THE MINE HEALTH AND SAFETY ACT - SUCCESS OR FAILURE?

A CRITICAL ASSESSMENT OF THE AETIOLOGY AND IMPACT OF THE ACT OF 1996 WITH REFERENCE TO CONTEXT, TRIPARTISM AND RISK MANAGEMENT

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Declaration of Authorship

I, Mavis Ann Hermanus, student number 8386230, declare that this thesis is my own original work. It is submitted for the degree of Doctor of Philosophy in the School of Mining Engineering at the University of the Witwatersrand. It has not been previously submitted for any degree or examination to this or any other university.

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- All the work submitted in this thesis is my own unaided work except where I have explicitly indicated otherwise.
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Dedication

To the miners and the mining communities of Southern Africa to whom we owe a great debt.

Acknowledgements

This thesis is the outcome of many years of work alongside of colleagues and friends who shaped and informed my thinking and knowledge of health and safety in mining. There are too many to mention, but many have been associated the following organisations - the Technical Advice Group, the Health Information Centre, the Workplace Information Group, the National Union of Mineworkers, the Department of Minerals and Energy, the Sociology of Work Programme, the Centre for Applied Legal Studies, the National Centre of Occupational Health, the Centre for Sustainable Development in Mining and Industry, the Department of Mining Engineering at the University of the Witwatersrand, the schools of public health at the universities of Cape Town, Kwa-Zulu Natal and the Witwatersrand and last, but not least, the Mine Health and Safety Council. I hope my research justly reflects the achievements, and individual and collective efforts of the many people who have contributed to the improvement health and safety in South African mining.

I would not have been able to work in this field for so long and with such fervour had it not been for the support of my family, and my husband, Tony, in particular.

Thank you for enabling me to grow and follow my heart. I am blessed indeed!

Abstract

Introduction

The overall aim of this research was to investigate how the MHSA came about and to assess whether it succeeded or failed in its objectives to improve mine health and safety in South African mines. The main hypothesis is that the MHSA's impact has been mixed. The effect of the MHSA was assessed in terms of:

- The nature of health and safety problem encountered in the South African mining sector
- The context in which the MHSA was introduced, and which changed over time (*does the MHSA 'fit the context?*), and
- The readiness of the stakeholders for tripartism and risk management (*could the tripartite stakeholders engage effectively and put a risk management approach into place for health and safety?*).

It was envisaged that the outcomes of this research would have relevance for not only South Africa but also for other developing countries which have, or which are contemplating, similar legislation.

Methods

In overview, this research which includes supporting papers employs a grounded theory approach and mixed methods, drawing on both quantitative and qualitative evidence and data. Quantitative data on occupational health and safety impacts and exposures were sourced from the Department of Mineral Resources, the Minerals Council of South Africa, the Mine Health and Safety Council and StatsSA, while qualitative data were drawn from observations, interviews, reports and peer reviewed literature. The combination of data sources provided the basis for theorising that an examination of the social and mining context, an understanding of the pros and cons of the regulatory approach to

be employed, and readiness for practicing tripartism and risk management would be necessary to assess how successfully the MHSA could be adopted.

Outcomes and Findings

The data allowed for conclusions to be drawn about the state of, and trends in, health and safety in South African mining before and after the advent of the MHSA. The history of South African mining, mining conditions, laws and social mores, provided evidence of systematic and deeply entrenched divisions that continue to hamper dialogue on the prospects for further improving health and safety, as well as on the future of the sector. The body of mining health and safety law was found to have increased after the adoption of the MHSA, while the availability of specific information on the standards to be met has decreased. The composition of the sector was found to have changed as large mining companies divested from the country, and the number of smaller mines increased alongside of informal and illegal mining. While the health and safety outcomes of the sector have improved, the primary factor has been the decline in gold mining activities, albeit that health and safety practice in the formal sector, including gold mining, has advanced. The features of South Africa’s political and economic environment, and that of its mining sector are not uncommon in developing countries, and thus the research findings have relevance for them.

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Abbreviations

ALARP	As Low and Reasonably Possible
AMCU	Association of Mineworkers and Construction Union
AMMSA	Association of Mine Managers of South Africa
ATR	Annual Training Report
ABET	Adult Basic Education and Training
BTA	Bow Tie Analysis
BUSA	Business Unity South Africa
CEO	Chief Executive Officer
CIOM	Chief Inspector of Mines
COIDA	COIDA Compensation of Occupational Injuries and Diseases Act
COAD	Chronic Obstructive Airway Disease
COP	Code of Practice
COPD	Chronic Obstructive Pulmonary Disease (same as COAD)
COSATU	Congress of South African Trade Unions
CSIR	Council for Scientific and Industrial Research
CWP	Coal Workers' Pneumoconiosis
DEA	Department of Environmental Affairs
DIFR	Disabling Injury Frequency Rate
DME	Department of Minerals and Energy
DMR	Department of Mineral Resources
DOH	Department of Health
DoL	Department of Labour
DPSA	Department of Public Service and Administration
DTI	Department of Trade and Industry
EBA	Energy Barrier Analysis
ETA	Event Tree Analysis
ERM	Enterprise Risk Management
EU	European Union
EWRM	Enterprise Wide Risk Management
FMECA	Failure Mode Effects and Criticality Analysis
FEDSUSA	Federation of Unions of South Africa
FFR	Fatality Frequency Rate
FSA	Formal Safety Assessment
FTA	Fault Tree Analysis
GME	Government Mining Engineer
HASAWA	Health and Safety at Work Act (UK)
HAZAN	Hazard Analysis

HAZID	Hazard Identification Study
HAZOP	Hazard Operability Study
H&S	Health and Safety
HCP	Hearing Conservation Programme/s
HPD	Hearing Protective Device/s
HSE	Health and Safety Executive
HSRC	Human Sciences Research Council
ILO	International Labour Organization
ILCI	International Loss Control Institute
i.r.o	In respect of
IRS	Internal Responsibility System
ISO	International Standards Organisation
IRM	Integrated Risk Management
MBOD	Medical Bureau of Occupational Disease
MHSA	Mine Health and Safety Act
MEC	Minerals Energy Complex
MHSI	Mine Health and Safety Inspectorate
MHSC	Mine Health and Safety Council
MISHC	Mining Industry Safety and Health Centre (Australia)
MIRM	Mineral Industry Risk Management
MINCOSA	Minerals Council of South Africa (formally COM)
MOHAC	Mine Occupational Health Advisory Committee
MPPC	Mineral Parliamentary Portfolio Committee
MPRDA	Mineral and Petroleum Resources Development Act
MOSA	Machinery and Occupational Safety Act (precursor to OHSA in South Africa)
MQA	Mining Qualifications Authority
MRAC	Mining Regulation Advisory Committee
MRS	Mine Rescue Services
MVSSA	Mine Ventilation Society of South Africa
NACTU	National Council of Trade Union of South Africa
NEDLAC	National Economic Development and Labour Council
NEMA	National Environmental Act
NIOH	National Institute of Occupational Health
NOSA	National Occupational Safety Association
NUM	National Union of Mineworkers
NUMSA	National Union of Metal Workers of South Africa
ODMWA	Occupational Disease of Mines and Works Act
OEL	Occupational Exposure Limit

OHS	Occupational Health and Safety
QRA	Qualitative Risk Assessment
QRA	Quantitative Risk Assessment
PAJA	Promotion of Administrative Justice Act
PHA	Preliminary Hazard Analysis
PIN	Provisional Improvement Notice
PPC	Parliamentary Portfolio Committee
PPE	Personal Protective Equipment
RA	Risk Assessment
PRA	Preliminary Risk Assessment or Probabilistic Risk Analysis
RCM	Risk Control Matrix
RM	Risk Management
SAHRC	South African Human Resources Council
SAMODD	South African Mining Occupational Diseases Database
SAMRASS	South African Mines Reportable Accident Statistical System
SHA	System Hazard Analysis
SIMRAC	Safety in Mines Research Advisory Committee
SLP	Social and Labour Plans
SMME	Small Medium and Micro Enterprises
SOP	Standard Operating Procedure
SRA	Society for Risk Analysis
SWIFT	Structured What If Technique
SWP	Safe Work Procedure
TARP	Triggered Action Response Plan
TEBA	The Employment Bureau of Africa (1976 onwards)
TLV	Threshold Limit Value
TRC	Truth and Reconciliation Commission
UN	United Nations
WANELA	Witwatersrand Native Labour Organisation
WSP	Workplace Skills Plan
WRAC	Workplace Risk Assessment and Control

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CHAPTER ONE: INTRODUCTION

1.1 Background

The Mine Health and Safety Act (MHSA) of 1996 (Mine Health and Safety Act, 1996) is part of a body of mineral law which came into effect in South Africa after the abolition of apartheid in the late 1980s and the establishment of a constitutional democracy in 1994.

The new political regime sought to change patterns of ownership in the mining sector, address racial discrimination, and improve the working conditions in the mines. The founding principles of the new minerals regime were state custodianship, safe mines, environmental stewardship and sustainable development of the minerals sector to the benefit of all South Africans. Legal provisions which prevented black South Africans from owning and operating mines; holding supervisory, professional, management and executive positions in mining companies were removed. The Mineral Petroleum and Development Act (MPDRA) was the principal instrument of change (Mineral Resources and Petroleum Development Act, 2002). The MHSA had already been promulgated by the time the MPDRA came into effect and was one of the first laws promulgated in alignment with the new direction of the country. Disquiet about the scale of mining deaths and injury, and continuing mining disasters led to the new government of 1994 prioritising mine health and safety (H&S). In 1993, five hundred and ninety eight (598) miners had died in mine accidents and 8,532 had been seriously injured (Leon *et al.*, 1995) The MHSA was created to bring about improvements in mine H&S. Core to this act were processes for tripartite engagement, cooperation between employers and mineworkers in the workplace, and risk management (Mine Health and Safety Act, 1996).

The MHSA was inspired by new thinking on the regulation of workplace H&S, advocated by the International Labour Organisation (ILO) and already adopted in a number of developed countries (ILO, 1981; ILO, 1995). Implementation of the MHSA proved challenging. South Africa was (and still is in

2019) a developing country, with very high levels of inequality and a high degree of mistrust between and among key stakeholders – government, mining companies, trade unions and the communities affected by mining. Compounding an already difficult situation were factors such as long-lived labour intensive mining methods which claimed many lives, high levels of disablement and occupational disease; and widespread social dislocation caused by the system of migrant labour which was central to mining.

1.2 Justification of the Research

1.2.1 Limited Insight into the Impact of Changed Legislation

In the United Kingdom (UK), the 1972 Report of the Committee on Health and Safety at Work led by Lord Alfred Robens, presented a novel regulatory framework for workplace H&S (Robens, 1972). This framework - of enforced self-regulation - was later amplified by requirements to adopt more systematic risk management (RM) processes. Robens saw in H&S a *'natural identity of interest between employers and employees'* on matters of H&S and advocated self-regulation and consultation through bipartite and tripartite processes. Robens' ideas had far-reaching and enduring influence. The UK's 1974 Health and Safety and Work etc. Act; the revision of the 1919 Mining Act of the Canadian province of Ontario and its evolution into the Occupational Health and Safety Act of 1978 ; the 1996 Act of British Columbia (Mines Act, 1996); the Mines Safety and Inspection Act 1994 of Western Australia (Mines Safety and Inspection Act, 1994); the Coal Mining Safety and Health Act 1999 (Coal Mining Safety and Health Act, 1999); and ILO Conventions 155 (ILO, 1981) and 176 (ILO, 1995), are all examples of changed regulation modelled on Robens' ideas. Key features are duties and rights, bipartite and tripartite stakeholder engagement and reliance on mutual learning and improvement.

To date in 2019, research on the effectiveness and limitations of such legislation has re-emphasised the pivotal role of the state in regulating H&S (Gunningham and Johnstone, 1999; Gunningham, 2007; Baldwin *et al*., 2012), questioned the assumption of the natural identity of interests (Pearce and

Tombs, 1990), and examined merits and limitations of self-regulation as well as alternative approaches to governance, e.g. command and control (Gunningham and Johnstone, 1999; Tucker, 2003; Nichols and Walters, 2016). With the passing of time, new questions have emerged as trade union membership and influence waned, and levels of subcontracting rose (Johnstone, 2009; Lewchuk et al., 2009). The latter introduces new layers and groupings of management, creates multiple employee-employer relationships, complex and potentially muddled managerial processes, and increases job insecurity.

Much research on workplace H&S emanates from developed countries and reflects these countries' experiences with the Robens' model. But Robens' thinking, and ILO conventions 155 and 176, have also influenced legislators in developing countries, including South Africa. The South African experience, as both a developing country and a country in transition, may therefore be instructive to other developing countries attempting to adopt a similar approach.

1.2.2 **Need to Improve Health and Safety in South African Mines**

Since the inception of mining in the late 1900s, mines in South Africa have been associated with high levels of silicosis and tuberculosis (TB), and high numbers of traumatic deaths due to mine accidents and disasters (Rees *et al*., 2009; Leon *et al*., 1995; Donsky, 1993; Leger, 1991; Eisner and Leger, 1988; Simons, 1961). Legislation aimed at protecting workers' H&S, such as the Miners' Phthisis Act of 1912 (Miners' Phthisis Act, 1912) and the Mines and Works Act first introduced in 1911 (Mines and Works Act, 1956), included H&S provisions which were amongst the earliest promulgated in the world. Yet the levels of mortality and morbidity in the industry remained high for much of its history. While the MHSA is the most recent legal intervention to address mine H&S, it has been amended several times to reflect changes in the mineral regulatory regime and to press the sector into bringing about significant improvements in H&S (2008 and 2013). Current sector level statistics suggest that much has changed for the better (MHSI, 2018). Nonetheless significant problems either inherited from the past or emergent, remain to be resolved. These include the persistence of TB (MINCOSA, 2018a) and exposures to high levels of noise (Moroe, 2018; Strauss *et al*., 2012) which have negative implications for safety, and which affect many mineworkers particularly those working underground. In addition, high levels of undiagnosed silicosis are prevalent amongst former mineworkers (Leon *et al*., 1995). In deep mines seismicity related hazards persist, while other hazards are re-emerging such as mine fires (Mines Rescue Services, 2017). New problems are associated with insufficient OHS capacity at smaller mines, increased H&S impacts on communities related to mining's increased footprint, and growing numbers of informal and illegal miners (SAHRC, 2015; SAHRC, 2016). Informal and illegal mines affect people working in and living around such mines. In addition, employees at licenced, operating mines are at risk when illegal mining takes place within these mines (McKay, 2014).

Ongoing efforts to improve H&S are tied to milestones, first launched in 2003, by agreement between government, employers and labour. The first milestones were to be met within a decade and included commitments to reduce fatalities to agreed levels. These levels, "benchmarks" were the combined fatality frequency rate (FFR) of the Australian, Canadian and the USA mining sectors and sub-sectors, measured as the number of fatalities per million hours worked. New cases of silicosis, and NIHL were to be eliminated within the same timeframe. In the period 2004 -2013, the industry's FFR of 0.25 (246 deaths) in 2004 had fallen to 0.09 (93 deaths) by 2013, while the benchmark (combined) FFR was 0.05. The milestone concept remains in effect with the addition of new commitments to eliminate coal mining pneumoconiosis and the interrelated epidemics of TB and HIV in 2014 (Msiza, 2014; Mbonambi, 2014).

The above, current and historical data show that the rate of fatalities in the sector has tended to decline continuously and that the incidence of occupational disease has dropped along with reductions in exposures to noise and airborne pollutants (COM, 2017; Hermanus, 2007). However, the actual numbers of deaths in the formal mining sector, albeit lower than historic levels, are still relatively high[1]; and the high prevalence and continuing incidence of occupational disease remains concerning. In addition, informal mining has grown with increased fatalities and more communities are affected by mining, both formal and informal. These developments are not measured or adequately regulated raising questions about the capacity and preparedness of the H&S regulators to monitor and deal with the full scope of mining's H&S impacts.

1.3 Key Concepts

1.3.1 Enabling legislation

The MHSA is an example of enabling legislation which places more emphasis on systems and frameworks than explicit instruction. Such legislation establishes a mix of general principles and duties, structures for stakeholder engagement, performance requirements, and processes for securing H&S through ongoing efforts to identify, assess and reduce risk (Bluff *et al*., 2003; Coglianese *et al*., 2003; May, 2003; Coglianese and Lazer, 2004). In general, legislation has become less prescriptive over time to take account of fast changing and increasingly complex technology, and the availability of alternative technologies and systems.

The requirements of the MHSA were thus to be met by demonstrating effective interpretation and application of the general principles, processes and duties to safeguard the H&S of the workforce. This usually involves justifying design parameters including operational limits, acceptance or rejection criteria, the precautions to be taken to secure H&S, and the arrangements for and quality of consultation and engagement. The Mine and Works Act (Mines and Works Act, 1956) which preceded

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[1] This trend is consistent with Hermanus' (2007) observation that the OHS performance of South African mines did not improve at the same pace as that of other major mining countries such as Australia, Canada and the USA.

the MHSA was prescriptive, and when the MHSA came into effect both the regulator and mining companies were required to adapt to the new H&S regime.

