has been suspended pending further consultations (Fin24, 2017:1). Key aspects of the new mining charter include an increase in black economic empowerment shareholding of all mines from a previous 26% to 30%. In addition, 50% of all board members and executive management must be black while 70% of all mining goods and 80% of all services in the mining industry must be procured from BEE entities. New mining rights are subject to a 1% revenue payment to BEE shareholders prior to any shareholder distribution (Mathews, 2017:1). Eskom are the biggest consumer of coal in SA and they have taken the above BEE requirement even further, insisting that they will only sign long-term contracts with collieries that are at least 51% black owned.

With coal resources estimated at some 30 billion tonnes, South Africa is home to 3.5% of the world's coal resources, with the country's production being 3.3% of the world's annual total. The Richards Bay Coal Terminal (RBCT) serves as the primary

export port. The RBCT was established in 1976 as a partnership between the then-leading coal companies with an initial annual capacity of 12Mt. This has steadily increased with a fine balancing of the needs of rail capacity to carry coal from the inland collieries to the coast to its current 91Mt design capacity (Chamber of Mines, 2017:1).

Figure 2.8: Current location of South African collieries



(Chamber of Mines, 2017:1)

Eskom is currently building two modern thermal coal power stations, Medupi and Kusile, which are the country's northernmost based coal reserves in the provinces of Mpumalanga and Limpopo. No other thermal coal power stations are in the planning stages as government and state-owned Eskom consider the feasibility of taking the nuclear power route. At current rates of production, South Africa has reserves sufficient to satisfy its needs for more than a century. The focus of production is gradually shifting away from the traditional Witbank (eMalahleni) coalfield as collieries approach the end of their productive lives (as seen in the map above). Emphasis is being placed on exploring and developing the Waterberg coalfield as well as others in the Limpopo province. Higher grades of final product are delivered to export markets, with the lower grade product burned by Eskom's specially designed power station boilers (Chamber of Mines, 2017:1).

The international coal industry is large and South Africa is an important participant in this industry. Despite the size of the international coal industry, it is not immune to change. Environmental pressures, the most important of which being the climate change debate, the Kyoto Protocol arising from this debate and the development of clean coal technologies to reduce the impact of coal production and usage on the environment are threats to the industry. At the end of 2015, a big shift from business as usual was achieved with the signing of the Paris Agreement at COP21. There were 195 countries whom agreed to a goal to limit global temperature increases to less than 2°C above pre-industrial levels and to reach a net-zero greenhouse gas emissions target by 2050. With the climate agreement taking effect in 2020, governments will likely implement new requirements for reporting on climate issues, with additional mitigation and adaptation measures to be rolled out speedily (PricewaterhouseCoopers, 2016b:24).

Other major pressures to the coal mining industry include competition from other sources of energy and that between coal producers, the deregulation of the electric power industry, renewable energy, fuel cells, corporate restructuring and legislative reform. Technology has in the past been the driver behind the growth and change of the South African coal industry, and so its future role in ensuring that coal is the fuel of choice for continued improvement in standards of living and for economic development must be pursued.

Climate change concerns have focused attention on the combustion of fossil fuels and on coal in particular. The industry has responded by applying technology and has developed the so-called clean coal technologies, which when applied to the production, processing, transport and combustion of coal, reduces its environmental impact. In South Africa, producers will also have to contend with a declining and lower quality reserve base, which will become increasingly more costly to mine. Positive projections on the growth in the seaborne thermal coal trade and the potential to increase export terminal capacity will present exciting challenges for the South African coal producer of the future. Co-operation between producers and consumers is necessary to convert the country's large coal resource into a coal reserve and to maximise the potential of the existing remaining and potential new reserves. Coal has many positive attributes such as (Rogers, 2014:2):

- The extensive worldwide reserve base;
- Safe to transport, store and use;
- A secure and cost effective form of energy;
- Potential for minimising environmental impact by applying Clean Coal Technologies.

Coal, however, suffers from negative perceptions and a poor image. The use of appropriate technologies and aggressive marketing can change this, so that the issue for coal becomes one of *how* it should be utilized and not *whether* it should be utilized. Innovative technology has the potential to still make coal a cleaner fuel of choice and the fuel for the third millennium.

Figure 2.9: Picture of mined coal from a colliery



(Anglo American, 2017:1)

2.6 CURRENT RM STRATEGIES UTILISED BY SOUTH AFRICAN MINING COMPANIES

Risks can arise from proceedings external to one's control or from operational difficulties. Each of the risks can have an influence on a company's ability to achieve its strategic goals. Such key strategic goals may include:

- Creating a sustainable organisation;
- Maximising operational performance;

- Optimising and streamlining portfolios.

A thorough understanding of the company's business model and strategy is crucial to the assessment of a company's success. Managers must generate a robust business that provides healthy and sustainable profitability and good cash flows. The coal mining industry has had some recovery from the swift reductions in commodity prices in 2015 and early 2016 however current macro-economic uncertainties are anticipated to cause unrelenting commodity price volatility (Anglo American, 2017:41). Commodity cycles are a big risk for the mining industry especially the coal export industry. Such instability is further worsened in a commodity pricing setting that is now virtually completely spot priced, compared to the quarterly and longer-term contract pricing mechanisms that used to be the norm. Company boards presently have a low risk appetite for new mining projects and investments unless they are world class orebodies with competitive cost options and long reserve lives (Anglo American, 2017:42).

2.6.1 The assessment process and key assumptions

The valuation of a company's forecasts is based upon the company's principal risks, its strategy and the financial plan. The strategy of coal mining companies must include the focus of improving profitability and cash flow as well as having a focused portfolio to generate sustainable value. A framework for strategic, project, operational and sustainable development related risks are presently in place at *some* South African coal mining companies via the strategic method below however it is not implemented which is a massive problem (Anglo American, 2017:44):

- Identifying risks:* A vigorous methodology is used to ascertain key risks across the business, which includes the business units, operations and projects. This must be applied reliably through the development and ongoing implementation of the business integrated RM framework.
- Analysing risks and controls to manage identified risks:* Once identified, the process will evaluate identified risks to establish root causes, financial and non-financial impacts, and likelihood of occurrence. Consideration of risk

treatments is taken into account to enable the creation of a prioritised register and in determining which of the risks should be considered as a principal risk.

- iii. *Determining management actions required:* The effectiveness and adequacy of controls are assessed here. If additional controls are required, these will be identified and responsibilities assigned.
- iv. *Reporting and monitoring:* Management is responsible for monitoring progress of actions to mitigate key risks and to determine if any such risk falls outside the limits of the company's risk appetite. Management is supported through internal controls, which evaluates the design and effectiveness of controls. The RM process is continuous; key risks are reported to the Audit Committee for further attention.

2.7 RISKS AND UNCERTAINTIES

It is important to appreciate that uncertainty is a much wider-ranging term, while risk originates from uncertainty. According to Ritholtz (2012:1), risk is the term used to describe cases of known probability. Uncertainty is when one cannot make any calculated assumption. Uncertainties and Risks are frequently renowned in the language of statistical probability (Ritholtz, 2012:2). Both risk and uncertainty can result in positive or negative influence on a business's operation and thus necessitate knowledgeable management. Risks may kindle from uncertainties associated to natural disasters, politics, management and cultural factors (Nielsen, 2010:4).

2.7.1 Risk

Oxford (2017:1) defines a risk as a "*Hazard, danger; exposure to mischance or peril*" and therefore has a strong undesirable connotation. The COSO ERM framework recognises risk as per "*the possibility that an event will occur and adversely affect the achievement of objectives*" (COSO, 2004:2). Thus, it implies at looking for potential negative effects, and presents a link to business via the association with the 'achievement of objectives' (Nielsen, 2010:16). Corresponding to their explanation of risk, COSO (2004:3) describes opportunities as "*the possibility that an event will occur and positively affect the achievement of objectives.*" This consequently

recognises risk as having a downside and an upside. It is imperative to note that the controlling of risk extends more than just eluding negative 'unwanted events', it is also about taking full advantage of probable opportunities.

Normally, risk is the probability of a dangerous, and negatively unforeseen situation to occur (Oxford, 2017:1). In finance, risk is linked to the hazard in the direction of an investment (Britannica, 2017:1). In terms of business, risk is the likelihood that an event may generate an adverse effect on the company. Business risks are categorised by the effect they might generate on different operational undertakings. Businesses try to avoid risk but the economy as a whole encourages them to take risks because the law of the financial markets is that the higher the risk, the higher the reward (Maylor, 2010:131).

Risks are concerns that require organised management plans that need to be continuously improved. Risks have their specific discrete features in terms of categories and timeframes which require detailed assessments and strategies. With regards to risk in the coal mining industry, (Kozarević *et al.*, 2014:7) emphasizes several key resources or fields that generate risks, as follows:

- Costs;
- Politics;
- Management;
- Engineering;
- Geology;
- Exploration;
- Environment;
- Revenue estimation;
- Resource pricing.

In the coal mining industry, there are various risks which can be ranked into likelihood and consequences and this assists to prioritise the risks (Kozarević *et al.*, 2014:8). The main functional types of risks to which the coal mining industry is exposed to include the following classifications (Kozarević *et al.*, 2013:806):

- Financial risks;
- Operational risks;
- Strategic risks;
- Political, legal and social risks;
- Managerial risks;
- Safety, health and environmental risks;
- Market risks.

Based on the examination of the present state of RM in the coal industry, it is probable to find weaknesses whose removal could considerably develop the ERM process and raise the level of economic protection for coal mining companies within the industry (Kozarević *et al.*, 2014:9). The general groups of risk as well as the nature of them in the coal mining industry will be deliberated below. They involve hazard risks, financial risks, operational risks and strategic risks.

2.7.1.1 Hazard risks

Hazard risks are risks related to the working environment, property, and natural catastrophe (Ritholtz, 2012:3). Originally, hazards referred to potential harms that can affect the health and safety of personnel and property. Besides common hazard groups such as physical, chemical, biological, mechanical and psychological which comes from the work environment or work methods, risk can also develop from uncontrollable factors like natural catastrophes. Interaction with hazards in the place of work does not always result in damage, injuries or health problems. Nonetheless, stopping hazards ensures that damages are minimal and that employees do not work under pressure from being injured or exposure to adverse health effects (Kozarević *et al.*, 2014:11).

2.7.1.2 Financial risks

Financial risk is a wide-ranging term that covers many risks associated with financing such as investment risk, credit risk, liquidity risk, interest rate risk, funding risk and pricing risk. The costs and the experiences involving financial risks that a company

may suffer depend on the scale of the company's financial transactions. Financial RM is regarded as a specialisation of RM. Furthermore, it is the careful review of a company's cash flow and forecasts, hedging techniques including stocks, and insurances used as a technique for decreasing risks in operation and other investments (Kozarević *et al.*, 2014:12).

2.7.1.3 Operational risks

Operational risks are often seen as human related risks because generally human errors lead to a company's operations failure. Nonetheless, operational risks comprise of all risks that occur from a company's internal actions involving people, products or services offered, operational systems, and external factors (Global Association of Risk Professionals, 2011:1). Although coalmines are extremely susceptible to operational risks, other types of industries share a mutual danger from this kind of risk. Some risks may be more extraordinary than others; nevertheless what matters is a robust and appropriate management structure according to the nominated operational risk methodology as discussed in section 2.10 of this Chapter. A General Manager of a mine needs to build an appropriate coordination of staff and resources, along with providing suitable leadership behaviour. Furthermore, monitoring, reviewing and updating the present management structure and information are vital steps in dealing with operational risks (Oracle Financial Services, 2010:1).

2.7.1.4 Strategic risks

Strategic risks suggest the prospects of a loss rising from poor strategic business decisions, plans or from the unsuitable implementation of the strategic plan. Strategic risks pose a danger to cash flow, capital availability, earnings and the company's sustainability. Since strategic plans specify the company's direction, structure, vision and objectives and if the probability of the strategic risks is low, then the company is more resilient (Lundqvist, 2015:441). Therefore, company boards are focusing on how they identify, assess and manage company risks. Strategic RM necessitates the focus on risks that affect shareholder value as the critical goal

(Coetzee & Lubbe, 2013:46). Strategic RM is a principal element of ERM as can be seen in section 2.11 of this Chapter.

2.8 RISK MANAGEMENT (RM)

RM is defined by the Institute of Internal Auditors (2012:1) as follows: *“A process to identify, assess, manage, and control potential events or situations to provide reasonable assurance regarding the achievement of the organization's objectives.”*

The association to the achievement of a company's objectives is crucial because it emphasises the significance of an integrated link amongst RM and general management, which these days is gradually more bound to the achievement of the company's objectives. A company prohibited from attaining its objectives is a certain risk. Caution should be applied to the term control as it can be misinterpreted as suggesting direct control over the possible events themselves, which will not always be the case. Reasonable assurance is significant in highlighting that RM will certainly not prevent all risks from occurring but majority will be covered. Finally, the term process highlights that RM is an instrument, which needs constant updating and has no real final stage; it is a continuous process (Nielsen, 2010:17).

In the world of finance, risk management refers to *“the practice of identifying potential risks in advance, analysing them and taking precautionary steps to reduce the risk”* (Economic Times, 2017:1). Rouse (2016:1) defines risk management as a *“process of identifying, assessing and controlling threats to an organization's capital and earnings. These threats, or risks, could stem from a wide variety of sources, including financial uncertainty, legal liabilities, IT security, strategic management errors, accidents and natural disasters.”* In another definition, risk is an event that, if it occurs, adversely affects the ability of a project to achieve its outcome objectives. Risk management according to Mitre (2017:1), is the *“process of identifying risk, assessing risk, and taking steps to reduce risk to an acceptable level”*. A final Risk management definition states that risk management *“is the process of identifying potential risks in an investment portfolio, and taking steps to mitigate it accordingly”* (IG: 2017:1).

Presenting prioritisation in the definition will show that most management practices to a large extent is about prioritisation and so is risk management. The final missing connection for providing the RM definition for this study is risk communication, which will be discussed in section 2.9 of this Chapter. All the above considerations lead to the following unique definition of RM: *“RM is a process to monitor, identify, assess, manage and prioritize risks. Emphasis is on a coordinated and economical application of resources to minimize and control the probability and/or impact of unfortunate events and not least to maximise the realization of opportunities and to communicate the risks and efforts”* (Nielsen, 2010:17).

Insurance businesses have constantly been working with risk assessments and risk analysis to warrant that their customers and their own yields stay on track. This day and age RM encompasses every type of business, from debt rating agencies regulators, global corporations, to small companies. It was not just the Enron case, or the 2008 financial crisis that agitated the entire world, but further beyond that, losses from companies own operations and failures of other enterprises require managers to focus on RM more pragmatically (Berenger *et al.*, 2016:405). This then links up well with section 2.8.1 in terms of RM at the operations and the value that it brings.

2.8.1. Risk Management in Operations

Risk goes hand in hand with a business's prospects to develop. Consequently, it is regularly accentuated in business strategies that RM is not to forbid the taking of risks completely, but to know the levels of risks, and to appropriately manage risks for improvement and growth. RM contains a set of continuous actions: awareness, identification, evaluation, and development of RM methods (discussed in section 2.10), decision making of suitable methods, implementation, and post management (Harvard Business Review, 2011:1) that can be applied to the operation.

At the same time as the risk-taking behaviour is encouraged under certain circumstances, incorrectly recognising the controllable level of risks leads to unsuitable methods, and lastly to losses in the operation. RM highlights the abilities of a business to foresee changes, not the evading of risk altogether. Actually, many

companies decide to avoid risk as their RM strategy. On one hand, this strategy allows for the shielding from certain losses. In contrast, this strategy negates potential profit and might cause other latent risks to develop (Biasi, 2011:12).

2.9 RISK MANAGEMENT COMMUNICATION

From the time since the famous and extensively discussed Enron and WorldCom corporate scandals, the business industry has seen a rapid growing request for internal and external transparency in decision-making, corporate priorities and financial reporting (Florio & Leoni, 2016:6). Business reputation is a progressively more significant aspect in all from promotion to customers, supplier relations, to investor and employer appeal. The '2008 financial crisis' and its enormous impact around the world fostered extra pressure on businesses for releasing information and communicating around their RM undertakings (Nielsen, 2010:19). Some esteemed financial institutions have failed at this, and almost every industry has been affected by the collapses and tight credit policies after the 2008 financial crisis. Within each of the affected industries, there would have been winning and losing businesses depending on how they had strategically positioned themselves to manage the risks that came with the crisis (Berenger *et al.*, 2016:406). All stakeholders will be attentive to the present and forthcoming wellbeing and resilience of companies when it comes to risk management (Florio & Leoni, 2016:7).

Risk communication is defined as *“an interactive process of the exchange of information and opinion among individuals, groups and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions or reactions to risk messages or to legal and institutional arrangements for risk management”* (Nielsen, 2010:20). Within business RM, there is a greater degree of linkage between risk taking and rewards. Therefore, by investing in a business, investors decide to assume risks in order to receive a possible gain and the board and management team must therefore communicate effectively and manage within a purposely set risk appetite and methodology. Risk management and communication is linked to risk frameworks and will be discussed below.

2.10 RISK MANAGEMENT FRAMEWORKS AND STRATEGIES

RM frameworks act as foundations for the improvement and considerations related to RM. Some of the most important arguments surrounding the RM frameworks will be discussed with special focus on the Committee of Sponsoring Organizations of the Treadway Commission (COSO) ERM framework as it constitutes today's most widely recognised risk management framework (Berenger *et al.*, 2016:406).

2.10.1 Frameworks

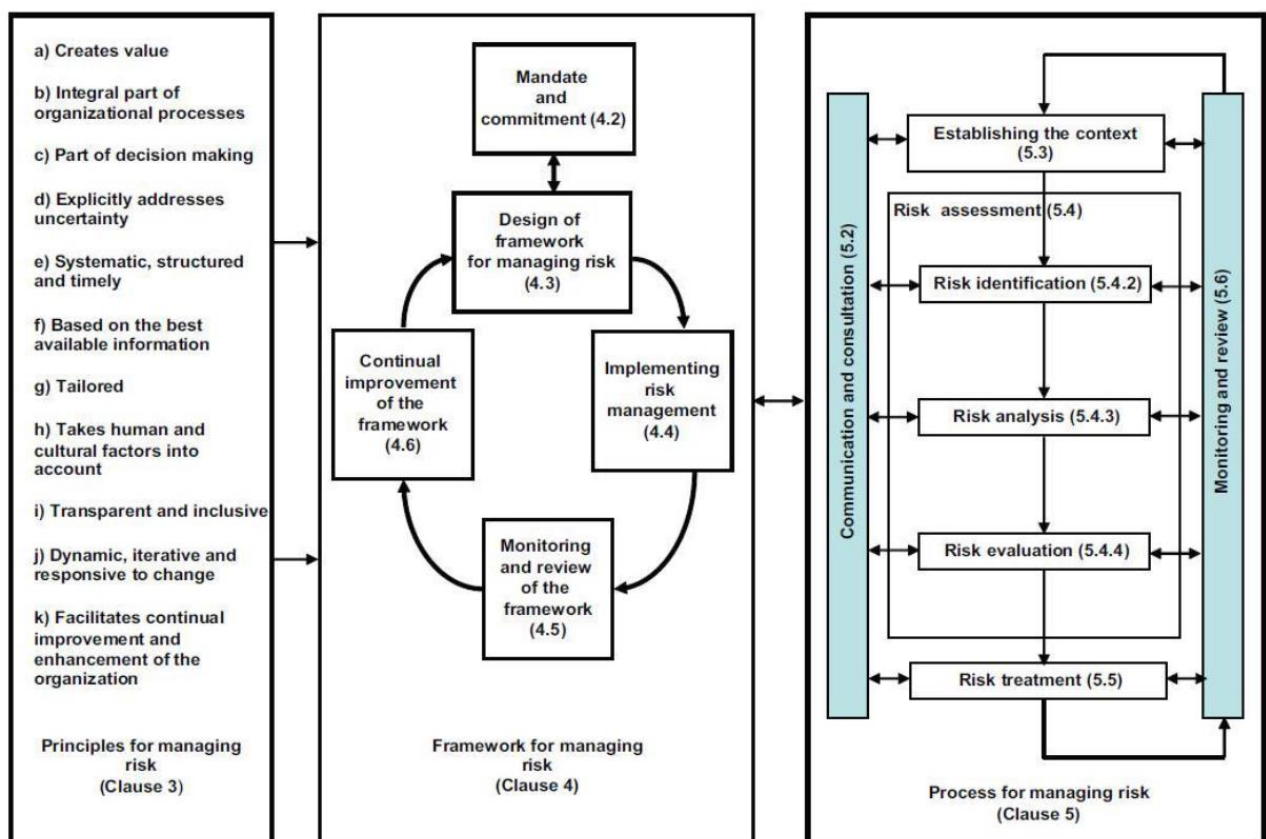
There are a number of institutes, bodies and standard-setters that exist which influence the development of RM and the surrounding frameworks. However, five key contemporary RM frameworks prevail namely (Berenger *et al.*, 2016:406):

- COSO: ERM – Integrated Framework;
- IRM, AIRMIC and ALARM: FERMA Risk Management Standard;
- AS/NZS 4360:2004 Risk Management;
- James Deloach: Enterprise-Wide Risk Management – Strategies for linking risk and opportunity;
- ISO 31000:2009 Risk Management – Principles and Guidelines.

The latest industry accepted RM framework that was developed is that of ISO 31000:2009 Risk Management – Principles and Guidelines that was published in November 2009. The intention with ISO 31000 is to provide “*principles and generic guidelines on risk management and that it is applied throughout the life of an organisation, and to a wide range of activities, including strategies and decisions, operations, processes, functions, projects, products, services and assets*” (International Organization for Standardization, 2009:1). With the extensive scope, the high recognition of ISO within a comprehensive array of disciplines and with ISO's own aim to synchronise risk management processes in present and upcoming standards, this standard is expected to have substantial influence and further expedite the implementation of RM in global and South African mining enterprises (International Organization for Standardization, 2009:1).

Some analysts even foresee that it will be a replacement for existing frameworks such as COSO in the years to come (Optare Systems, 2010:1). Although the different RM frameworks apply different styles and descriptions, they all follow more or less the same overall generic structure which is “*some relationship with objective and strategy setting followed by risk identification, assessment, response planning, action implementation and linked to the general level of control activities*” (Berenger et al., 2016:407). Certification and accreditation is good business practice and ISO 31000 or COSO integrated framework must be the new RM standard in the mining industry especially in the coal mining industry. The ISO 31000 flow chart diagram of the process flow for the standard can be seen in Figure 2.10 below. This diagram will aid in the better understanding of this RM standard.

Figure 2.10: ISO 31000 Risk Management Standard Process Flow



(International Organization for Standardization, 2009:1)

2.10.2 ISO 31000 Strategy Implementation in Mining

According to Piercey (2010:5), *“ISO 31000 brings good news to risk management. Those organisations adopting the standard should expect to see a rising perception of the importance of risk management, more visibility of the risk management process and certainly more traction with the leadership of the organisation”*. The standard has been adopted by multiple countries and mining companies across the world. In a South African context, Goldfields (2016:34) openly states that their existing ERM process is defined by the ISO 31000 international standard. The core components of this process are two-fold: operational and strategic RM. Other mining entities that want to adopt the standard include Rio Tinto and BHP Billiton. Anglo American (2016:40), similarly to Goldfields, states that *“their ERM methodology is based on ISO 31000 and is performed at strategic (markets, global economy), organisational (entity level), operational (safe, profitable) and technical levels.”*

Impala Platinum (2016:32) mentions the standard in their integrated annual report for 2016 as well. Management of health and safety falls under the South African OHSAS 18001. Management of risks, for which the entity has identified numerous strategic risks, falls under ISO 31000. The extent of adoption and implementation of ISO 31000 is unclear, however, gauging from the integrated annual reports, some mining entities in South Africa have made efforts to align their ERM framework to this new standard. There seems to be a common theme emerging among these organisations to incorporate both operational and strategic risks under one comprehensive ERM programme. ERM can be viewed as an integrated RM strategy, which incorporates all aspects of RM.

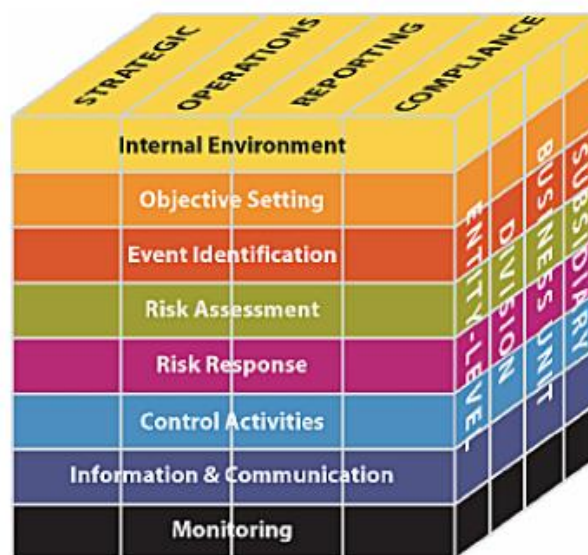
2.10.3 COSO ERM: An Integrated Risk Management Strategy

The COSO ERM framework is an extensively applied and renowned RM framework (more details of the transformation from RM into ERM will be discussed in sections 2.11 and 2.12). The COSO ERM framework is an integrated risk management framework and as apparent from the research of RM programs, many businesses choose to use RM frameworks, such as the COSO framework (Bromiley *et al.*, 2015:265). COSO was formed in 1985 in order to research fraudulent financial

reporting (COSO, 2004:1). COSO distributed their extensively applied Internal Control Framework in 1992, which defined internal control as a “*process designed to provide reasonable assurance regarding the achievement of objectives within the effectiveness and efficiency of operations, reliability of financial reporting and compliance with applicable laws and regulations*” (COSO, 2004:1). Corporate scandals such as Enron and WorldCom activated amongst others the Sarbanes-Oxley act in the United States of America and an overall demand for amplified focus on internal controls and integrated RM. In 2004, COSO published their ERM framework and the key elements in the methodology of the strategy, which can be applied to the coal mining industry are (COSO, 2004:2):

- Present ideas such as: risk appetite, risk tolerance and portfolio vision;
- Propose a common ERM language;
- Explain important ERM components;
- Provide strong direction and leadership for ERM;
- Deliberate on key ERM principles and models.

Figure 2.11: COSO ERM cube



(COSO, 2004:3)

Because COSO ERM is a broadly applied framework, it is unsurprisingly exposed to debate and critique. The COSO ERM framework concentrates on the connection

concerning the objectives that a business desires to achieve and each constituent of the RM process that signifies what is necessary to achieve them and this is presented by the elements in the cube in Figure 2.11 above (COSO, 2004:1). Each of the elements in the cube has its intrinsic worth on how COSO suggests that businesses approach ERM in order to be successful. All elements have significance in the exploration of ERM (Bromiley *et al.*, 2015:266) with the four main ERM characteristics being strategic, operations, reporting and compliance.

The table below summarises the differences between ISO 31000 and the COSO framework, which can be used to decide on which method to utilise at the mine. Both are applicable to the mining industry including coal mining.

Table 2.1: High-level overview of the ISO 31000 and COSO framework

	COSO Framework	ISO 31000
Who it applies to	Companies interested in satisfying internal control needs and in moving to a fuller risk management process	All industries and sectors
Its primary objective	Organisational, compliance and Control	Organisational, may be used for certification or regulatory compliance
The type of document	Guidance document or framework	Internationally recognised standard as an established norm or requirement

(Kganakga, 2013:102)

2.11 ENTERPRISE RISK MANAGEMENT (ERM)

At the moment, managing risk is becoming a serious concern and the capability to identify risks and adjust to the continuously changing business culture are amongst the critical success factors for businesses (Arena *et al.*, 2010:662). ERM is an integrated risk management framework, which has many advantages and will be discussed in detail. Management decisions in recognising risks and reacting to them led to different methods in dealing with risk. Therefore, the need to effectively detect

and react to the numerous risks results in the implementation of an integrated RM program by many companies (Woon *et al.*, 2011:32).

As companies develop, related risks propagate at the same time and together new areas of RM opens up. Therefore, organisational RM adapts to a specialised RM via the more integrated approach of Enterprise Risk Management (ERM). Nielsen (2010:23), defines ERM as *“The process by which organisations in all industries assess, control, exploit, finance and monitor risks from all sources for the purpose of increasing the organization's short and long term value to its stakeholders.”* Whereas traditional RM sees risk as individual hazards, ERM puts risks in the perspective of the business strategy. ERM offers a foundation for risk mitigation and coherent management. Traditional RM methods look at the downside of risk by looking at probable losses from risk events whereas ERM motivates management to be acquainted with risks from both a positive and negative standpoint (Investopedia, 2017:1).

The Casualty Actuarial Society (2017:1) intellectualised ERM as a means to developing the company's value. The process of ERM is subject to the risk types: financial risk, operational risk, hazard risk, and strategic risk as discussed in section 2.7.1 above (Lundqvist, 2015:443). ERM is an all-inclusive methodology for managers to recognise risks and select suitable responses to the risks in line with the company's risk appetite. A few decades ago, RM was not viewed as a strategic and critical managerial function. It was largely influenced by the managers' insight of risk affecting the business (Soltanizadeha *et al.*, 2014:228).

COSO (2004:1) definition for ERM is as follows *“Enterprise risk management is a process, affected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risks to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives.”* The important arguments are that the 'Enterprise' link to RM adds the inter-business element, in that it stresses that solitary risks are not seen in separation but viewed from an enterprise wide portfolio view. The definition further unambiguously includes the component of risk appetite, which discretely places the

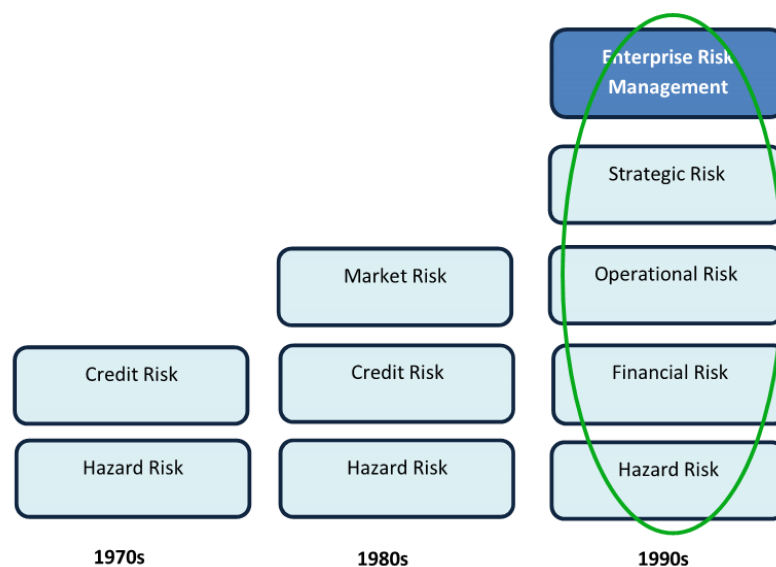
responsibility on management to proactively act according to the risk level that the business wants to take on. The objective element of the definition clearly includes the accomplishment of the business objectives namely that “*successful ERM is about optimising the likelihood of the entity reaching its objectives*” (Nielsen, 2010:24).