1.3.2 **Tripartism**

Tripartism is a term which describes social dialogue and cooperation between three parties. The tripartite and bipartite mechanisms of the MHSA are derived from the ILO's framing of these concepts as *'instruments'* for *'sound industrial relations and effective social dialogue'*. In the ILO framework, the parties who engage in social dialogue represent government, employers and organised labour. Engagement is seen to be the means to build consensus between these parties about social and economic development, and good governance. The ILO defines the foundations of effective engagement as (i) institutional and legal frameworks which enable social dialogue; (ii) rights to freedom of association and collective bargaining; (iii) well-capacitated, independent worker and employer organisations; and (iv) all parties having the political will and commitment to engage on important social issues (ILO, n.d.; ILO, 1998).

In the domain of occupational health and safety (OHS), the underlying assumptions of the tripartite approach are that government, employers and labour have sufficient shared interest in OHS to enable them to define common objectives which all three parties can actively support and jointly pursue. In the workplace it is expected that management and elected worker representatives collaborate through formal and informal arrangements in accordance with their general H&S duties and rights. The rights and duties assigned to workers and their representatives are designed to empower them to engage and participate effectively. Employers are required to inform, consult and involve the workforce in decisions on the management and control of OHS risk, in OHS investigations, in the identification and review of OHS risk, and on any changes that may affect OHS. Workforce representatives may call on the regulator (government) to intervene or assist in resolving any OHS matter. These arrangements which make up the practice of H&S tripartism are procedural and illustrative of the design of a typical process-based standard.

The MHSA drew on the report of the Robens Committee that inspired the Health and Safety at Work Act etc[2]. (Health and Safety at Work etc. Act, 1974) in the UK, and ILO conventions 155 and 176. The MSHA specified mechanisms and duties, like those of the UK act, to institutionalise engagement, and enable collaboration at mine sites and at national level. Collaborative mechanisms involve employers and employees coming together in the workplace to discuss, assess and attend to H&S; and government, employer and employee representatives coming together at national level to assess the state of H&S in the sector, and the adequacy of policy, programmes and priorities. The general duties of employers are to provide a safe and healthy working environment, and those of the workers are to look out for their own H&S and that their co-workers. Institutional mechanisms for engagement and tripartism created by the MHSA include (i) in the workplace, health and safety committees made up of employee and employer representatives, and (ii) at national level the establishment of the tripartite Mine Health and Safety Council.

1.3.3 Risk Management

This term refers to a systematic sequenced process which involves (i) identifying hazards, (ii) assessing the level of risk associated with each type or combination of hazards, and (iii) implementing effective controls which reduce both the likelihood and frequency of events injurious to H&S. Risk management requirements, like those for tripartism and bipartite engagement, are examples of process-based standards. The end point of a RM process may be to meet or go beyond a performance standard, such as the threshold limit value (TLV) or the occupational exposure limit (OEL) of an airborne pollutant.

[2] This is the actual name of the Act (includes etc.)

The MHSA includes risk management provisions which oblige employers to conduct or ensure that base-level risk assessments, periodic risk assessments and continuous risk assessments take place, are documented and acted on. Under the MHSA, the RM process is subject to the *'reasonably practicable'* criterion which requires employers to respond to risk with regard to ' *(a) the severity and scope of the hazard or risk concerned; (b) the state of knowledge reasonably available concerning that hazard or risk and of any means of removing or mitigating that hazard or risk; (c) the availability and suitability of means to remove or mitigate that hazard or risk; and (d) the costs and the benefits of removing or mitigating that hazard or risk'* (Mine Health and Safety Act, 1996). In the MHSA, risk identification, assessment and control are the means to effectively protect the workforce from H&S hazards.

1.4 Overall Aim and Specific Objectives

The overall aim of this research was to investigate how the MHSA came about and to assess whether it succeeded or failed in its objectives to improve mine H&S in South African mines.

The MHSA introduced, as described in the preceding sections, mechanisms for sharing information, consultation, participation and collaborative action, and RM. It was state of "the art" law at the time of its promulgation.

The main hypothesis was that:

The MHSA has not been as successful as current H&S data suggests. Other factors unrelated to the implementation of the MHSA, have contributed to falling fatalities and injuries (and possibly occupational disease) in the formal mining sector. Furthermore, official H&S data for the informal mining sector and in communities affected by mining is unavailable and, if considered, is likely to adversely affect the national picture of mine H&S.

The sub-hypotheses were:

(a) South Africa's experience with the MHSA has relevance for other developing countries intending to adopt/ or which have adopted similar legislation and,

(b) there are insights and lessons of current relevance to South African mining stakeholders.

These hypotheses were tested by examining the MHSA from different perspectives: its genesis; the context – science of H&S, advancement in mining methods, and the socio-political environment - into which the MHSA was introduced, and which changed over time; and the application of the key mechanisms of the Act, tripartism and RM. Examination of these aspects were expected to provide insight into the readiness of stakeholders for stakeholder engagement and RM; the robustness of stakeholder relationships; and the fit of the MHSA to the context in which it was operationalised.

The objectives of this study could thus be summarised as follows:

- Objective 1: To investigate the genesis of the Act with reference to the adoption of the key mechanisms of the Act, tripartism and RM.
- Objective 2: To explore the effect of mining context, both historic and evolving, on the ambit and impact of the MHSA.
- Objective 3: To examine the robustness of tripartite and risk assessment processes.
- Objective 4: Based on the above, to draw conclusions about the success of the MHSA, and the lessons which the South African experience holds for other developing countries.

Overall, the study endeavoured to establish an evidence base for assessing the impact of the MHSA and of the factors which have hindered or supported its implementation. This evidence could lead to improvements in the practice of tripartism and RM in the South African mining sector, opening up of discussion on how best to address the systemic risks affecting the H&S of mineworkers and others; and in other developing countries, greater consideration of the degree of alignment between the requirements of legislation and the context in which it is applied. The study should also point to topics which would benefit from further research – gaps in information or of for more granular investigation of particular processes or circumstances.

1.5 Organisation of this Thesis

Chapter 1 presents an outline of the research which underlies this thesis, a case for why this thesis is justified and introduces the key concepts it examines which emerge from different domains of study.

Chapter 2 surveys the relevant literature and is divided into sections which review the areas of research and expertise relevant to assessing the MHSA. The initial sections present and assess the available mine H&S data (2.2.1 and 2.2.2), the mining sector's capacity to innovate (2.3), and provide insight into how social conditions affected miners' H&S and stakeholder relationships (2.4). The subsequent section (2.5.1 and 2.5.2) examines approaches to regulating H&S; the implicit and/ or explicit choices made in designing such legislation, and what is known about the implementation and effect of such legislation. Next examined is the direction and form that H&S legislation has taken in recent years with reference to tripartism and RM, and how this is reflected in the MHSA (2.5.3 and 2.5.4) Chapter 2, also reflects on the gaps in the literature and how this thesis fills some of those gaps. Together all the sections of Chapter 2 set out the context for examining how the Act came about and the impact of the practices of tripartism and RM introduced by the Act on the protection of mineworkers and the public.

Chapter 3 describes the methodologies employed in conducting this research, including that of the supporting papers. Mixed study methods have been employed. Together the qualitative and quantitative aspects of the thesis seek evident for the advances made and the limitations encountered in implementing the MHSA.

Chapters 4-7 build on and are supported by four peer reviewed publications. Together these chapters examine how the MHSA came about, the environment in which the MHSA has been applied, and the evolving practices of tripartism and RM - the two key instruments of the Act.

- **Chapter 4** provides an account of the origins and the design of the MHSA and particularly explores the preparedness of the tripartite stakeholders for the practice of tripartism and RM.
- **Chapter 5** examines the context in which the MHSA has been applied. It offers an account of the circumstances which led to the adoption of labour intensive deep mining methods and the nature of the OHS risks associated with such mining. It examines current efforts to bring about technological change which have been pursued for the most part outside of the structures of MHSA. The changes brought about by the Minerals and Petroleum Development Act are also discussed in this chapter, focussing on the impact on people affected by mining, some of whom are covered by the MHSA and some of whom are not. Two published papers, on technology trends in mining and on the general impact of the MPDRA, expand on the evidence base of this chapter.
- **Chapter 6** explores the application of tripartism in mining, in both legislated and ad-hoc structures. Two published papers provided supporting evidence for this chapter. The first gives an account and analysis of the various ways in which tripartism has been practiced in South Africa and in mining specifically, while the second examines the implementation and fate of an employer led initiative, the Mine Occupational Health and Safety Leading Practice adoption system. MOSH was intended to reduce significant workplace risk.
- **Chapter 7** investigates the practice of RM internationally and in South African mining, with reference to the methods and tools employed in the sector and changes in OHS outcomes after the enactment of the MHSA.
- **Chapter 8** synthesizes the key recommendations for H&S policy, legislation, and practice by integrating and interpreting the findings which underpin this thesis. The implications for policy, regulation and practice are spelt out. I consider how my findings contribute to theory and propose

the next steps for future research. Lastly, I restate the challenges to improving H&S in South African mines and summarise how these results might inform decisions in developing countries facing similar challenges, and /or in which similar regulatory regimes are applied or contemplated.

Chapter 8 is followed by the list of references, and an appendix chapter. The latter includes the supporting published papers and the tools employed in conducting and framing the various aspects of the research which contributed to this thesis.

CHAPTER TWO: LITERATURE REVIEW – KEY DEVELOPMENTS, CONCEPTS AND THEORY

2.1 Introduction

This chapter provides the foundation for examining and assessing the MHSA from the different perspectives which together enable its impact on mine H&S to be evaluated:

- The science of H&S
- Evolving mining methodology
- The socio-political environment which shaped responses to evolving knowledge and expertise
- The evolution of H&S regulatory practice, concepts and theory, including tripartism and RM
- The regulation of mining in South Africa
- The innovations of the MHSA.

Each topic is explored in this chapter in the order indicated above.

2.2 Health and Safety in the South African Mining Industry

This section describes the H&S issues which were already of concern when the MHSA came into effect in 1996, as well as of their status at the time of writing.

Health hazards and safety hazards are distinguished by their effect. Occupational health hazards usually produce outcomes which are chronic and often also latent, cumulative and permanent. These typically result from workplace exposures to pollutants, noise, vibration, bacteria, viruses, fungi and/or parasites. Pollutants, noise and vibration are controlled by limiting exposure to levels below specified OELs or TLVs. Responses to biological hazards include, eradication of the hazard where possible, medical treatment of infected individuals and interventions to prevent others from being infected (Donaghue, 2004). Safety hazards are of a traumatic nature and range from minor injuries to injuries which are fatal. Ill-health and the presence of health hazards tend to increase the risk and severity of injury.

2.2.1 **Health**

Although data on the prevalence, incidence and exposure to health hazards are limited, there is incontrovertible evidence of a long history of widespread occupational disease and NIHL amongst workers, mainly black, in mining (Ehrlich, 2012; Leon *et al*., 1995). Most affected have been miners involved in drilling, blasting, sweeping and scraping operations. In terms of Occupational Diseases in Mines and Works Act (ODMWA) of 1973 (Occupational Diseases in Mines and Works Act, 1973), these occupations were typically classified as risk work (usually dusty work), as the person performing such work ran the risk of contracting a compensable disease. Silica dust, TB, coal dust, asbestos fibre and noise are the most pervasive and injurious health hazards (Naidoo, 2013; Murray *et al*., 2011; Edwards *et al*., 2011; Braun and Kisting, 2006). Exposures to TB and asbestos fibre have also significantly affected mining communities. Because long periods of latency[3] are characteristic of many occupational diseases, certain diseases such, as silicosis and pneumoconiosis, are more prevalent amongst former miners in labour-sending areas than on the mines. In addition, over time the risk of TB and HIV in labour sending communities increased as increasing numbers of ill miners returned home (Rees, 2006; Ehrlich, n.d.). In labour sending areas the chances of detecting and treating silicosis, TB and HIV, and/or securing the compensation benefits due to the miners affected by TB and silicosis are small, due to the absence of health services (DoH, 2016; Jeebhay and Jacobs, 1999) .

[3] The length of a latency period depends on the level and duration of exposure and can be months or years.

Coal Dust

Exposures to coal dust are associated with commercial coal mining which started in the 1870s following increased demand from diamond and gold mines for energy. Since 1923, coal has been the primary source of energy in industrialised South Africa, and its coal reserves are the sixth largest in the world (Mathu and Chinomona, 2013). It is estimated that open cast mines account for 53% of coal mining operations, while underground coal mines are 40% bord-and-pillar mining, 4% pillar extraction and 3% longwall mining (Jeffrey *et al*., 2015).

Risks of developing coal miners' pneumoconiosis (CWP), silicosis, progressive massive fibrosis, and chronic obstructive pulmonary or airway disease (COPD or COAD) are associated with exposure to coal mine dust. The South African OEL for coal mine dust is 2mg/m^3 except for when the silica content of such dust is greater than 5% whereupon the OEL, 0.1mg/m^3, for respirable crystalline silica applies. In coal mines, dust is released during drilling, coal cutting, transportation and crushing operations. Conveyor belts, coal haulage transfer points and haulage roads are prime areas for dust generation (Stanton *et al*., 2006). The average inherent silica content of South African coal seams amounts 3.54% (Phillips and Belle, 2003). However, the presence of sandstone bands in coal seams increase the potential for exposure generally and among roof-bolt operators particularly (Phillips and Belle, 2003). Ventilation systems, water sprays and scrubbers onboard continuous miners are among main methods for reducing dust levels.

Few studies have been conducted on the exposure of South African coalminers to coal dust and the prevalence of occupational diseases amongst them (Naidoo *et al*., 2005; Naidoo *et al*., 2006). Studies include reviews of coalminer autopsy data available from the National Institute for Occupational Health (NIOH) in Johannesburg and retrospective examination of occupational hygiene data. These records are known to be incomplete. Nevertheless, on the basis of the available autopsy data for the period 1975 to 1997 (3,167 autopsies in total), Naidoo *et al.* concluded that compared to white coalminers, the risk of black miners to TB and coal workers' pneumoconiosis (CWP) was 8.3 and 1.2 fold greater (Naidoo *et al*., 2005). At autopsy the frequency of disease amongst all coalminers varied widely, from 1.4 -10.4% for silicosis, and 9.2-14.7% for CWP, with more morbidity among anthracite miners (Naidoo, 2008). Naidoo also found that South African mines with higher levels of coal dust and with higher levels silica content in their coal dust, reported lower levels of disease than expected. In the international literature mines, in which levels of coal dust were similar, reported more respiratory disease than South African mines. This was the case even though OELs were exceeded on local many mines (Naidoo, 2008).

Naidoo's research and recent news reports imply that coal dust related diseases have been underdiagnosed and underreported amongst coalminers and as has been silicosis and TB among gold miners. In 2018, the process of gathering evidence for a class action lawsuit against coal mining companies for compensation of respiratory disease among coal miners got underway (TimesLive Reporter, 2018; Bega, 2018). The provinces in which ailing coalminers have been located include Limpopo, the Free State, the Eastern Cape, Mpumalanga and Kwa-Zulu Natal.

Asbestos Fibre

Asbestos has been used in many parts of the world for over 2000 years. Mining of significance began in South Africa in the 1930s, and by the 1970s the country was ranked as the third largest producer in the world. Asbestos mining peaked in 1977, when approximately 20,000 miners were employed in the industry and over 380,000,000 tons of asbestos were exported (Abratt et al., 2004). Three of the six types of naturally occurring asbestos, namely chrysotile, crocidolite, and amosite (white, blue and brown asbestos) were mined and milled on a large scale for commercial use. Blue asbestos was mined in the Northern Cape in a belt ranging from Prieska in the south to Pomfret in the north, blue and brown asbestos was mined in Limpopo in Sekhukhune District, and white asbestos was mined in Mpumalanga near Barberton. Most of the milled asbestos was exported. Locally, as elsewhere, it was used in the manufacture of cement products including roof sheets, and in applications in which its strengthening, fire retardant and insulation properties were valued. When knowledge of the health effects of inhaled asbestos fibre became widespread, asbestos use was banned in many countries (Phillips *et al*., 2016; Hart, 1988).

Initial mining methods in South Africa were crude. *'Spade and wheelbarrow operations'* and hand separation of the fibres from the ore were common. Later mining methods included stoping and opencast mining followed by crushing and dry milling (Hart, 1988). In 2002, the last asbestos mine operation, Msauli, closed (Laduma and The African Planning Partnership, 2007) and in 2007 the use of asbestos in the country was banned through regulations passed by the Department of Environment Affairs and Tourism (Environment Conservation Act, 1989 Regulations for the Prohibition of the Use, Manufacturing, Import and Export of Asbestos and Asbestos Containing Materials, 2008). While the most exposures to asbestos occurred in mining and milling operations, exposures were (and are) not confined to mining. Operations and settings in which exposure to asbestos fibres is a risk include transportation, manufacturing, construction and demolition work; areas around mines, on roads, at railways in ports; and in and around homes with weathered asbestos roofs (Phillips *et al*., 2016; Braun and Kisting, 2006).

The unique effects of asbestos exposure were first discussed in the English medical literature in the 1920s. In 1926 and 1927, mine doctors at an asbestos mine and milling operation in Zimbabwe (then known as Southern Rhodesia) sent samples of lung tissue to the South African Institute for Medical Research in Johannesburg for post-mortem examination. These samples were obtained from patients who had worked in the milling section at the mine and enabled the attending pathologist to conclude that chrysotile exposure was responsible for the condition observed, then known as pulmonary asbestosis (Simson, 1928). At an international conference on silicosis in Johannesburg in 1930, asbestosis was recognised as a new occupational disease, consistent with medical findings in the UK that asbestos inhalation could cause a fatal disease (Bartrip, 2004).

The link between asbestos and mesothelioma was recognised by Wagner in 1960 who described 33 cases amongst people in the Asbestos Hill mining area near Kimberley in the Northern Cape (Wagner *et al*., 1960). From then onwards malignant mesothelioma came to be accepted as a distinct '*diagnostic entity'* (Ribak *et al*., 1988) although scepticism remained until 1965 about the specific association of mesothelioma with asbestos exposure (Bartrip, 2004). Following the general acceptance of the relationship between asbestos exposure and lung cancer, the Asbestos Industry Regulations were introduced in the UK industry in 1931 and were believed to be protective. It was not until the late 1960s, following media attention to asbestos hazards and the launching of lawsuits in the UK and the USA that the need for proscription was recognised (Bartrip, 2004). Mining and use of asbestos however continued in many other parts of the world including South Africa.

Asbestos is thus known to cause three diseases, asbestosis, lung cancer and malignant mesothelioma of the pleura of the lungs which is also a cancer. Asbestosis is progressive and untreatable and develops after five or more years after heavy workplace exposure. The lung cancer caused by asbestosis and that caused by cigarette smoke is indistinguishable and equally deadly (McCulloch, 2008), so employment records are essential to supporting compensation claims. Mesothelioma develops up to 30 years or more after exposure, life expectancy after diagnosis is usually one year, and diagnosis of the condition especially in its early stages is reportedly difficult (Niklinski *et al.,* 2004,).

Different types of asbestos have different mesotheliomagenic potential, with crocidolite having the greatest potential to cause mesothelioma, followed in order by chrysotile and amosite. The size of an asbestos fibre is also a determinant of its toxicity, and according to the World Health Organisation (WHO) fibres that should be regulated have a length to diameter ratio of 3 to 1, a length greater than

5µm and a diameter less than 3µm (Phillips *et al*., 2016). However thin fibres of chrysotile of less than 5µm have also been found to cause malignant mesothelioma (Suzuki and Yuen, 2006).

Information about asbestos exposure and disease among asbestos workers is scant, as their health was poorly documented, disease amongst them was generally undiagnosed and underreported, and frank disease often appeared after a long latency period. The information on the death certificates of those likely to have been exposed was also incomplete (Sluis-Cremer *et al*., 1992).

By 2004, over 2,700 South Africans had died of mesothelioma, most of whom had been exposed to asbestos in the environment rather than in the workplace (Abratt *et al*., 2004). About 200 cases of mesothelioma are reported each year (Asbestos.com, n.d.) and could increase (Kielkowski *et al*., 2000) as exposure continues.

The Asbestos Relief Trust was established in 2003 following a hard fought legal battle which resulted in an out-of-court settlement of R460m between claimants and several companies (GENCOR, GEFCO, African Chrysotile Asbestos Ltd, Msauli and Hanover Mining Ltd) to provide treatment and compensation to those affected by asbestos related diseases (Asbestos Relief Trust, n.d.). Asbestos miners and people living near mines who had suffered environmental exposure were eligible claimants. Another company, Cape PLC reneged on an earlier settlement with claimants in 2001 when the company found itself in financial trouble. In 2007, Leigh Day, a law firm recovered £150,000 from Cape PLC (Leigh Day and Company, 2007). By 2003 the Asbestos Relief Trust had paid out at total of R250m in claims to 3,639 qualifying miners and claimants (Herbst, 2013). Continued environmental exposure to asbestos is likely for the foreseeable future as only 11 of the 230 asbestos mine sites in the country are reported to have been rehabilitated. The estimated cost of rehabilitation in 2017 was R1,7bn (Beangstrom, 2017).

Silica Dust

The Witwatersrand basin contains the country's main gold deposits in narrow reefs of quartz pebble conglomerate which extend deep into the ground. While these deposits are extensive, they are low grade and have been mined since discovery in 1886. The risk of exposure to crystalline silica particulates is high in South African gold mines due to the quartz (SiO_2) content of between 70 and 90% of the orebody (Janisch, 1986). Since the processes of breaking and clearing broken rock are labour intensive, effective dust control measures are essential to preventing and reducing exposure. Drillers, winch drivers, sweepers and rock haulers were and are most exposed. Blasting of rock generated massive clouds of dust. In a 2003 study on the generation and characteristics of dust in hard rock mines, the silica content of dust sources in two gold mines in different locations was found to range from 9-39% (Biffi and Belle, 2003). Over time technology changes on the mines reduced dust levels, but the reductions achieved did not appear to make a difference until recently (Martin and Magampa, 2018). The cost of the interventions required to reduce dust levels and unprotective OELs have been abiding concerns.

Hockings noted that, according to the proceedings of the Mine Managers Association of South Africa (AMMSA), by 1901 mine managers were already worried about the high levels of mortality amongst rock drillers which doctors associated with the dust inhaled during drilling (Hocking, 1997). Concerns were also raised in Britain, as many Cornish miners were employed on South African gold mines and were dying within five years of employment as rock drillers (Meiklejohn, 1954; Zwi *et al*., 1988). In 1902, the Government Mining Engineer's (GME) report included information on the death rate of rock drillers, 225 known deaths out of the 1,377 drillers in employment in the period October 1899 to January 1902. This led to a government Commission of Inquiry in 1902 to investigate and report on miners' phthisis. Other commissions followed in 1903, 1907 and 1911 (Oliver, 1905; Kotzé, 1915; Kotzé, 1916). Tuberculosis, also rife on the mines, compounded the effects of silicosis, leading to progressive massive fibrosis and *'probable death within two years'* (Katz, 1979). The Miners Phthisis

Act was introduced in 1912, following the introduction of the Mines and Works Act in the previous year (Miners' Phthisis Act, 1912). The Act required companies to compensate workers[4] for phthisis. The 1912 Act made South Africa the first state to recognise silicosis as a compensable disease. Tuberculosis was recognised as a compensable disease, separate from silicosis in 1916 (Katz, 1979).

The compensation regime was enabled by two developments, radiography and the konimeter which evaluated disease and exposure respectively. Radiography was available in the mining sector from the early 1900s. Miniature mass radiographs (MMR), initially developed in South Africa by Collender, were not as easy to interpret as standard-sized radiographs, and were used exclusively as a screening tool for TB and silicosis among black miners for many decades (Dormer and Collender, 1939; Retief, 1943). MMR became widely used from the 1960s onwards when it was incorporated into the periodic medical examinations of mineworkers in job grades 4 to 8, who were mainly black, until the early 2000s. At that point, full-size radiographs were made available to all miners (Ehrlich *et al*., 2018). The konimeter was invented by Robert Kotze in 1914 and made possible the measurement of silica dust levels. However, it was capable of snap readings only, better at capturing low levels of coarse dust but not high levels of fine dust and required many samples to produce a reasonable measure of exposure (Beadle, 1951, Plug, 2014). It remained in use through the 1990s when the gradual introduction of gravimetric sampling started, later than in other mining countries. This gradual introduction was guided by the notion of what was considered to be reasonably practicable (Belle, 2004). The transition to gravimetric sampling was not smooth (Unsted, 1997).

In respect of mining technology, several developments - the Miners Phthisis Act, the recognition of TB as a compensable disease, the establishment of dust department by the COM in 1914 (Bluhm *et al*., 2010), the 1919 recommendations of the Phthisis Prevention Committee (Burke and Richardson,

[4] Only white workers were compensated initially. When black workers became eligible for compensation, they were compensated at substantially lower rates (Katz, 1979).

1978), the regulation of rock drill design and the prohibition of dry drilling - encouraged the introduction of water-fed rock drills and the development of mechanised systems of ventilation.

The first attempt to allay dust in gold mines involved spraying water on the working faces and was not particularly effective. Although a better solution - a machine drill which incorporated a water spray was developed shortly thereafter - it was not widely taken up because it was more costly than hand-drilling. However, the *'free-standing water sprays or facemasks'* which were in use were unpopular with miners as they hindered their work (Hocking, 1997). According to Pogue, between 1902 and 1916 rockdrill use increased from 1000 machines to just over 6000 by 1916 when it hovered at about 40%. As drilling technology improved and hand drilling became uneconomical, rock drills were increasingly deployed with uptake climbing from 60% to 100% by 1933 (Pogue, 2006a). The water-fed rock drill had internal water tubes and water release ports at the front end of the drill steel. The drill ultimately used on the Witwatersrand mines was a Leyner type designed by George Leyner in Colorado, USA and adapted for conditions on the Witwatersrand (Holman, 1947). Gold output and reef excavation efficiencies improved over this period (Pogue, 2006a).

Dilution of dust through mine ventilation became a practical reality by 1905. East Rand Propriety Mines (ERPM) became the first fully ventilated mine, and by 1910 other mines followed suit with Village Deep Mine improving the ventilation layouts for deep mines (Barcza, 1958). By 1925, the role of ventilation in mine cooling started being discussed as heat levels in mines had become life threatening (Barcza, 1958).

According to the records of the South African Miners' Phthisis Medical Bureau, the introduction of the new drill and other measures - wetting broken rock and the walls of the working place, banning the use of compressed air in cleaning tasks, and diluting dust levels through ventilation - dramatically reduced dust levels in gold mines. By 1924, the likelihood of working miners developing silicosis within 15 years of underground mining work had diminished, but miners who work for longer periods remained at significant risk. While the problem was alleviated, it had clearly not been solved (Holman, 1947). Silicosis was no longer an acute disease. It had become a chronic disease as later studies showed (McCulloch, 2009). Consequent cases of silicosis amongst white workers were generally ascribed to exposures under earlier conditions when dust levels were still very high (Katz, 1979; Donsky, 1993). These workers were examined at the Medical Bureau while black workers were examined by mine doctors by delegation from the Medical Bureau (Donsky, 1993). Early detection of TB[5] and silicosis in black workers at mines also created opportunities for their summary discharge.

Differences in screening practice and the delegation of examinations to mine personnel contributed to the hidden epidemic amongst black miners along with underestimates of the actual levels of exposure to airborne silica particulates (Ehrlich, 2007; McCulloch, 2009). In addition, compensation benefits for both TB and silicosis accrued mainly to white workers. Not only was the actual level of silicosis amongst black workers unknown, but in the annual reports of the Miners' Phthisis Board, claims were made that the silicosis rates among black miners were even lower than their white counterparts. These data informed science and policy debates as the international community accepted it as authoritative, until another picture emerged much later when the prevalence of silicosis among former mineworkers became known (McCulloch, 2011).

Silicosis prevalence was estimated amongst former mine workers from various areas, by Trapido *et al* among ex-miners in the Libode area of the Eastern Cape at 22-37% (Trapido *et al*., 1998); by Steen *et al* among miners in Botswana at 26-31%; and among 624 Basotho goldminers at 25% by Girdler-Brown *et al*, who conducted the study 18 months after the miners had left the mines (Girdler-Brown *et al*., 2008). An analysis of the mineworker autopsy database at the NIOH, found that by 2007, at autopsy, the proportion of white and black miners with silicosis was 22% and 32% respectively (Nelson, 2013).

[5] Workers exposed to silica dust were more prone to developing silicosis

The study examined data for the period 1995 to 2007. In respect of exposure, in the 1990s, only 8 out of 48 operating gold mines reported that all their silica (quartz) concentrations were below the OEL of $0.1g/m^3$ (Rees, 2006).

The relationship between TB and silicosis had been confirmed more recently. Exposure to respirable silica greatly increases the risk of TB. Silica exposed workers are at risk *'even in the absence of silicosis'*, and after the exposure to silica dust ends (Hnizdo, 2003; teWaterNaude *et al*., 2006; Hnizdo and Murray, 1998). In the teWaterNaude study, the silica exposure levels measured were below the OEL of $0.1g/m^3$ applied in South African mines suggesting that this OEL may not be protective. Alongside of silicosis, miners also presented with high levels of TB, and chronic obstructive pulmonary disease (COPD), with TB incidence further compounded by the immunosuppression effect of HIV infection (Corbett *et al*., 2000; Glynn *et al*., 2008).

There is now no doubt about the epidemic of lung disease amongst black mineworkers. Currently lung diseases are mostly encountered among former mineworkers who were exposed to respirable silica and who now increasingly live in labour sending areas. This is due to declining levels of employment in gold mining[6], from a peak of approximately 520,000 workers in 1987 to levels in 2017 which were last seen in the early 1900's viz., 112,200 workers (Jones, 2017; MINCOSA, 2018b).

Figure 2.1 below shows the number of cases of silicosis diagnosed per year amongst mineworkers. Declining numbers in the sector closely correlate to declining numbers of employees in gold mining. However, dust control measures appear to have improved significantly as a result of several initiatives. These include the 2003 milestones which led to the publication of best practice guidelines in 2006 and 2007; the National Programme for the Elimination of Silicosis in South Africa launched by the DoL in

[6] South Africa remained the world's largest gold producer until 2006 (at 300t) although production had peaked in 1970 at 1000t (Jones, 2017).

2004; the Mine Occupational Safety and Health Leading Practice programme (MOSH) which was launched in 2008, and efforts at mines to capture or dampen down dust (Stanton *et al*., 2006; Stanton *et al*., 2007; Stewart and Malatji, 2018). The appended paper on the MOSH initiative described more recent interventions made to reduce silica dust exposures viz. treatment of the foot- and side waters in underground mines to prevent dust from becoming airborne; installation of water atomisation systems (the 'fogger') which removes dust from the air (Hermanus *et al*., 2015)

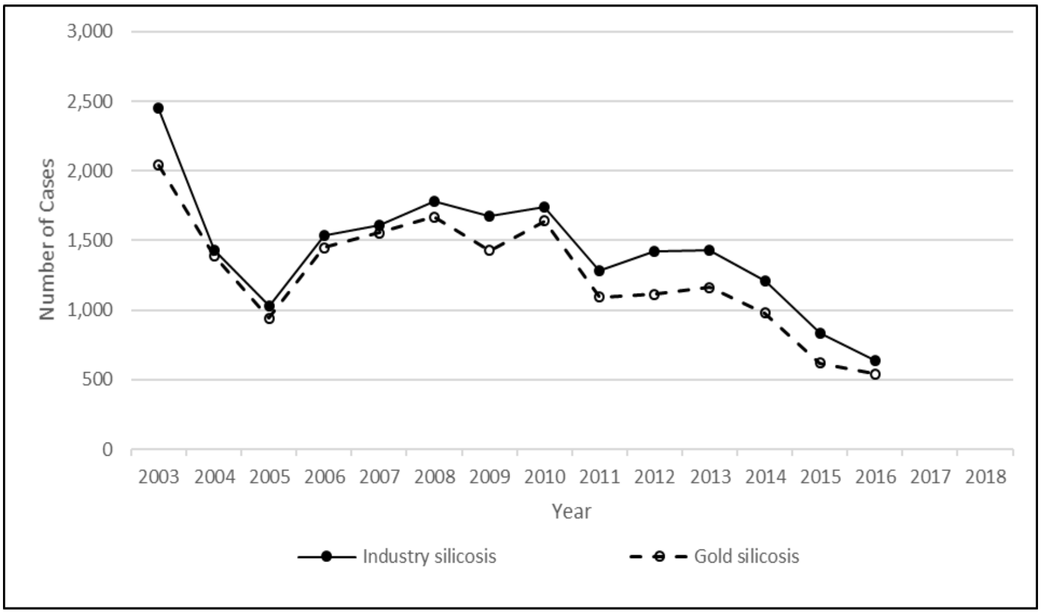

Figure 2.1 Cases of Silicosis in the Mining Industry and the Gold Sector per Year.
Sources: The MHSC and the DMR Annual Reports, and MINCOSA: Facts and Figures.

Tuberculosis (TB)

The terms PTB and TB are used interchangeably in this thesis. The mycobacterium tuberculosis which causes TB, usually attacks the lungs from which it can spread to other organs. Tuberculosis of the lungs, pulmonary tuberculosis or PTB, is the primary form of TB found in miners and the South African population. The Department of Health (DoH) launched a national survey of TB in 2018 to determine the prevalence of TB in the country. The results are expected to '*influence response strategies,* *programmes and interventions'*, and build on current efforts to successfully combat the TB epidemic. (HSRC, 2018).

According to the HSRC, *'TB is the leading cause of death in South Africa'* with 8.4% of deaths attributed to TB in 2014 and an estimated 454,000 people contracting TB in 2015, of which 252,000 were successfully treated. South Africa's TB burden is the 6th highest in the world (Global Health Education, 2018). The World Health Organisation (WHO) estimates that about 1% of South Africa's population of 50 million people develop active TB each year amounting to the third highest incidence rate of TB in the world, after India and China (South African Government, 2018).