An additional prominent element of definition is the statement that “*ERM is affected by an entity’s board of directors, management and other personnel*”. This implies that ERM comprises of each person in the company and is to be rooted from the top to the bottom of the company and that it is to be utilised in strategy setting. This fundamentally implies that ERM brings the separate silo-based RM activities together (discussed in section 2.7.1), and ensures an inclusive strategic perspective (Nielsen, 2010:25). This can open up opportunities and even reduce the cost of essential risk relieving actions.

2.12 THE EVOLUTION OF ENTERPRISE RISK MANAGEMENT

ERM has risen as one of the key features of the global expansion of the RM industry, which began in the early 1990s originally in the financial services and insurance industries as seen in Figure 2.12.

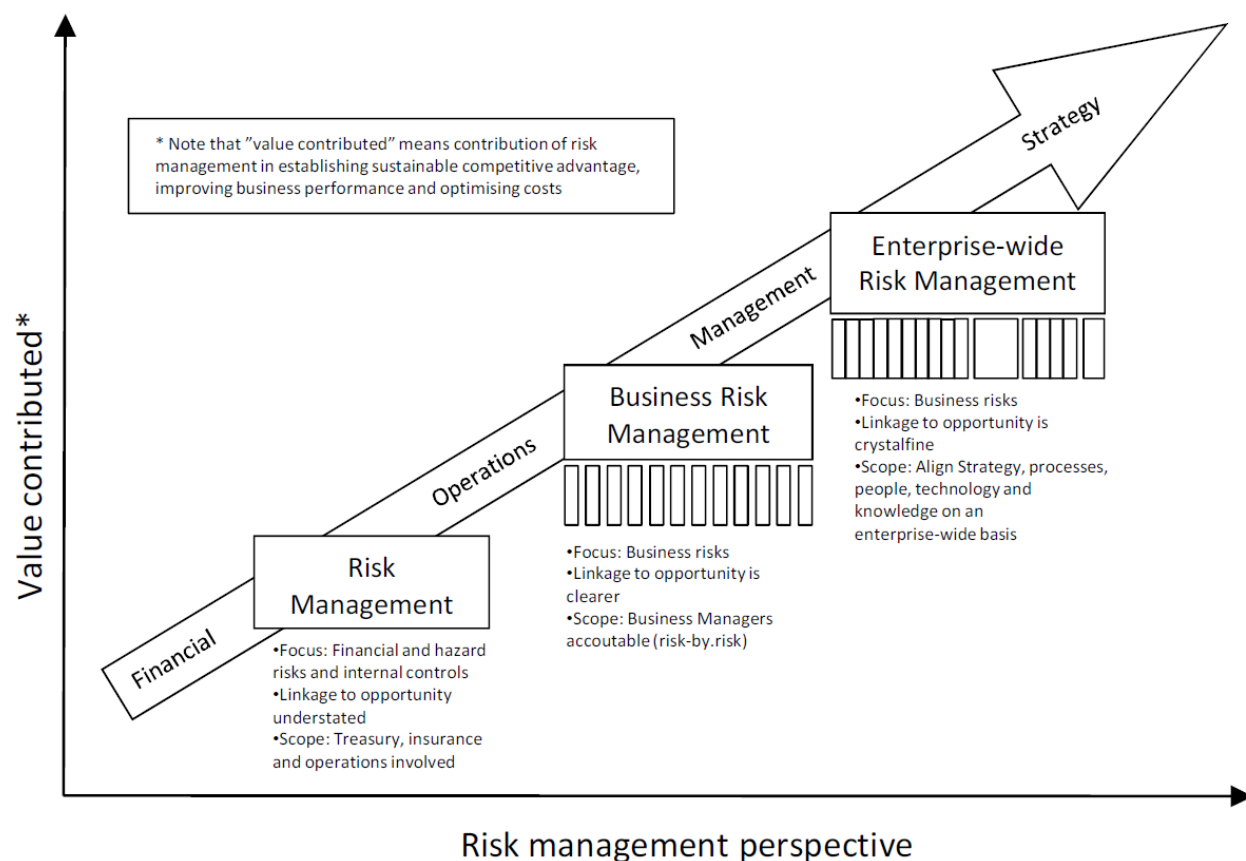
Figure 2.12: The evolution of RM into ERM



(Kganakga, 2013:9)

The expansion was instigated by shareholder and regulatory bodies concerns over the lack of control of banking institutions in the late 1980s, the derivatives tragedies of the 1990s and the corporate scandals of the 2000s. This manifested a declaration of regulatory, academic and practitioner dialogue around RM. Confronted with institutional pressures to prove enhanced governance and internal control, the financial industry saw a quick development of philosophies, procedures, practices, and tools under the umbrella of integrated RM or ERM (Kganakga, 2013:8). This integrated RM framework then spread to numerous other industries. RM traditionally focused on hazard risk and financial risk as seen in Figure 2.12 above. In the 1980s, market risk was added to the mix. In the 1990s, seeing risk from an enterprise integrative RM view began to be considered and so the application and implementation of ERM commenced.

Figure 2.13: The evolution of RM Model



(Nielsen, 2010:25)

An extensively used model for the improvement of RM methodology over time is the evolution of RM model, which is depicted in Figure 2.13 above. The model shows

how RM evolved into Business RM and then to ERM. The ERM meaning applied here mainly follows an amalgamation of RM and business RM. The model is fruitful in stressing the integrative method of ERM via a resilient link to opportunities and the alignment between people, strategy, technology, knowledge and processes.

2.13 THE STRATEGIC ADOPTION OF ERM

Arnold *et al.* (2015:2) defines the change in the progress of ERM as a much comprehensive and more essential framework to adopt than traditional RM. Arnold *et al.* (2015:2) explains that adopting ERM requires a cultural adjustment and a commitment from top management and the board of directors is vital to a prosperous ERM adoption. Working with risks from an enterprise outlook requires that information about risks be shared willingly which can be a challenge in many companies (Malhotra & Mackelprang, 2012:186). Financial service companies for example Deloitte and PricewaterhouseCoopers provide a range of ERM services to assist companies to integrate RM into their company strategy. ERM is seen as a serious management subject and therefore ERM tools are being utilised by progressively more companies (Farrell & Gallagher, 2014:631).

Adopting ERM may improve RM in a company and consequently heighten decision making abilities leading to company value maximisation (Daud *et al.*, 2010:35). In spite of the benefits of ERM, many businesses in the world still have to adopt it (Razali *et al.*, 2011:203). As an example, a study by RIMS (2011:1) of 1431 risk managers of US based companies established that only 17 percent of companies had a fully integrated ERM program, 37 percent had a partially integrated ERM program, and 23 percent had just started to invest in an ERM program, 3 percent had no program or plan for the next few years while 20 percent had no plan to adopt ERM at all.

As discussed before, traditional RM methods involve the silo type of approach in order to manage the numerous risks in different divisions of a company. In contrast, ERM is a moderately new framework that improves the skill of anticipating the portfolio of risk that a company will come across (Hayne & Free, 2014:311). ERM is seen as a top-down approach, which constitutes identifying, assessing, and

responding to strategic, operational, and financial risks in order to achieve four objectives (Harner, 2010:14) which is linked to section 2.10.3:

- Strategy - high level goals that align with company mission;
- Operations - effective and efficient use of resources;
- Reporting - reliability of reporting;
- Compliance - compliance with applicable laws and regulations.

Soltanizadeha *et al.* (2014:229) allocated companies into five groups centred around the level of ERM adoption and implementation. They include full adoption, partial adoption, in the planning process of adoption, thinking or assessing the possibility of adoption, and those who do not intend to adopt ERM. A study by Pagach & Warr (2011:190) discovered a rise in ERM adoption and appointments of Chief Risk Officers (CROs) among companies in unrelated industries. ERM adoption varies among the different industries with ERM being more rooted in certain industries such as the insurance and financial sectors. Pagach & Warr (2011:201) also assessed the effect of ERM on a company's long-term performance and it was found that instead of stakeholder pressure, economic value was the reason for companies around the world to adopt ERM. For example, Solthanizadeha *et al.* (2014:228) also clarified how ERM adoption affects a company's performance and that there is a definite connection between ERM, the cost of capital and business performance.

2.14 TRADITIONAL RISK MANAGEMENT (TRM) VERSUS ENTERPRISE RISK MANAGEMENT (ERM)

Historically, the management of risks has been done in silos as explained above in section 2.7.1. Financial risks, hazard risks, insurance risks, technology risks and market risks were all managed individually in separate sections (Hoyt & Liebenberg, 2011:797). Such a technique means that the "siloeed" management of risks may result in undesirable consequences at the enterprise level (Kganakga, 2013:10). Risks considered tolerable when assessed individually may result in an intolerable level of risk when considered altogether. Each set of individual risk solutions speaks a different RM language as Hoyt & Liebenberg (2011:801) explains. These several

languages of risk all need to be translated into one language that is relevant to all stakeholders especially management. This 'one language' can be achieved through ERM.

As the business and economic scene fluctuates due to forces of globalisation in which businesses operate in, an assortment of more risks challenges companies (Barton *et al.*, 2010:21). This growing risk situation necessitates that senior management adopt ERM. Beasley *et al.*, (2011:1) describes ERM as a formal process that is enterprise wide and that addresses risks in a group, where the relationships among the risks are well assessed. The goal of ERM is defined by Kganakga (2013:11) as *"the coordinated management of all risks faced by a company, whether it is risk related to corporate governance, auditing, supply chains, distribution systems, IT, or human resources with a purpose of gaining a systematic understanding of the interdependencies and correlations among risks"*. Consequently, ERM signifies the state of awareness crucial to make universally effective business decisions (PricewaterhouseCoopers, 2013:1). It is important to have an Enterprise Risk Profile of consistent categories, which has a collective depiction of a company's risk profile, accounting for all types of risk within the company and through the different business units and risk types (Baker, 2013:49). The Enterprise Risk Profile of a business is greatly associated to the corporate policies and strategic decisions that are made by management (Danijela *et al.*, 2015:768).

An additional distinctive feature of ERM is the notion of entrenching RM all the way through the company as a culture rather than as an extra bureaucratic task. Danijela *et al.* (2015:769) found that RM is more effective when it is an integrated part of the company's practices, rather than as an added extra that employees have to accommodate above their usual jobs. ERM encourages a risk-aware culture whereby employees are aware of and understand risk in the circumstances of the company. It is also where all resolutions in the company, from strategy to operations, involve the consideration of risk and where RM tools are used in everyday actions of all employees (Bertinetti *et al.*, 2013:1). An essential element of ERM is that risks and strategy are aligned and are integrated into the strategic planning and

performance metrics of the company (Beasley *et al.*, 2011:1). Below is a summary table of the key differentiators between ERM and TRM.

Table 2.2: TRM vs ERM Summary

Traditional risk management (TRM)	Enterprise risk management (ERM)
Fragmented departments or functions manage risk independently. Work in Silos.	Integrated risk management coordinated with senior-level oversight. Everyone in the company views RM as part of their jobs.
<i>Ad hoc</i> risk management done whenever managers believe a need exists to do it.	Continuous risk management process
Narrowly focused primarily on insurable and financial risks.	All business risks and opportunities considered within an organisation's risk appetite - Strategic objectives are the focal point for all risk encounters.

(Kganakga, 2013:10)

2.15 THE VALUE OF ENTERPRISE RISK MANAGEMENT

It is important for leaders and risk managers to be able to clearly articulate the value that an effective ERM program can bring to a company. Some of the value that ERM can bring to a company especially in the coal mining industry is outlined below (PricewaterhouseCoopers, 2014:1):

- *Provides early warning indicators* – ERM enables the leaders to identify potential events and respond to them early on, when there are still options and responses that can still be effective, thus avoiding unwanted surprises.
- *Enhanced transparency and a portfolio view of risk* – ERM provides leadership with the ability to see how risks from across the company interrelate, including how they potentially impact one another, and to respond accordingly.
- *Enhanced strategy and prioritisation* – ERM provides the timely risk information necessary to enable the agency to develop and pursue a well-

informed strategy that supports effective prioritisation of initiatives and activities across the agency.

- *Aligned risk appetite* – ERM facilitates the alignment of risk appetite from the top management decisions of the company integrated into daily business decisions.
- *Realisation of opportunities* – Effective ERM programs support not only risk identification and management, but also the identification and capitalisation of opportunities to more effectively meet the organisation's mission, goals, and objectives.

In order to ensure that the value of RM is seen in the company, internal controls are required and they are discussed in section 2.16 below.

2.16 DEFINING INTERNAL CONTROL AND ITS ROLE IN THE COMPANY

Vijayakumar and Nagaraja (2012:1) explain that *“internal control is one of the several factors influencing the performance of an organisation. It plays a vital role in achieving the organisation's intended objectives and it is fundamental to the success of the operation”*. Dietz and Snyder (2011:36) unpacks internal controls as *“processes, policies, procedures and systems that are established, operated and monitored by officers responsible for governance and management of the organisation, to provide reasonable assurance regarding the achievement of the organisation's objectives”*.

Vijayakumar and Nagaraja (2012:2), and Dietz and Snyder (2011:37) summarised the main purpose of effective internal control as the managing of risks, protecting assets of an organisation, deterring fraud, and improving compliance. The increasing number of business failures and some widely publicised scandals has encouraged companies to put more emphasis on their internal control systems. Jokipii (2010:116) notes that management is under increased pressure to enhance the effectiveness of internal controls and to effectively communicate this to the board of directors, shareholders and other stakeholders. Auditors, suppliers and customers of

organisations are also interested in internal controls since they may affect long-term confidence in reporting, accountability and in the corporate form of organisation.

Jokipii (2010:116) and Giriunas (2012:42) claims that despite the fact that internal control is an essential factor affecting the organisation, evidence of the actual performance of an internal control system within the organisational environment is almost non-existent and that the topic is relatively unexplored by researchers, even more so for the coal mining industry. Blaskovich and Taylor (2011:6) also found that the concept of internal control is narrow in scope as it is largely confined to accounting systems to support the accounting process.

2.16.1 Significance of Risk Management in the Internal Control System

The internal control system has been purported to be essential for organisations to reduce risks concerning the achievement of its objectives and pursue lasting growth. Although RM and internal control emanate from different backgrounds and have been developed through different paths, they have numerous common objectives, deal with various risks surrounding business landscape and work to maintain and enhance the value of the organisation.

As environments surrounding organisations are changing and the responses thereto of the companies are exposed to stricter criticism from markets, it has become necessary to integrate ERM with internal control and understand how they relate to each other. Mikes and Kaplan (2013:2) point out that the common thread in the recent corporate governance reforms, the COSO ERM Framework, ISO 31000 and other regulations is that they all frame RM as a corporate governance requirement, implying a relation with internal control. The Sarbanes-Oxley Act of 2002 Section 404, explained by the Securities and Exchange Commission (2009) and the South African King III (or King IV) Report on Corporate Governance (Institute of Directors, 2009:2) also relate RM to internal control, implying a risk-based assurance of internal control.

Kganakga (2013:43) points out that as a result of these reforms, organisations in the various sectors are faced with a growing number of options for managing the internal

control system, including the adoption of ERM. According to Kganakga (2013:44) these various corporate governance guidelines have also placed significant emphasis on an organisation's strategy to RM as a key mechanism that overarches the design of internal controls throughout the organisation. Vijayakumar and Nagaraja (2012:3) purport that RM forms an integral part of internal control. They explain that RM is essential for reducing the probability that corporate objectives will be jeopardised by unforeseen events. In doing so, internal control is one of the principal means by which risk is managed.

Vijayakumar and Nagaraja (2012:3) assert that internal control comprises the process of defining all risks that an organisation faces and then building a framework, not only to monitor and mitigate those risks but also to use RM as a tool to increase shareholders value. An organisation's objective and the environment in which it operates are constantly evolving and as a result, the risks that it faces also change. A sound system of internal controls depends on a thorough and consistent evaluation of the nature and extent of the risks to which the organisation is exposed. The systems and processes of control need to be adequately flexible to be able to change and adapt as the environment and the organisation's objectives and activities develop over time.

Since profits and increases in shareholder value are in part, the reward for successful risk taking in business, the purpose of internal control is to help manage and control risk appropriately, rather than to eliminate it. Put simply, internal controls help to provide reasonable, but not absolute assurance that a company will avoid being hindered in achieving its business objectives (Giriunas, 2012:43).

2.17 ERM MATURITY

Beasley *et al.* (2011:2) acknowledges that an increasing number of business leaders are realising that traditional approaches to RM require enhancement so that they are in a more-informed position to proactively manage emerging risks, especially those that are most likely to disrupt organisational objectives. However Arena *et al.*, (2011:779) found that ERM still means different things to different people. For instance to the mining industry it is just a compliance/ tick-box exercise, to the

finance industry it is a corporate governance requirement and to others, it is an instrument that can help an organisation to manage its risk effectively.

Coetzee and Lubbe (2013:46) found in their study that the South African private sector organisations listed on the Johannesburg Stock Exchange (JSE) are on average risk maturity, with a few organisations in the sample being risk mature. In assessing the level of adoption or maturity of ERM processes within organisations, there are various Capability Maturity (CM) models for benchmarking the maturity of ERM. In principle, the CM models describe capability maturity on a scale ranging from practically non-existent, to fully integrated and proficient levels (Coetzee & Lubbe, 2013:47).

At the initial stages (immaturity), ERM is either non-existent within the organisation, or performed only on an ad hoc basis. There is no formal process or practice to cross-assess the organisation's risks, thus providing a narrow view of risks. A more enterprise level RM is adopted at intermediate levels; RM is an explicit and formal process within the organisation and is consistently applied, with support from senior management and when the role of the CRO exists, a wider range of risks is considered.

Table 2.3: ERM Maturity

ERM Capability Maturity			
	Immature	Intermediate Levels/ Partial	Mature/Advanced
	• Ad hoc • Reactive • Absence of formal process • Absence of structure • Risk averse • Implicit treatment of risk • Lack of risk awareness • Narrow range of risks	• Explicit, Formal process • Consistency of application • Specific risk management tools • Risk is supported • Some monitoring and control • Wider range of risks considered • Position of chief risk officer (CRO) exists • Objectives policies, procedures, defined and communicated	• Institutionalised (integrated) • Proficient • All of the company's key risks considered • Board-level oversight • Strategically focussed • Pervading culture • Pro-active, flexible, adaptive • Organisational learning • Independent ERM function under leadership of CRO • ERM performance measurement and reporting capability • Performance-linked metrics

(Kganakga, 2013:12)

The RM processes reach maturity when they become integrated as a proficient capability throughout all business processes, which are tied to the organisation's *strategic* objectives and are dynamically adaptive to the needs of the organisation. At this level, RM pervades the culture of the organisation, is almost intuitively pro-active rather than reactive, and continually evolves as organisational members learn from experience, training and education (Beasley *et al.*, 2011:4; Shenkir & Walker, 2011:5). Table 2.3 above shows the typical descriptions of the ERM process maturity.

Capability Maturity models describe the characteristics of effective ERM, but the definitions are not necessarily grounded on sound empirical analysis of actual RM processes in organisations. These models as a result derive their process definitions and characteristics from translation of the principles of ERM as outlined in the various RM frameworks such as ISO 31000 and the COSO ERM Integrated Strategy.

2.17.1 ERM Strategy in the Mining Industry

Mining has become a potential catalytic force for fostering the economic growth of many countries especially in the developing world countries such as South Africa because the industry is a catalyst for the global economy (Creamer, 2012:1). When mining started on an industrial scale in the 1880s, miners faced very high levels of risk to both safety and health. Creamer (2012:1) points out that over the years the safety performance of mines in South Africa have improved, but not at the same rate (seen in section 2.4) as in other major mining countries such as Australia, Canada and the USA. Boegman (2013:1) emphasises that it is imperative that mining companies rethink risk and the risk landscape in which they operate, and gone are the days when risks for mining companies were limited to just health and safety matters.

Coal mining companies now need to integrate risk and performance management and they need to evolve their RM strategy to be more predictive in order to anticipate and plan for negative potential events. Deloitte (2012:3) concurs that whilst some traditional RM strategies may have served the industry well in the past, the scope,

complexity, and interdependencies of emerging risks are forcing many mining companies to adopt comprehensive and integrated strategies to RM. Kganakga (2013:15) found that the coal mining industry has become more risky over the years and it has in fact, become more uncertain.

2.17.1.1 ERM Strategy in a Complex South African Mining Industry

From a South African perspective, policy uncertainty, for example the highly debated topic of resource nationalisation and the new mining charter which was released in June 2017, caused havoc in market perceptions and this could have a significant impact on the operational performance of coal mining companies operating in South Africa. The industry is frequently rocked by problems concerning retrenchments, unemployment, low productivity, rising costs, volatile exchange rates, commodity prices and government regulations (Deloitte, 2016:4).

The South African coal mining industry is highly regulated and is considered by some to be a strategic resource. It operates under legal and fiscal frameworks linked together by various national, regional and commodity-focused associations committed to representing the industry, protecting its interests and improving performance (ICMM, 2012:2). Each jurisdiction publishes information that summarises key aspects of its mining law and administration. Non-compliance with regulatory requirements could result in forfeiture of mineral rights. Coal mining is also a hazardous activity. Apart from personal suffering, work-related injuries could lead to a shutdown of operations resulting in lost production and jeopardising the company's license to operate.

Besides the higher complexity and difficulty of having a clear overview of risks in larger organisations, regulations or good practices tend to require companies to report about RM in their annual reports. An example of such regulations or good practices are the requirements of the South African King III (or King IV) report on corporate governance, which have resulted in improved disclosure of risks by all companies. According to Boegman (2013:2), coal-mining companies in particular have been good at disclosing these risks. The regulatory, political and legal environment, followed closely by employee skills and safety are amongst the most

common risks disclosed by the companies (Boegman, 2013:2). However, the challenge remains to adequately embed ERM in the various coalmine operations, thus taking a holistic company-wide strategy to managing a company's risks.

2.18 ERM STRATEGY IMPLEMENTATION IN COAL MINING

Traditionally, the coal mining industry focused on RM to a lesser degree than other sectors however, the risk landscape is changing, with coal mining companies facing greater complexity and volatility. According to Chetty (2013:31), 32 percent of global mining companies feel that their level of risk has increased significantly. Overall, 61 percent of respondents to the Global Risk Survey, from the mining sector, viewed the level of risk to have increased either slightly or significantly, and within the mining sector, these higher levels of risk have become accepted.

In the traditional strategy of RM, mining companies manage individual risks undertaken by business units, in silos as discussed in prior sections. As such, the individual business units have little or no overarching view of the risks facing the business as a whole. The industry has focused on reshaping this strategy into a holistic and organisation wide ERM practice that is at the heart of organisational culture. It takes larger corporations three to seven years to bring about a fully-operational ERM strategy. Vandendooren and Vergauwe (2010:1) showed that 48 percent of respondents to Deloitte's ERM Global Benchmark Survey stated that their ERM programme was fully operational, while the remainder viewed their programme to be in a state of development. This industry-wide practice is largely driven by '*operational performance and regulatory compliance*'. South African coal mining companies need to follow this trend and start implementing ERM or integrated RM as of yesterday.

According to Vandendooren and Vergauwe (2010:2), key themes identified in the survey were: ERM programs are achieving enterprise wide coverage and risk-informed decision making in developing ERM scopes have expanded in recent years, progressing towards a real enterprise wide management practice. Risk information is increasingly incorporated into the critical decision making processes. Leading mining companies such as BHP Billiton and Rio Tinto are making the critical

link between risk and performance management through the emerging discipline of risk-adjusted performance measurement. Mining companies are embracing the philosophy of ERM, but its implementation presents a long road ahead.

As a testament to a growing emphasis on ERM, Standard & Poor's announced that it would include ERM factors when assessing the credit ratings of non-financial organisations. According to Dreyer (2010:2), when Standard and Poor's analyses the credit worthiness of corporate businesses, they always consider management assessment and credibility as important factors. They considered ERM as a catalyst to perform an in-depth review of management's understanding of financial markets and the operating environment, as these become more complex and risky.

Whilst ERM has been embraced by some coal mining companies, its implementation to reach complete and successful ERM programmes is a challenging process. According to the 2016 risk survey completed by Ernst & Young (2016:18), almost 25 percent of mining respondents rated their organisation as closer to poor rather than excellent and 55 percent believed that key operational and environmental risks were not actively managed. The study also shows that companies in the mining and metals sector are struggling to manage risk due to a lack of implementation of standardised RM information, processes and technologies.

The study further shows that companies realise the benefits of having a solid RM practice in place, illustrated by the fact that over 61 percent of respondents felt that *"increased resiliency and responsiveness, enhanced enterprise risk/reward opportunities, more accurate business plans, improved rate of return, and improved forecast accuracy"* would all, moderately to significantly, impact upon their business. According to Chetty (2013:21), all mining including coal-mining companies should consider ERM as one of the leading business priorities due to *"the level of risk inherent in the mining industry, the uncertainty pertaining to commodity prices and exchange rates fluctuations, and the level of investment required to meet future demand."*

2.19 TYPICAL RISKS FACING THE COAL MINING INDUSTRY

Coal mining companies such as Coal of Africa and Kuyasa Mining as well as diversified mining companies such as Anglo American, Glencore, BHP Billiton and Rio Tinto recognises that risk is inherent in all their business activities. Their risks can have a sustainability, financial, operational or reputational impact. The volatility in commodity markets over the past few years provides a good illustration of risk inherent in the mining business. As understanding the risks and developing appropriate responses are critical to a company's future success, they must highlight in their annual reports their commitment to an effective, robust system of risk identification, and an effective response to risks, in order to support the achievement of the company's objectives (Anglo American, 2017:41).

Table 2.4: Summary of typical risks facing the coal mining industry

Risk type	Explanation
External Risks	
Uncertainty and adverse changes to mining industry regulation, legislation or tax rates	Mining companies have no control over political acts or changes in local tax rates. Their licence to operate through mining rights is dependent on compliance with regulations. Increased costs can be incurred through additional regulations or resource taxes. Political instability can also result in civil unrest or nullification of existing mining permits or leases (Anglo American, 2017:45).
Fire and explosion risks are present at all mining operations, and processing facilities	Multiple fatalities and injuries, damage to assets, loss of production, reputation damage and loss of licence to operate. Financial costs associated with recovery and liability claims may be significant (Anglo American, 2017:45).
Fluctuations in commodity prices may negatively affect results, including cash flows and asset values	Fluctuations in commodity prices can occur due to price shifts reflecting underlying global economic and geopolitical factors, industry demand, increased supply due to the development of new productive resources or increased production from existing resources, technological change, product substitution and national tariffs (BHP Billiton, 2017:28).

Financial results may be negatively affected by exchange rate fluctuations	Fluctuations in the exchange rate currencies may have a significant impact on financial results. Operating costs are influenced by the currencies of the countries where assets and facilities are located and also by those currencies in which the costs of imported equipment and services are determined (BHP Billiton, 2017:28).
Reduction in Chinese demand may negatively impact results	The Chinese market has been driving global materials demand and pricing over the past decade. A continued slowing in China's economic growth and demand could result in lower prices for products and negatively impact results, including cash flows (BHP Billiton, 2017:28).
Actions by governments, emerging markets or political events in the countries could have a negative impact on business	There are varying degrees of political, judicial and commercial stability in the locations in which companies have assets around the globe. At the same time, exposure to emerging markets may involve additional risks that could have an adverse effect on the profitability of an operation. These risks could include terrorism, civil unrest, judicial activism, regulatory investigation, nationalisation, protectionism, renegotiation or nullification of existing contracts, leases, permits or other agreements, imports, controls or prohibitions on the production or use of certain products, restrictions on repatriation of earnings or capital and changes in laws and policy, as well as other unforeseeable risks (BHP Billiton, 2017:28).
Business risks	
Failure to discover or acquire new resources, maintain reserves or develop new operations could negatively affect future results and financial condition	The demand for products and production from operations results in existing reserves being depleted over time. Exploration activity occurs adjacent to established operations and in new regions, in developed and less-developed countries. A failure in the ability to discover or acquire new resources, maintain reserves or develop new operations in sufficient quantities to maintain or grow the current level of reserves could negatively affect results, financial condition and prospects (BHP Billiton, 2017:29).

Increased costs and schedule delays may adversely affect development projects	Incidents or unexpected conditions encountered during development projects may cause setbacks or cost overruns. Required licences, permits or authorisations to build a project may be unobtainable at anticipated costs, or may be obtained only after significant delay and market conditions may change, thereby making a project less profitable than initially projected (BHP Billiton, 2017:29).
Financial risks	
Profitability, liquidity and cash flow significant deterioration	If key financial ratios and credit ratings are not maintained, liquidity and cash reserves, interest rate costs on borrowed debt, future access to financial capital markets and the ability to fund current and future major capital programs could be adversely affected (BHP Billiton, 2017:29).
Operational risks	
Unexpected natural and operational catastrophes may adversely impact operations	Operational processes may be subject to operational accidents, such as port and shipping incidents, underground mine and processing plant fire and explosion, open-cut pit wall or tailings/waste storage facility failures, loss of power supply, railroad incidents, loss of control, environmental pollution, and mechanical critical equipment failures and cyber security attacks on company infrastructure. The operations may also be subject to unexpected natural catastrophes such as earthquakes, floods, hurricanes and tsunamis (BHP Billiton, 2017:30).
Cost pressures and reduced productivity could negatively impact operating margins and expansion plans	Although efforts are to reduce costs, a number of key cost inputs are commodity price-linked, the inability to reduce costs and a timing lag may adversely impact operating margins for an extended period (BHP Billiton, 2017:30).
Breaches in, or failures of information technology	These systems may be subject to security breaches (e.g. cyber-crime or activists) or other incidents (e.g. from negligence) that can result in misappropriation of funds, increased health and safety risks to people, disruption to operations, environmental

may adversely impact business activities	damage, poor product quality, loss of intellectual property, disclosure of commercially or personally sensitive information, legal or regulatory breaches and liability, other costs and reputational damage (BHP Billiton, 2017:30).
Sustainability risks	
Safety, health, environmental and community impacts, incidents or accidents may adversely affect people, operations and reputation or licence to operate	Safety Potential safety events that may have a material adverse impact on people, operations, reputation or licence to operate. Health Health risks faced include fatigue, musculoskeletal illnesses and occupational exposure to substances or agents including noise, silica, coalmine dust, diesel exhaust particulate, nickel and sulphuric acid mist and mental illness. Environment Environmental incidents have the potential to lead to material adverse impacts on people, operations, reputation or licence to operate. These include uncontrolled tailings containment breaches, subsidence from mining activities, escape of polluting substances and uncontrolled releases of hydrocarbons. Climate change The impacts of climate change may affect operations, productivity and the markets in which companies sell their products. The effects of climate change on the operations may include changes in rainfall patterns, water shortages, rising sea levels, increased storm intensities and higher temperatures. Community Community related risks may include community protests or civil unrest, complaints to grievance mechanisms and civil society activism and may cause delays or changes to proposed

	developments and interruptions to existing operations. Loss of reputation Fraudulent behaviour and dishonesty may lead to regulatory fines, disgorgement of profits, litigation, allegations or investigations by regulatory authorities, loss of operating licences and/or reputational damage (BHP Billiton, 2017:31).
Strategic risks	
Ability to secure planned value by successfully executing divestments and acquisitions.	Mining houses must become successful in acquiring businesses that provide cash flow and/or future growth, above that anticipated at the time of acquisition. Companies must look into the (RioTinto, 2017:14): • Business model • Future performance • Solvency • Liquidity • Group reputation
Labour Unrest	Workforce strikes or industrial action due to labour disputes has an impact on all the other disciplines: production, finance, engineering which can extend to the whole labour force. It can potentially lead to huge losses for the company.
Skills deficiency and shortage problems as well as talent retention	Skills deficiency and shortages are apparent in most countries and South Africa, amidst unemployment, the laying off of staff has a consequence effect of losing staff that companies want to retain, resulting in lose-lose situations.
Long term business strategy	Risks related to company strategy and sustainability of the business, touching on most of the risks above.
Nuclear and Renewable Energy - Not forecasting demand well enough	Another risk could be that buyers no longer want to use coal and this thus becomes loss of revenue to the mine due to macroeconomic factors. For example, if Eskom goes nuclear then this may result in less coal purchased by Eskom. Similarly, with increased renewable generation, SA is becoming less reliant on coal generation.