A World Bank document on its project in Southern African to combat TB, ascribed the high incidence of TB amongst mineworkers to a '*prolonged exposure to silica dust, poor living conditions, high HIV prevalence, poverty, circular movement of mineworkers across provincial and national borders, and a poor cross-border health referral system'* (World Bank, 2016). This statement is supported by several studies. Corbett *et al* showed that TB remained a *'silica-related occupational disease'*, but the TB incidence rates among HIV-positive silicotic miners were much higher than the TB incidence rates among HIV-negative miners. A four-fold increase in the TB incidence rate was observed (Corbett *et al*., 2000). A 2008 study by Glynn *et al* found that the incidence rate of TB among gold miners was higher than the already high national TB incidence rates at 1,914 per 100,000 workers in 1998 and 3,821 per 100,000 workers in 2004, i.e. about 1.9 and 3.8% respectively among gold miners with the increased rates observed in 2004 attributable HIV infection (Glynn *et al*., 2008).

More recent data from a mining sector screening initiative, Masoyise iTB Project supported by members of MINCOSA suggested the incidence rate of TB in the sector may be lower (1,197/100,000) than indicated in earlier studies but the incidence of TB amongst contract workers on mines (274/100,000) was acknowledged to be incorrect (Baloyi, 2016). Incidence rates ranged from 1,637/100,000 in gold mining, to 967/100,000 in platinum mining, and 233/100,000 in coal mining.

These figures were, while lower than other estimates, well above the World Health Organisation's threshold of 250/100,000 for a medical emergency (World Bank, 2016).

Official data issued by the DMR and captured in the MINCOSA's Facts and Figures reports are presented in Figure 2.2 below. The figure shows that until recently the number of TB cases in gold mining in a particular year largely determined the number of cases in the sector for that year. The relative rise of TB cases in platinum mining may be due in part to gold miners' re-employment at platinum mines. The number of officially reported cases in the figure however reflect much lower incidence rates than that of the sectors' own screening initiative. For example, the incidence of TB in 2016 is 1000 cases among 450,000 employees, i.e. ([1,000/450,000] x 100,000) or 222 cases of TB per 100,000 workers as opposed to 1,197 per 100,000 workers estimated in the Masoyise iTB initiative.

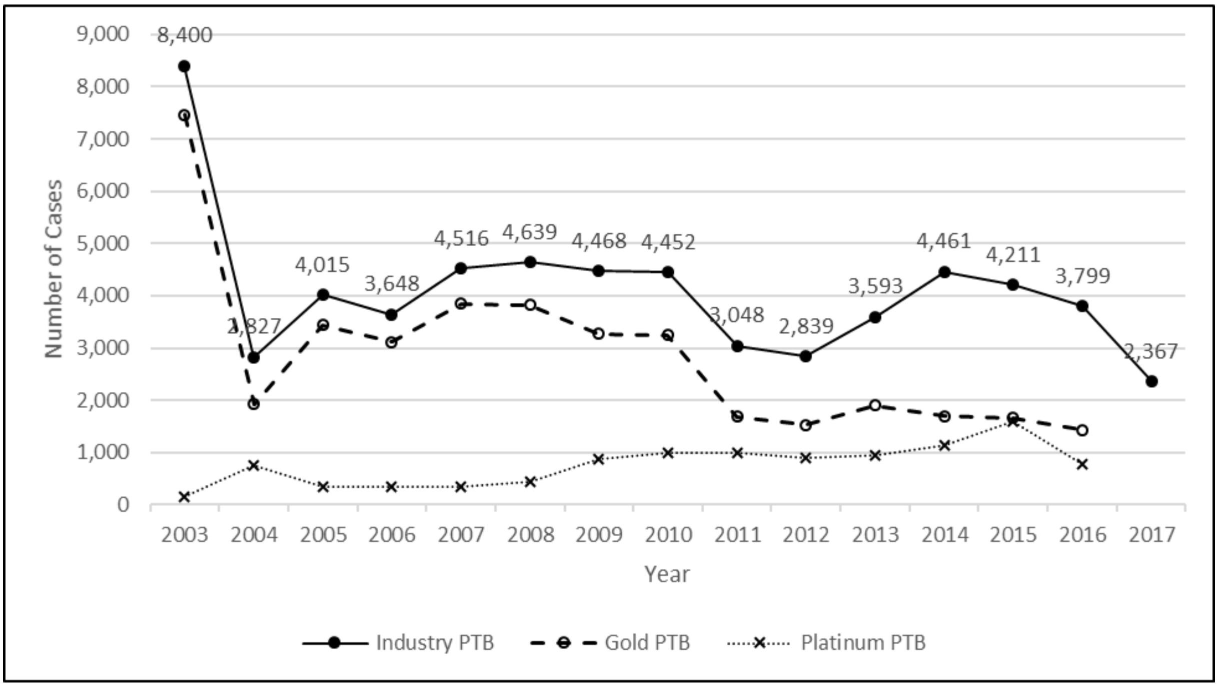

Figure 2.2 PTB Incidence in the Mining Sector

Sources: DMR and MHSI Annual Reports, MHSC Summit Presentations, COM /MINCOSA Facts and Figures reports

The tripartite Masoyise iTB Project is associated with the World Bank's (WB) initiative to combat TB in South Africa and 10 other Southern African countries. The major source of funding for the WB project is the Global Fund. It provided a grant of USD30m which is managed by the WITS Health Consortium at the University of the Witwatersrand. One of the goals of the WB project involves attending to the factors that drive TB in mining. Work plans include developing a system for monitoring the adherence of mineworkers to TB treatment regimens across country borders; improving the working and living conditions of mineworkers; increasing accessibility to health services and compensation benefits; more advocacy on TB; and improving models for identifying, diagnosing and treating people with TB. Other Global Fund grants have been made to address and prevent TB in Malawi, Mozambique, Zambia and Lesotho (World Bank, 2016).

Noise Induced Hearing Loss (NIHL)

The full extent of NIHL amongst South African mine workers is unknown, but noise levels in South African mines were (and are) well above the legislated OEL of 85dBA (up to 115dBA). Noise levels experienced in the mining environment are often higher than the noise characteristics of the machines in use as several factors come into play. Such factors include the near complete reflection of the incident noise energy; the degree of reverberation associated with the volume of the area in which machinery such as drills operate (the smaller the higher the level of noise); increased rockdrill power; longer lengths of the drill steel protruding from a hole; the addition of the noise of compressed air supply, and the noise of several machines working simultaneously (Workman-Davies, 1989).

The results of a two year study published in 2011 showed that more than two thirds of the participants were at risk to NIHL (Edwards *et al*., 2011). Of the 355 participants in year one and of the 190 participants in year two, 66,7% and 78,4% respectively were exposed to noise levels above the 85dBA OEL. High levels of exposure were present at all the project sites, UG gold and platinum, open and UG coal, open and UG diamond, sand and aggregate and cement ‘readymix’ plant. The highest number of workers affected were gold, platinum and coal miners. The highest noise levels were associated with the use of drilling and rock breaking equipment. Occupations in which workers were at highest risk were stopers, mechanical assistants and development team rock drill operators with noise levels ranging from 96.1 – 113.5 dBA. The study recommended the adoption of multidisciplinary intervention strategies to reduce NIHL, the establishment of a national database of personal noise exposure, and the application of noise prevention engineering by equipment manufacturers.

A more recent study (Kanji et al., 2017) on mineworkers' knowledge of NIHL yielded perplexing results. Of the 90 participants from two mines, all knew that excessive exposure to noise caused deafness; 89 knew that wearing hearing protection devices (HPD) and monitoring of their hearing was important; however most could not communicate with the attending medical professionals; all lacked understanding of their audiometric results, and less than half of the miners sampled reported consistent use of the HPDs. This study recommended individualised training of mineworkers during medical surveillance examinations to overcome the barriers identified which prevented more effective use of the HPDs. Other studies have shown that hearing loss occurs even when hearing conservation programmes have been established (Bomela, 2006; Strauss *et al*., 2012; Moroe, 2018). Moroe's study on the effectiveness of Hearing Conservation Programmes (HCP) concluded that the implementation of an HCP was complex; involved several stakeholders and multiple pillars such as formulating, implementing, monitoring and evaluation; was influenced by mine size, resource availability and mine culture; and was shaped and reshaped by continuing consultation and 'cross-fertilization' of ideas. Monroe's results underscore the need for deep and thorough engagement between mine personnel responsible for the HCP and the workforce.

Official data on NHIL in the mining sector (Figure 2.3) show that NIHL occurs across the sector and although gold mines reported the highest number of new cases in the past, platinum and gold mining now account for a similar number of new cases of NIHL. The spike in the NIHL cases on platinum mines in 2004 was most likely due to changes in employment levels and better case finding, as no material changes in mining methods or machinery took place at that time. The numbers of new cases reported in gold platinum and coal mining appear to have levelled out since 2012 as shown in Figure 2.3. The number of new cases per year are not indicative of the prevalence of NIHL in the sector (which is the cumulative number of employees suffering from hearing loss).

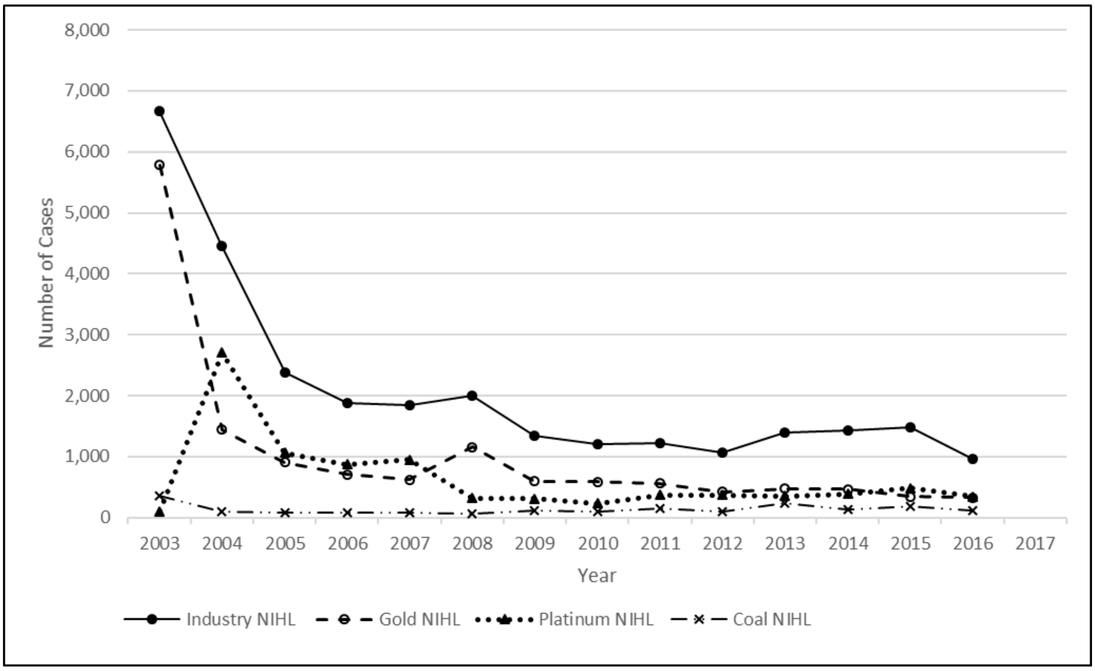

Figure 2.3 Number of New Cases of NIHL in the Mining Sector per Year

Sources: DMR & MHSI Annual Reports, MHSC Mine Health and Safety Summit reports, MINCOSA Facts and Figures

In the USA, a review covering a period of 35 years and which included 700,000 cross sectional measurements of noise in mining, revealed that whereas noise in the sector was decreasing, decreasing exposure to noise was not uniform across the sector. Most advances were made in surface mines where improvements in mining technology and noise control programmes appear to have been contributing factors. Noise exposure was highest in underground mines where noise levels can still exceed 115dBa (Roberts *et al.*, 2017). In an earlier, separate study, approximately 90% of coal miners were found to have hearing impairment at age 50, compared to 49% of miners in metal and non-metal mines (Matetic, 2005). It is unlikely that NIHL would be less prevalent among all South African miners.

Heat

Heat stress is a hazard in gold and platinum mines in South Africa, and the first death due to heat stress was recorded in a gold mine in 1924. Excessive heat reduces capacity for work, impairs decision-making and causes heat disorders such as heat stroke which can be fatal (Schutte, 2009). Significant technology development went into the cooling of mines. From 1972 onwards, the research and development required to enable the use of chilled water to directly cool rock surfaces underground was undertaken by COMRO. COMRO's work led to the success of full-scale trials conducted between 1975 and 1977. Given the increasing depth of mining with the attendant auto-compression (Joule-Thomson effect[7]), and distances over which water was transported to reach the workplaces, mining refrigeration units were moved underground progressively. The successful application of water-cooling technologies led to research into hydro-hydraulic mining systems which made use of the pressure created by columns of water in vertical shafts (Pogue and Rampa, 2006; Hermanus, 1988). This technology ultimately never took off (Pogue, 2006b).

Mainly chilled water was used to cool mines until the early 2000s, but ice cooling was gradually adopted in the deepest mines such as the Mponeng Mine of AngloGold Ashanti and Gold Fields' Kloof Mine (Kolver, 2008). However, these efforts did not remove the need to acclimatise workers to hot working conditions (Schneider, 2016). While heat stress was usually addressed through reducing the heat load in the work environment (shielding, refrigeration of water used in drilling and increased airflow), and by mechanisation which enabled work at lower metabolic rates; technological constraints and the higher cost of comprehensive ice -cooling systems led to continued reliance on heat acclimatisation and heat stress management controls. Mines in which the wet bulb temperature

[7] The Joule–Thomson effect refers to the changes in the temperature of an insulated liquid as the pressure increases. Liquid water cools when compressed and heats when it expands.

exceeded 27.4°C are regarded as hot mines in South Africa, but wet bulb temperatures of 32°C in working areas were not unusual (Webber *et al*., 2003).

Fitness for work in hot environments has been circumscribed by the following individual risk profile factors: medical conditions which reduce heat intolerance, age above 50 years, intensity of work, heat intolerance and a history of heat disorders (Schutte, 2009, p. 3). Schutte (2009), a South African ergonomic expert, foresaw that female miners would encounter more difficulties with UG work under the prevailing hot working conditions. Combined controls proposed for reducing heat stress comprise mining methods which optimise thermal load, the use of wet bulb globe temperature measurements (to ensure that temperatures do not exceed 28°C) and specified air velocity levels (Webber *et al*., 2003, The process of acclimatisation was not dignified or comfortable for miners who, until well into the 1970's, stripped naked before being weighed and directed to step up and down concrete steps for four hours or more, and for up to 8 or 9 days in heated and humid rooms (Horner and Kooy, 1976; Wyndham and Strydom, 1969). The process raised complaints and forceful protest (Horner and Kooy, 1976).

Other Issues

Examples of less widely encountered exposures that have nonetheless warranted specific attention are exposures to platinum and rhodium salts. These exposures are associated with platinum processing operations which are located on mine sites. Exposures cause platinum salt sensitivity (platinosis) and rhodium salt sensitivity for which removal from exposure is the only remedy (Anglo American Corporation, 2018) .

2.2.2 **Safety**

In a paper written in the early 1960s, an associate professor of Native Law and Administration, Simons, at the University of Cape Town (UCT) analysed the death rates of workers on South African mines from 1900 onwards, using data from the Chamber of Mines (COM) and government reports (Simons, 1961). He noted that fatality rates on the mines had improved from 4.40 and 3.40 per 1,000 workers for black and white workers respectively to 1.56 per 1,000 workers in 1956 for all workers. The number of deaths however remained high, such that by 1960, thirty-six thousand (36,000) miners had died in accidents and the number of deaths per *year 'fluctuated around 800'*.

Simons attributed the death rates he observed to inadequate technical and *'material'* safeguards. In deep gold mining natural hazards such as high temperatures, humidity, poor ventilation, rock pressure and rock bursts were contributing factors; and shaft-sinking and development operations appeared to be the most hazardous. In coal mines, transport related accidents (truck and tramways), falls of ground and gas explosions caused most of the deaths (Simons, 1961). With reference to the Mining Regulations Commission of 1907 and early reports of Government Mining Engineers, Simons argued that human factors played a significant role in mine accidents such as the employment of inexperienced and untrained people, inadequacies in supervision, work pressures created by linking remuneration to output, low rates of compensation for deaths and injuries, and the colour bar which created an *'unrealistic separation'* of supervision and manual work, resulting in *'carelessness and inefficiency'* (Simons, 1961). The observations made by Simons resonate with many concerns that are still raised and investigated.

Currently, most fatalities in South African mining can be attributed to falls of ground and transportation (COM, 2017). While the number of fatalities in the sector declined steadily over the years, by the time the Leon Commission sat, the number of fatalities in the sector remained well in excess of the numbers and rates of fatalities in the mining sectors of countries such as the USA, the UK, Canada and Australia (Eisner and Leger, 1988; Wagner *et al*., 1988; Hermanus, 2007; Jansen and Brent, 2005; Lim *et al*., 2011). This led to significant differences between public perspectives of the state of mine safety and the perspectives of industry representatives. Negative perspectives of the industry's commitment to the H&S of their employees were reinforced by the regular occurrence of mine disasters, which in South Africa are defined as events in which more than four workers lose their lives. A report commissioned by SIMRAC listed 10 of the worst disasters in gold mining and 10 of the worst explosion related disasters in coal mining, 20 in total, which occurred in the period 1926 to 1990. The number deaths associated with each these disasters ranged from 21 to 177 (Guild and Stanton, 2003). A notable omission from the list was the disaster at the Coalbrook Mine of Clydesdale Colliery in 1960 which claimed 437 lives and resulted from the failure of 900 support pillars, 180 metres underground.

Figures 2.4 and 2.5 on the next two pages show how the number of fatalities and the FFR of the sector as a whole largely track the number fatalities and the Fatality Frequency Rate (FFR) of gold mining. Figure 2.5 also shows that while the gold and industry FFR are closely correlated, employment levels in the industry overall and in the gold sector are not. Employment levels in gold have declined since 2000 while that of industry rose and plateaued out. This suggests that the improvement in the fatalities level of the sector has been significantly shaped by developments in gold mining.

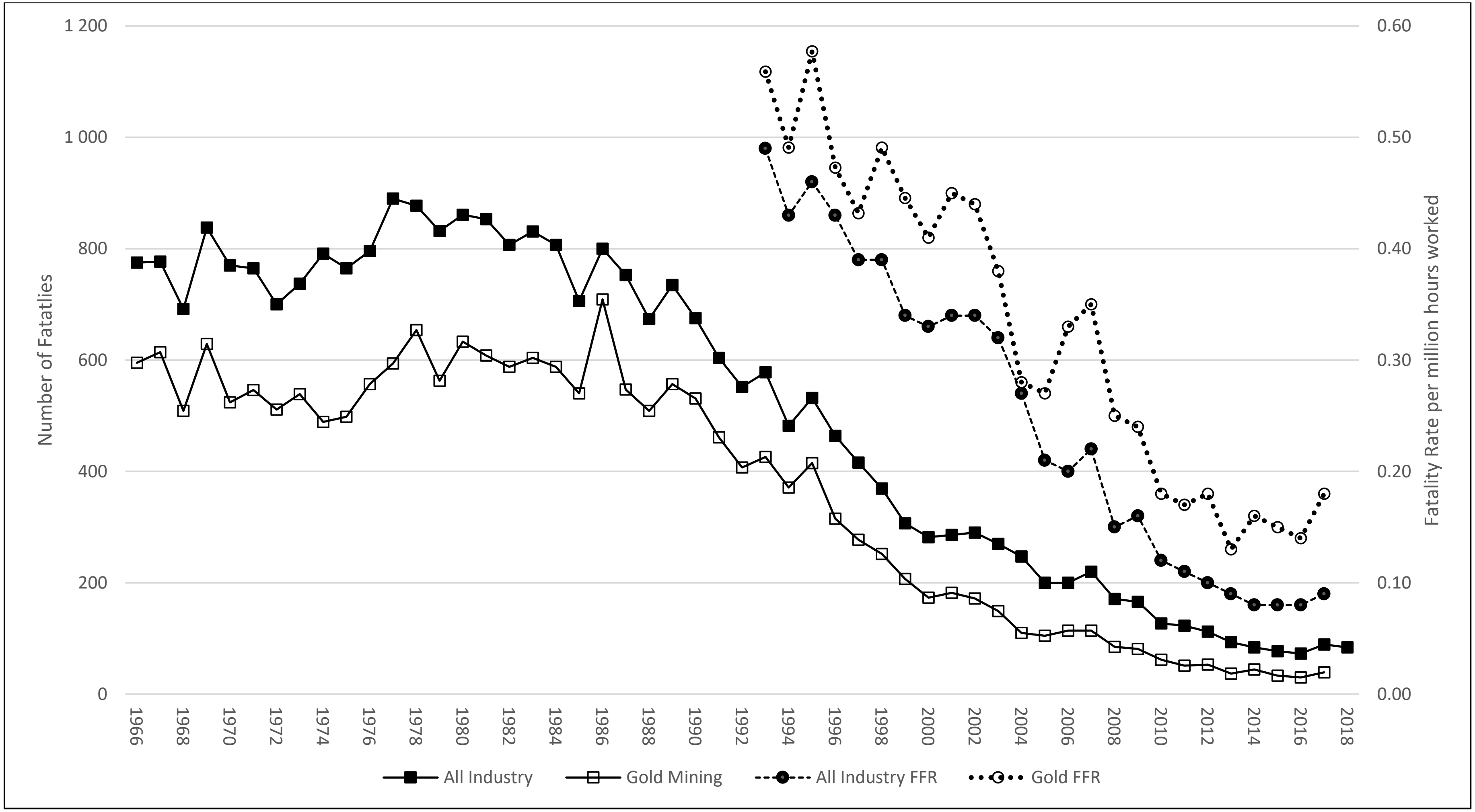

Figure 2.4. All Industry and Gold Mining Fatalities and Fatality Rates

Sources: MHSI Annual Reports, MHSC Mining Summits Presentations and Annual Reports, COM/ MINCOSA Facts and Figures, Leon Commission Vol. 1.

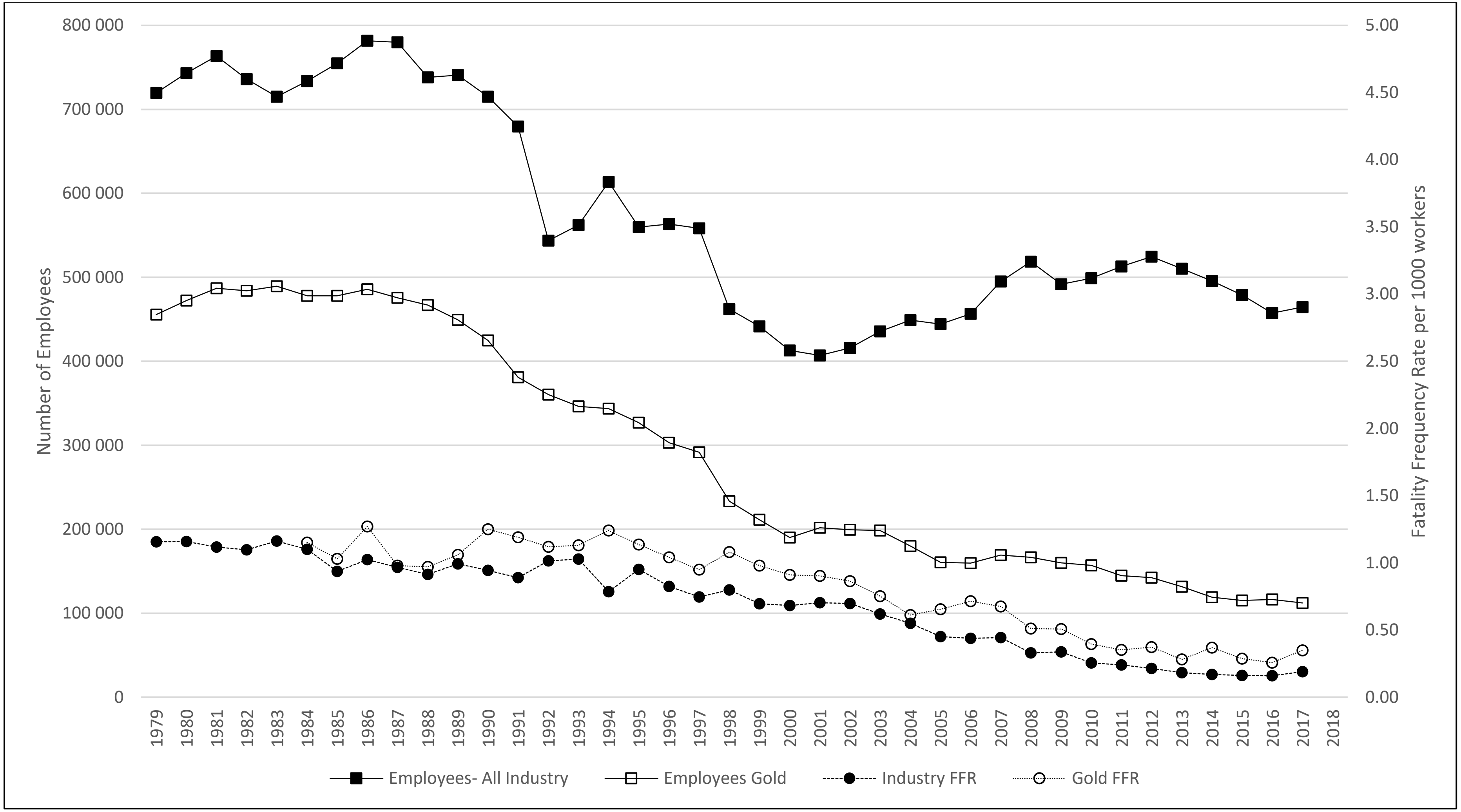

Figure 2.5 Number of Employees, All Industry and Gold Mining and Fatality Frequency Rates All Industry and Gold Mining

Sources: MHSI Annual Reports, MHSC Mining Summits Presentations and Annual Reports, COM/ MINCOSA Facts and Figures, Leon Commission Vol. 1.

Fatality trends in gold mining reflect both declining employment levels and more effective measures to prevent falls of ground, the scale of the former being larger than the latter. Some of these improvements arose out of long-term initiatives to combat falls of ground and reduce the magnitude and impact of mine induced seismicity, while other arose out of more recent initiatives such as the MOSH programme which promoted the practice of netting and bolting of the mine roof, and better methods of making the workplace safe.

A study published in 2002, nine years after the establishment of SIMRAC, credited the following technologies, in order of significance, with having contributed most to improving safety in gold and platinum mines: pre-stressed elongates which replaced rapid yielding props proximate to the working face; mine planning with design software; backfill which brought permanent support closer to the face, and advancement in seismic technology which resulted in improved monitoring networks, recording, and analysis (Triebel and van Niekerk, 2001, p. 17). The advances were due to combined efforts of external suppliers working with in-house experts, Miningtek, COMRO and the Integrated Seismic Systems Institute (ISSI). At the time ideas for future research included safety culture (how to influence people's behaviour; training on key issues such as strata control; support systems including in-stope evaluation methods; support design in seismicity prone mines and active support at the face; the phenomenon of seismicity (Triebel and van Niekerk, 2001, p. 22). A SIMRAC report of 2006, which evaluated the impact of rock related research concluded that slower than expected reduction of rock related accidents could be attributed to a range of factors such as the increasing difficulty of mining conditions; *'shortcomings in other components of the mining cycle, e.g. cleaning; failure to implement existing knowledge; and shortcomings in training, supervision and enforcement'* (Durrheim *et al*., 2006).

Fatalities due to flammable gas and coal dust explosions decreased from a peak in the 1980s. Frictional ignition of flammable gas during mechanised coal mining operations has been a particular concern, associated with hard coals which have high coarse grain quartz content (> 30%). When cutting hard coal, picks can become excessively worn and require higher than normal cutting forces and energy to maintain production rates. In the absence of effective cooling water spray systems, the worn picks of the machinery, longwall shearers and continuous miners, can *'leave a high temperature smear'* of molten quartz on the rock face, hot enough to ignite flammable gasses (Spencer et al, 2000; Phillips, 1996). The first friction ignition in South African coal mines was recorded in 1968. In the 1970s, 1980s and 1990s respectively, 7, 31 and about 10 frictional ignitions in coal mines were recorded. These ignitions peaked during the transition from conventional drill and blast coal mining to mechanised coal mining, accounting for over 50% of ignitions in the period 1984 to 1993. The high extraction rates achieved by mechanisation more readily released critical concentrations of flammable gas and fine coal dust particles (du Plessis, 2017, pp. 2–3). According to the available data, ignition risks tended to be higher in the winter months (Biffi and Belle, 2003). While the risk of ignition was significantly reduced through improved ventilation systems and direct cooling of the picks by the mid-1990s, a recent paper published in the Journal of the Mine Ventilation Society of South Africa found wanting, amongst coal mining companies and suppliers of continuous miners alike, the transfer and application of knowledge about frictional ignition risks (Ngobeni, 2018).

While the prevention of mine fires has improved significantly over time, there are worrying signs of a resurgence of mine fire risk in both avoidable and new perilous circumstances. Mine Rescue Services (MRS) tracks the incidence of mine fires. It is a private, not for profit organisation, which trains volunteer rescue teams and provides specialised support in the event of mine accidents and fires. According the MRS records, the incidence of mine fires declined over the period 1998 to 2013, with a high of 82 and a low of 10 fires recorded in these years respectively. From 2013 onwards, mine fires steadily increased from 10 in 2013 to 27 in 2017 (the annual report date). In 2017, vehicle fires, electrical fires and spontaneous combustion accounted for 14 of the fires reported. The causes of 7 fires were unknown due to the danger of entry or the necessity to seal off the affected area. The MRS has voiced concern over the exposure of the members of rescue teams to *'extreme hazards and risks posed by hostile and informal environments'* of illegal mining. In this respect, it is seeking amendment of its contract with the DMR (Mines Rescue Services, 2017). Mine fires in unlicensed mining operations are one feature of the changing context of mining in the country.

2.3 Technical Prowess

The technical prowess of the industry as described in the scientific literature (Mendecki, 1997; Pogue, 2006a; Pogue, 2006b; Durrheim, 2010; van der Merwe and Madden, 2010) was, and is, widely respected. In his 2006 dissertation, Pogue cites some of the early innovations of the South African gold mining industry as the industrialisation of the cyanide process for extracting gold, refining rock drill technology, developing deep mine ventilation systems, developing methods of acclimatising workers to hot and humid working environments, voluntarily establishing Rand Mutual Assurance Company to address the issue of workers' compensation, establishing a Mine Safety Committee in 1913 and the Mine Rescue Brigade system in 1924 (Pogue, 2006a).

Yet, the sector's leadership failed to grasp the enormity of the H&S impacts of mining on black workers and labour sending communities. The 1986 presidential address to the South African Institute of Mining and Metallurgy (SAIMM) by Dr. Horst Wagner took place amid the occurrence of several significant and disruptive mining disasters. It focussed on productivity. The message of the address centred on achieving real improvements in the productivity of mining through better mining methods and technologies, rather than relying on improvements in mine management, supervision and training which were likely to achieve only short term improvements (Carson, 1986). Dedicated efforts to improve miners' health safety were to follow later, after the Leon Commission report.

2.4 Social Conditions of Miners and Mining Communities

Black mineworkers were housed in mine hostels on most mines. The mine hostel system originated in the diamond fields of the Northern Cape and was adopted on the gold mines. Conditions were crowded, unsanitary and harsh. Initially, miners cooked in their rooms, often suffered from malnutrition, wore wet and soiled clothes, and relied on the bucket system for the removal of night soil (Flynn, 1992; McCulloch, 2012). Such conditions encouraged the spread of pneumonia and tuberculosis, and miners who already suffered from phthisis or who were exposed to silica dust were particularly vulnerable to succumbing to tuberculosis.

The strictures of the mining compound and harsh conditions underground also triggered episodic outbreaks of violent conflict between miners, usually bound up with dissatisfaction about one or other aspect of working or living conditions (Horner and Kooy, 1976). McNamara, who explored the reasons for factional and interpersonal conflict on mines from an anthropological perspective, concluded these conflicts could not be understood without consideration of their *'underlying material antecedents'*. They were inflamed by the social structure imposed on workers at mines; the social stress and dissonance experienced by workers, and the absence of means to recognise the roots of conflict, let alone resolve it (McNamara, 1985). Moodie's work deepened the understanding of the nature of conflict on mines. He, too, pointed to a confluence of causal factors including housing arrangements, the assignment of responsibilities on ethnic grounds and the misery of the miners. He concluded that conflicts could be seen as the *'practice of politics by violent means'* when real interests of groups of workers were at stake. These interests depended on the prevailing conditions at a mine (Moodie, 1992). The outbreak of violence during mine strikes resonate with Moodie and McNamara's analyses. The 1987 strike by 300,000 mineworkers called by the NUM when the hostel system was still at intact, is an example of violence sparked by a confluence of factors. This strike included two demands which were H&S related, danger pay and improved death benefits. As control over the hostels were central to organising and sustaining strikes, and also the terrain of mine appointed indunas responsible for oversight of the hostels (Horner and Kooy, 1976), the violent confrontations that marred the strike were in part battles over control of the hostels. Mine hostels provided an organisational base for the NUM, and the dismantling of the hostel system contributed to the decline of the NUM in recent years (Sluis-Cremer *et al*., 1992).

2.5 The Regulation of Occupational Health and Safety

2.5.1 Premises of OHS regulation

Legislation dealing with OHS falls under the ambit of public law which is a body of law for organising and governing the relationships between the state (government), private companies and citizens. The premise of public law is that governments, through regulating, act in the interests of society as a whole. It differs from private law which deals with issues between individuals, families and businesses, and addresses disputes on private matters rather than disputes which affect the general public or the state. The ambit of public law is wide, and subdivided into statutes of parliament, regulations, by-laws etc. It includes statutory, administrative, constitutional, criminal, municipal, international and common law; and applies to many aspects of daily life, including property ownership, transportation, employment, dispute resolution, environmental protection, food and drug safety, and workplace safety and health. Given the range of activities subject to statutory or regulatory control under public law, many activities of individuals or organisations are affected. Public law may establish the requirements to meet certain objectives or prescribe exactly what must be or what can be done, and to what standard. It also specifies what is prohibited, and what penalties apply to violations of the law. In South Africa, the constitution of the country is the supreme law and is the legal foundation of all other laws, such as H&S which is regulated through the constitution, common law and legislation. Legislation takes the form of statutes amplified through regulations and guidelines. The governance of H&S involves a combination of common, statutory and administrative law, which are all subject to provisions of the constitution (Benjamin and Thompson, 1992). Both the Mine Health and Safety Act (MHSA) and the Occupational Health and Safety Act (OHSA) establish the structure and function of the state agencies which promote H&S, administer and enforce the law (Occupational Health and Safety Act, 1993; Mine Health and Safety Act, 1996). Whenever a mine inspector, mine manager, or an OHS representative exercises a statutory right or acts or performs a function in terms of the MHSA and/or its regulations, public law is at work.