2.20 CHAPTER SUMMARY

It is evident from the literature that has been reviewed that the academic knowledgebase of integrated RM, ERM and internal controls is very limited. Even more so from a South African perspective, particularly in mining, it is almost non-existent in especially coal mining. However, guidance does exist in the form of corporate governance guidelines that mines can utilise to inform best practice application in a local context.

Discussions following the global financial crisis of 2008 have generated renewed regulatory and corporate interest in RM, corporate governance, internal control, and the promotion of ERM as the strategic model for RM (Blaskovich & Taylor, 2011:6). Despite the intense concern related to RM within businesses, there has not been enough academic research in the mining ERM area. Inadequate research has been done to study the facets of whether ERM adds value to mines and there is lack of empirical evidence to suggest the effectiveness of the ERM programmes in mining (Gates *et al.*, 2012:28). Even more so, from a South African perspective, particularly in coal mining, ERM literature is almost non-existent. This was confirmed via a thorough data base search by the researcher and two NWU librarians whom searched databases such as EBSCOhost, Google Scholar, SAEpublications and ScienceDirect.

Vijayakumar and Nagaraja (2012:3) affirms that ERM is an integral part of the business processes at all levels of the organisation. It is a strategic system established and operated in a company to carry out its business properly and efficiently. Internal controls is at the same time essential for a company to reduce risks concerning the achievement of its objectives and pursue lasting growth (Arena *et al.*, 2011:780; Gates *et al.*, 2012:29; Vijayakumar & Nagaraja, 2012:4). The coal-mining sector is faced with a growing number of risks and some have adopted ERM to improve their RM via internal controls (Gates *et al.*, 2012:29). The literature has placed significant emphasis on the mining industry's strategies to RM as a key mechanism that overarches the design of effective ERM in the organisation. Based on the RM literature, the ERM strategy theoretically provides a platform for improved internal control. ERM interventions, informed by the organisation's context, enhance

the internal control system, which in turn is implied to help the coal mining industry to meet their strategic objectives, thus improving performance.

In summary, this Chapter discussed the literature around RM in mining (global, SA and coal), the evolution of ERM, how it differs from traditional RM, its adoption in companies including those in the coal mining industry, the role of internal controls, the significance of RM in internal control system, and ERM implementation. Built from these theoretical analyses are many themes that cover the adoption of ERM as a business imperative, the impact of ERM on internal control and key success factors to ensure ERM enhances the mine's success. The literature review formed the basis for the research questions to be answered and was utilised as a tool for guiding the data collection and analysis process, which is explained in Chapter 3.

CHAPTER 3: EMPIRICAL INVESTIGATION

3.1. INTRODUCTION

The primary objective of this study is to determine the value adding function of risk management strategies to an opencast colliery in South Africa with specific reference to site management, contractors and employees. The Chapter describes the instrument used and the research procedure followed to obtain the data. The data gathering process and discussion of research results were also explained, specifically bearing in mind that the main goal being to achieve all of the specific objectives of the study as set out in Chapter 1 (and below). A formal questionnaire was utilised to conduct the empirical research study. Participants consisted of site management, contractors and employees from an opencast colliery in South Africa.

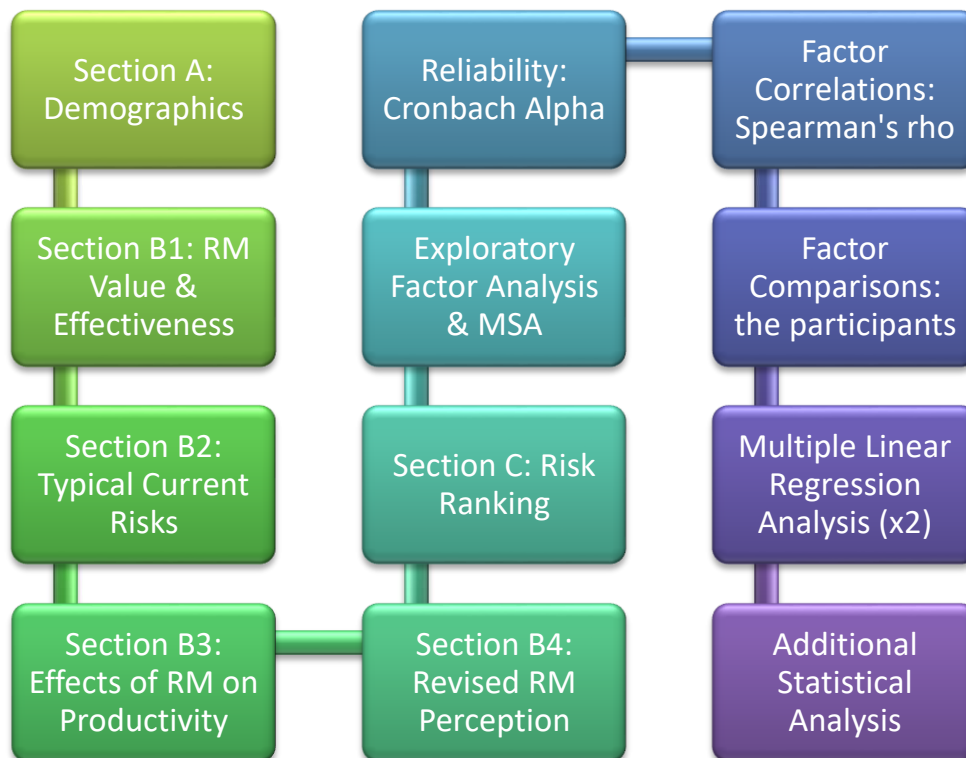
The quantitative research method was utilised to test the research questions and achieve the objectives as set out in Chapter 1 (and below). The data retrieved from the questionnaires was transformed to usable and accurate information with the support of various statistical methods. Cronbach's alpha coefficients were used to determine the reliability of the measuring instrument. Factor Analysis was also utilised including multiple linear regression analysis. The significance of the relationship between the variables was also determined and the Chapter concludes with a summary of the findings. Briefly, this Chapter reports on the following aspects: Research methodology; Validity of the research instrument; Reliability of the data; and the Results.

This Chapter presents the results of the empirical investigation regarding the following research objectives: i) Whether integrated RM is a value adding strategic function to the mine with specific reference to managers, employees and contractors; ii) To determine if integrated RM is effective at the mine; ii) The extent to which RM has been adopted by managers, employees and contractors; iv) Whether RM affects productivity, v) To determine the critically high risks for the mine to address or look into and vi) To determine if a change in RM perception is possible (especially from just a safety mind-set to integrated RM).

3.2. RESEARCH METHODOLOGY

Figure 3.1 below is a flow diagram of the approach covering the sections below, which aims to act as a summary or guideline as to the layout of this Chapter as well as to indicate the level of statistics that was completed.

Figure 3.1: Summary of Statistical Analysis and Layout of Chapter 3



(Source: Own Compilation)

3.2.1. Questionnaire development and construction

The measuring instrument for the study was a questionnaire that was distributed among potential respondents as explained in Chapter 1. The questionnaire was customised for site management, contractors and employees working in an opencast colliery. Every questionnaire was accompanied by a covering letter that explained the purpose of and the instructions for completing the questionnaire (see Annexure A). The five sections discussed below were combined into a single questionnaire, which was completed by the participants and formed the quantitative component of the study. The questionnaire layout will be discussed below.

3.2.1.1 Section A: Demographic Information and Baseline on RM

Section A included the demographical information of the respondents and their initial perceptions about RM at the colliery. The purpose of the questions contained in this section was to perform statistical comparisons between the different groups of individuals. The participants responded to the following questions by indicating their answers with a tick, cross or by highlighting the appropriate option:

- Role: Manager, Employee or Contractor;
- Department;
- Gender;
- Age;
- Preferred language;
- Race;
- Level of education;
- Work experience;
- Initial Risk Management perception.

RM is a function of many constructs and some of them, which are the focus of the study, will be discussed below.

3.2.1.2 Section B1: Risk Management Value

This section consisted of 14 questions and tested the perceptions of the value and effectiveness of RM at the colliery. The section also differentiated the opinions of managers, contractors and employees against each other; the results of which proved to be very interesting. A gap analysis was performed and will be discussed as well. By using a four point Likert scale, the respondents indicated to which extent they agreed or disagreed with the statements. The scale ranged from one (strongly disagree) to four (strongly agree).

3.2.1.3 Section B2: Current Typical Risks

This section consisted of 25 questions and tested the perceptions of the risks that the colliery presently faces. The risks vary from internally to externally related risks and the perceptions on the key risks to address are established from this section. The risks in this section was extracted from the annual reports of mining companies as well as during the interview screening process (pilot study) as discussed in Chapter 1. Once again, the respondents indicated their extent of agreement by using the four point Likert scale.

3.2.1.4 Section B3: Risk Management effects on Productivity

This section consisted of 10 questions and tested how productivity and RM are related and whether productivity is affected by RM. Once again, the respondents indicated their extent of agreement by using the four point Likert scale and a gap analysis was performed and discussed as well.

3.2.1.5 Section B4: Revised Risk Management Perception

This section consisted of seven questions and tested the revised risk perception of the managers, employees and contractors after going through sections B1, B2 and B3. Once again, the respondents indicated their extent of agreement by using the four point Likert scale.

3.2.1.6 Section C: General Risk Management Information

This section consisted of four questions, two opened-ended questions and two Likert scale questions and was focused on general RM. It also tested the ranking of risks as well as the perceived change in RM alignment.

3.2.2. Data collection and study population

The convenience sampling technique was used in the study as explained in Chapter one of this report. The convenience sample was used because it was fit for purpose

since it enabled the researcher to gather the data from suitable participants. The sample was obtained from site management, contractors and employees working in an opencast colliery in South Africa. These specific groups were chosen for sampling as it would provide the information that was needed to answer the research questions. There was also a pilot study that was conducted as explained in Chapter one, which was in the form of a qualitative interview and this, was used to fine-tune the quantitative questionnaire (the draft questionnaire itself also underwent pilot testing).

The questionnaires were hand delivered and in some cases e-mailed to the potential respondents. Participants who did not respond to the survey on or before the set due date were reminded to complete the questionnaire. Several participants responded and returned their completed questionnaires. Ultimately, 161 completed questionnaires were received back from a total of 200 which resulted in an ultimate response rate of 75.5%. Most of the questionnaires were obtained via physical collection and a few via e-mail.

3.2.3. Confidentiality

The participants received cover letters explaining that the information that was to be disclosed by them would be treated with confidentiality. All individual and personal information that was received were displayed anonymously. Confidentiality and anonymity was therefore ensured throughout the study.

3.2.4. Statistical Analysis

The data collected was captured and transformed into useable information by the Statistical Consultation Services of the North-West University (Potchefstroom campus) with the use of IBM SPSS statistics software version 23 (2016) and SAS 9.4 (2016). The mean values and standard deviations, as well as the percentages of the different variables were calculated.

Other statistical techniques that were employed in the study included:

- Descriptive statistics;
- The KMO measure of sampling adequacy;
- Cronbach alpha;
- Factor analysis;
- Multiple linear regression analysis;
- Annova;
- Spearman's rho;
- Cohens d (effect sizes).

3.3. RESPONSE RATE TO THE QUESTIONNAIRE

Table 3.1 below illustrates the response rate achieved to the questionnaires that was submitted to the participants. The questionnaires were distributed among 200 managers, employees and contractors at a coalmine in the Vaal Triangle and 161 questionnaires were completed and collected. Of the 161 questionnaires that were received back, 10 questionnaires were omitted due to not being fully completed. Therefore, 151 usable questionnaires were included in the study, which resulted in a response rate of 75.5%, which is good.

Table 3.1: Response to the survey questionnaire

Number of questionnaires distributed, received, omitted and used	Frequency	Percentage
Number of questionnaires distributed	200	100%
Number of questionnaires received back	161	80.5%
Number of questionnaires omitted	10	5%
Response rate	151	75.5%

(Source: Own Compilation)

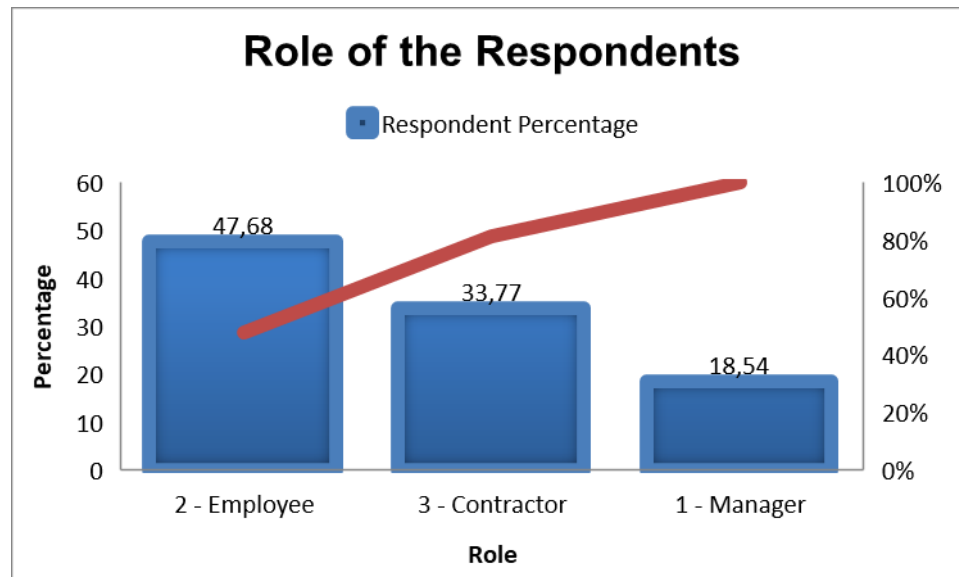
3.4. RESULTS: SECTION A - DEMOGRAPHICAL INFORMATION

The results of this section of the questionnaire will be in the form of inferential descriptive statistics and will be detailed and explained by means of Pareto charts, bar charts, pie charts as well as frequency and percentage distributions tables. Consequently, the results obtained will be analysed and discussed.

3.4.1. Statistical Analysis of the Role of the respondents at the colliery: Manager, Employee and Contractor

From the table and the graph below, it is possible to deduce that managers accounted for 18.54% (28), employees 47.68% (72) and contractors 33.77% (51) of the participants for the research. This is a good balance of participants in terms of their roles at the colliery. The graph below visually summarises the results and the table below details the results obtained.

Figure 3.2: A Pareto Chart to summarise the role of the respondents



(*the red line represents cumulative percentage)

(Source: Own Compilation)

Table 3.2: Summary of the participant's role within the colliery

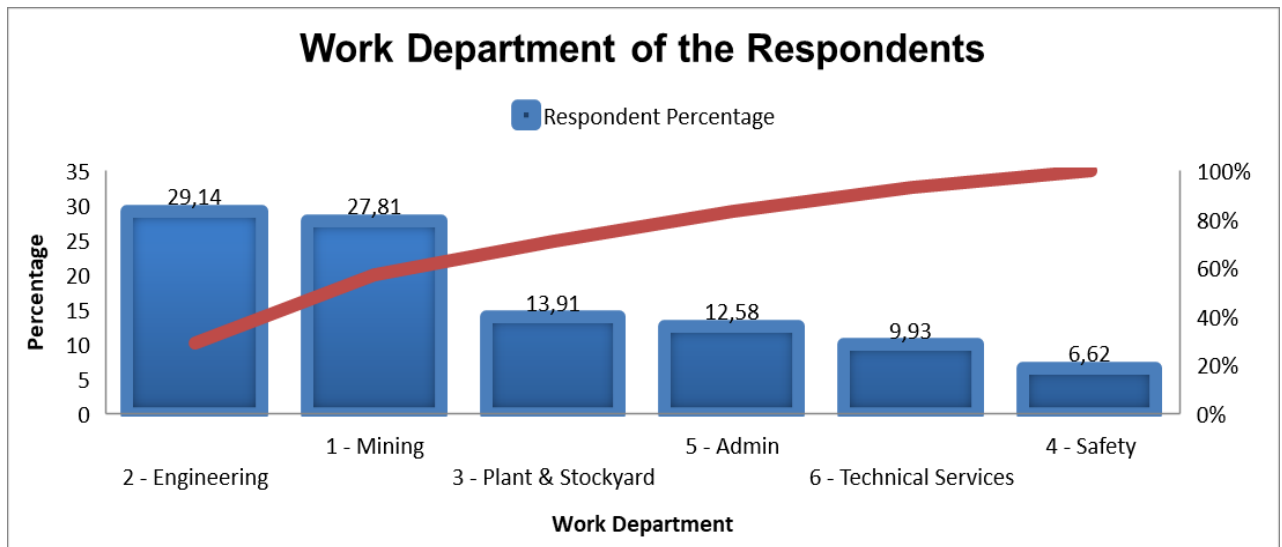
A1	Frequency	Respondent %	Cumulative Frequency	Cumulative %
1 - Manager	28	18.54	28	18.54
2 - Employee	72	47.68	100	66.23
3 - Contractor	51	33.77	151	100

(Source: Own Compilation)

3.4.2. Statistical Analysis of the Department of the respondents at the colliery

In terms of the department of the participants, they vary into six departments. Thus Mining accounted for 27.81% (42), Engineering at 29.14% (44), Plant and Stockyard with 13.91% (21), Safety at 6.62% (10), Admin with 12.58% (19) and finally Technical Services with 9.93% (15) of the participants for the research. This is a good balance of participants in terms of their departments at the colliery.

Figure 3.3: A Pareto Chart to summarise the work department of the respondents



(*the red line represents cumulative percentage)

(Source: Own Compilation)

Table 3.3: Summary of the department of the respondents within the colliery

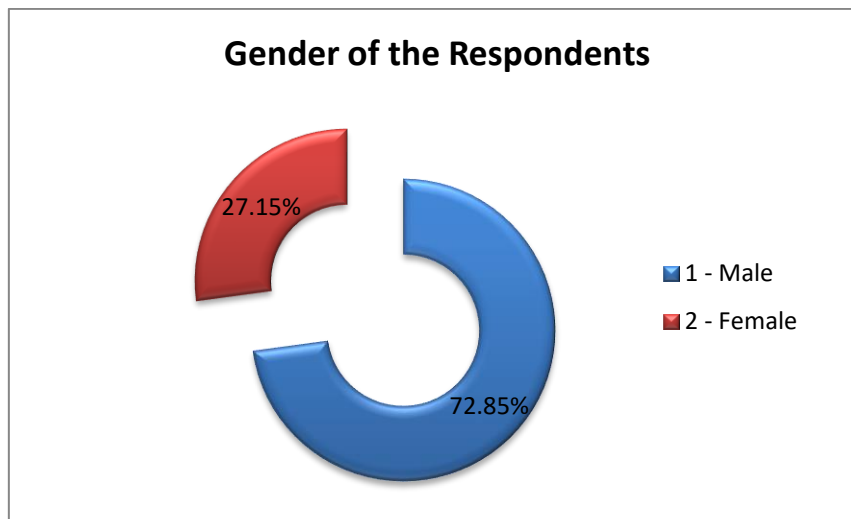
A2	Frequency	Respondent %	Cumulative Frequency	Cumulative %
1 - Mining	42	27.81	42	27.81
2 - Engineering	44	29.14	86	56.95
3 - Plant & Stockyard	21	13.91	107	70.86
4 - Safety	10	6.62	117	77.48
5 - Admin	19	12.58	136	90.07
6 - Technical Services	15	9.93	151	100

(Source: Own Compilation)

3.4.3. Statistical Analysis of the Gender of the respondents at the colliery

With regards to the gender of the participants males accounted for 72.85% (110) and females being 27.15% (41) of the participants for the research. This is a not a good balance of participants at the colliery but this roughly reflects the actual situation. The colliery needs to empower women in mining more.

Figure 3.4: Percentage breakdown of the gender of the respondents



(Source: Own Compilation)

Table 3.4: Summary of the Gender of the respondents

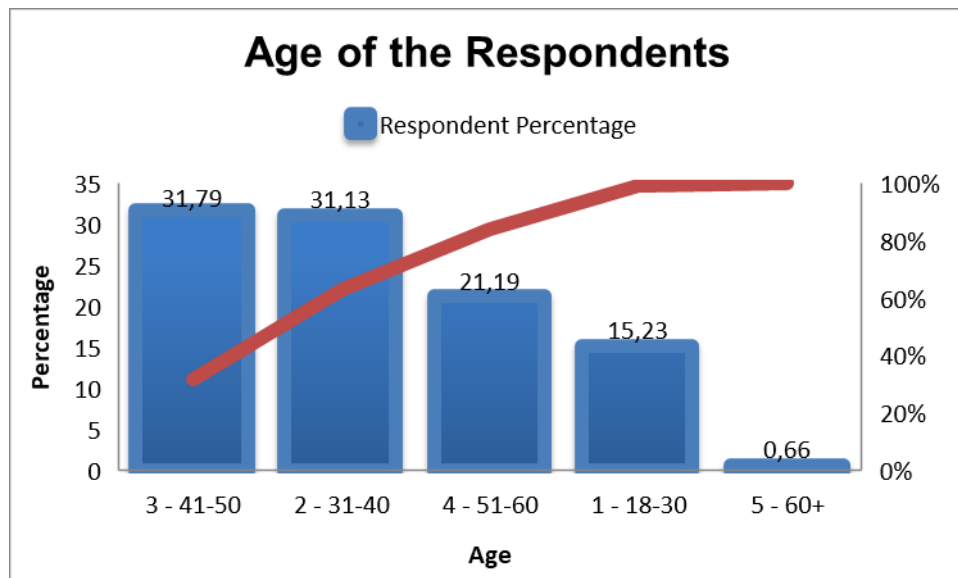
A3	Frequency	Respondent %	Cumulative Frequency	Cumulative %
1 - Male	110	72.85	110	72.85
2 - Female	41	27.15	151	100

(Source: Own Compilation)

3.4.4. Statistical Analysis of the Age of the respondents at the colliery

In terms of the age of the participants, they vary into five categories. Thus, 18-30 year olds accounted for 15.23% (23), 31-40 year olds at 31.13% (47), 41-50 year olds with 31.79% (48), 51-60 year olds at 21.19% (32) and one person above 60 at 0.66% (1). This is a fair balance of participants in terms of their age at the colliery however, one can deduce that the workforce is ageing and so a younger workforce needs to soon be employed. Thus, skills transfer will be vital for the mine.

Figure 3.5: A Pareto Chart to summarise the age of the respondents



(*the red line represents cumulative percentage)

(Source: Own Compilation)

Table 3.5: Summary of the Age of the respondents

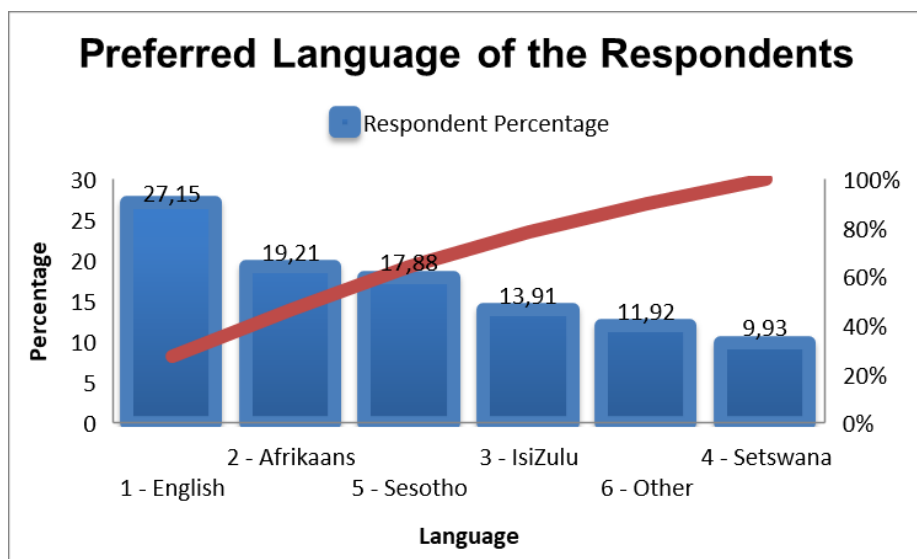
A4	Frequency	Respondent %	Cumulative Frequency	Cumulative %
1 - 18-30	23	15.23	23	15.23
2 - 31-40	47	31.13	70	46.36
3 - 41-50	48	31.79	118	78.15
4 - 51-60	32	21.19	150	99.34
5 - 60+	1	0.66	151	100

(Source: Own Compilation)

3.4.5. Statistical Analysis of the Preferred Language of the respondents at the colliery

With regards to the preferred language of the participants, they vary into six categories. English accounted for 27.15% (41), Afrikaans at 19.21% (29), IsiZulu with 13.91% (21), Setswana at 9.93% (15), Sesotho with 17.88% (27) and finally other languages such as Xhosa, Venda, Tsonga, Swati and Ndebele with 11.92% (18) of the participants for the research. This is a fair representation of participants in terms of their preferred language at the colliery.

Figure 3.6: A Pareto Chart to summarise the preferred language of the respondents



(*the red line represents cumulative percentage)

(Source: Own Compilation)

Table 3.6: Summary of the preferred language of the respondents

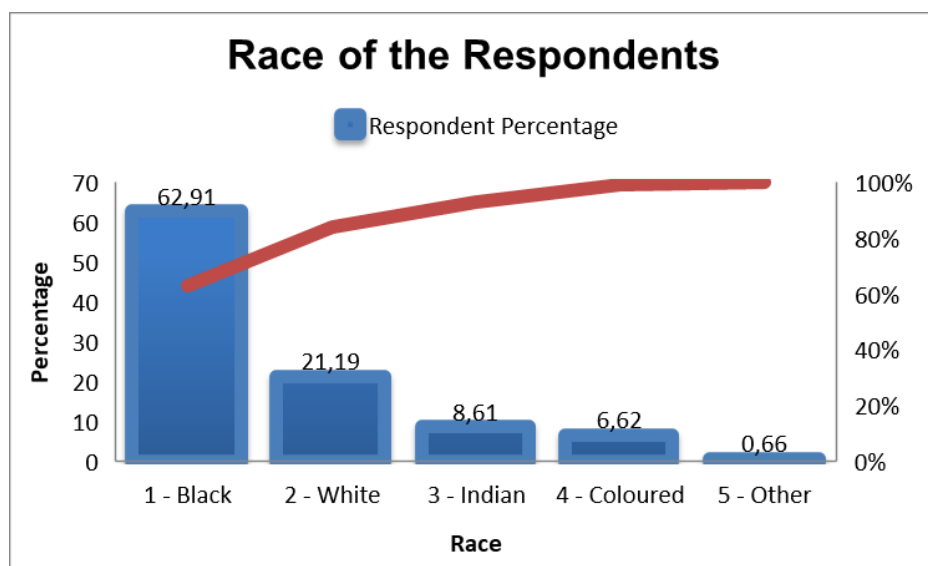
A5	Frequency	Respondent %	Cumulative Frequency	Cumulative %
1 - English	41	27.15	41	27.15
2 - Afrikaans	29	19.21	70	46.36
3 - IsiZulu	21	13.91	91	60.26
4 - Setswana	15	9.93	106	70.2
5 - Sesotho	27	17.88	133	88.08
6 - Other	18	11.92	151	100

(Source: Own Compilation)

3.4.6. Statistical Analysis of the Race of the respondents at the colliery

In terms of the race of the participants, they vary into five categories. Black participants accounted for majority of the workforce at 62.91% (95), white participants at 21.19% (32), Indians with 8.61% (13), Coloureds at 6.62% (10) and one 'other' at 0.66% (1) whom is probably a foreign international. This seems to be an acceptable balance of participants in terms of their race at the colliery for this particular area.

Figure 3.7: A Pareto Chart to summarise the race of the respondents



(*the red line represents cumulative percentage)

(Source: Own Compilation)

Table 3.7: Summary of the race of the participants

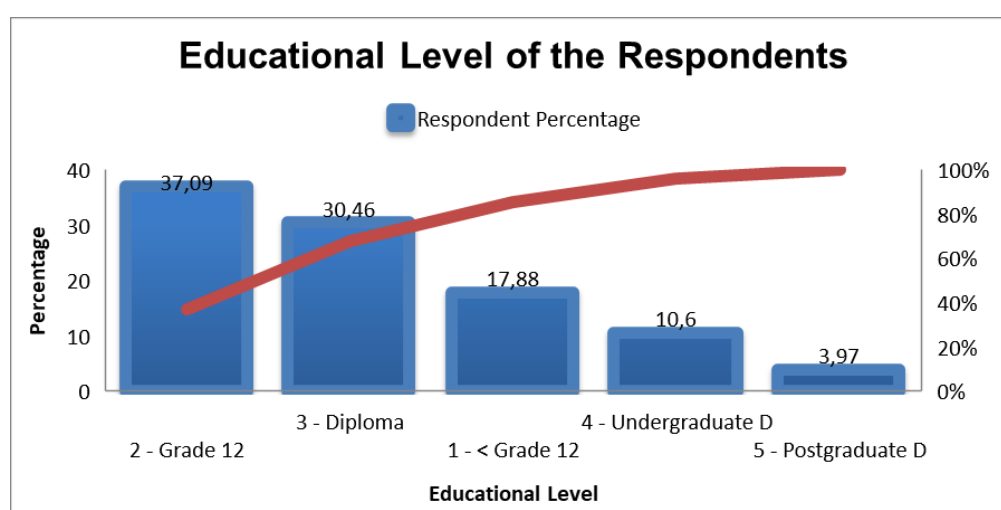
A6	Frequency	Respondent %	Cumulative Frequency	Cumulative %
1 - Black	95	62.91	95	62.91
2 - White	32	21.19	127	84.11
3 - Indian	13	8.61	140	92.72
4 - Coloured	10	6.62	150	99.34
5 - Other	1	0.66	151	100

(Source: Own Compilation)

3.4.7. Statistical Analysis of the Level of Education of the respondents at the colliery

With regards to the level of education of the participants, they vary into five categories as well. Participants with less than grade 12 accounted for 17.88% (27), participants with grade 12 being 37.09% (56), participants with diplomas was 30.46% (46), participants with an undergraduate degree accounted for 10.6% (16) and postgraduate qualifications was low at 3.97% (6). The workforce seems to be fairly well educated except for the individuals who did not complete grade 12. The mine should consider supporting these individuals to complete at least grade 12 via ABET.

Figure 3.8: A Pareto Chart to summarise the level of education of the respondents



(*the red line represents cumulative percentage)

(Source: Own Compilation)

Table 3.8: Summary of the level of education of the respondents

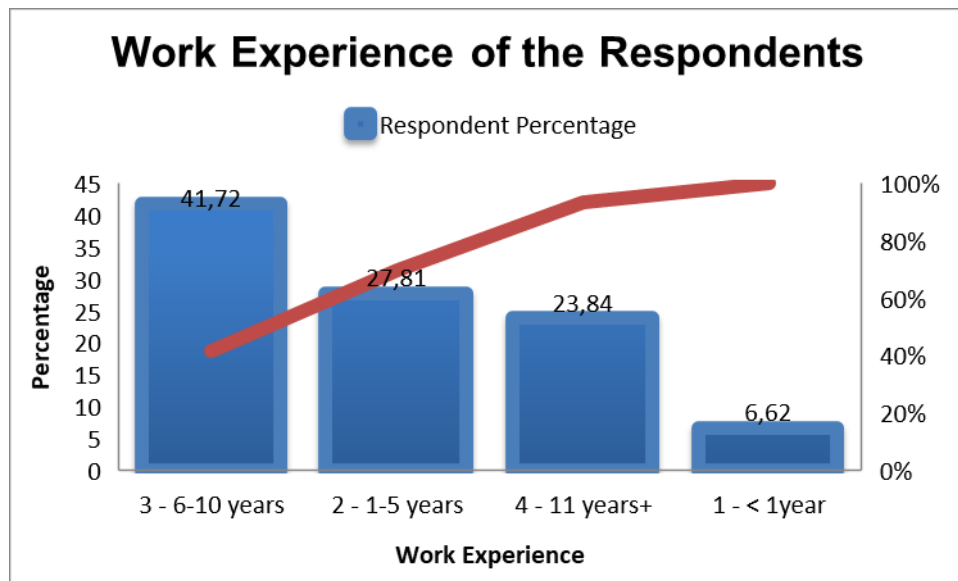
A7	Frequency	Respondent %	Cumulative Frequency	Cumulative %
1 - < Grade 12	27	17.88	27	17.88
2 - Grade 12	56	37.09	83	54.97
3 - Diploma	46	30.46	129	85.43
4 - Undergraduate Degree	16	10.6	145	96.03
5 - Postgraduate Degree	6	3.97	151	100

(Source: Own Compilation)

3.4.8. Statistical Analysis of the Work Experience of the respondents at the colliery

In terms of the work experience of the participants, they vary into four categories. Personnel with less than one year of experience accounted for 6.62% (10), personnel with 1-5 years of experience were 27.81% (42), 6-10 years of experience participants were 41.72% (63), and lastly the experienced personnel with 11 years plus experience was 23.84% (36). The workforce has experienced individuals and the mine must strive to retain these personnel working for the mine until retirement if possible, as this will result in lower employee turnover and thus higher productivity.

Figure 3.9: A Pareto Chart to summarise the work experience of the respondents



(*the red line represents cumulative percentage)

(Source: Own Compilation)

Table 3.9: Summary of the work experience of the respondents

A10	Frequency	Respondent %	Cumulative Frequency	Cumulative %
1 - < 1 year	10	6.62	10	6.62
2 - 1-5 years	42	27.81	52	34.44
3 - 6-10 years	63	41.72	115	76.16
4 - 11 years+	36	23.84	151	100

(Source: Own Compilation)

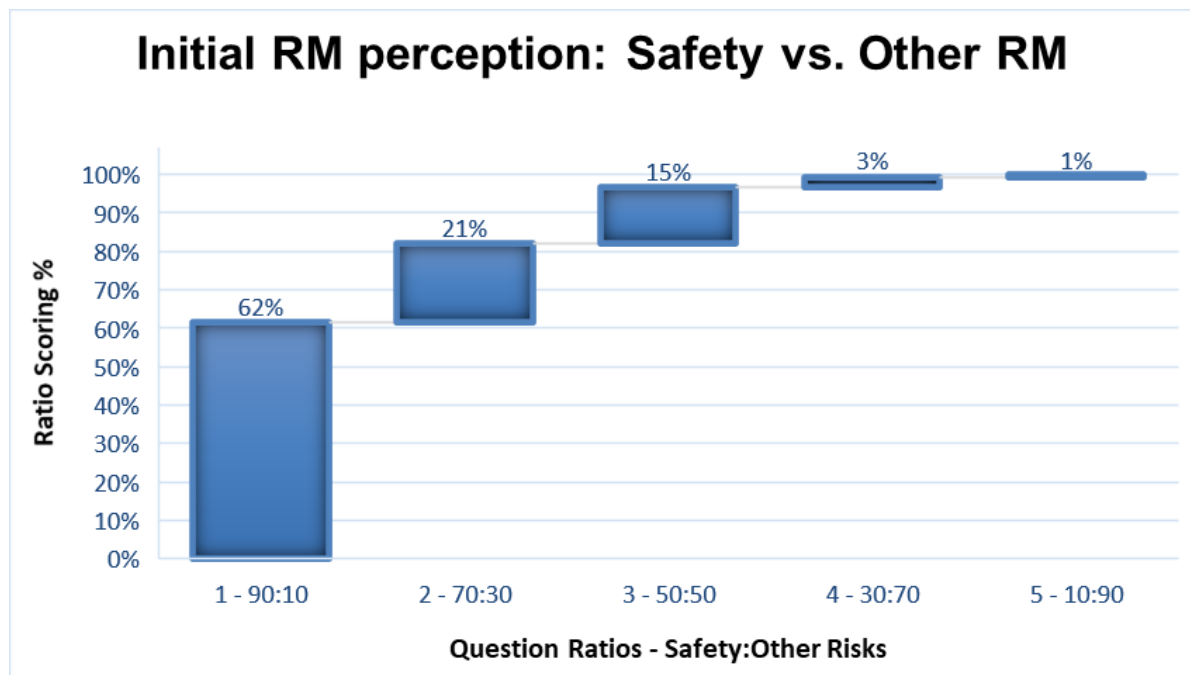
3.4.9. Statistical Analysis of the Initial Risk Management Perception of the respondents at the colliery

The question that was asked to the participants with regards to their RM perception was: ***“What do you estimate is the closest current % split between Safety RM and other types of RM in terms of the options below (Safety:Other)?”***

This question was asked before exposure to the other RM aspects in the questionnaire such as Section 2 and 3 for example. This question was then repeated

at the end of the questionnaire in Section C to gauge as to whether their perceptions have changed from mostly safety RM to integrated RM because they were exposed to many different RM aspects from Sections 2 and 3 (this was inspired by the qualitative pilot interview where all participants thought differently about RM after the interview).

Figure 3.10: A Waterfall Chart to summarise the respondents' initial RM perception



(Source: Own Compilation)

The results show that there is definitely a change in perception amongst the participants. The majority of the personnel initially rated safety:other risks very high at 62% for the 90:10 ratio and 21% for the 70:30 ratio with a cumulative % of 83%, thus most people believed that safety was the more critical than any other risk. This perception had however changed as will be seen in Section 3.4.10 (C2), which is the data after participants had time to realise that there are many other risks that affect the operation. Most of the new responses sit in the middle between 70:30, 50:50 and 30:70 with no responses in the 90:10 and 10:90 categories. This proves that making people aware of the risks can change their RM perception.

Table 3.10: Initial RM perception of the respondents

A9	Frequency	Respondent Percentage	Cumulative Frequency	Cumulative %
1 - 90:10	93	61.59	93	61.59
2 - 70:30	31	20.53	124	82.12
3 - 50:50	22	14.57	146	96.69
4 - 30:70	4	2.65	150	99.34
5 - 10:90	1	0.66	151	100

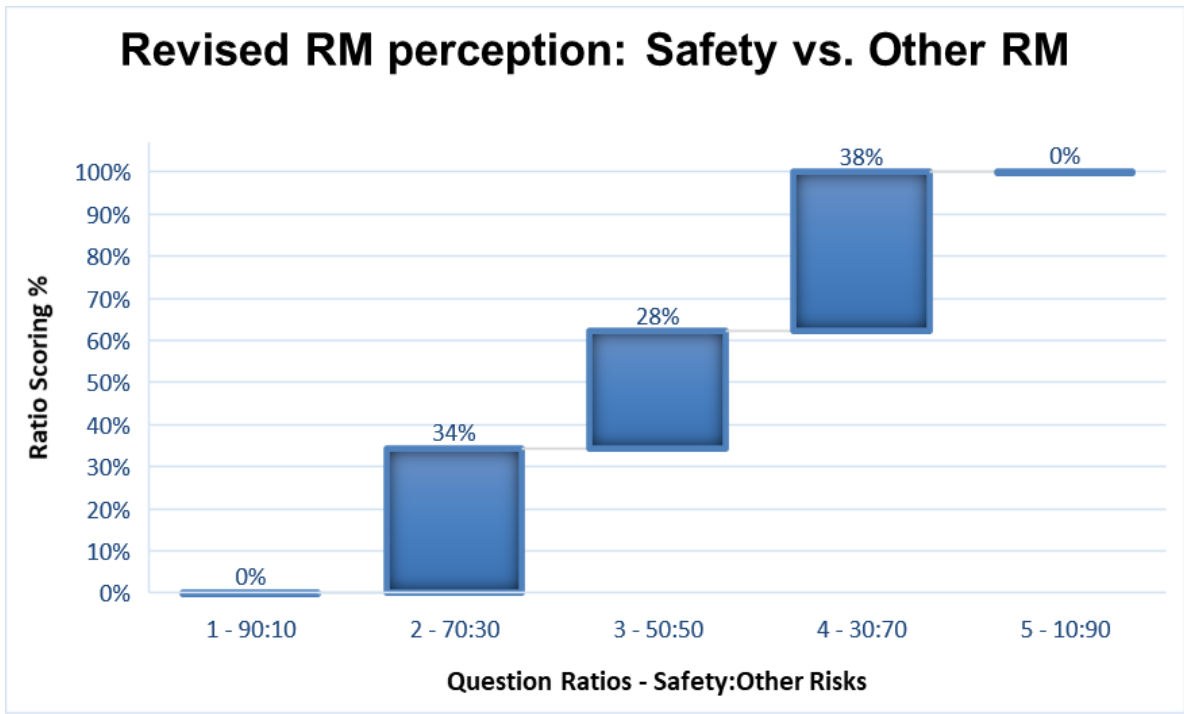
(Source: Own Compilation)

This will now have to be compared with section C2 of the questionnaire and the findings are illustrated below.

3.4.10. SECTION C: C2 Statistical Analysis of the Revised Risk Management Perception of the respondents at the colliery

The data shows that the participants' perceptions have changed from just safety RM to slightly more integrated RM. The majority of the personnel rated safety:other risks very high at 34% for the 70:30 ratio, 28% for the 50:50 ratio and 38% for the 30:70 ratio with a cumulative % of 100%. This is very useful information in that it shows that although safety is important, too much focus is on it whilst neglecting the numerous other risks that can also drastically hurt the business. People realise that there is more to RM than safety and that safety is one key component of integrated RM that must be addressed. Internal and external risks have been highlighted to the participants and this created a paradigm shift in thinking. People need to understand how integrated RM affects the profitability of the mine in everything that they do because they have a significant impact on the mine.

Figure 3.11: A Waterfall Chart to summarise the respondents' revised RM perception



(Source: Own Compilation)

Table 3.11: Revised RM perception of the respondents

C2	Frequency	Respondent Percentage	Cumulative Frequency	Cumulative %
1 - 90:10	0	0	0	0
2 - 70:30	52	34	52	34.44
3 - 50:50	42	28	94	62.25
4 - 30:70	57	38	151	100
5 - 10:90	0	0	0	0

(Source: Own Compilation)

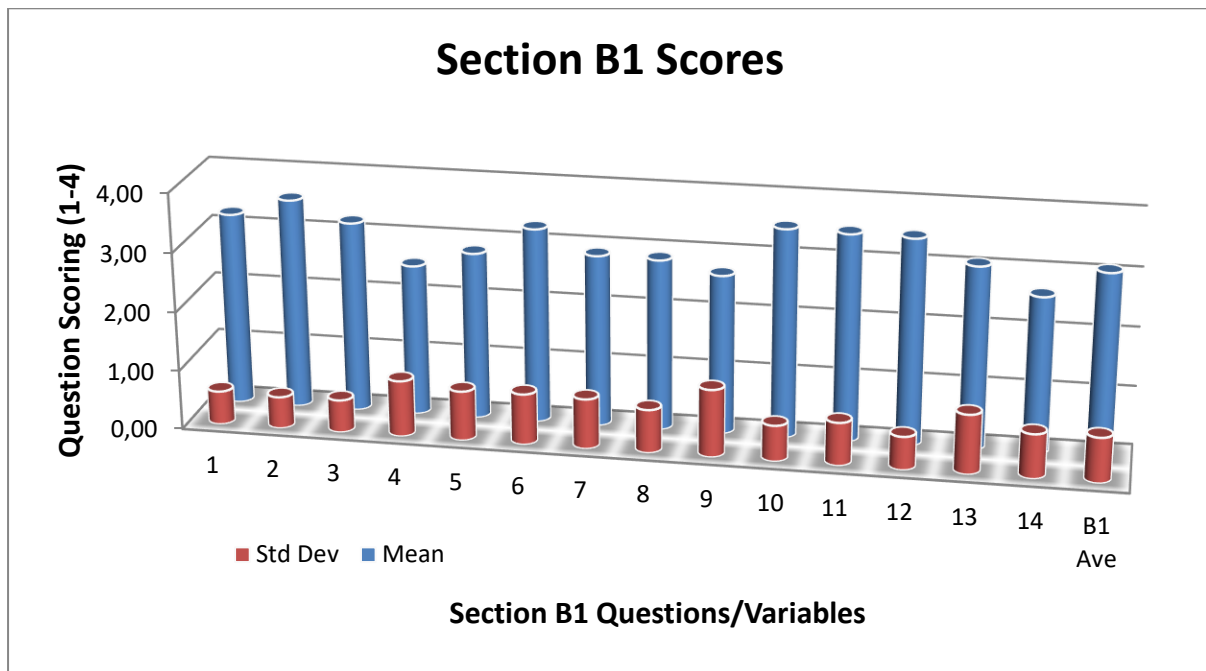
3.5. RESULTS: SECTION B1 - STATISTICAL ANALYSIS OF THE VALUE AND EFFECTIVENESS OF RM AT THE COLLIERY

In terms of the actual RM data collected, the majority of the participants agree that RM is valuable and is thus effective at the mine to mitigate the various risks. As a reminder, the Likert scale had four options: strongly agree: '4', agree: '3', disagree: '2' and strongly disagree: '1'. On average, most people agree 3.10/4.00 with a standard deviation of 0.76 that RM is a valuable tool that adds value to the company. The questionnaire is in Appendix A. More details will be discussed in the sections to follow.

In terms of the table below, 'Mean' refers to the average value of all the numbers. 'Standard deviation (SD)' is a value expressing how much the members of a group differ from the mean value of the group. 'Min' means the minimum selected value and 'Max' means the maximum selected value in the questionnaire. 'N' is the number of valid participants used in the analysis (Glen, 2017a:1).

The highest score for section B1 was 3.55/4.00, which was for question 2, which indicates that the participants believe that RM is a very valuable tool to the mine. This is followed by 3.52/4.00 for question 10, which indicates that RM is effective at the mine to mitigate the various risks. The third highest score was 3.50/4.00 for question 11, which indicates that the participants believe that the effectiveness of RM at the mine proves its value adding function. The lowest score was 2.55/4.00 for question 4, which indicates that the participants do not believe that all of the risks are adequately addressed by the mine. A possible gap is the lack of understanding of the contractors in terms of RM as seen in question 8 and 14 since they are also low scoring questions.

Figure 3.12: Percentage breakdown of results for Section B1 – Value of RM



(Source: Own Compilation)

Table 3.12: Summary of the descriptive statistics for Section B1 - Value

Variable	N	Mean	Std Dev	Min	Max
1 - Integrated RM strategy	151	3.25	0.57	1	4
2 - Valuable tool	151	3.55	0.54	1	4
3 - Value adding	151	3.22	0.55	1	4
4 - Addressing of risks	151	2.55	0.95	1	4
5 - Performing of RM	151	2.82	0.84	1	4
6 – Existing RM framework adoption by managers	151	3.29	0.86	1	4
7 - Existing RM framework adoption by employees	151	2.90	0.85	1	4
8 - Existing RM framework adoption by contractors	151	2.89	0.74	1	4
9 - RM is a key aspect	151	2.69	1.14	1	4
10 - RM is effective	151	3.52	0.61	1	4
11 - Effectiveness of RM means value adding	151	3.50	0.73	1	4

12 - <i>Management's</i> understanding of RM	151	3.48	0.56	2	4
13 - <i>Employees'</i> understanding of RM	151	3.09	1.01	1	4
14 - <i>Contractors'</i> understanding of RM	151	2.64	0.75	1	4
B1 Average Score	151.00	3.10	0.76	1.07	4.00

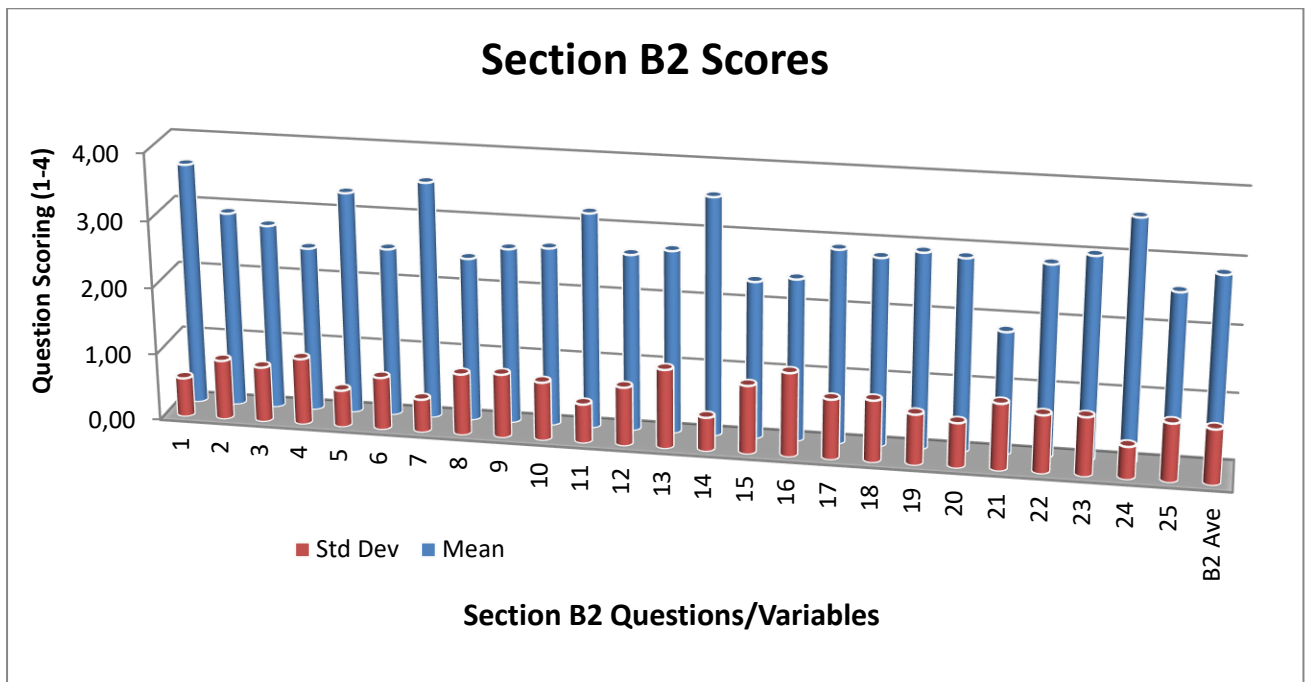
(Source: Own Compilation)

3.6. RESULTS: SECTION B2 - STATISTICAL ANALYSIS OF THE TYPICAL CURRENT RISKS AT THE COLLIERY

In this section, personnel evaluated the different risks that affect the mine. The participants agree that the risks listed in Section B2 are risks that must be addressed or looked into by the mine. As a reminder, the Likert scale had four options: *strongly agree*: '4', *agree*: '3', *disagree*: '2' and *strongly disagree*: '1' and the questionnaire is in Appendix A. On average, most people agree 2.85/4.00 with a standard deviation 0.83 that these risks are critical to be mitigated. More details will be discussed in the sections to follow.

The highest mean score for section B2 was 3.61/4.00, which was for question 1, which indicates that the participants believe that integrated RM is all about safety. This is followed by 3.60/4.00 for question 24, which indicates that the failure to discover new coal mining resources is a major risk to the mine. The third highest score was 3.56/4.00 for question 14, which indicates that the participants believe that safety is a critical risk to address at the mine. The lowest mean score was 1.83/4.00 for question 21, which indicates that the participants do not believe that mechanisation is the way to go in coal mining. This is definitely a gap because as technology improves, automation and thus mechanisation will be the future.

Figure 3.13: Percentage breakdown of results for Section B2 – Typical Current Risks



(Source: Own Compilation)

Table 3.13: Summary of the descriptive statistics for Section B2 – Typical Current Risks

Variable	N	Mean	Std Dev	Min	Max
1 - Integrated RM & Safety	151	3.61	0.59	2	4
2 - Volatile global macro-economic conditions	151	2.91	0.89	1	4
3 - Increasing cost of energy	151	2.76	0.83	1	4
4 - Constrained water supply (e.g. drought)	151	2.46	1.00	1	4
5 - Selecting the incorrect projects	151	3.32	0.56	1	4
6 - Changes to mining industry regulation, legislation or tax rates	151	2.52	0.79	1	4
7 - Safety performance	151	3.54	0.50	3	4
8 - release of waste/pollution	151	2.44	0.92	1	4
9 - Unexpected failure of a slope	151	2.62	0.96	1	4
10 - Fire and explosion	151	2.67	0.88	1	4
11 - Market conditions	151	3.22	0.59	2	4

12 - Labour unrest	151	2.64	0.88	1	4
13 - Social unrest	151	2.74	1.19	1	4
14 - Safety is a critical risk	151	3.56	0.51	2	4
15 - Security at the mine	151	2.35	1.03	1	4
16 - Socio-economic (community development) plans	151	2.42	1.26	1	4
17 - Current unstable political environment	151	2.89	0.90	1	4
18 - IT (cyber) security	151	2.81	0.93	1	4
19 - Recent credit downgrade	151	2.92	0.76	1	4
20 - Coal price volatility	151	2.87	0.68	1	4
21 - Mechanisation	151	1.83	1.00	1	4
22 - Exchange rate fluctuations	151	2.85	0.87	1	4
23 - Decrease in global demand	151	3.01	0.89	1	4
24 - Failure to discover new coal mining resources	151	3.60	0.49	3	4
25 - Skills deficiency	151	2.56	0.88	1	4
B2 Average Score	151.00	2.85	0.83	1.28	4.00

(Source: Own Compilation)

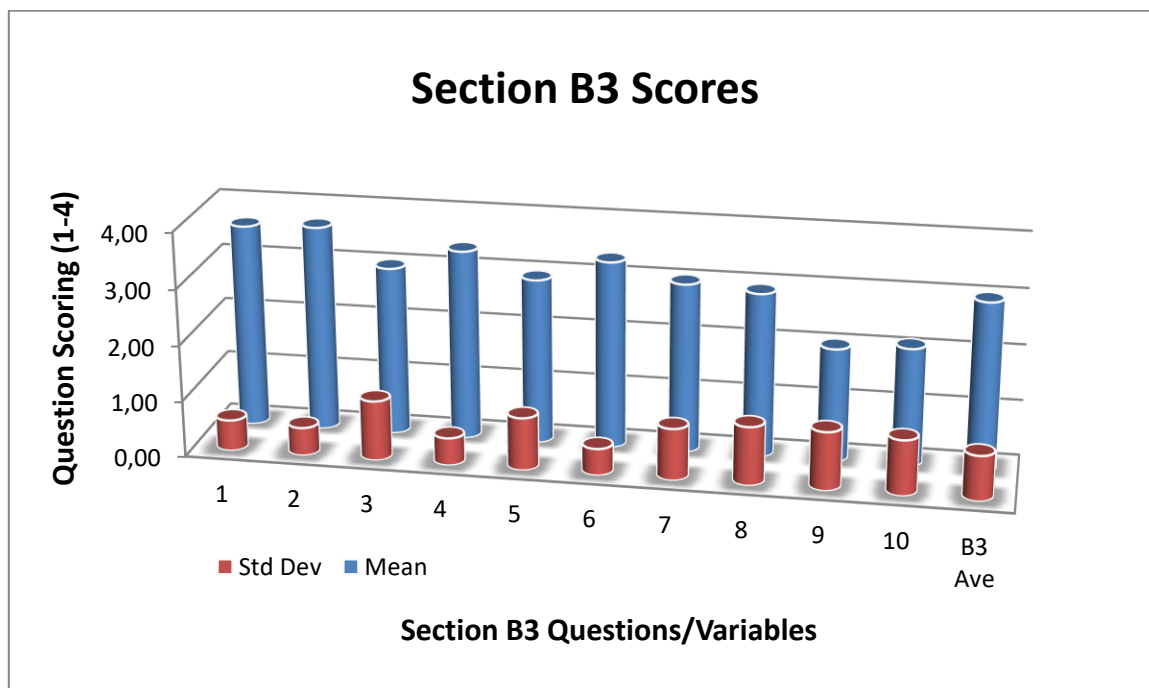
3.7. RESULTS: SECTION B3 - STATISTICAL ANALYSIS OF THE EFFECTS OF RM ON PRODUCTIVITY AT THE COLLIERY

Section B3 illustrates how RM affects productivity of the mine. The participants agree that the productivity of the mine is affected by integrated RM strategies. On average, most people agree 3.01/4.00 with a standard deviation 0.80. As a reminder, the Likert scale had four options: strongly agree: '4', agree: '3', disagree: '2' and strongly disagree: '1' and the questionnaire is in Appendix A. More details will be discussed in the sections to follow.

The highest score for section B3 was 3.67/4.00, which was for question 2, which indicates that the participants believe that integrated RM will enhance the productivity of the mine. This is followed by 3.62/4.00 for question 1, which indicates

that by not addressing risks affecting the mine, this ultimately means failing to realise operational productivity. The third highest score was 3.38/4.00 for question 4, which indicates that the participants believe that managing risk better will ensure that the mine is able to generate the required sustainable operating profit. The lowest score was 2.03/4.00 for question 9, which indicates that the participants do not believe that there is a major risk in terms of production stoppage directives from governmental departments (e.g. DMR). This is definitely a gap that must be addressed because the DMR for example is very strict and they issue work stoppage instructions quite often.

Figure 3.14: Percentage breakdown of results Section B3 – RM effects on Productivity



(Source: Own Compilation)

Table 3.14: Summary of the descriptive statistics for Section B3 – RM effects on Productivity

Variable	N	Mean	Std Dev	Min	Max
1 - Addressing of risks vs productivity	151	3.62	0.55	1	4
2 - Integrated RM vs productivity	151	3.67	0.50	2	4
3 - Ability to meet production demands	151	3.01	1.07	1	4
4 - Sustainable operating profit	151	3.38	0.49	3	4
5 - Sustainable cash flows	151	2.95	0.94	1	4
6 - Cost/ton production targets	151	3.34	0.47	3	4
7 - Equipment availability and reliability targets	151	3.02	0.92	1	4
8 - Annual return on capital (ROCE) target.	151	2.93	1.04	1	4
9 - Production stoppage (e.g. DMR).	151	2.03	1.04	1	4
10 - Utilisation of assets RM problem	151	2.11	0.98	1	4
B3 Average Score	151	3.01	0.80	1.50	4.00

(Source: Own Compilation)

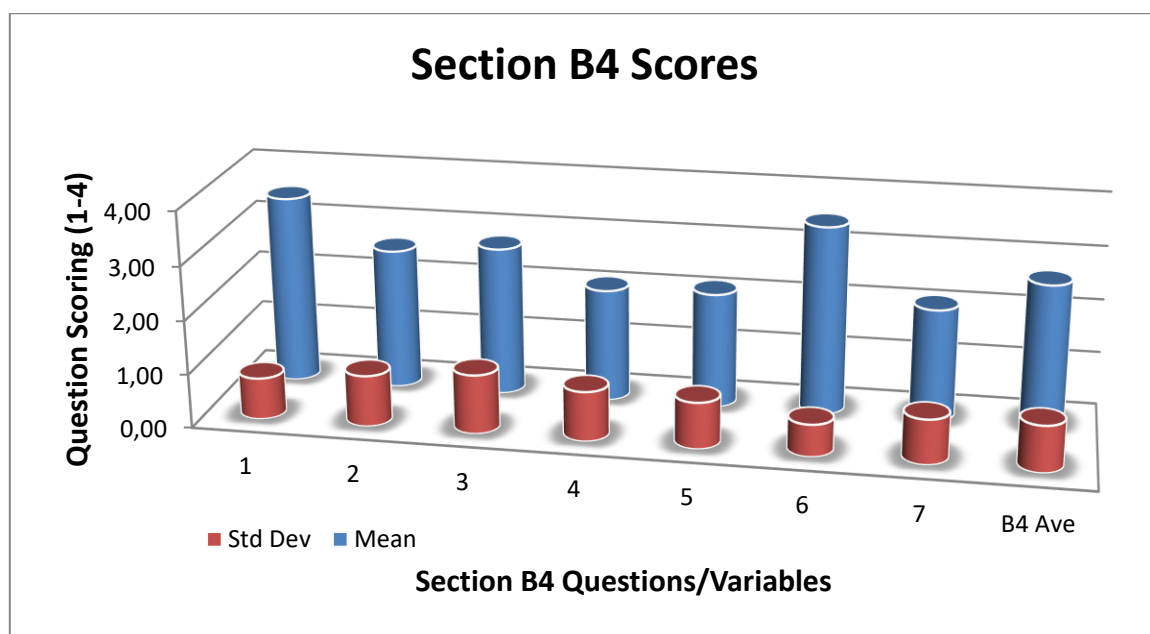
3.8. RESULTS: SECTION B4 - STATISTICAL ANALYSIS OF THE REVISED RM PERCEPTION AT THE COLLIERY

Section B4 illustrates the revised risk perception of the participants after going through Sections B1, B2 and B3. As a reminder, the Likert scale had four options: strongly agree: '4', agree: '3', disagree: '2' and strongly disagree: '1' and the questionnaire is in Appendix A. The participants just about agree that their risk perception has somewhat changed. On average, most people agree 2.67/4.00 with a standard deviation 0.86. More details will be discussed in the sections to follow.

There is a tie for the highest score in section B4. Question 1 scored was 3.50/4.00, which indicates that the participants believe that their views have changed from mine safety risk management to mine integrated risk management. Questions 6 also scored 3.50/4.00, which indicates the participants believe that addressing all of the risks in section B2 will add value to the mine. The third highest score was 2.76/4.00

for question 3, which indicates that employees are effective in taking full ownership (adopting) of RM. The lowest score was 2.09/4.00 for question 7, which indicates that after taking into account all of the risks referred to in section B2, the participants do not all believe that the mine still has a good integrated RM strategy in place. This is definitely a gap that must be addressed because the participants now feel that the mine does not have a good enough integrated RM strategy in place whereas before completing sections B2 and B3, they believed that all was well.