Dudley and Brito describe three theories of public law in which (i) regulators act in the interest of society viz. public interest theory, (ii) capture theory in which regulators are captured by special interests, and (iii) the economic theory of regulation in which an interest group convinces '*government to use its coercive power to the group's benefit*' thereby improving its '*wellbeing at the expense of others'* (Dudley and Brito, 2012). For the purposes of this study, public interest theory is particularly relevant in light of the transition of South Africa to a constitutional democracy at the time that the MHSA came into force (The Constitution of the Republic of South Africa, 1996). Capture and economic theories of regulation are helpful in examining how the MHSA was interpreted in subsequent years.

Generally, in market economies, the main rationale for public law is public interest theory and that such law addresses market failures. But there are other public interests which stem from considerations of human rights and/or the desire to promote social objectives such as alleviating poverty or addressing inequality. These considerations go beyond the idea that markets are the best way to allocate goods and services; and reflect social choices to protect disadvantaged and vulnerable citizens, and build or maintain social cohesion (Campbell, 2006; Baldwin *et al*., 2012). Thus, industries, services and certain occupations can be regulated for a combination of reasons - market failures, human rights or social cohesion.

Health and safety (and environmental) regulation, can be linked to three types of market failure, externalities, public goods and asymmetric information. In the public interest, such legislation seeks to reduce risks of illness, death or injury, and of degradation of vital public goods such as clean air, water or arable land. It also involves questions of ethics and social justice about the morality of exposing sections of society to higher degrees of risk.

Ultimately the design of OHS legislation, implicitly or explicitly, incorporates trade-offs, balancing a range of interests and making policy choices about what is desirable and/or practicality. This has implications for the acceptability and adequacy of strategies to workplace exposure, the balance to be struck between considerations for the welfare of workers, public welfare and economic activity and the level of protection which can practically be achieved (Rothstein *et al*., 2017). Confounding issues include different views on the responsibility of government in regulating the economy or a sector; different interpretations of the rules by the employers and employees; and the extent to which the nature of the risks associated with different industrial processes are understood and treated as required in law. Ideally the parties involved and affected should be satisfied that the regulations are effective and fair.

From a RM perspective H&S risks are pure risks – the outcomes are usually negative or neutral. More generally, risks could have negative or positive outcomes, and the objective of RM is to eliminate or reduce the likelihood and consequences of negative risk and enhance the likelihood of positive or neutral outcomes. Public expectations of positive RM outcomes have increased. Recently coined phrases like *'risk averse society'* and *'compensation culture'* point to this development in Europe and North America. There are concerns that public sentiment has shifted towards unattainable expectations of complete elimination of negative risk (Neal, 2000; Vogel, 2001; Hand, 2010; Lord Young, 2010). In the UK, the HSE was consequently prompted to issue *'sensible risk management'* guidelines (HSE, n.d.). In the rest of Europe, the point of departure for health, safety and environmental regulation is the "precautionary principle". However, the term risk averse society does not resonate with the situation in South Africa where acceptable levels of OHS have not yet been achieved and best practices to protect workers have not yet been fully implemented. Nonetheless, there are expectations that risks (such as seismic risks) which are not yet fully understood, should be eliminated. Social expectations, as described above are relevant to the interpretation of requirements of tripartite engagement and RM and are discussed further in the chapters on tripartism and RM.

2.5.2 **Reasons for Regulatory Success or Failure**

Baldwin provides a helpful scheme for recognising good regulation and explaining regulatory failures. In this scheme the legitimacy of good regulation rests on: (i) its authorisation through a fairly elected legislature (or parliament); (ii) enforcement through a properly accountable and responsible regulator; (iii) regulatory processes which follow due process which is fair, accessible, open and amenable to *'democratic influence'*; (iv) the availability of expertise, experience, skills, and specialised knowledge in and to the regulator; (v) efficient implementation and delivery of outputs (Baldwin *et al*., 2012). Reasons for regulatory failure, according to Baldwin, include (i) with reference to public interest, regulators favouring of concentrated interests; (ii) with reference to ideas, worldview or beliefs, approaches which lead to blind-spots if implemented single-mindedly or exclusively; and (iii) with reference to institutional approaches (a) drift due to changing preferences in government, agency drift amounting to departure from their statutory objectives, and industry drift with industry not complying to regulation; (b) with reference to layering, different agencies having different understanding and objectives which overlap or are in force simultaneously; (c) unintended consequences due to changes in the environment, the limited basis of decisions (which is inherently limited as all knowledge cannot be known or processed effectively); and (d) imperviousness to disturbance which discourages self-reflection and self-learning (Baldwin *et al*., 2012).

An OECD report on regulatory policy found that reasons for compliance and non-compliance to regulations could be organised into three categories (i) level of knowledge and understanding of the rules, (ii) level of willingness to comply for range of reasons, economic, acceptance of the policy goals, a sense of good citizenship, and pressure from enforcement agencies (iv) the degree to which compliance is possible (Public Management Committee of the OECD, 2000).

2.5.3 **Regulatory Approaches**

The different ways in which H&S can be regulated are described in this section. Several options are available. OHS legislation can be prescriptive or enabling, while regulatory functions can be directly undertaken by the state, delegated to agencies outside of the state or left to the regulated entities themselves, who are then expected to police one another with or without some level of state oversight.

When the government regulates H&S directly, the regulatory agency is an institution of the state. However, regulators may delegate certain of their functions to other organisations which may not be state run. Table 2.1 below presents a summary of direct regulatory strategies applicable to OHS, and their advantages and disadvantages. These strategies may be used in combination.

Table 2.1 Direct Regulation Strategies (own compilation)

No	Strategy	Posited Pros	Posited Cons
1	**Command and control regimes with or without rule making powers**. Standards are imposed and are backed with penalties and criminal prosecutions. Law requires certain kinds of conduct, contains prohibitions, may include conditions for entry. Regulator aims to optimally detect, require remedy and penalise non-compliant behaviour. In this regime, as in the others below, informing the regulated and those who require protection, can strengthen the system. Similarly, conferring protected health and safety rights to employees and others such as access to clean air or water can bring other parties into play and strengthen the system.	Regulator can act forcibly and without delay. Actions could include outlawing, halting or quarantining dangerous activities or areas, imposing penalties, and stop unqualified people from practising. Direct action can assure the public that the law is being applied in its interest. Non-compliance can be defined unambiguously. Providing information and conferring rights may not be sufficient to create *a 'level playing field'.* Regulator is in a position to share best practice and promote cross sector learning.	Regulators can become captured because a close association with the regulated tends to develop due to the level of information required to command and control them. The information required to regulate complex industries is very extensive. Thus, regulators come to rely on industry for most of their primary information and insights to enable both standard setting and appropriate enforcement action. Command and control regulators may become protectors of the industry rather than the public when influenced by powerful political or private groups. Command and control regimes are prone to creating complex and inflexible rules, which are both burdensome for the industry and the regulator itself. The rules can become difficult to interpret and enforce.
2	**Incentive based regimes**. In this regime, levies, taxes, grants or subsidies are used to penalise non-compliance, and incentivise effective RM and compliance.	Once the reward or penalty regime is established there is little room for discretion. There is less requirement for regulators to constantly engage industry, reducing chances of capture. Incentive based regimes may be cheaper.	Rules may be very complex. Inspection and enforcement may be necessary anyway to ensure that incentive schemes are properly deployed. The tasks of identifying appropriate abatement or remedial measures fall to the regulated. Incentives may not be sufficient to encourage irresponsible entities or individuals to comply. Taxes may not be sufficient or appropriate means to remedy harms especially where 'tipping points' are present. Allocation of taxes may be difficult when many operations contribute to a common problem. The regime is ultimately a trial and error system with adjustment made after the fact. This approach may be completely inappropriate in the face of fatal or catastrophic risk.

Continued overleaf

No	Strategy	Posited Pros	Posited Cons
3.	**Disclosure Regulation.** Mandatory disclosures required (as in the safety case approach for nuclear power stations). False declarations are prohibited. Information may be made public to, for example, name and shame poor operators and to point to best practices.	Minimal intervention. Can strengthen other regulatory approaches. The likelihood of significant reputational risk enhances the effectiveness of this strategy.	The significance of shared information may be misunderstood. The regulator may not receive full information. The cost of producing adequate information and dissemination may be high. It may be easier for the regulator to scrutinise information for operational or product acceptability. Disclosure regulation may be better for non-catastrophic hazards, when misjudgement of products or processes is not likely to have serious consequences. This approach is least suitable as a standalone strategy.
4.	**Public Compensation or Social Insurance Schemes.** Premiums paid by the employer are commensurate with claims history. State compensation systems may also be mandated to direct funds to improving health and safety.	Statuary right to sue employers for OHS related harms are forfeited for statuary compensation which is easier for individual employees to secure. When based on conditions in the work environment, improvement is incentivised.	Private insurers may be less inclined to address risks due to tensions between their key role to spread risk rather than isolate it. When based on past accident records, data may be too random to be useful and non-reporting of accidents may be encouraged. *The extent of harms may be underestimated, go uncompensated, and unrecorded if they are latent for long periods* [8].

Sources: (Baldwin *et al.,* 2012; O'Sullivan and Flannery, 2012; Power *et al*., 2008).

Indirect regulation strategies, in contrast to strategies for direct regulation, involve arrangements in which the state delegates its regulatory responsibilities completely (or in part to) other bodies, albeit that transgressions remain punishable. Third parties may take responsibility for a regulatory function such as, specialist inspections, identifying transgressions of rules - including those which are required to be developed in-house. An example of an in-part delegation of inspectors' authorities in South Africa are the Approved Inspection Authority Arrangements of the DoL which are provided for in the OHSA. These authorities undertake, on behalf of the DoL, occupational hygiene and major hazard

[8] Author's own addition.

installations inspections, pressure vessel and electrical equipment installation inspections (DoL, 2018a; DoL, 2018b).

Self-regulation is a regulatory strategy which relies on an industry or a sector to regulate itself. Familiar examples are professional bodies which oversee the conduct of their members in fields such as law, engineering, and journalists; and bodies such as school boards and company boards. Self- regulatory agencies may appoint inspection authorities to carry out certain oversight activities on their behalf. Traditionally arguments for self-regulation rest on expertise and efficiency, and the argument against self-regulation is whether self-regulatory agencies can work in the interests of the public rather than serve the interest of their members. These arguments give rise to issues such as the mandates of these agencies, their accountability in respect of normal democratic processes, and their capacity to act fairly or sanction their members (Baldwin *et al*., 2012). Closer examination of the case of self-regulation suggests that it can be effective on its own or supplementary to other regulatory and policy instruments, despite significant hurdles and a checkered history, (Gunningham, 2011; Gunningham and Rees, 1997). Gunningham and Rees argue that the *'form and limits of effective'* regulation warrants further examination and that the infusion of morals and principles in an industry and its prospects for *'institutionalizing responsibility'* are important issues (Gunningham and Rees, 1997).

Enabling regulation blurs the line between command and control regimes and self-regulation as it does not specify requirements but instead relies on the interpretation of principles, duties, process-based standards, performance or outcomes-based standards and processes for stakeholder involvement. However, the regulator maintains the authority to assess whether these interpretations are consistent with relevant principles and duties, and whether the processes and outcomes are valid. The entity identifies the hazard/s, the level of associated risk/s and is expected to implement appropriate controls. In this regime, a regulator may provide guidance on how to identify hazards, assess their severity, and the choice of controls. The distinguishing feature of this approach to regulation is thus, that while it sets out processes and systems to support effective RM, the entity itself is required to decide on what is to be done and how.

Advocates of RM processes expected it to lead to less regulation as it offered the means to establish fit-for-purpose solutions to risks without the need for legal prescription. It also offered the promise of regulation, which did not constrain technological development as detailed legislation is wont to do. The possibility of creating H&S legislation which did not date too quickly, or stifle innovation was raised by the Robens Committee which saw the problem as one of *'building obsolescence into statutory regulations'* (Robens, 1972).

In the most flexible enabling regulatory regime, the owners or operators of facilities, such as nuclear plants or mines, present a case for safety, the "safety case" based on RM principles and processes. This involves demonstrating how the design and operating parameters of a plant or the operation provide for the elimination or minimisation of risks to the workforce and the public. The safety case approach was pioneered in the nuclear sector in which the design and performance parameters of power plants are, of necessity, of a high standard with well-established and well defended requirements.

While it is possible to distinguish between prescriptive and enabling regimes, in practice the elements which define the two approaches are not mutually exclusive. For example, when decisions on safeguards are made, it is usual to consider what has already been established, proven, or prescribed elsewhere. Proven remedies are also likely to involve technologies or components designed or manufactured to high degrees of specification.

Enabling regulatory frameworks are most likely to provide for various levels of consultation and co-regulation, with workers and management working together consultatively at work sites; and collaboration (as opposed to consultation) between organisations representing workers, employers and the state in the development of policy at national or provincial/ level. This approach to regulation is also called co-regulation. In the workplace, the tasks undertaken consultatively could include identifying hazards, assessing levels of risks associated with hazards, and deciding on how best to manage risks in the short and longer term. Collaborative policy making requires the parties involved to reach sufficient consensus. Discussion on the advantages and disadvantages of co-regulation as a regulatory approach suggest that it is flexible, inclusive and responsive but also point to difficulties in exercising effective oversight (Rubinstein, 2018; Balleisen and Eisner, 2009; Baker and Moss, 2009).

Worker involvement in enabling and co-regulatory OHS regimes is the subject of an extensive body of research in which both the principles and the practice of worker involvement has been explored. The involvement of workers and their representatives at operational and policy level indicate difficulties which translate into limitations in participation and influence, but the severity and nature of this problem appear to be context dependent. Declining trade union membership in many countries also plays a role, as does the culture of seeing operational decisions as a "management prerogative". Other limitations, include an absence of mutual understanding of the roles of safety representatives, and limitations in the tools for effective participation available to workers. In Victoria, Australia for example, worker representatives can issue a Provisional Improvement Notice (PIN) to induce compliance by the employer.

Page found that the main determinants of effective OHS consultation are: '*the political climate, the performance of the regulator, legislative weakness and a lack of competence and/ or commitment*' (Page, 2002) One issue in Page's research which resonates with the situation in South Africa is defining the role of OHS representatives, to represent workers or to act as OHS helpers – aka volunteer fire-fighters. Representatives have increasingly taken on the latter role, characterised by Coulson as a process of *'responsibilisation'* (Coulson, 2018). Another variation of this problem has been documented in the Norwegian Oil and Gas Industry, where managers and safety representatives were found to value different sources of information and evidence. This affected the *'climate of participation and collaboration'* and created tensions between those with direct responsibilities for safety initiatives and those who participate in the initiatives as safety representatives (Hovden *et al*., 2008). Preparing safety representatives adequately for their roles is clearly a challenge. Mahan et al stress the value of *'peer training'* (training of workers by other workers or union representatives) in their paper which discusses effective training models (Mahan et al., 2013). Mahan and others' findings echo the findings of research undertaken by Walters who has focused much of his life's work on H&S representatives. Walters *et al.* continually stressed the importance of autonomous worker representation within participative workplace culture, along with strong legislation, effective oversight by the regulator, and senior management leadership (Walters et al., 2016; Nichols and Walters, 2016; Walters, 2010; Walters *et al*., 2005; Johnstone *et al*., 2004 Walters *et al*., 2001; Walters, 1998; Walters, 1996).

An HSE commissioned study in 2010 which captured managers' sentiment about the value worker involvement concluded that while it was difficult to isolate the effects of worker involvement on H&S from other effects: *'They are, however, undoubtedly present, including increased near-miss reporting and improvements to health and safety, helping staff through the recession (limited evidence), reduced injury and absence data and improved morale. The companies that have involved their workers in a meaningful sense speak positively about the experience and are often looking to expand upon it'* (Fidderman and McDonnell, 2010).

The effectiveness of worker participation in OHS has also been affected by the changing nature of work, and the same changes - increased sub-contracting, joint ventures, independent contracts, and insecure work – have raised the level of workplace risk arising from miscommunication or exclusion. Fractured organisational structures have in turn created more demand on enforcement agencies who require information and insight from an array of actors including workers and their representatives.

Innovative regulatory mechanisms constitute one response to these difficulties, such as establishing 'the person conducting a business or undertaking' (PCBU) as the primary duty holder in order to promote more cohesion at workplaces (Gallagher and Underhill, 2012; Johnstone, 1999).

The literature is largely silent on consultative and collaborative processes in developing countries. In these countries it is likely that workers will be at a greater disadvantage to management in respect of expertise and formal training; will be more unfamiliar with the technologies employed at work; and will be less familiar with the rationale and the debates behind OHS policies and procedures. Nonetheless in South Africa for example, where OHSA and MHSA mirror the legislation in place in the UK, Australia and Canada; workers and their representatives are expected to navigate and apply these regulatory frameworks effectively.