Figure 3.15: Percentage breakdown of results for Section B4 – Revised RM perception



(Source: Own Compilation)

Table 3.15: Summary of the descriptive statistics for Section B4 – Revised RM perception

Variable	N	Mean	Std Dev	Min	Max
1 - Safety risk management vs integrated risk management	151	3.50	0.77	1	4
2 - <i>Managers</i> are effective in taking full ownership of RM	151	2.61	0.95	1	4
3 - Employees are effective in taking full ownership of RM	151	2.76	1.10	1	4

4 – Contractors are effective in taking full ownership of RM	151	2.11	0.93	1	4
5 - All of the risks are adequately addressed	151	2.14	0.86	1	4
6 - Addressing these risks will add value	151	3.50	0.60	1	4
7 - The mine has a good integrated RM strategy in place	151	2.09	0.84	1	4
B4 Average Score	151	2.67	0.86	1.00	4.00

(Source: Own Compilation)

3.9. RESULTS: SECTION C – STATISTICAL ANALYSIS OF GENERAL RM AT THE COLLIERY

3.9.1 Section C3: Risk Ranking at the Colliery

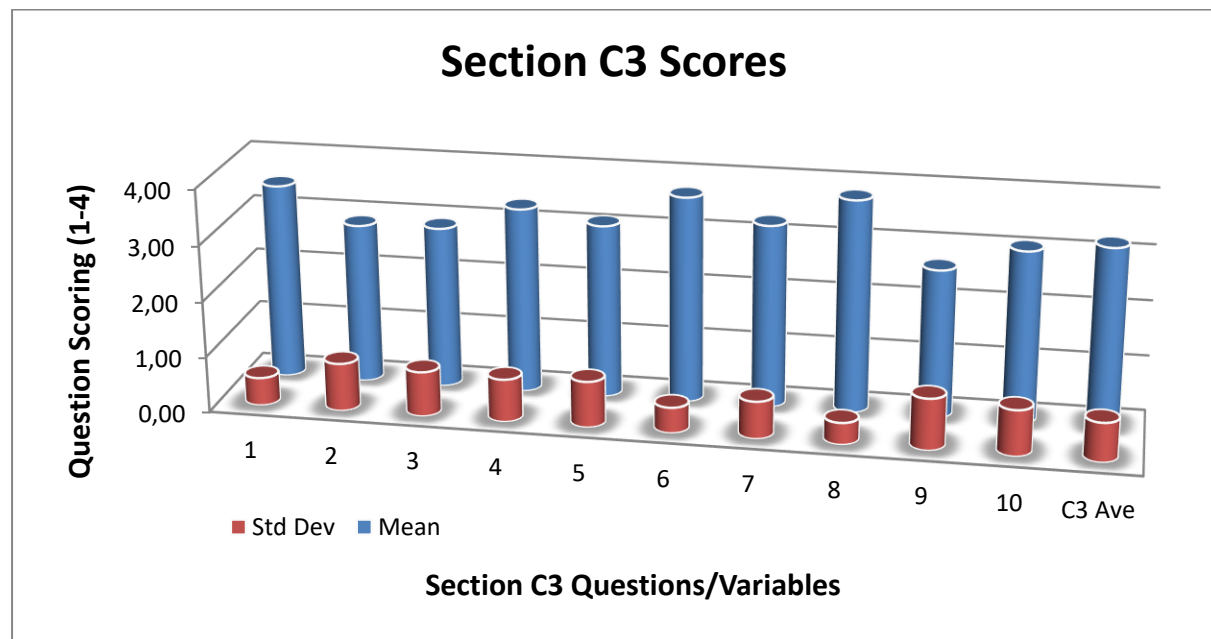
Ranking a 'selection' of the risks highlighted in B2 after completing sections B1, B2, B3 and B4 had resulted in change in the personnel's risk perception to see broader risks (the selection was developed from the interview process as discussed in Chapter 1). Safety moved out of the number '1' position to number '3', which nonetheless still makes it very important. The risk ranking is highlighted below from the most important risk to the least important risk:

- 1) Recent financial credit rating downgrade was ranked first as the most important risk to the mine because this affects the future of the mine;
- 2) Ranked in second is political influence especially in Eskom tied coalmines, which may link to corruption;
- 3) The third risk is safety as discussed above;
- 4) The fourth ranked risk is coal price volatility;
- 5) IT (Cyber) threats comes in fifth due to the recent IT phishing as well as ransomware and email hacking that recently affected the company and the country;
- 6) Labour unrest is in sixth place;

- 7) Slope failure is in seventh;
- 8) Policy uncertainty featured in the eighth place due to the delaying on the new mining charter, which was recently gazetted however, there was not enough consultations and an outcry with regards to the policy;
- 9) In ninth place is the environment;
- 10) Tenth place belongs to mechanisation.

The overall mean scoring was 3.23/4.00 with a standard deviation of 0.70, which shows that the participants generally agree that these risks are real and are important to be risk evaluated. The top two risks are externally influenced which poses a challenge to mitigate whereas the third risk can be internally managed. Cyber threats are becoming a bigger risk as digitisation multiplies hence it is a major risk that needs to be mitigated. Mechanisation of mines is also a huge risk to the employment of people but it does the improve productivity and unit costs of the mine.

Figure 3.16: Percentage breakdown of results for Section C – Risk Ranking



(Source: Own Compilation)

Table 3.16: Summary of the descriptive statistics for Section C – Risk Ranking

Variable	N	Mean	Std Dev	Min	Max	Ranking
1 – Safety	151	3.51	0.50	3	4	3
2 – Environment	151	2.87	0.86	1	4	9
3 – Policy uncertainty	151	2.90	0.80	2	4	8
4 – Coal Price Volatility	151	3.33	0.77	2	4	4
5 – Labour unrest	151	3.11	0.82	2	4	6
6 – Political influence	151	3.70	0.46	3	4	2
7 – IT (Cyber) Threats	151	3.28	0.67	2	4	5
8 – Recent financial credit rating downgrade	151	3.81	0.39	3	4	1
9 – Mechanisation	151	2.66	0.92	1	4	10
10 – Slope failure	151	3.08	0.82	2	4	7
C3 Average	151	3.23	0.70	2.10	4.00	N/A

(Source: Own Compilation)

Based on the results above, the next step in the statistical analysis process was to try to simplify all the numerous variables into constructs or factors. Thus, the next section illustrates the factors that were developed for the data.

3.10. EXPLORATORY FACTOR ANALYSIS ON RM AT THE COLLIERY

Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors (Rahn, 2017:1). Factor analysis is a useful tool for investigating variable relationships for complex concepts such as risk scales. The tool allows researchers to investigate concepts that are not easily measured directly by contracting a large number of variables into a few interpretable underlying factors. Factor analysis helps to deal with datasets where there are large numbers of observed variables that are thought to reflect a smaller number of underlying variables. The tool is one of the most commonly used inter-dependency techniques and is used when the relevant set of variables shows a systematic interdependence and the objective is to find out the latent factors that create a commonality.

Exploratory factor analysis aims at exploring the relationships among the variables and does not have a prior fixed number of factors. In an exploratory factor analysis, the final number of factors is determined by the data and the interpretation of the factors. Cut-offs of factor loadings can be much lower for exploratory factor analyses (Rahn, 2017:1). For this study, the exploratory factor analysis method was utilised. Rahn (2017:1) summarizes the factor analysis method as follows:

- A data reduction tool;
- Removes redundancy or duplication from a set of correlated variables;
- Represents correlated variables with a smaller set of 'derived' variables;
- Factors are formed that are relatively independent of one another.

3.10.1 Application of Factor Analysis

- a) Identification of Underlying Factors:
 - i. clusters variables into homogeneous sets;
 - ii. creates new variables (i.e. factors);
 - iii. allows one to gain insight to categories;
- b) Screening of Variables:
 - i. identifies groupings to allow one to select one variable to represent many;
 - ii. useful in regression;
- c) Summary:
 - i. Allows one to describe many variables using a few factors;
- d) Sampling of variables:
 - i. helps select small group of variables of representative variables from larger set;
- e) Clustering of objects:
 - i. Helps one to put items into categories depending on their factor scores (Pearce & Yong, 2013:79).

3.10.2 Steps in Factor Analysis

- a. Collect and explore data: choose relevant variables;
- b. Extract initial factors (via principal components);
- c. Choose number of factors to retain via factor loading;
- d. Choose estimation method/estimate model;
- e. Rotate and interpret;
- f. Decide if changes need to be made (e.g. drop item(s), include item(s)), and repeat steps (d)-(e);
- g. Construct scales and use in further analysis (Pearce & Yong, 2013:80).

3.10.3 Kaiser's Measure of Sample Adequacy (MSA)

To determine whether factor analysis may be appropriate, Kaiser's measure of sample adequacy (MSA) was calculated via SPSS to give an indication of the inter-correlations among the variables. This index ranges from '0' to '1', reaching '1' when each variable is perfectly predicted by the other variables. The measure can be interpreted with the following guidelines (Glen, 2017b:1):

Table 3.17: MSA Score Interpretation

MSA Score	Interpretation
≥ 0.80	Meritorious
0.70	Middling
0.60	Mediocre
0.50	Miserable
< 0.50	Unacceptable

(Glen, 2017b:1)

3.10.4 Section B1: Risk Management Value

The overall MSA score for section B1 (Value) was 0.872 (meritorious) as can be seen from Table 3.18, thus factor analysis would be appropriate for this dataset. Three factors were evident from in Table 3.19 however only two factors were chosen

based on the principles discussed above. The third factor was removed because there were only two variables in the factor, the factor loadings were low and the Cronbach alpha coefficient was poor (Cronbach alpha coefficients will be discussed in section 3.11 below).

3.10.4.1 Factor Grouping for B1

The grouping of the variables into the factors for B1 was based on the rotated factor pattern scores as can be seen in Table 3.19 below and as per the factor analysis steps in section 3.10.2.

Factor 1 (Value and Effectiveness): B1.13, B1.9, B1.6, B1.4, B1.12, B1.7, B1.2, B1.10 and B1.11 (this proves that value and effectiveness are linked).

Factor 2 (Contractors: RM Perceptions): B1.5, B1.14, B1.8 and B1.3.

Table 3.18: MSA Scores for each question of section B1

B1	1	2	3	4	5	6	7	8	9	10
MSA	0.630	0.926	0.813	0.923	0.880	0.892	0.927	0.542	0.879	0.903

(Source: Own Compilation)

Kaiser's Measure of Sampling Adequacy: Overall MSA = 0.872

Table 3.19: Rotated Factor Pattern (Standardized Regression Coefficients) of section B1

B1	Factor 1	Factor 2	Factor 3
13	0.879	.	.
9	0.841	.	.
6	0.774	.	.
4	0.768	.	.
12	0.745	.	.
7	0.709	.	.
2	0.696	.	.

10	0.647	.	.
5	0.636	0.363	.
11	0.517	.	0.397
14	.	0.771	.
8	.	0.725	.
3	.	0.568	.
1	.		0.828

(*Values less than 0.3 are not printed)

(Source: Own Compilation)

3.10.5 Section B2 - Current Typical Risks

The overall MSA score for section B2 (Current Typical Risks) was 0.928 (meritorious) as can be seen from Table 3.20 thus, factor analysis would be appropriate for this dataset. Four factors were evident from Table 3.21 below however only three factors were chosen based on the principles discussed above. The fourth factor was removed because the factor loadings were low and the Cronbach alpha coefficient was poor.

3.10.5.1 Factor Grouping for B2

The grouping of the variables into the factors for B2 was based on the rotated factor pattern scores as can be seen in Table 3.21 below and as per the factor analysis steps in section 3.10.2.

Factor 1 (Risks Set 1: Internal and External risks): B2.2, B2.22, B2.10, B2.23, B2.9, B2.19, B2.8, B2.3, B2.13, B2.17, B2.4, B2.15, B2.18 and B2.1.

Factor 2 (Risks Set 2: Labour related risks): B2.12, B2.25, B2.21, B2.11, B2.6 and B2.16.

Factor 3 (Risks Set 3: Performance Delivery risks): B2.5, B2.7 and B2.20.

Table 3.20: MSA Scores for each question of section B2

B2	1	2	3	4	5	6	7	8	9	10
MSA	0.862	0.954	0.924	0.964	0.872	0.937	0.871	0.962	0.958	0.926
B2	11	12	13	14	15	16	17	18	19	20
MSA	0.740	0.835	0.952	0.877	0.939	0.897	0.948	0.961	0.957	0.922
B2	21	22	23	24	25					
MSA	0.900	0.928	0.933	0.838	0.865					

(Source: Own Compilation)

Kaiser's Measure of Sampling Adequacy: Overall MSA = 0.928

Table 3.21: Rotated Factor Pattern (Standardized Regression Coefficients) of section B2

B2	Factor 1	Factor 2	Factor 3	Factor 4
2	0.785			
22	0.743			
10	0.741			
23	0.689			0.347
9	0.666			
19	0.655			
8	0.654			
3	0.642			0.320
13	0.616	0.389		
17	0.602			
4	0.595			
15	0.559	0.447		
18	0.557		0.327	
1	0.620	0.422		
12		0.816		
25		0.724		
21		0.629		
11		0.623		

6	0.354	0.502		
16	0.329	0.673		0.358
5			0.732	
7			0.622	
20		0.371	0.567	
24				0.838
14				0.648

(*Values less than 0.3 are not printed)

(Source: Own Compilation)

3.10.6 Section B3 - Risk Management effects on Productivity

The overall MSA score for section B3 (Productivity) was 0.775 (middling) as can be seen from Table 3.22 thus, factor analysis would be appropriate for this dataset as well. Four factors were evident from Table 3.23 below however only two factors were chosen based on the principles discussed above. The third and fourth factors were removed because the factor loadings were low and the Cronbach alpha coefficients were poor.

3.10.6.1 Factor Grouping for B3

The grouping of the variables into the factors for B3 was based on the rotated factor pattern scores as can be seen in Table 3.23 below and as per the factor analysis steps in section 3.10.2.

Factor 1 (General Productivity): B3.8, B3.7, B3.3 and B3.5.

Factor 2 (Internal Productivity): B3.10, B3.9 and B3.6.

Table 3.22: MSA Scores for each question of section B3

B3	1	2	3	4	5	6	7	8	9	10
MSA	0.546	0.825	0.804	0.549	0.851	0.793	0.822	0.821	0.73	0.373

(Source: Own Compilation)

Kaiser's Measure of Sampling Adequacy: Overall MSA = 0.775

Table 3.23: Rotated Factor Pattern (Standardized Regression Coefficients) of section B3

B3	Factor 1	Factor 2	Factor 3	Factor 4
8	0.926			
7	0.893			
3	0.875			
5	0.845			
10		0.901		
9	0.466	0.656		
6		0.578		
1			0.881	
2			0.592	0.492
4				0.868

(*Values less than 0.3 are not printed)

(Source: Own Compilation)

3.10.7 Section B4 - Revised Risk Management Perception

The overall MSA score for section B4 (Revised Risk Perception) was 0.814 (meritorious) as can be seen in Table 3.24 thus, factor analysis would be appropriate for this dataset. Two factors were evident from Table 3.25 below however only one factor was chosen based on the principles discussed above. The second factor was removed because the factor loadings were low and the Cronbach alpha coefficient was poor.

3.10.7.1 Factor Grouping for B4

The grouping of the variables into the factors for B4 was based on the rotated factor pattern scores as can be seen in Table 3.25 below and as per the factor analysis steps in section 3.10.2.

Factor 1 (Revised RM Perception): B4.3, B4.7, B4.2, B4.1, B4.5 and B4.6.

Table 3.24: MSA Scores for each question of section B4

B4	1	2	3	4	5	6	7
MSA	0.879	0.8	0.771	0.651	0.848	0.799	0.853

(Source: Own Compilation)

Kaiser's Measure of Sampling Adequacy: Overall MSA = 0.814

Table 3.25: Rotated Factor Pattern (Standardized Regression Coefficients) of section B4

B4	Factor 1	Factor 2
3	0.873	
7	0.792	
2	0.773	
1	0.754	
5	0.654	0.373
6	0.52	0.483
4		0.778

(*Values less than 0.3 are not printed)

(Source: Own Compilation)

3.11. RELIABILITY OF THE MEASURING INSTRUMENT

The reliability of a measuring instrument can be determined by assessing the internal consistency between the various items of the measuring instrument. To accomplish this, Cronbach's alpha coefficients can be calculated (Welman *et al.*, 2011:153). In the current study, the Cronbach's alpha coefficients were determined to indicate consistency between the factors discussed above. A higher internal consistency means that there is a higher degree of generalisability between the different items in the measuring instrument (Welman *et al.*, 2011:154). The index of reliability is determined by taking every item in the measuring instrument and correlating it with every other item in the same measuring instrument. An average inter-item correlation

is then determined. The values of the coefficients can range between '0' and '1'. A value closer to '1' indicates more reliable results as it means that the internal consistency is higher. A value of '0' indicates no reliability and means that the items were inadequately formulated (Bryman *et al.*, 2014:322). The interpretations for the Cronbach's alpha coefficients are indicated in Table 3.26 below.

Table 3.26: Cronbach's alpha coefficients

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.8 \leq \alpha < 0.9$	Good
$0.7 \leq \alpha < 0.8$	Acceptable
$0.6 \leq \alpha < 0.7$	Questionable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

(Levine *et al.*, 2011:556)

Reliability of the items was determined by using the responses of all 151 participants. In the current study, the measuring instrument had acceptable to excellent reliability. Most of the Cronbach Alpha values for the different factors were showing acceptable reliability, some were excellent, some good, majority acceptable and some questionable as seen in Table 3.27 below. There were no unacceptable values. The highest value attained was 0.940 for Risk Set '1' and the lowest value was 0.601 for Productivity Internal. The overall average Cronbach Alpha coefficient was 0.767, which is acceptable. This also to a certain extent confirms that the results are valid because the factors are linked, they make sense and they correlate as will be seen below in section 3.12.

Table 3.27: Summary of the Factor Analysis Statistics

Statistics for the Factor Analysis				
Factors	N	Mean	Std. Deviation	Cronbach Alpha Coefficient
B1_ValueAndEff	151	3.17	0.607	0.892
B1_Contractors	151	2.89	0.491	0.602
B2_RiskSet1	151	2.63	0.683	0.940
B2_RiskSet2	151	2.55	0.624	0.764
B2_RiskSet3	151	3.24	0.435	0.604
B3_ProdGeneral	151	2.97	0.877	0.907
B3_ProdInternal	151	2.49	0.646	0.601
B4_RevisedRiskPerc	151	2.76	0.639	0.832
Overall Ave	151	2.84	0.626	0.767

(Source: Own Compilation)

3.12 STATISTICAL CORRELATIONS BETWEEN THE FACTORS AT THE COLLIERY

Spearman Correlation Coefficient is also referred to as Spearman Rank Correlation or Spearman's rho. It is typically denoted either with the Greek letter ρ (ρ), or r_s . It is one of the few cases where a Greek letter denotes a value of a sample and not the characteristic of the general population. Like all correlation coefficients, Spearman's rho measures the strength of association of two variables. As such, the Spearman Correlation Coefficient is a close sibling to Pearson's Bivariate Correlation Coefficient, Point-Biserial Correlation, and the Canonical Correlation (Lani, 2017:1).

The correlations between the factors via Spearman's rho can be seen in Table 3.29 below. There are many correlations that can be noticed because they have rho values above 0.5, which implies a large practically significant relationship. There were some rho values below 0.3, which implied a medium practical visible relationship, and there were a few rho values below 0.1, which implied small to no practical significant relationship (Lani, 2017:1). However, majority of the rho values were greater than 0.5.

As an example, there is a high correlation between the value and effectiveness of RM with risk set '1' (0.719), general productivity (0.747) and revised risk perception (0.717). There is a low correlation between value and effectiveness of RM and risk set '2' (0.110). The same concept applies to all the other factors, which can be deduced from Table 3.29 below, which is a summary of the Spearman's rho correlations.

A p-value is used in hypothesis testing to help one to support or reject the null hypothesis. The p-value is the evidence against a null hypothesis. The smaller the p-value, the stronger the evidence that one should reject the null hypothesis. A small $p (\leq 0.05)$, reject the null hypothesis. This is strong evidence that the null hypothesis is invalid (Glen, 2017a:1). The table below shows the different p-value ranges and meaning to the values.

Table 3.28: p-value meaning

p-value	Connotation
If $p > 0.10$	Not significant
If $p \leq 0.10$	Marginally significant
If $p \leq 0.05$	Significant
If $p \leq 0.01$	Highly significant

(Glen, 2017a:1)

In terms of the p-value and statistical significance, most factors showed p-values less than 0.05, which implied a statistical significant relationship. As an example from Table 3.29, there is high statistical significance between the value and effectiveness of RM with all other factors since their p-values are less than 0.05. The exception is for the 'Internal Productivity' factor because it has a p-value of 0.051, which is more than the 0.05 cut-off. The same concept applies to all the other factors, which can be deduced from Table 3.29 below.

Table 3.29: Summary of the Correlations: Spearman's rho

Correlations: Spearman's rho									
		B1_Value AndEff	B1_Con tractors	B2_Risk Set1	B2_Risk Set2	B2_Risk Set3	B3_Prod General	B3_Prod Internal	B4_Revised RiskPerc
B1_Value AndEff	Correlation Coefficient (CC)	1.000	0.331	0.719	0.110	0.470	0.747	0.159	0.717
	Sig. (2-tailed) - p		0.00	0.003	0.180	0.000	0.002	0.051	0.001
B1_Contr actors	Correlation Coefficient	0.331	1.000	0.463	0.528	0.380	0.426	0.525	0.459
	Sig. (2-tailed) - p	0.001		0.001	0.000	0.006	0.000	0.002	0.003
B2_Risk Set1	Correlation Coefficient	0.719	0.463	1.000	0.006	0.514	0.789	0.282	0.810
	Sig. (2-tailed) - p	0.002	0.003		0.944	0.001	0.003	0.008	0.001
B2_Risk Set2	Correlation Coefficient	-0.110	0.528	0.006	1.000	0.164	-0.057	0.621	0.018
	Sig. (2-tailed) - p	0.180	0.000	0.944		0.044	0.485	0.000	0.825
B2_Risk Set3	Correlation Coefficient	0.470	0.380	0.514	0.164	1.000	0.543	0.316	0.558
	Sig. (2-tailed) - p	0.008	0.005	0.000	0.044		0.000	0.004	0.000
B3_Prod General	Correlation Coefficient	0.747	0.426	0.789	-0.057	0.543	1.000	0.303	0.766

	Sig. (2-tailed) - p	0.003	0.006	0.000	0.485	0.000		0.006	0.000
B3_ProdInternal	Correlation Coefficient	0.159	0.525	0.282	0.621	0.316	0.303	1.000	0.309
	Sig. (2-tailed) - p	0.051	0.000	0.002	0.000	0.004	0.001		0.002
B4_RevisedRiskPeric	Correlation Coefficient	0.717	0.459	0.810	0.018	0.558	0.766	0.309	1.000
	Sig. (2-tailed) p	0.002	0.001	0.005	0.825	0.000	0.005	0.000	

(Source: Own Compilation)

* Row 1 - Indicates practical significance of the relationship for Spearman's correlations. Guideline values (Lani, 2017:1):

- ~0.1 - small, no practical significant relationship.
- ~0.3 - medium, practical visible relationship.
- ~0.5 - large, practical significant relationship.

** Row 2 - Indicates whether or not there is a statistical significant relationship. Guideline values (Lani, 2017:1):

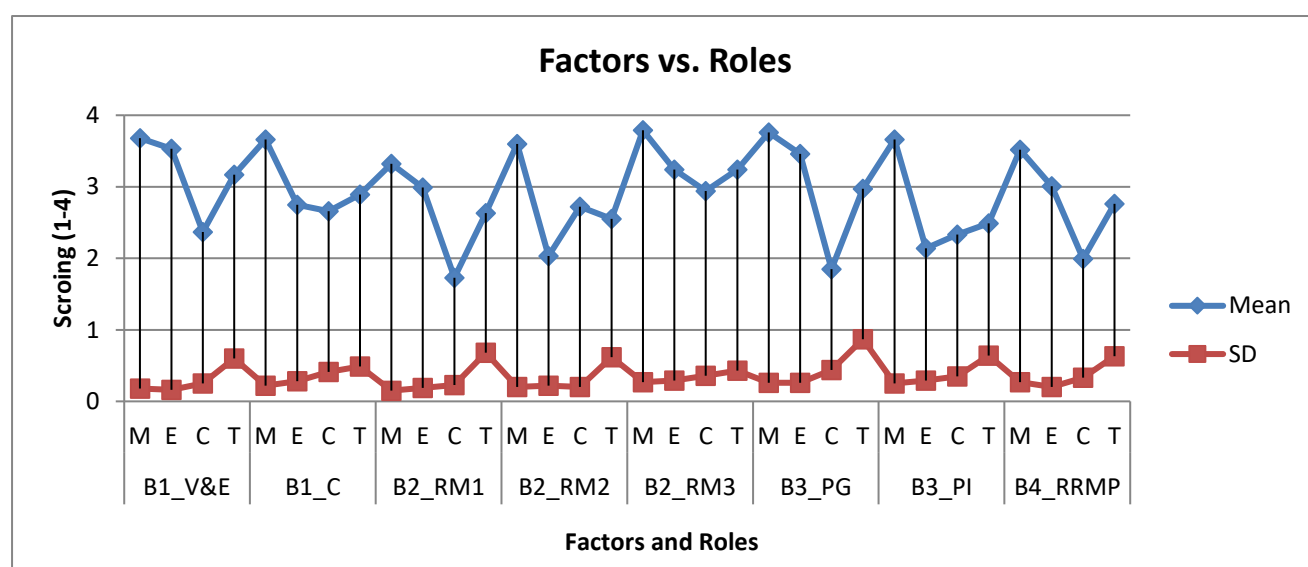
- $P < 0.05$ means statistical significant relationship.

Section 3.13 below uses the factor analysis results to discuss the comparisons of managers, employees and contractors assessments against all factors in B1, B2, B3 and B4.

3.13 STATISTICAL COMPARISON OF MANAGERS, EMPLOYEES AND CONTRACTORS PERCEPTIONS AGAINST ALL FACTORS IN B1, B2, B3 & B4

Figure 3.17 is a summary graph of the comparison of Managers, Employees and Contractors perceptions against all factors in sections B1, B2, B3 and B4. It also includes the effect sizes as well as the 95% confidence intervals in the midst of the means and standard deviations (SD).

Figure 3.17: Mean and SD for the factors against the respondents' roles



(*M – Managers, E- Employees, C – Contractors, T- Total)

(Source: Own Compilation)

3.13.1 Factor 1 (B1 – Value and effectiveness)

For this factor, the participants on average agree (3.17/4.00) that RM adds value and is effective to the mine. Managers and employees strongly agree (3.68/4.00 and 3.53/4.00 respectively). Contractors agree (2.57/4.00). Thus, the participants believe that RM does indeed have value and is effective at the mine.

3.13.2 Factor 2 (B1 – Contractors)

For this factor, the participants on average agree (2.89/4.00) that contractors are effective and add value in terms of RM at the mine. Managers strongly agree (3.66/4.00). Employees and contractors agree (2.75/4.00 and 2.66/4.00

respectively). Thus, the participants believe that contractors add value to RM and are effective in the RM process.

3.13.3 Factor 3 (B2 – Risk Set ‘1’ - Internal and External risks)

For this factor, the participants on average agree (2.63/4.00) that the risks in risk set ‘1’ affects the mine. Managers and employees agree (3.32/4.00 and 2.99/4.00 respectively). Contractors disagree (1.73/4.00). Thus, the participants on average believe that Risk Set ‘1’ (Internal and External risks) does have an impact on the mine.

3.13.4 Factor 4 (B2 – Risk Set ‘2’ - Labour related risks)

For this factor, the participants on average agree (2.55/4.00) that the risks in risk set ‘2’ affects the mine. Managers strongly agree (3.60/4.00) whereas employees tend to disagree (2.03/4.00 – have to be rounded down) and contractors agree (2.72/4.00). Thus, the participants on average believe that Risk Set ‘2’ (Labour related risks) also does have an impact on the mine.

3.13.5 Factor 5 (B2 – Risk Set ‘3’ - Performance Delivery risks)

For this factor, the participants on average agree (3.24/4.00) that the risks in risk set ‘3’ affects the mine. Managers strongly agree (3.79/4.00), employees, and contractors tend to agree (3.24/4.00 and 2.94/4.00 respectively). Thus, the participants believe that Risk Set ‘3’ (Performance Delivery risks) also does have an impact on the mine.

3.13.6 Factor 6 (B3 – General Productivity)

For this factor, the participants on average agree (2.97/4.00) that the risks affect the general productivity of the mine. Managers strongly agree (3.76/4.00) with employees agreeing (3.46/4.00) and contractors disagreeing (1.85/4.00). Thus, on average the participants believe that RM does affect the general productivity of the mine.

3.13.7 Factor 7 (B3 – Internal Productivity)

For this factor, the participants on average agree (2.51/4.00) that the risks affect the internal productivity of the mine. Managers strongly agree (3.66/4.00) with

employees and contractors disagreeing (2.34/4.00 and 2.33/4.00 respectively – have to be rounded down). Thus, the participants on average believe that RM does affect the internal productivity of the mine.

3.13.8 Factor 8 (B4 – Revised RM Perception)

For this factor, the participants on average agree (2.76/4.00) that a revised view of RM will benefit the mine. Managers strongly agree (3.52/4.00) with employees agreeing (3.01/4.00) and contractors disagreeing (1.99/4.00). Thus, on average the participants believe that they have a revised perception of RM and this will indeed benefit the mine.

Cohen's d is one of the most common ways to measure effect size. An effect size is how large an effect of something is. For example to show that Risk A has a better effect than Risk B. Cohen's d is the appropriate effect size measure if two groups have similar standard deviations and are of similar size (Glen, 2016:1).

Table 3.30 Conclusions from effect sizes – Cohens d

Effect size (f^2)	Effect	Conclusion
Smaller than 0.15	Small	Non-significant
Between 0.15-0.35	Medium	Significant
Larger than 0.35	Large	Practically important

(Glen, 2016:1)

Therefore, from Table 3.31 below, it can be seen that most Cohen's d values are greater than 0.35, which implies that they are practically significant. The means and standard deviations as well as the 95% confidence interval bounds are illustrated for all factors. The means and standard deviations were discussed above via Figure 3.17.

Table 3.31: Summary of the comparison of the factors with the respondents' role

Factors M – Manager E – Employee C- Contractor T - Total		Mean	SD	95% Confidence Interval for Mean		Effect size (Cohen's d)	
				Lower Bound	Upper Bound	Manager	Employee
B1_ValueAndEff (B1_V&E)	M	3.68	0.18	3.61	3.75		
	E	3.53	0.16	3.49	3.57	0.78	
	C	2.57	0.25	2.30	2.45	5.14	4.56
	T	3.17	0.60	3.07	3.27		
B1_Contractors (B1_C)	M	3.66	0.22	3.57	3.74		
	E	2.75	0.28	2.69	2.82	3.21	
	C	2.66	0.41	2.54	2.77	2.41	0.23
	T	2.89	0.49	2.81	2.97		
B2_RiskSet1 (B2_RM1)	M	3.32	0.15	3.26	3.38		
	E	2.99	0.19	2.95	3.04	1.65	
	C	1.73	0.23	1.66	1.80	6.75	5.37
	T	2.63	0.68	2.52	2.74		
B2_RiskSet2 (B2_RM2)	M	3.60	0.20	3.52	3.68		
	E	2.03	0.22	1.98	2.08	7.00	
	C	2.72	0.20	2.66	2.78	4.22	3.09
	T	2.55	0.62	2.45	2.65		
B2_RiskSet3 (B2_RM3)	M	3.79	0.27	3.69	3.90		
	E	3.24	0.29	3.17	3.31	1.87	
	C	2.94	0.36	2.83	3.04	2.32	0.81
	T	3.24	0.43	3.17	3.31		
B3_ProdGeneral (B3_PG)	M	3.76	0.26	3.66	3.86		
	E	3.46	0.26	3.40	3.52	1.16	
	C	1.85	0.44	1.72	1.97	4.28	3.59
	T	2.97	0.87	2.83	3.11		
B3_ProdInternal (B3_PI)	M	3.66	0.25	3.56	3.76		
	E	2.34	0.29	2.08	2.21	5.23	

	C	2.33	0.35	2.23	2.43	3.71	0.52
	T	2.51	0.64	2.38	2.59		
B4_RevisedRiskPerc (B4_RRMP)	M	3.52	0.27	3.41	3.63		
	E	3.01	0.20	2.97	3.06	1.84	
	C	1.99	0.33	1.90	2.09	4.59	3.07
	T	2.76	0.63	2.66	2.87		

(Source: Own Compilation)

The next section will use some of the factors discussed above to perform a multiple linear regression analysis, which will be used to predict RM value and effectiveness as well as the change in RM perception.