2.5.4 **Enforcement Strategies**

Approaches to enforcement lie on a continuum ranging from persuasion to punishment. Easily accessible guidance documents are available online to inspectors in the UK, Australia, and the USA. These documents explain and provide information on the principles that inform their work, and the procedures and tools they require when inspecting, conducting investigations, enforcing compliance or preparing for court (HSE, 2005, HSE, n.d., HSE, 2015; WorkSafe Australia, 2011; Department of State Development, 2016; Department of Mines and Petroleum, 2015; Department of Employment, Economic Development and Innovation, 2010; U.S. Department of Labor *et al*., 2013). Enforcement practice has also been reviewed in these jurisdictions as well as Canada (Bellringer, 2016; Hampton, 2005; Mine Health and Safety Administration (MHSA), 2006; New South Wales Government *et al*., 2007). Some regulators have the discretion to tailor their responses to the circumstances which they encounter, while others, the USA most notably, follow detailed enforcement prescripts which stipulate the actions to be taken following specific transgressions.

The HSE and Australian enforcement practice guides refer to principles expected to inform the enforcement practice of mine inspectors. These principles are implicit in the US codes and include proportionality, targeted enforcement, consistency, transparency and accountability. In essence inspectors are required to consider:

Proportionality in the application of the law with reference to risk-based criteria, in securing sustained compliance; and in choosing appropriate interventions ranging from offering advice, to issuing directives, applying penalties or initiating prosecution

Targeted enforcement action against risk-based criteria to ensure that serious risks, trends or breaches are prioritised, and that that duty holders take immediate action to deal with such risks

Consistency in approach and decision-making with an eye to equitability and fairness. Through consistency regulators maintain the confidence of the entities they regulate and secure their co-operation. In order to achieve consistency an inspector may seek assistance from more experienced colleagues or specialists. In turn, experienced inspectors are expected to assist trainees or less experienced inspectors

Transparency about how the inspectorate operates or rationalises different courses of action e.g. prosecution for failing in certain duties, or peer review to transfer good practice.

Accountability and willingness to explain enforcement decisions and to take care that decisions are within the scope of provided guidelines.

The issue of proportionality is further clarified as escalating levels of enforcement in which the first interventions are mild and become progressively harsher, culminating in the suspension of an entity's licence to operate. Proportionality in regulation finds expression in the regulatory pyramid (Ayres and Braithwaite, 1992; Gunningham and Johnstone, 1999; Johnstone, 2003; Braithwaite, 2006) presented in Figure 2.6 below.

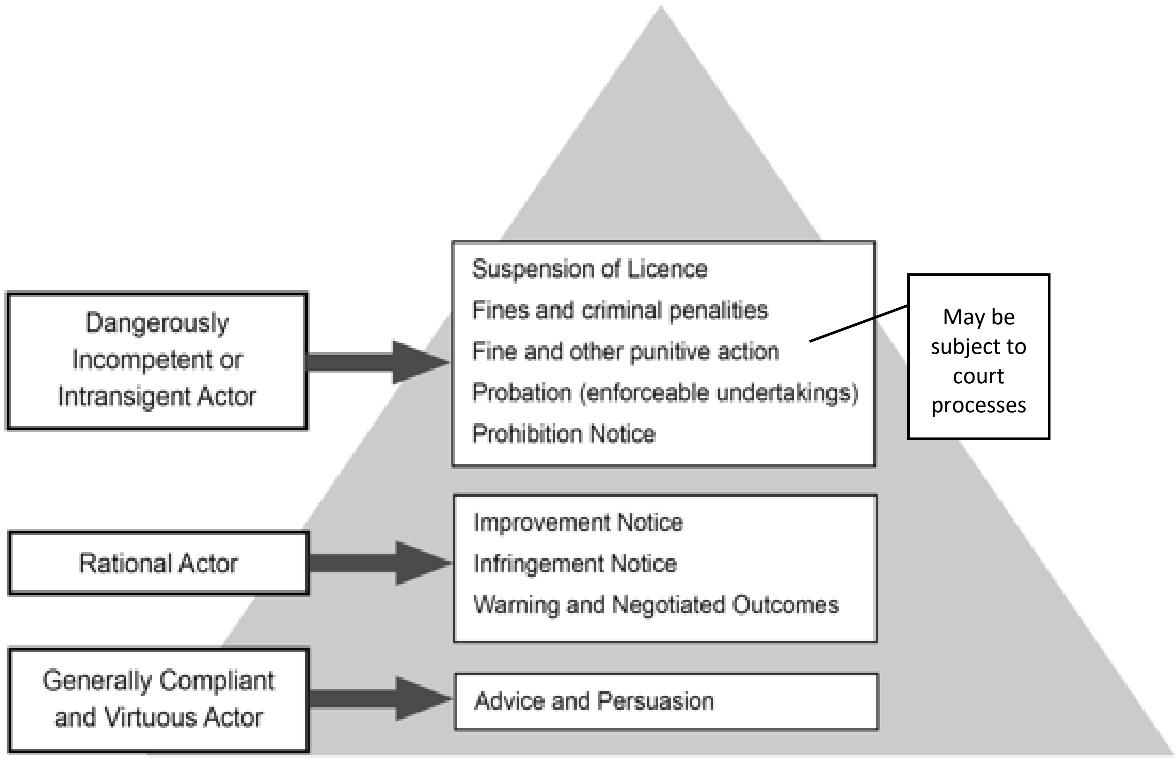

Figure 2.6 Enforcement Pyramid

Sources: Ayres and Braithwaite, 1992; Johnstone, 2003; Braithwaite, 2006.

Nevertheless, achieving compliance is a complex and difficult task, and the enforcement actions taken by regulators are but one reason why organisations submit to rules. Other factors affecting levels of compliance are attitude - whether organisations are committed to compliance or want to comply or not; the capacity of organisations to comply; and the ability of regulators to detect non-compliant organisations, gather information and act fairly. Research and experience also suggest that the enforcement pyramid cannot be followed as slavishly as Figure 2.6 suggests. In routine inspections and audits the first four steps are likely to be applied but following events in which people were seriously injured or killed, application of steps 5 upwards are more likely (Gunningham and Johnstone, 1999).

Sparrow makes the point that the task of identifying *'important problems'* or in current parlance 'significant risks' appears *'beguilingly simple'* but could present significant implementation challenges to the entity in question. Risk assessment could have implications for strategic plans, budgeting processes, performance reporting, human resources and information management.

Regulators, on the other hand, operate in an environment which requires technical and political judgement. These are not new issues as regulators *'inhabit and are obliged to navigate, a landscape of conflicting and shifting interests'* (Sparrow, 2000, p. 17). Inspectors are invariably faced with choices at some point which, even in the best of circumstances, do not easily marry public expectations and the reality of industrial activity. For example, regulators contend with risks that can be addressed easily and quickly, as well as risks for which no short term or easy remedies are available. This may be due to the time required to procure equipment, or because entire processes have to be redesigned or developed. However, in both instances, questions arise about the tolerability of risks. Does the activity stop or continue? While non-compliance may or may not be tolerated by a regulator, for justifiable reasons the regulator could face public criticism in either instance, for either placing jobs at risk, disregarding public interest, or courting major catastrophe.

Research on effective compliance and enforcement has considered the limitations of rules in OHS regulation (Baldwin, 1990); debates on the relative merits of strategies involving punishment or persuasion (Shapiro and Rabinowitz, 1997); consideration of the regulatory pyramid approach (Ayres and Braithwaite, 1992; Haines, 1997); the target-analytic approach which takes account of an organisation's reasons for non- compliance; and the merits and complexities of risk based enforcement strategies which allocate regulatory resources according to the level of risk associated with certain operations or activities (Joy, 2004; Joy, 2014; Baldwin and Black, 2016). Ultimately multi-pronged rational strategies emerge as the most practical approach for regulators, given the range of organisations encountered, and their varied capacities and outlooks (Gunningham, 2007). Scholars have also explored the limits of regulation in the face of the changing nature and organisation of work, and nature of regulatory reform as a dynamic social, actuarial and political project (Haines, 2011; Haines, 2013).

The punitive aspects of enforcement in particular has received much attention, with earlier arguments stressing its importance, the need to invoke such sanctions earlier rather than later in the process of regulation, and to hold senior management accountable. Later arguments located punitive measures within an overall scheme of regulatory options as already described, which while ordered, depend on judicious judgements on the part of regulators. Shapiro, Rabinovitz, Tombs and Pierce cautioned against too much reliance on cooperation and persuasion (Shapiro and Rabinowitz, 1997; Pearce and Tombs, 1990; Pearce and Tombs, 1991). Frank, Lombness and Hawkins (Hawkins 1990) suggested that taking punitive action was a reasonable approach for regulators who are under resourced and unable to monitor industry effectively (Frank and Lombness, 1988; Hawkins, 1990). Earlier Hawkins' had also argued in a book on the environment that in enforcement of environmental regulations punitive action under criminal law could serve as a deterrent (Hawkins, 1984) . A case was also made for treating serious transgressions as criminal offences (e.g. corporate manslaughter) to deter other violations (Almond, 2013). Health and safety cases which are prosecuted usually involve recklessness, negligence and failures to act on warning signs. Concurrent and later research raised concerns that ill-advised prosecution approaches could lead to adversarial relationships, in which information is withheld rather than shared, ultimately undermining the effectiveness of the regulatory process (Gunningham, 2015; Gunningham and Sinclair, 2009).

Information sharing is a crucial feature of risk-based regulation in the context of uncertainty and the regulator's position on the periphery of the environment in which technical change takes place. Other factors which are relevant to information sharing, are inherent uncertainties over the standard of care to be taken when the knowledge of a hazard is incomplete. Gaps in information and uncertainty can present challenges to both regulators and regulated entities on how to interpret developments and properly investigate incidents. Tensions between the regulator and the regulated could also have implications for the foundations of collaborative systems, namely that stakeholders have shared responsibility for policy and complementary roles in governance. These issues are explored in the chapters on tripartism and RM.

2.6 Tripartism

Dialogue is central to conflict prevention and resolution. The word stems from the ancient term 'dialagos' which means "flow of meaning". In a dialogue process, expectations are that participants are committed to listening, reflecting and questioning, with a view to arriving at a shared understanding of an issue or situation. Under circumstances of conflict or potential conflict, it is also necessary for participants to suspend judgement or assumptions so that they may arrive at mutually acceptable decisions. Conditions for successful dialogue include a space and environment which is safe, opportunities to explore assumptions and beliefs without judgement, and opportunities to explore and examine the sources of conflict or disagreement through questioning and reflecting (Hind, 2016). As a special form of dialogue, tripartism is a mechanism for governments, employers and labour to work in partnership to improve working conditions and protect workers' rights.

Tripartism is the founding philosophy of the ILO which was established in 1919 after World War I, and its creation was included in the Treaty of Versailles. At a time when extreme exploitation in industrialising Europe was triggering social unrest and uprisings, the treaty reflected the belief that only social justice could secure '*universal and lasting peace'* (ILO, n.d.).

Of all the international institutions, the ILO is the only one which is tripartite i.e. that brings labour, employers and government together. Tripartism, as a process, has come to encompass all types of social dialogue between these three parties on any issue of economic and social policy. This includes information exchange, negotiation, dispute resolution, consultation, dispute prevention and collective bargaining (ILO, n.d.). In addition to advocating for tripartism, the ILO created binding and non-binding labour standards. Since inception, it has created 189 Conventions which become legally binding once ratified by a country's government (Sengenberger, 2013). The core labour standards of the ILO include the right to collective bargaining, the abolition of forced labour, and the prohibition of workplace discrimination, all standards which the South African government fell afoul of prior to 1994. The Conventions cover a range of topics including OHS in industry and mining. The South African government ratified these conventions C155 and C176 respectively, in 2003 and 2000 (ILO, 1981; ILO, 1995; ILO, n.d.).

As indicated in Chapter 1, section 3.2, the premises for effective tripartism as advocated by the ILO include conditions which allow for frank discussion, all parties having the technical capacity to engage effectively, trade unions which are independent and representative, engagement on an equal footing by willing and committed parties, and collective and institutional support to follow through on the outcomes of their consultations (Qiao and Appelbaum, 2011).

Concerns about the applicability and durability of tripartism are manifold, with the underlying argument being that successful tripartism is a temporal phenomenon, closely linked to social circumstance. For some, it has been an historical exception made possible by a period of relative global prosperity, albeit not ubiquitous. For others, circumstances in the Anglo-Saxon economies, i.e. the fall of fascism, the anti-fascist consensus and the relative strength of labour, in which all other options were exhausted, enabled a compromise to be struck between capital and labour. From this perspective, contemporary developments related to the 2008 financial crisis and the impacts of globalisation suggest that the position of labour and governments have weakened since the 1970s, while capital has been strengthened by globalisation. As a result, the outlook for social peace is seen to be poor (Croucher and Wood, 2015). Another perspective is that the setting in which tripartism is initiated, is decisive. For example, national governments who have a social agenda and who are attractive to investors for a variety of reasons such as mineral resource endowment, and who can promote and institutionalise tripartism can make headway towards social peace and justice. A further line of reasoning is that while interest in formal institutions for tripartite governance may decline, tripartite policy co-ordination, ad-hoc agreements, and social pacts remain possible (Mailand, 2007).

Overall, the consensus seems to be that while prospects for tripartism are not equal in all parts of the world, and while the process is ambitious, it is a realisable goal (Croucher and Wood, 2015). When South Africa democratised in the mid-1990s, for example, tripartism became part of a larger process of democratisation during which tripartite institutions, such as the National Economic Development and Labour Council (NEDLAC), were established. According to Dibben *et al*, the moment of tripartism in South Africa came and passed, due to the unrepresentativeness of unions; the dominance of the ANC which prevented the development of genuine coalitions between trade unions (expected to be independent) and government; narrow economic advancement schemes which advanced the interests of small groups of elites, and divided business interests (Dibben *et al*., 2015). In mining specifically, the Mine Health Safety Council and the Mining Qualifications Authority are examples of tripartite institutions established under the MHSA and which, like NEDLAC, are in operation. The trajectories of the MHSC and the MQA are discussed in Chapter 5.

2.7 Foundations and Evolution of Risk Management

2.7.1 What is Risk Management (RM)?

RM is about rational risk-taking – understanding, measuring and weighing up the consequences of risk and then making decisions about the course of action to be followed (Bernstein, 1996). Although RM draws on a number of established practices and concepts, some of which lie deep in the past, as a subject of study and research it is relatively new - less than 50 years old (Aven, 2016). The disciplines that have contributed to the development of risk assessment and RM include mathematics, statistics, engineering, biology, social science and behavioural science.

2.7.2 **The Development of RM**

The practices and concepts on which RM is premised, include many deliberative, decision-making processes. These include the decision-making processes practiced by the Athenians over 2400 years ago (Buchanan and O'Connell, 2006); the introduction of probability theory by the mathematician, Blaise Pascal, who worked on solving a gambling puzzle in the mid-1600s; the use of insurance to finance voyages of trading vessels; the use of financial instruments to buy and sell goods at pre-arranged prices; the organisation and analysis of birth and death records; the efforts by medical practitioners and public health specialists to understand and address the H&S risks arising from the industrial revolution, and the design of social decision-making processes (Bernstein, 1996; Buchanan and O'Connell, 2006; Frey and Steiner, 2014).

The foundations of modern RM can be traced back to the Renaissance period in Europe, around 300 years ago. As the theoretical underpinnings of RM were established, with advances in probability and decision theory, statistical methods and the modelling of decision-making processes. While early developments in science and mathematics held out the promise that it would be possible to calculate with certainty, the full range and probability of outcomes and decisions, twentieth century thinkers came to recognise that the complexity of human interactions led to the creation of unknowable conditions and unforeseeable outcomes. Even in the field of finance for example, the most advanced and sophisticated computer-based models, failed to identify the market risks and vulnerabilities which led to the recent financial crises. These and other events exposed the ultimate limitations of modelling and model parameters; and demonstrated that informed judgement and testing would continue to have a place in RM (Bernstein, 1996; Buchanan and O'Connell, 2006; Cleary and Malleret, 2006). Table 2.2 below summarises the contributions of individuals who significantly contributed to the theoretical basis of RM.