3.14 MULTIPLE LINEAR REGRESSION ANALYSIS AT THE COLLIERY

Multiple linear regression analysis is used when the influence of two or more independent variables on a dependent variable needs to be determined (Levine *et al.*, 2011: 556). This statistical procedure requires the collection of data, where after an equation can be developed to illustrate the relationships between the chosen variables. The dependent variable is the variable that is predicted. The variables that are used to make the prediction are termed the independent variables (Levine *et al.*, 2011:557). Essentially, the goal is to be able to assess the relationship between the dependant variable and the independent variables in order to develop a regression equation (line of best fit) between the dependent and independent variables. In this analysis, two separate multiple linear regression models were used to explain the results.

3.14.1 Multiple Linear Regression 1: RM value and effectiveness

This analysis is aimed to determine the influence of three constructs namely Risk Set '1', Risk Set '2', and Risk Set '3' on the value and effectiveness construct to determine which risk sets needs to be managed more in order to add value and thus to be effective at prioritising the right risks first.

a. Dependent variable: B1_ValueAndEff

b. Independent variable: B2_RiskSet3, B2_RiskSet2, B2_RiskSet1

The value of 'R' in Table 3.32 represents the portion of the dependent variable's variance explained by the model. The R-value in this model is 0.909, which is actually very good. The 'R²' of a data set indicated the multiple coefficient of determination. This number indicated the fraction of the variability of the dependent variable, that was explained by the independent variable in the predicted multiple linear regression equation (Levine *et al.*, 2011:558). In Table 3.32 below, the 'R²' value is high at 0.827 with means a very good fit (the adjusted 'R²' value is also high at 0.824). Therefore, 82.4% of the variation in value and effectiveness of RM could be explained by the three constructs namely Risk Set '1', Risk Set '2', and Risk Set '3'.

The p-values are now used to test each of the independent variables for individual statistical significance. A *p*-value below 0.05 indicates statistical significance, and therefore a significant relationship between the independent and dependent variable exists. A *p*-value above 0.05 points out that no significant relationships between the variables are present (Canhoto *et al.*, 2015:156). Table 3.34 below indicated that two independent variables had a *p*-value less than 0.05. The *p*-value of Risk Set '1' was demonstrated to be *p* = 0.000. Consequently, if Risk Set '1' increases, the value and effectiveness of RM will also increase. The *p*-value of Risk Set '2' was demonstrated to be *p* = 0.016. Consequently, if Risk Set '2' increases, the value and effectiveness of RM will also increase. The *p*-value of Risk Set '3' was however demonstrated to be *p* = 0.250. Consequently, Risk Set '3' showed no significant relationship to predict the dependent variable as per Table 3.34 and was therefore removed from the equation. Thus, from the data in Table 3.34 (Column B) below, the multiple linear regression equation was found to be:

$$\text{RM Value and Effectiveness} = 1.119 + 0.778*(\text{Risk Set 1}) - 0.088*(\text{Risk Set 2}).$$

Whereby:

Risks Set '1': Internal and External risks = function {B2.2, B2.22, B2.10, B2.23, B2.9, B2.19, B2.8, B2.3, B2.13, B2.17, B2.4, B2.15, B2.18 and B2.1}

Risks Set '2': Labour related risks = function {B2.12, B2.25, B2.21, B2.11, B2.6 and B2.16}

The above equation of '*RM Value and Effectiveness*' is significantly related to Risk Set '1' and Risk Set '2' because the p-values are less than 0.05. The data also indicates that 82.4% of the variance could be explained or accounted for by the Risk Sets scores, thus the model can be used because there is a line of best fit between the dependent and independent variables.

Table 3.32: Summary of the Regression Model

Model Summary				
Model 1	R	R ²	Adjusted R ²	Std. Error
B1_ValueAndEff	0.909	0.827	0.824	0.255
a. Predictors: (Constant), B2_RiskSet3, B2_RiskSet2, B2_RiskSet1				

(Source: Own Compilation)

From Table 3.33 below, it can be seen that regression had 3 degrees of freedom and residual has 147 degrees of freedom. The F-test for the overall significance is 234.4 which is very good and the p-value for the F -test is less an 0.05, thus it is significant.

Table 3.33: Anova Table for the Regression Model

ANOVA						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	45.735	3	15.245	234.392	.000 ^b
	Residual	9.561	147	0.065		
	Total	55.297	150			
a. Dependent Variable: B1_ValueAndEff						
b. Predictors: (Constant), B2_RiskSet3, B2_RiskSet2, B2_RiskSet1						

(Source: Own Compilation)

The coefficients below in Table 3.34 show the individual contribution of each predictor to model. A change in the dependent variable per one unit increase of the

corresponding independent variable when the other independent variables are held constant.

Table 3.34: Model Coefficient Data of the Regression Model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig. p	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.119	0.161		6.94	0.000		
	B2_RiskSet1	0.778	0.037	0.876	20.7	0.000	0.66	1.51
	B2_RiskSet2	-0.088	0.036	-0.091	-2.43	0.016	0.85	1.17
	B2_RiskSet3	0.072	0.062	0.051	1.15	0.250	0.59	1.67

(Source: Own Compilation)

3.14.2 Multiple Linear Regression 2: Change in RM Perception

This analysis is aimed to determine the influence of three constructs namely Risk Set '1', Risk Set '2', and Risk Set '3' on the Revised RM perception construct to determine which risks affect the RM perception of the participants the most.

a. Dependent Variable: B4_RevisedRiskPerc

b. Independent Variables: B2_RiskSet3, B2_RiskSet2, B2_RiskSet1

The R-value in this model is 0.881, which is actually very good. In Table 3.35 below, the 'R²' value is high at 0.777 with means a good fit (the adjusted 'R²' value is also high at 0.772). Therefore, 77.2% of the variation in Revised RM perception could be explained by the three constructs namely Risk Set '1', Risk Set '2', and Risk Set '3'. Table 3.37 indicated that two independent variables had a *p*-value less than 0.05. The *p*-value of Risk Set '1' was demonstrated to be *p* = 0.000. Consequently, if Risk Set '1' increases, the Revised RM perception will also increase. The *p*-value of Risk Set '2' was demonstrated to be *p* = 0.032. Consequently, if Risk Set '2' increases, the Revised RM perception will also increase. The *p*-value of Risk Set '3' was however demonstrated to be *p* = 0.414. Thus, Risk Set '3' showed no significant

relationship to predict the dependent variable and was thus removed from the model. Thus from the data in Table 3.37 (Column B) below, the multiple linear regression equation was found to be:

$$RM\ Perception = 0.230 + 0.799*(Risk\ Set\ 1) + 0.094*(Risk\ Set\ 2).$$

Whereby:

Risks Set 1: Internal and External risks = function {B2.2, B2.22, B2.10, B2.23, B2.9, B2.19, B2.8, B2.3, B2.13, B2.17, B2.4, B2.15, B2.18 and B2.1}

Risks Set 2: Labour related risks = function {B2.12, B2.25, B2.21, B2.11, B2.6 and B2.16}

The above equation of RM Perception is significantly related to Risk Set '1' and Risk Set '2' because the p-values are less than 0.05. The data also indicates that 77.2% of the variance could be explained or accounted for by the Risk Sets scores, thus the model can be used because there is a line of best fit between the dependent and independent variables.

Table 3.35: Summary of the Regression Model

Model Summary				
Model 2	R	R ²	Adjusted R ²	Std. Error
B4_RevisedRiskPerc	0.881	0.777	0.772	0.305
a. Predictors: (Constant), B2_RiskSet3, B2_RiskSet2, B2_RiskSet1				

(Source: Own Compilation)

From Table 3.36 below, it can be seen that regression has 3 degrees of freedom and residual has 147 degrees of freedom. The F-test for the overall significance is 170.53 which is very good and the p-value for the F -test is less an 0.05, thus it is significant.

Table 3.36: Anova Table for the Regression Model

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	47.690	3	15.89	170.53	.000 ^b
	Residual	13.703	147	0.093		
	Total	61.393	150			
a. Dependent Variable: B4_RevisedRiskPerc						
b. Predictors: (Constant), B2_RiskSet3, B2_RiskSet2, B2_RiskSet1						

(Source: Own Compilation)

The coefficients below in Table 3.37 show the individual contribution of each predictor to model. A change in the dependent variable per one unit increase of the corresponding independent variable when the other independent variables are held constant.

Table 3.37: Model Coefficient Data for the Regression Model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
2	(Constant)	0.230	0.193		1.19	0.236		
	B2_RiskSet1	0.799	0.045	0.853	17.8	0.000	0.662	1.51
	B2_RiskSet2	0.094	0.043	0.091	2.16	0.032	0.850	1.17
	B2_RiskSet3	0.061	0.074	0.041	0.81	0.414	0.596	1.67

(Source: Own Compilation)

Section 3.15 below is a supplementary statistical analysis that was not initially part of the study but illustrates important findings that adds value to the field of RM and to the study itself.

3.15 FURTHER STATISTICAL ANALYSIS AT THE COLLIERY

The data analysis below was completed in order to supplement the factor analysis and regression analysis done above as well as to ensure that all of the research questions are answered and thus to achieve all of the objectives of this study. As a reminder, the Likert scale had four options: *strongly agree*: '4', *agree*: '3', *disagree*: '2' and *strongly disagree*: '1' and the questionnaire is in Appendix A.

3.15.1 Value

Question B1.2: *"I believe that RM is a very valuable tool to the mine."*

Managers and employees strongly agree (3.77/4.00 and 3.76/4.00 respectively) that RM is a valuable tool to the mine whereas contractors agree (3.15/4.00). Overall, on average, all participants strongly agree (3.56/4.00) and this can be seen in Figure 3.18.

Question B1.3: *"I perform RM because it is value adding to my job."*

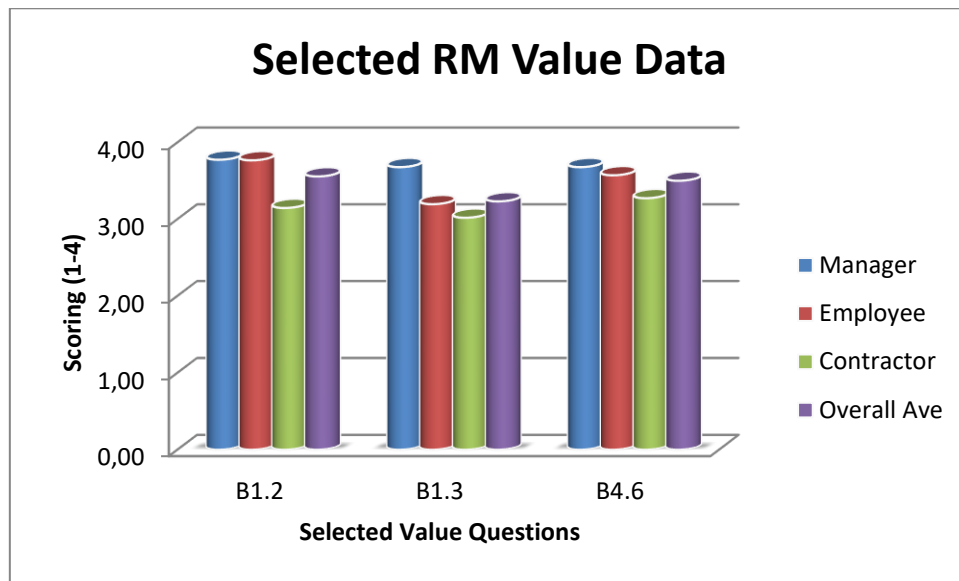
Managers strongly agree (3.68/4.00) that they perform RM because it is value adding to their job whereas employees and contractors agree (3.19/4.00 and 3.02/4.00 respectively). Overall, on average, all participants agree (3.23/4.00) as seen in Figure 3.18.

Question B4.6: *"I believe that addressing risks will add value to the mine."*

Managers and employees strongly agree (3.68/4.00 and 3.57/4.00 respectively) that addressing risks will add value to the mine whereas contractors agree (3.02/4.00). Overall, on average, all participants strongly agree (3.50/4.00) and this can be seen in Figure 3.18.

Discussion: On average, most participants believe that RM is a value adding function that is necessary at the mine. Most participants strongly agree (85.75%) with the statements above.

Figure 3.18: Scoring of selected RM Value questions



(Source: Own Compilation)

3.15.2 Effectiveness

Question B1.10: *“RM is effective at the colliery to mitigate the various risks.”*

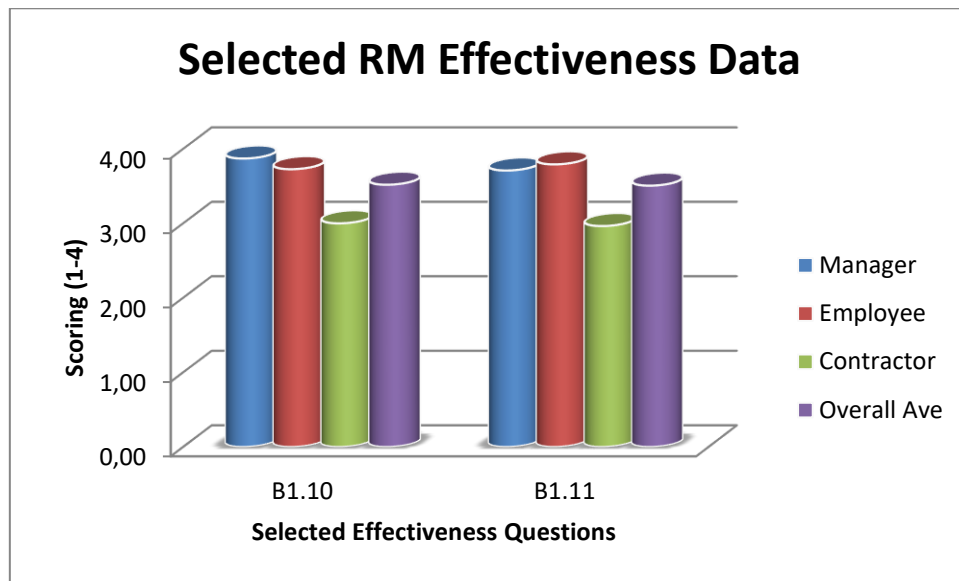
Managers and employees strongly agree (3.87/4.00 and 3.73/4.00 respectively) that RM is effective at the colliery to mitigate the various risks whereas contractors agree (3.00/4.00). Overall, on average, all participants strongly agree (3.52/4.00). This can be seen in Figure 3.19.

Question B1.11: *“I believe that the effectiveness of RM at the mine proves its value adding function.”*

Once again, Managers and employees strongly agree (3.71/4.00 and 3.79/4.00 respectively) that the effectiveness of RM at the mine proves its value adding function whereas contractors agree (2.96/4.00). Overall, on average, all participants strongly agree (3.51/4.00) as seen in Figure 3.19.

Discussion: On average, most participants believe that RM is an effective tool at the mine and is thus also value adding. Most participants strongly agree (87.88%) with the statements above.

Figure 3.19: Scoring of selected RM Effectiveness questions



(Source: Own Compilation)

3.15.3 Safety

Question B2.1: *“I think that integrated RM is all about safety.”*

Managers agree (3.03/4.00) that integrated RM is all about safety whereas employees and contractors strongly agree (3.71/4.00 and 3.80/4.00 respectively). Overall, on average, all participants strongly agree (3.61/4.00). This was an expectedly unfortunate response from all parties (this was also gauged from the pilot interview study as explained in Chapter 1). This can be seen in Figure 3.20.

Question B2.7: *“I believe that the failure to deliver a continuous improvement in safety performance is a risk to the mine.”*

Managers and employees strongly agree (3.87/4.00 and 3.61/4.00 respectively) that the failure to deliver a continuous improvement in safety performance is a risk to the mine whereas contractors agree (3.24/4.00). Overall, on average, all participants strongly agree (3.53/4.00) as seen in Figure 3.20.

Question B2.14: *“Safety is a critical risk to address at the mine.”*

Managers and employees strongly agree (3.94/4.00 and 3.66/4.00 respectively) that safety is a critical risk to address at the mine whereas contractors agree (3.20/4.00).

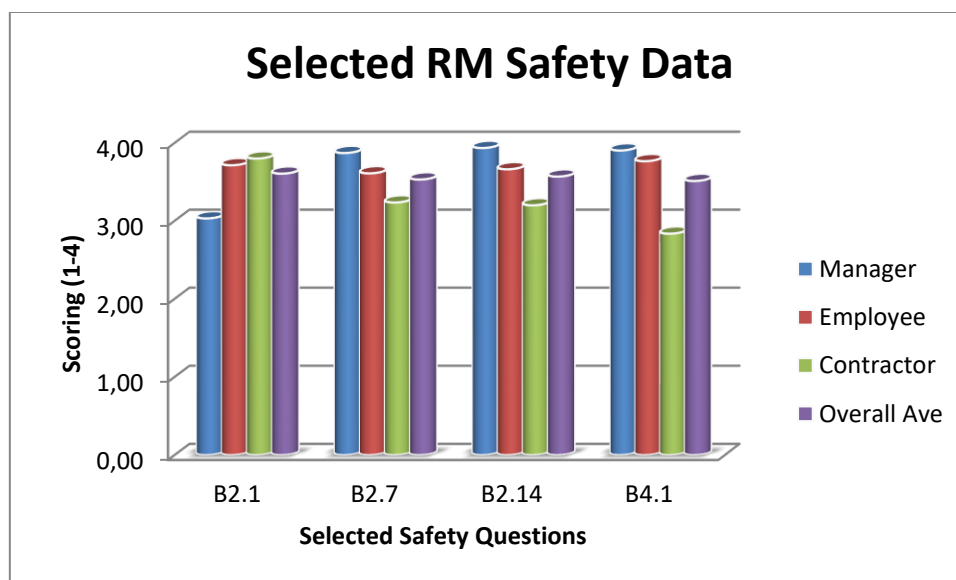
Overall, on average, all participants strongly agree (3.57/4.00). This can be seen in Figure 3.20.

Question B4.1: *“Have your views changed from mine safety risk management to mine integrated risk management?”*

Managers and employees strongly agree (3.90/4.00 and 3.77/4.00 respectively) that their views have changed from mine safety risk management to mine integrated risk management whereas contractors agree (2.84/4.00). Overall, on average, all participants strongly agree (3.51/4.00) as seen in Figure 3.20.

Discussion: Safety is a critical component of RM at the mine and will always be. On average, most participants (88.75%) ranked safety at the mine as a serious risk. Most participants strongly agree (90.25%) that integrated RM is all about safety. After some knowledge about integrated RM had been gained via the questionnaire, most participants (87.75%) believed that their perception had changed from just safety RM to integrated RM.

Figure 3.20: Scoring of selected RM Safety questions



(Source: Own Compilation)

3.15.4 Productivity

Question B3.1: *“I believe that not addressing risks to the mine ultimately means failing to realise operational productivity.”*

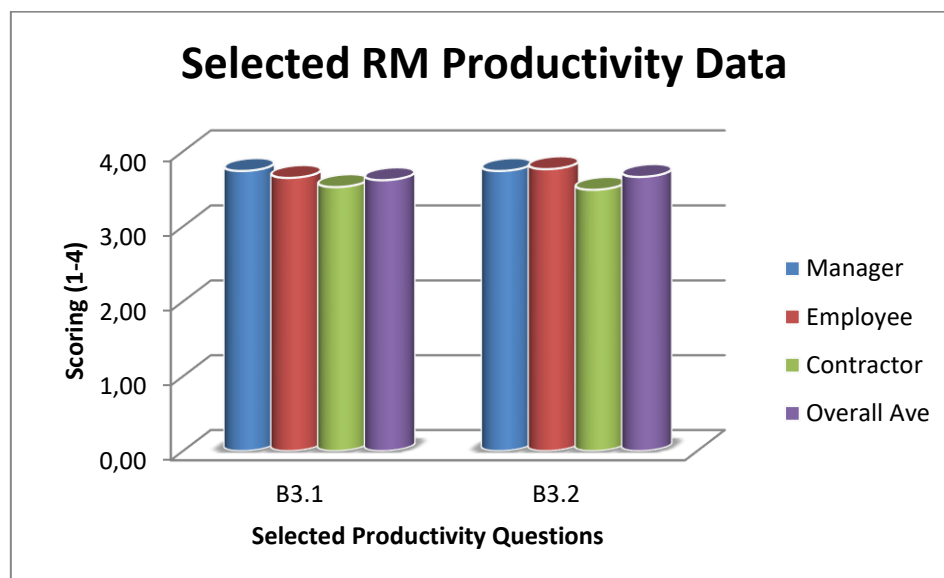
Managers, employees and contractors strongly agree (3.74/4.00, 3.65/4.00 and 3.53/4.00 respectively) that not addressing risks to the mine ultimately means failing to realise operational productivity. Overall, on average, all participants strongly agree (3.62/4.00). This can be seen in Figure 3.21.

Question B3.2: *“I am of the opinion that integrated RM will enhance the productivity of the mine.”*

Managers and employees strongly agree (3.74/4.00 and 3.77/4.00 respectively) that integrated RM will enhance the productivity of the mine whereas contractors agree (3.49/4.00). Overall, on average, all participants strongly agree (3.66/4.00) as seen in Figure 3.21.

Discussion: On average, most participants believe that productivity is affected by risks and that productivity can be improved via well-implemented integrated RM strategies. Most participants strongly agree (87.88%) with the statements above.

Figure 3.21: Scoring of selected RM Productivity questions



(Source: Own Compilation)

3.15.5 Selected Typical Risks

Question B2.2: *“The volatile global macro-economic conditions’ leading to sustained low coal prices is a major risk for the mine.”*

Managers strongly agree (3.77/4.00) that the volatile global macro-economic conditions’ leading to sustained low coal prices is a major risk for the mine while employees agree (3.26/4.00) and contractors disagree (1.95/4.00). Overall, on average, all participants agree (2.93/4.00). This can be seen in Figure 3.22.

Question B2.6: *“Adverse changes to mining industry regulation, legislation or tax rates will negatively impact the mine (e.g. new mining charter).”*

Managers strongly agree (3.81/4.00) that adverse changes to mining industry regulation, legislation or tax rates will negatively impact the mine while employees and contractors disagree (2.32/4.00 and 2.09/4.00 respectively – must be rounded off down). Overall, on average, all participants agree (2.54/4.00) because the average score for managers is really high as seen in Figure 3.22.

Question B2.17: *“I think that the current unstable political environment is a major risk to the mine.”*

Managers strongly agree (3.81/4.00) that the current unstable political environment is a major risk to the mine while employees agree (3.26/4.00) and contractors disagree (1.85/4.00). Overall, on average, all participants agree (2.91/4.00) as seen in Figure 3.22.

Question B2.18: *“I think that IT (cyber) security is a major risk to the mine e.g. Ransomware or email hacking.”*

Managers and employees agree (3.48/4.00 and 3.09/4.00 respectively) that IT (cyber) security is a major risk to the mine whereas contractors disagree (2.04/4.00 – must be rounded off down). Overall, on average, all participants agree (2.83/4.00). This can be seen in Figure 3.22.

Question B2.19: *“The recent economic credit downgrade is a major risk to the mine.”*

Managers strongly agree (3.77/4.00) that the recent economic credit downgrade is a major risk to the mine while employees agree (2.99/4.00) and contractors disagree (2.29/4.00 – must be rounded off down). Overall, on average, all participants agree (2.92/4.00) as seen in Figure 3.22.

Question B2.21: *“I think that mechanisation is the way to go in coal mining.”*

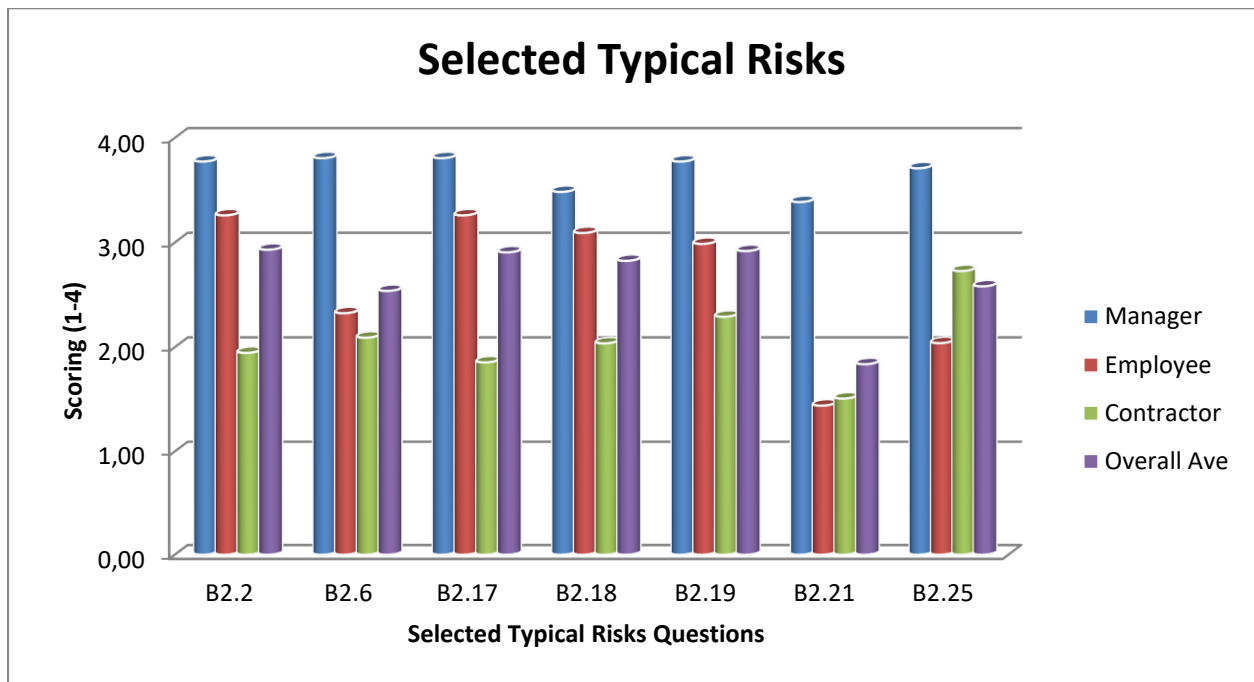
Contractors and employees disagree (1.51/4.00 and 1.44/4.00 respectively) that mechanisation is the way to go in coal mining whereas managers agree (3.39/4.00). Overall, on average, all participants disagree (1.84/4.00). This can be seen in Figure 3.22.

Question B2.25: *“There is a skills deficiency risk in terms of our own workforce.”*

Managers strongly agree (3.71/4.00) that there is a skills deficiency risk in terms of the workforce while employees disagree (2.04/4.00 – must be rounded off down) and contractors agree (2.73/4.00). Overall, on average, all participants agree (2.58/4.00) as seen in Figure 3.22.

Discussion: In terms of the risks highlighted above, there are certainly some gaps that need to be addressed. Managers generally strongly agree on most statements above, whereas employees and contractors have differing views. Contractors do not believe that the volatile global macro-economic conditions’ leading to sustained low coal prices is a major risk for the mine, which is a problem (48.75%). An interesting differing opinion is whereby employees believe that there is no risk of skillset deficiency in the workplace, however managers and contractors differ in their opinions.

Figure 3.22: Scoring of selected Typical Risk questions



(Source: Own Compilation)

3.15.6 RM Perception Change

Question B1.1: *“I believe that the mine has a good integrated RM strategy in place.”*

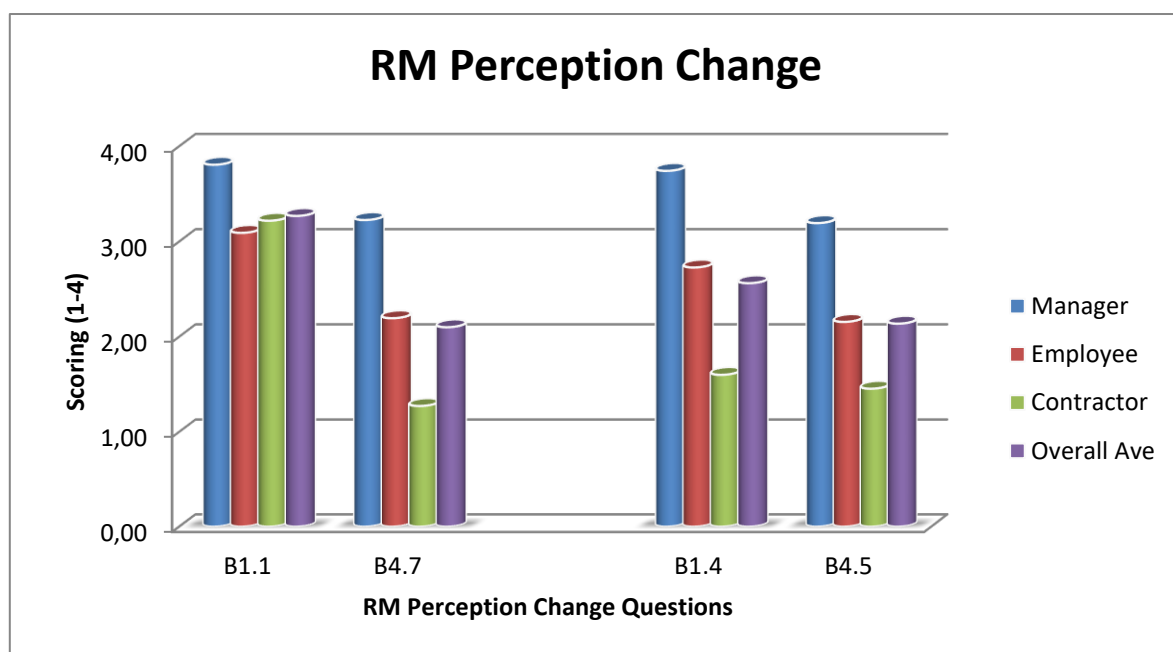
Managers initially strongly agree (3.81/4.00) that the mine has a good integrated RM strategy in place while employees and contractors agree (3.09/4.00 and 3.22/4.00 respectively). Overall, on average, all participants agree (3.27/4.00). This can be seen in Figure 3.23.

Question B4.7: *“Taking into account all of the risks referred to in this questionnaire (Section 2 and 3), I believe that the mine has a good integrated RM strategy in place.”*

Managers now agree (3.23/4.00) that the mine has a good integrated RM strategy in place while employees disagree (2.19/4.00 – must be rounded off down) and contractors strongly disagree (1.27/4.00). Overall, on average, all participants disagree (2.10/4.00 – must be rounded off down) as seen in Figure 3.23.

Discussion: Question B4.7 just retests the RM perceptions of the participants after they have gone through the main aspects of the questionnaire. B4.7 is the same question as in B1.1. This proves that all levels of employees have had a change in perception with regards to RM. They initially believed that the mine had a *good RM strategy in place* because they mainly thought risk was about safety however once they learnt about other risk types their perception had changed. This can be seen in Figure 3.23.

Figure 3.23: Scoring of selected RM Perception change questions



(Source: Own Compilation)

Question B1.4: *“I think that all of the risks are adequately addressed by the mine.”*

Managers initially strongly agree (3.74/4.00) that all of the risks are adequately addressed by the mine while employees agree (2.73/4.00) and contractors disagree (1.60/4.00). Overall, on average, all participants agree (2.56/4.00). This can be seen in Figure 3.23.

Question B4.5: *“Taking into account all of the risks discussed in this questionnaire (Section 2 and 3), I still think that all of the risks are adequately addressed by the mine.”*

Managers now agree (3.19/4.00) that all of the risks are adequately addressed by the mine while employees disagree (2.16/4.00 – must be rounded off down) and contractors strongly disagree (1.45/4.00). Overall, on average, all participants disagree (2.14/4.00 – must be rounded off down) as seen in Figure 3.23.

Discussion: Question B4.5 once again just retests the RM perceptions of the participants after they have gone through the main aspects of the questionnaire. B4.5 is the same question as in B1.4. This proves that all levels of employees have had a change in perception with regards to RM. They initially believed that *all of the risks are adequately addressed by the mine* because they mainly thought that risk was about safety however once they learnt about other risk types their perception had changed.

3.15.7 Extent of RM Adoption

Question B1.6: *“I am of the opinion that the RM framework of the mine has been fully adopted by all managers.”*

Managers and employees strongly agree (3.74/4.00 and 3.73/4.00 respectively) that the RM framework of the mine has been fully adopted by all managers while contractors disagree (2.45/4.00 – must be rounded off down). Overall, on average, all participants agree (3.31/4.00). This can be seen in Figure 3.24.

Question B1.7: *“I am of the opinion that the RM framework of the mine has been fully adopted by all employees.”*

Managers strongly agree (3.77/4.00) that the RM framework of the mine has been fully adopted by all employees while employees agree (3.05/4.00) and contractors disagree (2.15/4.00 – must be rounded off down). Overall, on average, all participants agree (2.91/4.00) as seen in Figure 3.24.

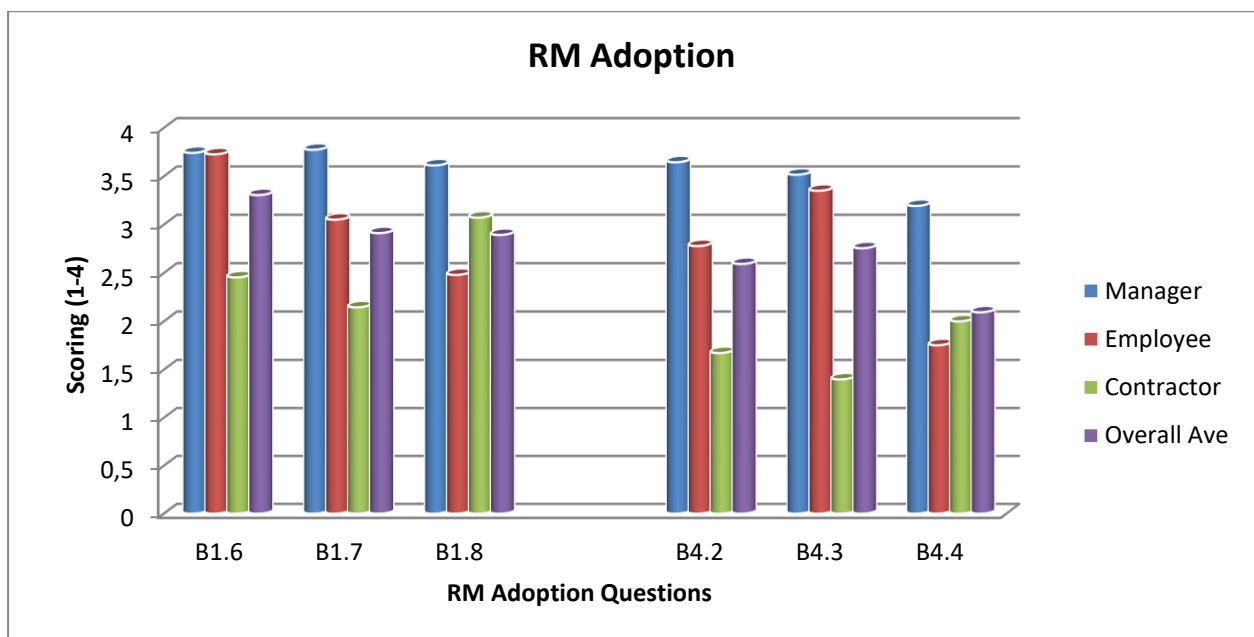
Question B1.8: *“I am of the opinion that the existing RM framework of the mine has been fully adopted by all contractors.”*

Managers strongly agree (3.61/4.00) that the RM framework of the mine has been fully adopted by all contractors while employees disagree (2.48/4.00 – must be

rounded off down) and contractors agree (3.07/4.00). Overall, on average, all participants agree (2.89/4.00). This can be seen in Figure 3.24.

Discussion: Managers strongly believe (92.67%) that the RM framework has been adopted by all other managers, employees and contractors. Employees tend to agree with managers except that they disagree that contractors have fully adopted the existing RM framework. Contractors on the other hand disagree that both managers and employees have fully adopted the existing RM framework.

Figure 3.24: Scoring of selected RM Adoption questions



(Source: Own Compilation)

Question B4.2: *“In your opinion, do you believe that managers are effective in taking full ownership (adopting) of RM?”*

Managers strongly agree (3.65/4.00) that other managers are effective in taking full ownership (adopting) of RM while employees agree (2.78/4.00) and contractors disagree (1.67/4.00). Overall, on average, all participants agree (2.59/4.00) as seen in Figure 3.24.

Question B4.3: *“In your opinion, do you believe that employees are effective in taking full ownership (adopting) of RM?”*

Managers strongly agree (3.52/4.00) that employees are effective in taking full ownership (adopting) of RM while employees agree (3.35/4.00) and contractors strongly disagree (1.40/4.00). Overall, on average, all participants agree (2.76/4.00). This can be seen in Figure 3.24.

Question B4.4: *“In your opinion, do you believe that contractors are effective in taking full ownership (adopting) of RM?”*

Managers agree (3.19/4.00) that contractors are effective in taking full ownership (adopting) of RM while employees and even contractors disagree (1.75/4.00 and 2.00/4.00 respectively). Overall, on average, all participants disagree (2.09/4.00 – must be rounded off down) as seen in Figure 3.24.

Discussion: Managers strongly believe (86.33%) that all personnel are effective in taking full ownership (adopting) of RM. They do however have a lower confidence in contractors. Employees tend to agree with managers except that they disagree that contractors are effective in taking full ownership of RM. Contractors on the other hand disagree that both contractors themselves and employees are effective in taking full ownership of RM.

The Chapter summary will be discussed in the next section, which encapsulates the whole of Chapter 3 and its integration with the objectives of the study.

3.16 CHAPTER SUMMARY

Overall, it can be seen that the data collected assists in answering the research questions as stated in Chapter 1 (and below), thus it answers the objectives of the study as well. In addition, it links very well with the findings in the literature review and provides for good discussions in Chapter 4.

The primary objective was to determine if integrated RM is a value adding strategic function to the mine with specific reference to managers, employees and contractors. The first secondary objective was to determine if integrated RM is effective to the mine and then the extent to which RM has been adopted by managers, employees and contractors was the next objective to accomplish. The other secondary objective was to determine if RM does affect productivity. The critically high risks for the mine to address or look into was then required to be determined and ranked. Finally, it was required to determine if there was a change in RM perception that was proven to be possible especially from just a safety RM mind-set to an integrated RM mind-set, which was the last objective.

The research design boded well because the data collected was reliable and captured a good sample and thus produced good useable data that was transformed into very useful information that has huge managerial implications for the mine as well as other businesses too. In terms of the objectives, all the necessary information required to achieve them were discussed in this Chapter and will be further expanded upon in Chapter 4.

CHAPTER 4: CONCLUSION AND RECOMMENDATIONS

4.1 INTRODUCTION

The purpose of this fourth and final Chapter is to conclude and discuss the findings of the literature and empirical studies as set out in the previous Chapters. This Chapter also focuses on practical managerial recommendations, as well as incorporated action plans to enhance integrated RM strategies at the colliery of study.

Thus, the Chapter commences with conclusions that were drawn from the literature and empirical studies. Thereafter, recommendations and brief action plans are discussed with an explanation on how the recommendations can be put into practice. Chapter 4 further revisits the research objectives and provides a critical evaluation of the achievement of the primary and secondary objectives before concluding with suggestions on future research.

4.2 MAIN CONCLUSIONS REGARDING THE STUDY

This section deals with the main conclusions from the literature study in Chapter 2 and the empirical study in Chapter 3.

4.2.1 Conclusions on the Literature Study

The literature review was critical in assisting to draft the interview schedule and ultimately the questionnaire used for the study to gather the necessary data for the empirical research. The literature review is based on investigating the value of integrated risk management strategies at a South African opencast colliery. The literature review is very detailed and a summary of its contents is as follows:

- Overview of the mining and coal mining industries;
- RM in the mining industry with focus on coal;
- General risk theory;

- RM theory;
- RM Strategies/frameworks;
- ERM;
- ERM in mining;
- Value of RM;
- The evolution of RM;
- Internal control for RM;
- Key success factors to ensure ERM enhances the organisational success;
- Strategic imperatives of ERM;
- Typical risks facing mining companies in RSA.

The information in the literature review ties up well with the findings in the empirical study as well as in this final Chapter. The literature review sets the foundation for the objectives of the study to be met. It is however evident from the literature that has been reviewed that the academic knowledgebase of RM is somewhat limited. Even more so from a South African perspective, particularly in mining and it is almost non-existent in coal mining. However, guidance does exist in the form of corporate governance guidelines that companies utilise to inform best practice application in a local context. This study will also aid to improve the lack of literature in this field.

4.2.2 Conclusions on the Empirical Study

An empirical study was conducted on 151 participants at an opencast colliery in South Africa. Based on the literature review presented in Chapter 2 and the results obtained in Chapter 3, it is now possible to draw conclusions and recommendations on the value of integrated risk management strategies at a South African opencast colliery. The conclusions are based on the demographics and nine different RM aspects, which will be discussed below.

4.2.2.1 Conclusions regarding the Demographic Information

In terms of demographics, there was quite a diverse range of participants that provided valid data. They varied in terms of roles, department, gender, age,

language, race, education and work experience. This then enabled the researcher to gain a more suitable dataset that represented the actual workforce. The majority of the participants (47.7%) were employees, this was followed by contractors (33.8%) and then managers (18.5%). Most of the participants were from the mining and engineering departments, which is ideal because they are generally the personnel ultimately impacted by RM. In terms of gender, 72.9% were male as expected in the mining industry however this is a key trait that needs to change with time because women in mining are essential and the company needs to look at this aspect to get this ratio more balanced. The colliery needs to empower women in mining more however there is the risk of women being promoted without actually attaining the necessary experience and having the right skillset, which can pose a huge challenge for the mine.

With regards to age, the majority of the participants are between 31 and 60 years of age. This is a fair balance of participants in terms of their age at the colliery however, one can deduce that the workforce is ageing and so a younger labour force needs to be given an employment opportunity at the mine. Thus, skills transfer will be vital for the mine. Concerning language, there seems to be shift in preferred language from the mother tongue languages to English as 27.2% of participants prefer English and this is presumed to be caused by the trend in globalisation and urbanisation. In terms of race, black participants accounted for the majority of the workforce at 62.9% and white participants at 21.2%. This seems to be an acceptable balance of participants in terms of their race at the colliery for this particular area's demography.

The workforce seems to be fairly well educated except for the individuals who did not complete grade 12 (17.9%). The mine should consider supporting these individuals to complete at least grade 12 via ABET. The mine has a fairly experienced workforce with 41.7% above 6 years and 23.8% above 11 years. The mine must strive to retain these personnel, as this will result in lower employee turnover and thus higher productivity. Overall, the purposive convenience sampling technique captured a very good set of demographic data so this then sets the foundation to enable the researcher to gain reliable and valid results.

4.2.2.2 Conclusions on the Reliability and Validity of the study

In terms of MSA values, most were above 0.8 (merituous) and only one value was below 0.8 but above 0.7 (middling) so this begins to demonstrate reliable results. With regards to the Cronbach alpha coefficients, majority of the factors were within the acceptable to excellent range of 0.7 to 1.0, thus one can deduce reliable results. The p-values were generally <0.05 which proved that most of the data was significant. The p-values were generally low because the standard deviations were small so the effect sizes were thus large. There were also a lot of correlations that was observed via Spearman's rho and this contributed to increased reliability. Overall, from the statistics obtained, the researcher attests that the data is reliable.

With regards to validity, an initial pilot study was completed via an interview process with 10 mine personnel (managers, employees and contractors included) and this was very valuable. A second pilot study on the final draft questionnaire was also completed with five mine personnel (managers, employees and contractors included) to ensure that the questionnaire was fit for purpose and that all errors were identified and removed. The questionnaire was designed for the population of study as well as to achieve the objectives of the study, which it does accomplish. The questionnaire does indeed measure what it is supposed to measure as seen in the results of Chapter 3. In addition, the sample population and the demographics of the participants attained were excellent.

The literature study also collaborated with the empirical findings and the reliability that was achieved as discussed above was very good. Thus, the researcher believes that the results are internally valid because there is very high content, construct and face validity. One can argue that this was achieved through triangulation because of the quantitative study, the qualitative pilot study, as well as the factor analysis and multiple linear regressions that was completed which proves that the data obtained is valid and that the results are valid as well.

4.2.2.3 Conclusions regarding the Value of Integrated RM Strategies at a South African Opencast Colliery

The majority of the participants agree that RM is valuable and is thus effective at the colliery to mitigate the various risks. On average, most people agree (77.5%) that RM is a valuable tool that adds value to the company. With regards to the value and effectiveness factor, the participants on average agree (79.3%) that RM adds value and is effective for the mine. Managers and employees strongly agree (92.0% and 88.3% respectively), and contractors agree (64.3%). This therefore implies that the participants think that RM is value adding and is thus an effective tool that must be utilised.

In terms of another question posed, managers and employees strongly agree (94.3% and 94.0% respectively) that RM is a valuable tool to the mine whereas contractors agree (78.8%). Overall, on average, all participants strongly agree (89.0%). Managers also strongly agree (92.0%) that they perform RM because it is value adding to their job whereas employees and contractors agree (79.8% and 75.5% respectively). Overall, on average, all participants agree (80.8%). Managers and employees strongly agree (92.0% and 89.3% respectively) that addressing risks will add value to the mine whereas contractors agree (75.5%). Overall, on average, all participants strongly agree (87.5%). Thus, one can conclude that integrated RM strategies do indeed add value to the mine.

Overall, managers and employees seemed to be more aligned as to the value of RM however; contractors are not fully on the same wavelength. Thus, more emphasis needs to be placed on contractors.

4.2.2.4 Conclusions regarding whether Integrated RM is Effective at the Colliery

By measuring the value adding aspect of RM as discussed above, this also implies effectiveness. Thus one can deduce that because RM is value adding, then RM must also be effective at the mine. This can be verified by section 3.15.2 in Chapter 3. Managers and employees strongly agree (96.8% and 93.3% respectively) that RM is

effective at the colliery to mitigate the various risks whereas contractors agree (75.0%). Overall, on average, all participants strongly agree (88.0%). Managers and employees also strongly agree (92.3% and 94.8% respectively) that the effectiveness of RM at the mine proves its value adding function whereas contractors agree (74.0%). Overall, on average, all participants strongly agree (87.8%). Thus, one can conclude that integrated RM strategies are effective at the mine.

Overall, managers and employees seemed to be aligned as to the effectiveness of RM with contractors also aligned however not as much as the other two groups. Thus, more attention can be placed on contractors to improve this aspect.

4.2.2.5 Conclusions regarding the Current Typical Critically High Risks facing the Colliery

The participants agree that the risks listed in section 3.6 are risks that must be addressed or looked into by the mine (these risks were tabled based on the literature review and the pilot interview that was conducted). On average, most people agree (71.3%) that these risks are critical and must to be mitigated or reduced as much as possible.

For the Risk Set '1' factor (section 3.13.3), the participants on average agree (65.8%) that these set of risks affects the mine. Managers and employees agree (83.0% and 74.8% respectively) whilst contractors disagree (43.3%). For the Risk Set '2' factor (section 3.13.4), the participants on average agree (63.8%) that these set of risks also affects the mine. Managers strongly agree (90.0%) whereas employees tend to disagree (50.8% - have to be rounded down) and contractors agree (68.0%). For the Risk Set '3' Factor (section 3.13.5), the participants on average agree (81.0%) that the risks in risk set '3' affects the mine. Managers strongly agree (94.8%), employees, and contractors tend to agree (81.0% and 73.5% respectively). More details can be seen in Chapter 3, section 3.10.5.

In a different set of questions (section 3.15.5), managers strongly agree (94.3%) that the volatile global macro-economic conditions' leading to sustained low coal prices is a major risk for the mine while employees agree (81.5%) and contractors disagree

(48.8%). Overall, on average, all participants agree (73.3%). Managers strongly agree (95.3%) that adverse changes to mining industry regulation, legislation or tax rates will negatively impact the mine while employees and contractors disagree (51.0% and 52.3% respectively - have to be rounded down). However, on average, all participants agree (63.5%) due to the high scoring for managers. Managers strongly agree (95.3%) that the current unstable political environment is a major risk to the mine while employees agree (81.5%) and contractors disagree (46.3%). Overall, on average, all participants agree (72.8%).

Managers and employees agree (87.0% and 77.3% respectively) that IT (cyber) security is a major risk to the mine whereas contractors disagree (51.0% - have to be rounded down). Overall, on average, all participants agree (70.8%). Managers strongly agree (94.3%) that the recent economic credit downgrade is a major risk to the mine while employees agree (74.8%) and contractors agree (60.3%). Overall, on average, all participants agree (73.0%). Contractors and employees disagree (37.8% and 36.0% respectively) that mechanisation is the way to go in coal mining whereas managers agree (84.8%) that it is the future of coal mining. Overall, on average, all participants disagree (46.0%). Managers strongly agree (92.8%) that there is a skills deficiency risk in terms of the workforce while employees disagree (49.2%) and contractors agree (68.3%). Overall, on average, all participants agree (64.5%).

Overall, all personnel are in agreement with the majority of the risks that are affecting the mine however managers, employees and contractors do have their own views on certain risks. They all thus need to be more aligned. Mechanisation and skills deficiency risks are interesting topics and this is seen via the interesting responses received. There was a section in the questionnaire that requested for 'Risk Ranking' (section 3.9 in this report) of a 'selection' of the critical risks which was highlighted in section B2 of the questionnaire. The selection of risks was developed from the pilot interview process and the literature review as discussed in Chapters 1 and 2. It is important to note that after the participants had completed sections B1, B2, B3 and B4, the risk perception of the participants had changed to see broader risks that they had never thought about before.

The risk that was highlighted as the most critical is the recent financial credit rating downgrade because this affects the future of the mine. Ranked in second place is political influence especially in Eskom tied coalmines, which may be linked to corruption. The third most critical risk is safety and the fourth is coal price volatility. Safety moved out of the number '1' position to number '3' which nonetheless still makes it very important which also proves a change in RM perception. IT (cyber) threats comes in fifth due to the recent IT phishing scams as well as ransomware and email hacking that recently affected the company, the country and the world. Labour unrest is in sixth place closely followed by slope failure in seventh. Policy uncertainty featured in eighth place due to the many delays of the publishing of the new mining charter, which was recently gazetted however; there were not enough consultations and thus an outcry concerning the policy. In ninth place is the environmental related risks and the tenth place belongs to mechanisation in mining which is a risk to job security of the employees. The overall mean scoring was 3.23/4.00 (81%) with a standard deviation of 0.70, which shows that the participants generally agree that these risks are real and are important to be risk assessed.

Table 4.1: Summary of the Risk Ranking

Variable	Ranking
1 – Safety	3
2 – Environment	9
3 – Policy uncertainty	8
4 – Coal Price Volatility	4
5 – Labour unrest	6
6 – Political influence	2
7 – IT (Cyber) Threats	5
8 – Recent financial credit rating downgrade	1
9 – Mechanisation	10
10 – Slope failure	7

(Source: Own Compilation)

The critical risks of the colliery were identified, assessed and ranked. Therefore, one can conclude that the current typical critically high risks facing the colliery were evaluated via this study.

4.2.2.6 Conclusions regarding how RM Strategies affects Productivity

The participants agree that the productivity of the mine is affected by integrated RM strategies. On average, most people agree (75.3%). In terms of factor '1' on Productivity (General) in section 3.10.6, the participants on average agree (74.3%) that risks affect the general productivity of the mine. Managers strongly agree (94.0%) with employees agreeing (86.5%) and contractors disagreeing (46.3%). For factor '2' of Productivity (Internal), the participants on average agree (62.8%) that the risks affect the internal productivity of the mine. Managers strongly agree (94.5%) with employees and contractors disagreeing (49.4% and 49.1% respectively). In another set of questions (section 3.15.4), managers, employees and contractors strongly agree that not addressing risks to the mine ultimately means failing to realise operational productivity. Overall, on average, all participants strongly agree (93.5%, 91.3% and 88.3% respectively). Managers and employees strongly agree (93.5% and 94.3% respectively) that integrated RM will enhance the productivity of the mine whereas contractors agree (87.3%). Thus, RM does affect productivity and it has the potential to ensure sustainable productivity. Therefore, one can conclude that integrated RM strategies affect productivity.

Overall, there is agreement amongst the different personnel, however there are some differences in views for certain questions that were asked. But they are however more or less aligned.

4.2.2.7 Conclusions regarding the Initial RM Perception

The deduction attained from the data in section 3.4.9 means that most people initially thought that RM was mostly about safety. In their minds, whenever they think about risk, they think safety, and this seems to be a programming or lack of training type of problem because safety is just one aspect of RM. The data from section 3.4.9 showed that 61.59% of individuals believe that safety accounts for 90% of RM and

the other risks the remaining 10% of RM. A further 20.53% believe that safety accounts for 70% of RM and other risks 30% which is still too low. There is definitely a missing training link whereby the coal mining industry personnel generally believe that safety is RM which is not entirely correct because it is only one aspect of it, nonetheless an important aspect. Management needs to look at a paradigm shift to enable its personnel to think differently about RM as well as the proper management of incidents in all RM areas; not only safety, health and environment.

4.2.2.8 Conclusions regarding whether RM Perception can change from mainly Safety RM to Integrated RM

Participants agree that their risk perception has somewhat changed after going through sections B1, B2 and B3 of the questionnaire. On average, most participants agree (66.8%) (section 3.13.8) that their RM perception has changed. The risk perception question was initially asked (in section A of the questionnaire) before exposure to the other RM aspects via the questionnaire such as in section B2 and B3 for example. The same risk perception question was then repeated toward the end of the questionnaire in section C (after B2 and B3) to gauge whether the participants perceptions have changed from Safety RM to Integrated RM because they were exposed to many different RM aspects in sections 2 and 3. This questioning technique was inspired by the pilot interview where all participants thought very differently about RM after the interview as supposed to just having a safety RM mind-set at the beginning of the interview.

The results show that there is definitely a change in perception amongst the participants (section 3.4.9 and 3.4.10). The majority of the personnel initially rated 'safety:other' risks very high at 61.59% for the 90:10 ratio and 20.53% for the 70:30 ratio with a cumulative percentage of 82.12%. Thus, most people believed that safety was more critical than the other risks. This perception has changed as can be seen in section 3.4.10, which is the data after participants had time to realise that there are many other risks that affect the operation including safety. Most of the revised responses sit in the middle between a 70:30, 50:50 and 30:70 rating with no responses in the 90:10 or 10:90 categories. This proves that making people aware of the risks can change their RM perception. Safety also moved out of the number '1'

position to number '3' in the risk ranking section 3.9 which, nonetheless still makes it very important but it proves a change in RM perception.

The data proves that the participants' perceptions have changed from just safety RM to slightly more integrated RM. This is very useful information in that it shows that although safety is important, there is possibly too much focus on it whilst neglecting the numerous other risks that can also drastically hurt the business. People now realise that there is more to RM than safety and that safety is one of many key components of integrated RM that must be addressed. Internal and external risks have been highlighted to the participants and this created a paradigm shift in thinking. People need to understand how integrated RM affects the profitability of the mine in everything that they do because each individual has a huge impact on RM.

Furthermore, the *factor* of 'Revised Risk Perception' in sections 3.10.7 and 3.13.8 shows that the participants on average agree (66.8%) that they have a revised view of RM and this will benefit the mine. Managers *strongly agree* (88.0%) with employees agreeing (75.3%) and contractors disagreeing (49.8%). In another question (B1.1), managers 'initially' strongly agree (95.3%) that the mine has a good integrated RM strategy in place while employees and contractors agree (77.3% and 80.5% respectively). Overall, on average, all participants agree (81.8%). After being re-asked the question at the end of the questionnaire (B4.7) "*Taking into account all of the risks referred to in this questionnaire, I believe that the mine has a good integrated RM strategy in place.*" Managers 'now' agree (80.75%) that the mine has a good integrated RM strategy in place while employees disagree (48.2%) and contractors strongly disagree (31.8%). Overall, on average, all participants *disagree* (49.1%). Question B4.7 in the questionnaire just retests the RM perceptions of the participants after they have gone through the main aspects of the questionnaire such as sections B2 and B3. Since, B4.7 is the same question as in B1.1, this proves that all personnel have had a change in perception with regards to RM. They initially believed that the mine had a good RM strategy in place because they mainly thought RM was about safety however once they learnt about other risk types their perception had changed.

In another question (B1.4), managers 'initially' strongly agreed (93.5%) that all of the risks are adequately addressed by the mine while employees agree (68.3%) and contractors disagree (42.0%). Overall, on average, all participants agree (64.0%). After being re-asked the question at the end of the questionnaire (B4.5) "*Taking into account all of the risks discussed in this questionnaire, I still think that all of the risks are adequately addressed by the mine*"; managers 'now' agree (79.8%) that all of the risks are adequately addressed by the mine while employees disagree (48.2%) and contractors strongly disagree (36.3%). Overall, on average, all participants disagree (49.5%). Question B4.5 once again just retests the RM perceptions of the participants after they have gone through the main aspects of the questionnaire in sections B2 and B3. Since, B4.5 is the same question as in B1.4, this proves that all personnel have had a change in perception with regards to RM. They initially believed that all of the risks are adequately addressed by the mine because they mainly thought risk was about safety however once they learnt about other risk types their perception had changed. Thus, one can conclude that RM perception can change from mainly Safety RM to Integrated RM via training or via good information sharing.

4.2.2.9 Conclusion regarding the Extent to which RM has been Adopted by Managers, Employees and Contractors

Managers and employees strongly agree (93.5% and 93.0% respectively) that the RM framework of the mine has been fully adopted by all '*managers*' while contractors agree (61.3%). Overall, on average, all participants agree (82.8%). Managers also strongly agree (94.3%) that the RM framework of the mine has been fully adopted by all '*employees*' while employees agree (76.3%) and contractors disagree (49.2%). Overall, on average, all participants just about agree (72.8%). Managers also strongly agree (90.3%) that the RM framework of the mine has been fully adopted by all '*contractors*' while employees disagree (49.5%) and contractors agree (76.8%). Overall, on average, all participants agree (72.3%).

Managers strongly agree (91.3%) that other '*managers*' are effective in taking full ownership (adopting) of RM while employees agree (69.5%) and contractors disagree (41.8%). Overall, on average, all participants agree (64.8%). Managers also

strongly agree (88.0%) that '*employees*' are effective in taking full ownership (adopting) of RM while employees agree (83.8%) and contractors totally disagree (35.0%). Overall, on average, all participants agree (69.0%). Managers agree (79.8%) that '*contractors*' are effective in taking full ownership (adopting) of RM while employees and even contractors disagree (43.8% and 45.8% respectively). Overall, on average, all participants disagree (49.4%). Thus, one can conclude that managers, employees and contractors have very different perceptions regarding the adoption of RM. Managers generally believe that RM is fully adopted; however employees and contractors beg to differ. Hence, there is an alignment problem in this regard.

Overall, there is difference of opinions regarding to the ratings of the different groups against one another. Thus, more emphasis needs to be placed on the alignment of all personnel in the adoption of RM strategies.

4.2.2.10 General Conclusions

From the results in Chapter 3, managers have a high perception that the RM at the operation is *very good*. Employees see RM at the operation as *good* while contractors see it as generally *poor*. Managers also originally felt very confident in themselves in that they are managing all the risks very well and were thus complacent. The results show that employees and contractors do not agree totally with them. Managers themselves had a change in perception as could be seen in section 3.15.6 of this study. They still believe that they are managing the risks but they are not as confident as they originally were. Employees and contractors disagree with managers. This is therefore an aspect that management needs to focus on and get alignment with the rest of the workforce. During the interview process, the researcher felt that there was also a lack on alignment between site personnel and Head Office/Corporate personnel with regards to the alignment of RM strategies. This is something that must be looked into as well, whereby possibly training can be provided to align everyone.

Managers and employees in general believe that contractors are a higher risk and thus need to be managed with more caution (section 3.15.7). Managers agree

(79.8%) that 'contractors' are effective in taking full ownership (adopting) of RM while employees and even contractors disagree (43.8% and 45.8% respectively). Overall, on average, all participants disagree (49.4%). An interesting topic was that of mechanisation of coal mining. Contractors and employees disagree (37.8% and 36.0% respectively) that mechanisation is the way to go in coal mining whereas managers agree (84.8%) that it is the future of mining. Overall, on average, all participants disagree (46.0%). Managers see mechanisation as the future whereas employees and contractors feel that it is a threat to their jobs and are therefore not in support of it. This is potentially a big risk especially because the mine will be prone to strikes if the wrong message is portrayed. Employees will be the ones who will need to drive the tools and technology and if they do not like the idea of mechanisation, they will vandalise the equipment and this could cause the technology to fail.

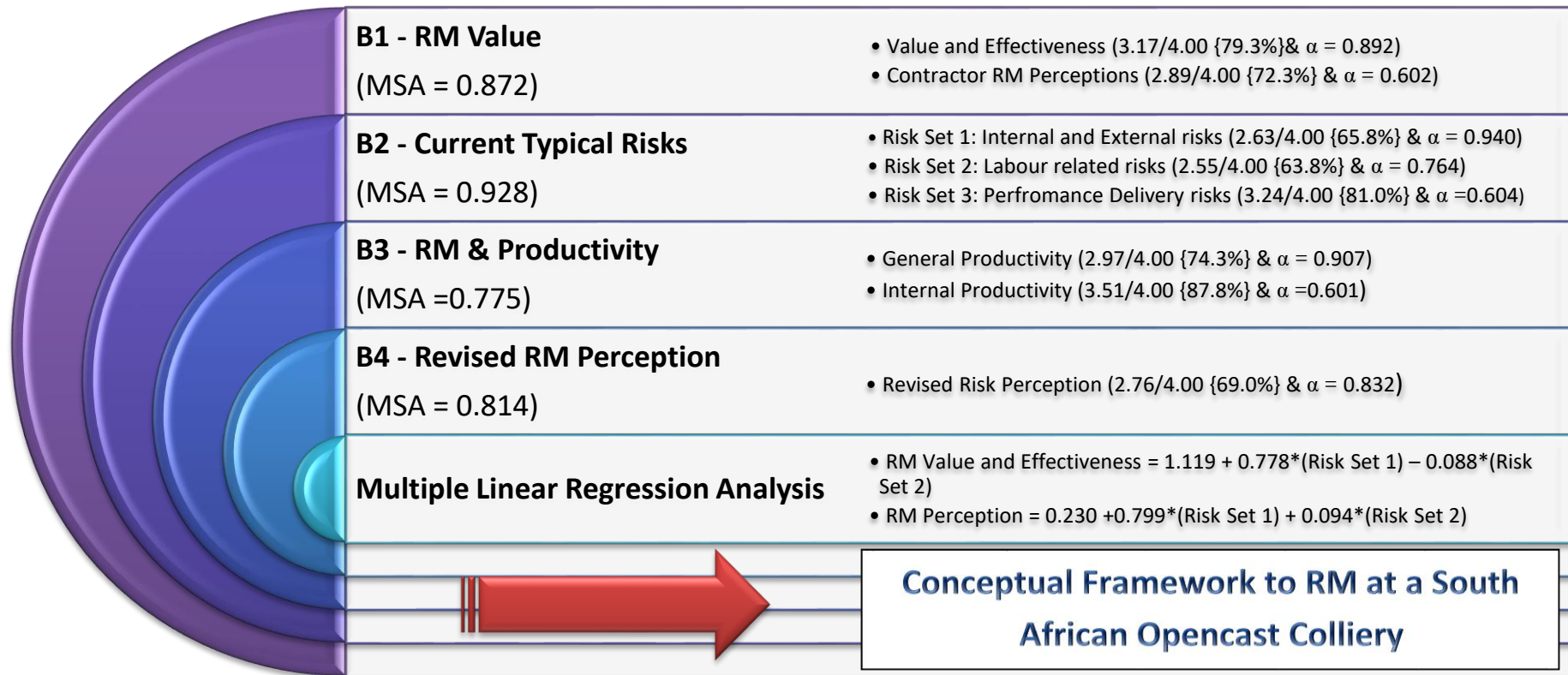
One risk that came up in the open-ended questions section of the questionnaire was the risk of moving to greener and cleaner non-carbon based energy. Since coal is a so called greenhouse gas producer of 'dirty energy', the entire industry will soon be under threat if not already. Interestingly, this risk was not even listed as a threat in the annual reports of various mining companies that was studied in the literature review, which is of concern. Another key problem facing majority of mining companies is the skillset deficiency in the industry. This was looked at in section 3.15.5 where the question was asked, "*Is there is a skills deficiency risk in terms of our own workforce.*" Managers strongly agreed (92.8%) that there is a skills deficiency risk in terms of the workforce while employees disagreed (49.2%) and contractors agreed (68.3%). Overall, on average, all participants agreed (64.5%). This is thus something that must be taken note of for further investigation because it has huge implications for the company and the industry as a whole.

Thus, in general there are gaps in RM that must be filled as soon as possible because as mining becomes more complex and as competition becomes more fierce, a smarter RM workforce may be the difference between attaining the company's goals and failing to realise the company's true potential. Thus, RM plays a key role in identifying the risks and mitigating its effects on the mine.

4.3 CONCEPTUAL FRAMEWORK

The visual framework below in Figure 4.1 is a high-level summary of the results discussed in Chapters 3 and 4.

Figure 4.1: The Conceptual Framework to RM at a South African Opencast Colliery



(Source: Own Compilation) (* α = Cronbach Alpha)

4.4 CONTRIBUTION OF THE STUDY

This study's contribution is of great academic, managerial and practical importance because the findings of this research will assist management, employees and contractors as well as Head Office personnel to better manage risks on site and to ensure that effective RM is maintained at the operation, thus creating value to the organisation by preventing serious disasters that can cause permanent damage to the mine, its reputation and its sustainability. The mine will benefit substantially from this research via the effects on its triple bottom line. The mine will profit from the study because the research evaluated the value of RM at the mine and simultaneously identified anomalies that existed that the mine can use to better manage their risk profile. By having a proper RM strategy in place, the colliery will have a competitive advantage against its competition.

The field of study will benefit from this research because this type of study has not been undertaken at a colliery before and there is limited literature on RM value in the mining industry, thus it will add to the existing literature in the RM field. Most mining related risk research is based on underground mining operations, however this research will be examining an opencast operation, thus it is a major difference and is of great importance.

4.5 RECOMMENDATIONS AND MANAGERIAL IMPLICATIONS

There are many recommendations and managerial implications that can be identified from this study. Firstly, it is recommended that the mine implements an integrated RM system such the ISO 30001 or the COSO framework to ensure that an integrated RM or ERM strategy is in place that links up with effective internal controls as explained in the literature review. The mine needs to adopt an integrated RM framework or ERM strategy, which also links to the operational RM processes. They will also need to institute a 'risk incident management' system which can accommodate the identification, reporting, capturing, assessing, and closing out of any risk that can cause problems for the mine.

Enhancing and sustaining the RM capability at the mine will require a process of continuous improvement. Changes in prevailing conditions in the coal mining industry's operating environment, the mine's objectives and the expectations of key stakeholders may require additional effort to enhance and maintain the desired RM capability maturity. Management, risk management practitioners and internal auditors can increase the probability of RM success and its intended benefits on the internal control system if they use a RM framework. To this effect, the mine must utilise the RM framework that is suggested to be implemented for RM and internal control integration. The framework can help the mine to be more resilient in times of uncertainty and difficulty.

There is also too much focus only on safety RM at the mine and although it is important, there are other critical risks that needs to be addressed too. The intense focus on only safety needs to be somewhat changed to accommodate an integrated RM mind-set and therefore general RM training must be given to all employees. The colliery needs to educate the workforce about the various risks that affect the mine and the coal mining industry. Implementing this RM cultural change will assist the mine tremendously because when the mine is not doing well, for example due to low coal prices or poor exchange rates, then if the workforce understands the predicament that the mine is in, then they will attempt to work more efficiently and effectively, strikes will be reduced, wage negotiations will go much smoother and thus the advantages are endless. This will thus assist to sensitise the workforce to the challenges affecting the mine, and consequently the burden will not only fall on the shoulders management, but it will filter down through the whole workforce, which will result in collective thinking to solve the problems. There are various other advantages to educate the workforce, but the bottom line is that it will affect productivity and thus profitability and sustainability. There must also be a feedback system in place in order to ensure the effective management and communication of the RM strategy on site to the entire workforce because a chain is only as strong as its weakest link so all links need to be strong.

The mind-set change can initially be done as a once off training and thereafter as annual refreshers via the mine induction process. Personnel need to understand all the risks affecting the mine and must play their part to mitigate the risks as best as

possible. Managers need to also prioritise the different risks as identified in this study. They need to frequently review these risks; the researcher suggests a review at least once every quarter. The mine must regularly update their RM strategy and communicate changes to the rest of the operation so that they are all aligned.

The mine does not have an appointed individual or chief risk officer dedicated to this cause, thus this is maybe an opportunity that the mine should have a look into (even if it's just a secondary job of a senior manager for the time being). The mine needs to focus on risks that are in their control and put mitigation plans in place regarding the risks that are out of their control. Thus all internal risks need strong employee focus whereas all external risks needs to be communicated in order to sensitise the workforce so that everyone is on the same page with regards to integrated RM strategy. RM should be filtered into the mission, vision, values and objectives of colliery. If such focus is given to RM from 'top' management, then this demonstrates that a lot of value is placed on integrated RM by the mine in order to drive and to mitigate risks effectively.

With regards to the level of education of the participants, the workforce seems to be fairly well educated except for the individuals who did not complete grade 12. Personnel with less than grade 12 accounted for 17.88% (27). The mine should consider supporting these individuals to complete at least grade 12 via ABET. In terms of the work experience of the participants, personnel with 6-10 years of experience were 41.72% (63) and the more experienced personnel with 11 year plus experience was 23.84% (36). Thus, the workforce has experienced individuals and the mine must strive to retain these personnel working for the mine until retirement if possible, as this will result in lower employee turnover and thus higher productivity. Also, knowledge and skills transfer should be encouraged from these experienced personnel to the juniors via effective programmes arranged and managed by the company.

In terms of the mining industry, this research provides insights for management, general managers and boards of companies to strive for the on-going improvement of their risk preparedness and effective corporate governance to achieve their objective of managing and minimising risk and thus to ultimately fulfil their

stakeholders commitments. While the maturity levels of the RM practices in the mining industry are at intermediate levels, more work needs to be done around improving this maturity. The fact that mines have not fully integrated RM with other business processes and the overall culture of the mine is a cause for concern, particularly if mines want to institutionalise RM. Therefore, it is recommended that more emphasis be placed on integrating the rest of the processes around communication and performance measurement as well as building a more organic culture that will allow a RM culture to permeate through the mining industry.

The quality and the role of the leadership team in driving RM efforts are paramount. Enterprise operating in the mining sector is constantly influenced by external and internal factors, and changes of these factors may increase the risks to its performance. The demand to improve the RM strategic system is fulfilled upon obtaining the right risk information from the right risk process as internal controls rely on a sound and comprehensive risk management process. Therefore, more focus needs to be placed on how the tone at the top filters through the mine to get everyone within the mine to understand RM and their role in controlling the risks.

Risk management practitioners or Chief Risk Officers of the mine are in charge of risk management in their organisations and have the responsibility for deploying and implementing the overall risk management program agreed upon by the organisation's board and senior management. For this purpose, it is recommended that the mine establish a structured strategic system that is both permanent and adaptable for the purpose of identifying, analysing and managing all the key risks facing the mine and providing support to management in driving the enhancement and maintenance of the integrated RM in their organisations especially at the operational level.

Internal audits are an important component of internal control in the business and through RM, the value provided by internal audits is significant and ties to the risks pertinent to the achievement of the organisations strategic objectives. More non-financial assurance is being done, however, it is recommended that internal audit functions focus more on developing their audit skills to be able to provide specific assurance and recommendations on the more advanced enterprise risks in order to

move risk management ahead in their organisations and ensure a sustained and strategic system of internal controls.

4.6 EVALUATION OF THE ACHIEVEMENT OF THE STUDY OBJECTIVES

In this section, the success of the study will be critically evaluated by determining whether the research objectives (as formulated in section 1.4) were met.

4.6.1. Primary Objective

The primary objective of the study is to determine whether RM strategies is a value-adding function to an opencast colliery in South Africa with specific reference to site management, employees and contractors. Subsequently, the primary objective did link to some of the secondary objectives of the study.

Overall, the primary objective was met. This was done via the literature review in Chapter 2 and, sections 3.5, 3.10.4 and 3.13. It was also achieved via sections 3.14.1 and 3.15.1 and these results all come to the same conclusion that integrated RM is a value adding strategic function to the mine. This result was attained from managers, employees and contractors.

4.6.2. Secondary Objectives

The following secondary objectives were addressed with the aim of achieving all of the objectives:

1. To determine whether integrated RM is an effective tool to the mine,
2. To determine the extent to which RM has been adopted by managers, employees and contractors,
3. To reveal whether RM affects productivity,
4. To determine the critically high risks for the mine to address or look into and to rank these risks,

5. To determine if there was a change in RM perception by managers, employees and contractors after becoming more knowledgeable about integrated RM (especially from a safety RM mind-set to an integrated RM or an ERM focus).

Secondary objective '1' was achieved via sections 3.5, 3.10.4.1, 3.13, 3.14.1 and 3.15.2. The results of these sections all come to the same conclusion that Integrated RM is an effective tool to the mine.

Secondary objective '2' was achieved via sections 3.8, and 3.15.7. The results of these sections all come to the same conclusion regarding the extent to which RM has been adopted by managers, employees and contractors, which shows that managers, employees and contractors are not aligned or in agreement regarding this.

Secondary objective '3' was achieved via sections 3.7; 3.10.6; 3.13 and 3.15.4. The results of these sections all come to the same conclusion that RM does affect productivity.

Secondary objective '4' was achieved via sections 3.6; 3.9; 3.10.7; 3.13; 3.14 and 3.15.5. The results of these sections all come to the same conclusion regarding the critically high risks for the mine to address or look into. These risks were evaluated and ranked by managers, employees and contractors.

Secondary objective '5' was achieved via sections 3.4.9; 3.4.10; 3.8; 3.10.7; 3.13; 3.14.2 and 3.15.6. The results of these sections all come to the same conclusion that there was a change in RM perception specifically from a safety RM mind-set to an integrated RM strategic focus.

It can be concluded that both the primary and secondary objectives were met. In addition, the research title suits the research topic and the results that were obtained links very well with the objectives of this study.

4.6.3. Other Findings

Another very useful finding that was not initially part of the objectives was the ‘safety’ aspects of RM which was covered in the literature review as well in the pilot interview and finally in the questionnaire via section 3.15.3. The participants overwhelmingly confirmed that safety is important however, their ranking and perception of safety RM has changed and they now focus on the broader picture, which includes safety RM as one of the RM concepts.

4.7 RECOMMENDATIONS FOR FUTURE RESEARCH

Suggestions for future research include the following:

Further studies to determine whether the findings in this study are generalisable to other mining industries e.g. gold and platinum. In addition, other studies to determine if the findings are generalisable to other industries e.g. steel or oil and gas as well as to other coal industries around the world. Also the effect of the risk of green and clean energy (global warming/climate change) on the entire coal mining industry must be investigated because this is a major threat to the industry and most probably rightfully so in order to save the environment and reduce the impact of global warming/climate change. Also, more investigations into ERM in the mining industry can add value to the literature in this field.

Another suggestion is to investigate the hidden significance behind the risk sets ‘1, 2 and 3’ constructs/factors. The researcher had named them as Risks Set ‘1’: Internal and External risk, Risk Set ‘2’: Labour related risk and Risk Set ‘3’: Performance Delivery risks. However, more work is required in this regard because it is felt that there is more to this than meets the eye.

The findings might not be generalisable to mines across the globe. It is therefore worthwhile to replicate the study in other countries. It is also suggested to include more participants in the target population. The current study consisted of 151 research participants. In addition, the purposive convenience sampling method was used to conduct the research and therefore the questionnaire was distributed and

completed only among participants who were fairly easy to reach. A more representative sample of participants can be attained by for example simple random sampling by utilising a database comprising of participants working in the mining industry in South Africa.

Measuring the state of ERM adoption in mining industries of other developing and developed countries can be useful. Determining how internal audit functions have geared up to be able to provide specific assurance and recommendations on more advanced enterprise risks, particularly in the technical aspects of business operations can be useful. Investigating how the bottom-up approach to ERM can be integrated with the top-down approach can also be looked into. Further research that could be performed on ERM and internal control improvement include the following aspects:

- The relationship between improved enterprise-wide internal control and performance of the organisation, determining the evidence of how strategic objectives are being achieved as a result of the improved internal control.
- The correlation between ERM maturity level and the intended value it provides.
- Investigating whether the sophistication of the ERM process is dependent on the maturity of the organisation. Evaluating ERM cost versus ERM return on investment.
- Exploring the moral dilemma of setting risk tolerance levels in high reliability organisations, i.e. organisations that have no choice but to function reliably. If reliability is compromised, it costs the company its sustainability, legal penalties or even the loss of human lives.

4.8 CONCLUSION

In this final Chapter, conclusions were drawn from the results that were discussed in Chapter 3 as well as the literature study in Chapter 2. Additionally, Chapter 4 points out where the empirical research supports and challenges the literature review that was completed. Then, conclusions were made regarding the RM variables of study and recommendations were formulated based on the results obtained. A brief discussion of action plans to be followed was then deliberated on, which will assist in the practical and swift implementation of the recommendations. The Chapter concluded by assessing whether the primary and secondary objectives had been achieved and suggestions for future research were lastly made.

The majority of the participants agree (77.5%) that RM is valuable and is thus effective at the colliery to mitigate the various risks it is exposed to. Managers, employees and contractors strongly agree (88.0%) that RM is effective at the colliery to mitigate these various risks. The participants agree (71.3%) that the risks listed in the questionnaire are risks that must be addressed by the mine because these risks are critical and must to be mitigated as much as possible. The risk that was ranked as the most serious current risk is the recent financial credit rating downgrade because this affects the future of the mine. Ranked in second place is political influence and instability especially in Eskom tied coalmines, with the third most critically ranked risk being safety. Most personnel initially thought that RM was mostly about safety whereby 61.59% of individuals believed that safety accounts for 90% of RM and the other risks the remaining 10% of RM. However, Participants agree (66.8%) that their risk perception has to a certain extent changed after going through sections B1, B2 and B3 of the questionnaire, thus the ranking of safety RM in third place and not first place (evaluated in section C). The participants also agree (75.3%) that the productivity of the mine is affected by integrated RM strategies.

It is recommended that the mine implement an integrated RM strategy such the ISO 30001 or the COSO framework that is aligned with effective internal controls. The intense focus on 'only' safety needs to be changed to accommodate an integrated RM mind-set. Therefore, RM training about the various risks that affect the mine and the coal mining industry must be given to all personnel. There must also be a

feedback system in place in order to ensure the effective management and communication of the RM strategy to the entire workforce. The mine also needs to appoint a chief risk officer, a consultant or even if it is just a secondary job of a senior manager (for the time being) to effectively drive the RM strategy. Full 'Board' and 'top management' support of RM is vital and must be attained because it is pertinent to the achievement of the mine's strategic objectives.

It can be seen that the data collected in this research study contributes in answering all of the research questions as stated in Chapter 1, thus it answers the objectives of the study as well. In addition, it links very well with the findings in the literature review in Chapter 2. The research design also boded well because the data collected was valid, reliable and captured a very good sample of participants. This then produced respectable and useable data that was transformed into very useful information that has huge managerial implications for the colliery as well as for other businesses. Overall, the researcher believes that the primary and secondary objectives of the research were achieved as well as the incorporation of other findings that were not initially part of the study. This then added value to the study, which can be used for further research on the topic. Holistically, this research proved that integrated RM strategies are effective and they do indeed add tremendous value to the colliery. This being the case, the researcher was therefore able to develop practical and implementable managerial recommendations for the various stakeholders of RM at the colliery.

The researcher worked extremely hard to ensure that the '*golden thread*' for this study was achieved and this can be confirmed through this dissertation that it was indeed accomplished. The title linked very well with the problem statement and the objectives of the study and is consequently well suited to this research. The outcomes of the research methodology, the literature review, the empirical investigation, the conclusions reached and the research objectives were all realised because all aspects of the study were well aligned.

As pointed out in the introduction of this dissertation, RM has been a widely debated topic from the early days of financial risk where it was considered irrelevant under perfect market conditions. However, the changing economic and business landscape

results in uncertainties in today's economies. Therefore, every company is, to some extent, in the business of risk management, irrespective of what products or services the company delivers. To give a company the competitive edge, Kganakga (2013:86) explains that *“An organisation that manages risk on an integrated and strategic basis will be positioned as an organisation which has risk management as a core competency, and which is therefore able to anticipate risks better than its competitors, giving it the competitive advantage well into the future.”*

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ANNEXURES

APPENDIX A: QUANTITATIVE QUESTIONNAIRE



Integrated Risk Management Questionnaire

Dear Participant,

I am a final year MBA student at the North-West University (School of Business and Governance) and I am conducting a study based on investigating the value of integrated risk management strategies at a South African opencast colliery.

Global and local economic markets as well as politics are in constant change and this continuous variation translates into business risk. Internal business operational changes also create substantial risk, thus risk management (RM) is integral to every business irrespective of the type of product or service offered and therefore operational (internal and external) risks needs to be managed appropriately. There are various strategies that one can adapt to a business to deal with risks; however it is critical to determine if these strategies are adding value to the organisation and if it is effective enough to deal with the business risks of today (Vijayakumar & Nagaraja, 2012:4).

Please answer the questions as honestly and objectively as possible. Your anonymity will be well-maintained and this questionnaire is purely on a voluntary basis only. Ethical compliance has been acquired and maintained (EMSPBS16/11/25-01/05). All data obtained will be confidential and utilised for academic research purposes only. The research findings can be made available to you once requested.

I thank you in advance for your participation.

Regards

The Researcher

Questionnaire Number:

Section A: Biographical Information

Please tick one option most suitable to you.

1. Are you a manager, employee or a contractor?

Manager ☐ 1 Employee ☐ 2 Contractor ☐ 3

2. In which department do you belong to?

Mining ☐ 1 Engineering ☐ 2 Plant & Stockyard ☐ 3
Safety ☐ 4 Admin ☐ 5 Technical Services ☐ 6

3. Please indicate your gender:

Male ☐ 1 Female ☐ 2

4. Please indicate your age:

18 – 30 ☐ 1 31 – 40 ☐ 2 41 – 50 ☐ 3 51 – 60 ☐ 4 60+ ☐ 5

5. Please indicate your preferred language:

English ☐ 1 Afrikaans ☐ 2 IsiZulu ☐ 3
Setswana ☐ 4 Sesotho ☐ 5 Other ☐ 6

6. Please indicate your race:

Black ☐ 1 White ☐ 2 Indian ☐ 3 Coloured ☐ 4 Other ☐ 5

7. Please indicate your highest level of education:

< Grade 12 ☐ 1 Grade 12 ☐ 2 Diploma ☐ 3
Undergraduate Degree ☐ 4 Postgraduate Degree ☐ 5

8. Please indicate your current employment level:

Junior management ☐ 1 Middle management ☐ 2 Senior management ☐ 3
Artisan ☐ 4 Operator ☐ 5 Supervisor ☐ 6 Not sure ☐ 7

9. What do you estimate is the closest current % split between Safety RM and other types of RM in terms of the options below (Safety:Other)?

90:10 70:30 50:50 30:70 10:90

10. Please indicate your work experience.

<1 year 1-5 years 6-10 years 11 years +

Section B: Integrated Risk Management Information

Please tick one option that you feel best describes the statements below.

Legend	<i>Strongly Disagree</i>	<i>1</i>
	<i>Disagree</i>	<i>2</i>
	<i>Agree</i>	<i>3</i>
	<i>Strongly Agree</i>	<i>4</i>

Statement		Strongly Disagree	Disagree	Agree	Strongly Agree
Section B1 – RM Value					
1	I believe that the mine has a good integrated RM strategy in place.	1	2	3	4
2	I believe that RM is a very valuable tool to the mine.	1	2	3	4
3	I perform RM because it is value adding to my job.	1	2	3	4
4	I think that all of the risks are adequately addressed by the mine.	1	2	3	4
5	I perform RM ONLY because of company policy.	1	2	3	4
6	I am of the opinion that the existing RM framework of the mine has been fully adopted by all <i>managers</i> .	1	2	3	4
7	I am of the opinion that the existing RM framework of the mine has been fully adopted by all <i>employees</i> .	1	2	3	4
8	I am of the opinion that the existing RM framework of the mine has been fully adopted by all <i>contractors</i> .	1	2	3	4
9	I perform RM because it is a key aspect of my job.	1	2	3	4
10	RM is effective at the colliery to mitigate the various risks.	1	2	3	4
11	I believe that the effectiveness of RM at the mine proves its value adding function.	1	2	3	4
12	I believe that <i>management</i> have an adequate understanding of RM at the mine.	1	2	3	4
13	I believe that <i>employees</i> have an adequate understanding of RM at the mine.	1	2	3	4
14	I believe that <i>contractors</i> have an adequate understanding of RM at the mine.	1	2	3	4
Section B2: Current Typical Risks					
1	I think that integrated RM is all about safety.	1	2	3	4
2	The volatile global macro-economic conditions' leading to sustained	1	2	3	4

	low coal prices is a major risk for the mine.				
3	The increasing cost of the supply of energy (e.g. electricity and diesel) is a major risk to the mine.	1	2	3	4
4	I believe that a constrained water supply (e.g. due to drought) is a serious risk to the mine.	1	2	3	4
5	Selecting the incorrect projects in the portfolio to invest in or develop is a key risk to avoid.	1	2	3	4
6	Adverse changes to mining industry regulation, legislation or tax rates will negatively impact the mine (e.g. new mining charter).	1	2	3	4
7	I believe that the failure to deliver a continuous improvement in safety performance is a risk to the mine.	1	2	3	4
8	The release of waste/pollution is a key risk to address.	1	2	3	4
9	An unexpected failure of a slope is a huge risk to the mine.	1	2	3	4
10	Fire and explosion risks are high at the mine.	1	2	3	4
11	I believe that market conditions have a huge impact on the mine.	1	2	3	4
12	Labour unrest is a major risk and will negatively impact the mine.	1	2	3	4
13	Social unrest is a major risk and will negatively impact the mine.	1	2	3	4
14	Safety is a critical risk to address at the mine.	1	2	3	4
15	I believe that there is a concern in terms of security at the mine e.g. theft and violence.	1	2	3	4
16	I believe that there is a risk in maintaining the mine's Socio-economic (community development) plans.	1	2	3	4
17	I think that the current unstable political environment is a major risk to the mine.	1	2	3	4
18	I think that IT (cyber) security is a major risk to the mine e.g. Ransomware or email hacking.	1	2	3	4
19	The recent economic credit downgrade is a major risk to the mine.	1	2	3	4
20	I believe that coal price volatility has a major impact on the mine.	1	2	3	4
21	I think that mechanisation is the way to go in coal mining.	1	2	3	4
22	There is a risk that the mine's financial results may be negatively affected by aggressive exchange rate fluctuations.	1	2	3	4
23	There is a risk that the mine may be negatively affected by the decrease in global demand e.g. China Slowdown.	1	2	3	4
24	The failure to discover new coal mining resources is a major risk to the life of mine (LOM).	1	2	3	4
25	There is a skills deficiency risk in terms of our own workforce.	1	2	3	4
Section B3: RM Productivity					
1	I believe that not addressing risks to the mine ultimately means failing to realise operational productivity.	1	2	3	4
2	I am of the opinion that integrated RM will enhance the productivity of the mine.	1	2	3	4
3	I believe that there is a risk that the mine is unable to meet production demands due to the various risks discussed.	1	2	3	4
4	I believe that managing risk better will ensure that the mine is able to generate the required sustainable operating profit.	1	2	3	4
5	I believe that managing risk better will ensure that the mine is able to generate the required sustainable cash flows.	1	2	3	4
6	I believe that managing risk better will ensure that the mine is able to meet the required cost/ton production targets.	1	2	3	4
7	I believe that managing risk better will ensure that the mine is able to meet the equipment availability and reliability targets e.g. MTTF.	1	2	3	4

8	I believe that managing risk better will ensure that the mine is able to meet the annual return on capital (ROCE) target.	1	2	3	4
9	I believe that there is a major risk in terms of production stoppage directives from governmental departments (e.g. DMR).	1	2	3	4
10	I believe that there is an utilisation of assets RM problem at the mine, which affects productivity.	1	2	3	4
Section B4: Revised RM Perception					
1	Have your views changed from mine safety risk management to mine integrated risk management?	1	2	3	4
2	In your opinion, do you believe that <i>managers</i> are effective in taking full ownership (adopting) of RM?	1	2	3	4
3	In your opinion, do you believe that <i>employees</i> are effective in taking full ownership (adopting) of RM?	1	2	3	4
4	In your opinion, do you believe that <i>contractors</i> are effective in taking full ownership (adopting) of RM?	1	2	3	4
5	Taking into account all of the risks discussed in this questionnaire, I still think that all of the risks are adequately addressed by the mine.	1	2	3	4
6	I believe that addressing these risks will add value to the mine.	1	2	3	4
7	Taking into account all of the risks referred to above, I believe that the mine has a good integrated RM strategy in place.	1	2	3	4

Section C: General Risk Management Information

Please answer the questions below briefly but to the best of your ability.

1. What are the major risks you believe the mine have not yet addressed?

2. What do you perceive now is the % split between Safety RM and other types of RM after completing this questionnaire (Safety:Other)?

90:10 70:30 50:50 30:70 10:90

3. Please **rank** the following risks according to which you perceive are more/less important for the mine to address.

Legend	Not important	1
	Important	2
	Very important	3
	Extremely important	4

Risk	Ranking			
Safety	1	2	3	4
Environment	1	2	3	4
Policy changes	1	2	3	4
Coal price volatility	1	2	3	4
Labour unrest	1	2	3	4
Political influence	1	2	3	4
IT (Cyber) threats	1	2	3	4
Recent financial credit downgrade	1	2	3	4
Mechanisation	1	2	3	4
Slope failure	1	2	3	4

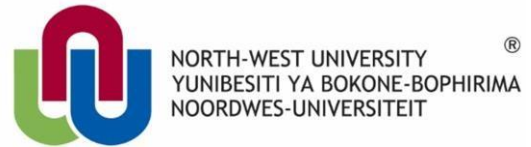
4. What recommendations do you have regarding integrated risk management for the mine?

Thank you for completing this survey! If not handed to me directly, kindly scan and email to theshan.govender@outlook.com. Much appreciated.

Regards

The Researcher

APPENDIX B: QUALITATIVE INTERVIEW SCHEDULE



Integrated Risk Management Semi-Structured Interview Guideline

Dear Participant,

I am a final year MBA student at the North-West University (School of Business and Governance) and I am conducting a study based on investigating the value of integrated risk management strategies at a South African opencast colliery.

Interview schedule:

- Express gratitude to the participant for attending the interview.
- Clarify the purpose of the interview highlighting that it is the participant's own views that are essential.
- Highlight that an audio recording of the interview will take place and that this is purely for record keeping purposes.
- Establish if they are willing to be interviewed. If they are willing, then appeal to them to sign their consent below.
- Explain that confidentiality will be well-maintained and that all data obtained will be kept confidential and utilised for academic research purposes only.

Interviews will be held with the following personnel:

Four site-managers, five company employees and one contractor employee.

Interview themes:

Research themes that will be discussed are the value of integrated risk management strategies at a South African opencast colliery.

Signature:

Date:

Questioning procedure:

There will be crucial questions under each theme with sub-questions. These sub-questions will be used depending on whether the answer given requires further probing or clarity. The same questions will be asked to all interviewees.

1. Is there a formal risk management framework used at the organisation?
 - Follow-up: If yes, please expand a bit more on this type of framework/s.
2. What types of risks are crucial to be addressed at the organisation?
 - Follow-up: Can you please rank them according to risk importance?
 - Follow-up: Can you please give me an idea as to risk timeline priorities (short, medium or long-term)?
3. In your opinion, do you feel that all of the risks described above are addressed relatively effectively by the organisation?
 - Follow-up: Please explain which risks are not addressed appropriately (more details and examples)?
4. Do you believe that addressing these risks will add value to the organisation?
 - Probe: Why?
5. Do you feel that mechanisation is a way to go within the organisation and the industry to counteract some of the risks inherent to the mining business?
 - Probe: What is your feeling?
6. What do you think about South Africa's recent credit downgrade to "Junk Status" by the ratings agencies and its particular effects on the organisation?
7. Do you believe that the political uncertainty, the new mining charter policy, and the social and labour unrest are major risks to the organisation?
Probe: Please expand a bit more on these aspects.

8. What do you think about the commodity price volatility cycle effects on the organisation and the industry?
9. In your opinion, do you think that the employees and managers are effective in taking full ownership of risk management at the organisation?
 - Probe: Please expand a bit more on this aspect.
10. Taking into account the overall risk scenario and our discussion, do you think that the organisation has a good integrated risk management strategy?
 - Follow-up: Why do you think so?