Table 2.2. The Development of the Concept of Risk

Milestones in the Development of the Concept of Risk	
Year	**Development**
1654	Blaise Pascal and Pierre de Fermat founded the mathematical theory of probability when presented with a process gambling problem. Two players wanted to leave the gambling table before finishing their game and wanted to know how the stakes should be divided, in light of their current scores.
1689	Daniel Bernoulli published the law of large numbers according to which the mean of the outcomes of a large number of observations of identical and independent events, phenomena or experiments will approach the theoretical mean as more observations are made, or more trials are performed. Essentially as sample size grows the sample mean approaches the population mean.
1730	Abraham de Moivre while analysing mortality statistics developed concepts of the normal distribution (bell) curve and of standard deviation.
1738	Daniel Benoulli developed the concept of personal utility in decision making. This theory proposed that the utility a person ascribed to a small increase in wealth was proportional to that person's prior wealth; or that personal utility of an item or service is the measure of satisfaction that a person derives from the consumption of that product or service.
1763	Thomas Bayes was the first to use probability inductively. The theory underlying this concept is that if the premises of an inductive argument are strong or true, then the inductive argument will reveal very likely conclusions. Bayes' work on statistical inference also showed how new information and research could be used to refine probabilities that were based on information available earlier, enabling the description of more likely outcomes; and that no single correct mathematical answer could be provided to questions of probability under conditions of uncertainty.
1800	Carl Friedrich Gauss built on the work done by De Moivre, developing the least squares statistical method which reduces the effect of measurement error, assuming that such errors are normally distributed. It is employed to determine best fit trend lines.
1809	Pierre Simon de La Place developed the central limit theorem which showed for non-normal data, sample means tend to be normally distributed about the population mean, if the sample sizes are large enough.
1886	Francis Galton who researched heredity in plants (sweet peas) and humans, showed that over generations, variations between people and peas gravitated toward the mean (the aggregation around the mean). Research by William Baumol of Princeton University, published in 1979 suggested that aggregation or convergence about the mean may also apply to the productivity rates in market based industrial economies.
1921	Frank Knight provided the insight that certain things could be measured while others could not, grasping that reality included conditions and circumstances which people could not foresee. He defined risk as measurable uncertainty as opposed to true uncertainly which was unmeasurable. He postulated that mathematical calculations had limited use in forecasting events, because events related to the conduct of people could be regarded as unique since there were not enough

Milestones in the Development of the Concept of Risk	
Year	**Development**
	similar events in past experience that made possible the use of mathematical formulae to infer probability.
1938	Chester Barnard, a practicing senior business executive, reflected on the need for co-operation in organisations and described the key functions of executives as communicating, securing the co-operation of staff and strategic planning. He stressed the informal aspects of organisation and laid the foundations for current thinking about organisational leadership and culture, and the risks associated with deficiencies in these areas.
1944	John von Neumann and Oskar Morgenstern developed the mathematical theory of games and applications in economics, leading to insights into how people behave when they cooperate or compete.
1968	Howard Raffi published the book "*Decision-Analysis*" which opened up a new area of study relevant to RM. He used mathematics and statistical methods to show how people make decisions when outcomes are uncertain. He assumed that people do not always make decisions on a well thought out basis as suggested by game theory. His work was directed towards helping people make better decisions when their minds are divided and enabling people / different interest groups to arrive at mutually beneficial decisions.
1970	John DC Little published his theory on decision calculus which included a model which supported decision making by managers and which could incorporate new information as it became available.
1972	Irving Janis contributed to the understanding of flaws in decision-making, popularising the term "group think", which described situations in which consensus is favoured over arriving at the best result.
1979-2011	Daniel Kahneman and Amos Tversky developed theories about the bias in human decision-making which are linked to how people think and feel. They showed how non-rational behaviour is identifiable and predictable. These theories have found widespread application in economics.

Sources: McCaffrey, 2018; Bruch and Feinberg, 2017; Cleary and Malleret, 2006; Buchanan and O'Connell, 2006; Bernstein, 1996; Baumol, 1986, and Tversky and Kahneman, 1978.

Research from the 1970's onwards continued to challenge the assumptions of rationality underlying game theories and models of decision-making based on such theories. This gave prominence to research into human behaviour leading to the establishment of new fields of study such as behavioural psychology and behavioural economics. These studies have largely been conducted in the fields of economics and finance and not in the industrial environments in which pure risks dominate, and which is largely the subject of this thesis. Nonetheless, human factors have become important in the management of pure risks and its place in H&S risk management is discussed in Chapter 7.

2.7.3 **Application of RM to Organisational Decision-making**

As a formal facet of organisational decision-making, RM first appeared in business entities in the late 1940s, after World War II (Dickinson, 2001). By the mid-1950s academics began to take an interest in the subject with the first papers published in the United States and thereafter in the United Kingdom, on whether RM was limited to the consideration of pure risks, on what the boundaries of the field were and the absence of definitive terminology (Crockford, 1976).

RM in companies initially revolved around financial and insurable risks which were grouped together and insured on an all risks basis. Insurable risk included the consequences of natural catastrophes, human error, accidents and fraud, i.e. pure risk[9], and contributed considerably to the cost of insurance. As corporate RM functions evolved and insurance markets became more established around the mid-1950s, risk managers became responsible for finding alternatives to purchasing insurance, containing the cost thereof and limiting losses. This had the effect of broadening of the scope of RM towards encompassing measures to avoid and reduce the impact of insurable risks. With improvements in management practice aimed at securing business continuity, comprehensive internal management systems were developed and these in turn contributed to a more holistic approach to RM (Dickinson, 2001; Georges, 2013).

Aven made similar observations about the development of a generic concept of risk as Dickinson and Georges. He traced the concept of risk over time and showed that while different scientific and academic traditions such as engineering, medicine, epidemiology, natural science, social science and

[9] Risks which refer to the chance of loss or no loss in contrast to speculative risks which involve the chance of gain or no gain or loss

philosophy have influenced the way risk is understood and measured, the overall trend is towards a more holistic and general concept. For example, as diverse disciplines concerned with assessing and managing decision problems shared and compared information, new methods of describing and measuring uncertainty, other than probability, have become widely accepted (Aven, 2010a; Aven, 2010b).

In industrial environments, as RM extended beyond risk associated with finance, many of the RM tools and control techniques employed in engineering disciplines and in systems engineering were adopted by RM practitioners. Over time RM techniques found application in workplace H&S, public H&S, fleet management, fire, security, pollution, product liability, computing and natural resource management i.e. all situations which could lead to significant losses in an organization.

According to Aven, the main activities in the risk field currently are characterised as (Aven, 2016):

- Applying risk assessment and RM methodologies to analysing and treating risks associated with specific activities, such as mining, shale gas extraction and investments, and
- Developing and refining the concepts and tools for risk assessment and RM through generic research.

While generic research largely defines the scope of risk science, applications in different settings also provide new insights and contribute to the refinement of specific risk assessment and treatment methods.

2.7.4 **Breaking with Traditional Approaches to OHS**

For H&S, the 1970s marked a move away from traditional approaches to preventing workplace injuries and ill-health, based on learning from experience, towards the application of RM principles. A defining point was the conclusion of the work of the Robens Committee on Safety and Health at Work and its advocacy of simplified principle-based enabling legislation in place of numerous prescriptive and detailed statutes (Robens, 1972). Traditional approaches to H&S also emphasised the role of worker behaviour (unsafe acts) over unsafe physical or mechanical conditions in the causation of accidents, leading to an emphasis on supervision of the workforce and the personal attributes of individual workers (Heinrich, 1941). To paraphrase the Robens Committee, Heinrich's thesis focused on how injuries came about, rather than how accidents could be prevented, leading to a "backward" look at the problem of accident prevention, and consideration of "*a fraction of the total problem"* (Robens, 1972). At the same time, the engineers who considered and made decisions about risk while designing equipment and processes operated in a different sphere from those in the operational environment. RM brought these separate worlds together and promoted proactively identifying, preventing and controlling risks through safe design, bringing additional resources to bear, and new approaches to human factors. Over time RM thinking was incorporated into most traditional OHS management programmes, so that at present, very few of these programmes rely entirely on past experience of accident and incidents. From an RM perspective, the elements of traditional OHS management programmes tend to appear in the action section of an RM process (following hazard identification and risk assessment). The table below contains a description of a typical traditional OHS programme. RM essentially introduced a focussed approach to OHS RM rather than a generic one and stressed the importance of reducing systemic factors which increase the probability of an unwanted event.

Table 2.3 Traditional Approach to OHS as represented in The International Mine Safety Rating System

Traditional Approaches to OHS

Traditional Approaches to OHS rely on building on past experience (incidents and practice), setting standards / expectations and checking the level of conformity to these.

The typical elements of a traditional health and safety programme are set out in the text below:

• Leadership and administration	• Personal protective Equipment
• Management training	• Health and Control Services
• Planned inspections	• Program Evaluation Systems
• Job/Task Analysis and Procedures	• Purchasing and Engineering Controls
• Accident / Incident Investigation	• Personal Communications
• Job/Task Observation	• Groups Meetings
• Emergency Preparedness	• General Promotion
• Organizational rules	• Hiring and Placement
• Accident Incident Analyses	• Records and Reports
• Employee Training	• Off-the Job Safety

Source: Definitions and Terminology. Frank Bird and James Finlay, 1984

The term risk has several meanings, associated with its varied historical use, its use in everyday life and its use in science (natural, engineering and social). In science and engineering, researchers or practitioners seek to understand, assess and ultimately manage risk. Given its wide use, the term has both generic and specific meanings and these often depend on the field and/ or situation in question. At a generic level, risk is the potential of gaining or losing something of value to individuals, groups of people or society. Considerations of risk arise in the context of activities and events which are planned or result from natural phenomena, for example the operation of a system, the adoption of a new technology, the use of a drug, or the occurrence of an earthquake. It considers the outcomes (expectations, effects, objectives, implications) of these activities or events and the likelihood that they will be realised. While the focus is often on negative or undesirable outcomes, the outcomes of interest could also be positive. Some qualitative definitions of risk, proposed by the Society for Risk Analysis (SRA), are listed in Table 2.4 below. The International Standards Organisation (ISO) definition of risk as *“the effect of uncertainty on objectives”*, which could be regarded a special case of definitions 4 or 7 in the table below.

Table 2.4 Definitions of Risk proposed by the Society for Risk Analysis

No.	Definition of Risk
1	Risk is the possibility of an unfortunate occurrence
2	Risk is the potential for realization of unwanted, negative consequences of an event
3	Risk is exposure to a proposition (e.g. the occurrence of a loss) of which one is uncertain
4	Risk is the consequences of the activity and associated uncertainties
5	Risk is uncertainty about and severity of the consequences of an activity with respect to something that human’s value
6	Risk is the occurrences of some specified consequences of the activity and associated uncertainties
7	Risk is the deviation from a reference value and associated uncertainties

Source: Society for Risk Analysis, 2015

Typically, formal descriptions of risk involve two measures, likelihood and consequence. The risk metrics and descriptors cited by the SRA are listed in the table below. As indicated by the SRA they are situation dependent. In all instances in which risk is described, the appropriateness of the metrics or descriptors could be called into question. For example, metrics could describe expected consequences for populations or individuals, and these are not equivalent or interchangeable.

Table 2.5 Risk Metrics

No.	Risk Metric or Description
1	The combination of probability and magnitude/severity of consequences
2	The combination of the probability of a hazard occurring and a vulnerability metric given the occurrence of the hazard
3	The triplet (s_i, p_i, c_i), where s_i is the *i*th scenario, p_i is the probability of that scenario, and c_i is the consequence of the *i*th scenario, *i* =1,2, …N.
4	The triplet (C,Q,K), where C' is some specified consequences, Q a measure of uncertainty associated with C' (typically probability), and K the background knowledge that supports C' and Q (which includes a judgment of the strength of this knowledge)
5	Expected consequences (damage, loss).For example, computed by: Expected number of fatalities in a period of one year (Potential Loss of Life, PLL) or the expected number of fatalities per 100 million hours of exposure (Fatal Accident Rate, FAR) P(hazard occurring) x P(exposure of object| hazard occurring) x E[damage | hazard and exposure], i.e. the product of the probability of the hazard occurring and the probability that the relevant object is exposed given the hazard, and the expected damage given that the hazard occurs, and the object is exposed (the last term is a vulnerability metric) Expected disutility
6	A possibility distribution for the damage (for example a triangular possibility distribution)

Source: Society for Risk Analysis, 2015.

2.7.5 Lay and Expert Experience of Risk

Risk experts, practitioners and researchers with insight into the nature of risk and the application of risk assessment methodology, are not the only people who decide on the acceptability of risks. In the workplace, and in matters of concern to the public, expert perspectives come up against the views of people directly exposed to risk and/or people who have an interest in, or challenge, the conclusions of experts. These engagements are inherently difficult because the adequacy of formal risk analyses is difficult to demonstrate, judgement (which can be contested) is involved in some way, and there are inherent limitations in risk assessment methods (Fischhoff et al., 1984; Fischhoff, 1995). While studies in risk perception and communication, and behavioural science have contributed to understanding the differences in the ways in which subject experts and laypeople understand, assess and approach risk and RM, the difficulties of reaching agreements on the acceptability of risk remains. At its core, is the '*social contract between those who create risks… and those who bear them...*'(Fischhoff, 1995).

Risk experts also have to contend with the fact that most people have an intuitive appreciation of risk. From a risk–based perspective, risk is present in all the decisions and choices which people make, and risk taking is central to the development and growth of human beings. For example, as children grow up, they take on new and more challenging tasks involving some risk such as the safety risks associated with learning to ride a bicycle, to swim or to travel independently to and from school. As adults, people make decisions with outcomes that could be life changing, for example, to enrol in an expensive MBA course, drive motorcycles, race cars, climb mountains, run marathons, gamble, drink alcohol, choose to be tattooed, drive fossil fuel guzzling motor cars and use ozone depleting chemicals. The issue of risk may not formally be recognised when these decisions or choices are made, but potential benefits are often anticipated. The benefits sought could be mastering a skill, career advancement, the thrill of adventure, financial reward, pleasure, status value, shock value or beauty. The costs which are discounted, consciously or unconsciously, in seeking these benefits could be financial difficulties, injury, ill-health, living with pollution, contributing to climate change and so forth. In this way everyday life enables people to develop insight into risk and RM. The environments in which people live and work also invoke decisions about the acceptability of risk. For example, people who live in man-made environments, depend on systems and services designed by engineers for many of the amenities which make up modern life. These systems deliver food, water and power, provide transportation and transport routes, enable communication, and remove, carry away and treat waste. They tend to operate in the background of daily life until disruption or failures occur. When this happens, concerns are often expressed about the reliability of services, public safety and health, and the appropriateness of the level and nature of risks associated with these services, the acceptability of the decisions made by the engineers who designed them and the technicians responsible for maintenance. Furthermore, decisions about risks which are encountered at work or affect society at large often require the input of laypeople to determine their acceptability and legitimacy i.e. citizens have political and legal rights to participate in debates about the acceptability of risks which affect them. This returns to one of the central difficulties in RM, how to engage in constructive discussions about risk with people who are potentially affected; to frame debates and questions about risk honestly and appropriately; to understand and respond to questions about the risks which organisations create for others[10]; and the nature of the social contract between the creators of risk and those exposed. The issue of the acceptability of OHS risks also arises in this way. The exercise in the following table, extracted from my MSc. level course on RM in mining is a thought experiment on how and why people take risks in their everyday life and how they might respond to the risks imposed on them. In the lecture room, it is considered individually before general discussion on the questions at the bottom of the table.

[10] Robens' Report 1972: The *'primary responsibility for safety would lie with those who create the risks'…*

Table 2.6 Everyone is a Risk Manager Exercise

<table>
<tr><th colspan="2">Everyone is a Risk Manager Exercise</th></tr>
<tr><td>Situation 1: Your organisation is very careful to maintain and enhance its reputation as a good corporate citizen. In keeping with this sentiment, senior management decides to hold the year-end party at the Salvation Army facility in Hillbrow, Johannesburg. The plan is as follows. Employees are to arrive at the facility mid-morning, and spend the rest of the day, cleaning up and repairing the premises. Employees are also to help to set out the new furniture and equipment the company has bought for the facility. In the evening, employees' partners or spouses are expected to arrive around supper time, and to participate in supper arranged for employees, spouses or partners and the homeless people who the Salvation Army customarily assists. As a senior employee you and your spouse have been invited and are expected to attend and participate wholeheartedly. (Hillbrow is a suburb of Johannesburg which is currently considered unsafe). Consider whether you are happy to receive this invitation? How will you respond and why?</td><td>Situation 2: Your son is a shy, but athletic 16-year old. You have a sense that he is sometimes bullied at school. He has been chosen to represent the school at an athletics meeting in a major city 1,000 km away from home. He is conflicted, sick with anxiety about going, tearful about whether he will cope and worried about the behaviour of the bigger older athletes in the team, BUT he also seems to want to participate. At times, he seems to want you to come up with a reason for him withdrawing without losing face. Consider how you would respond to this situation and why?</td></tr>
<tr><td colspan="2">These situations invoke some of the issues which arise when trying to frame a constructive discussion about risk. What exactly is the risk? Who is at risk? Why do you want to take this risk i.e. what are your objectives or the perceived benefits? Why do you not want to take this risk i.e. what could go wrong? Is the risk acceptable or unacceptable? Who made the decision about this risk? A single person? Several? Is there a power deferential between them? What effect does this have? Who is responsible?</td></tr>
</table>

Source: M A Hermanus MINN 7049 course, Module 1. Department of Mining Engineering, University of the Witwatersrand

In summary, risks arise in everyday life and they are inherent in individual decisions and actions. In making decisions or doing things people make unconscious or conscious judgements about the advantages or disadvantages involved to themselves and/or their associates. In personal situations people usually deal with risk informally, but there are times when people adopt more structured approaches to establish whether they are really comfortable with the benefits and costs of certain decisions or actions. In contrast, in work environments the opposite should apply. When dealing with safety risk for example, a structured method rooted in a systematic approach to RM should apply. In short, in organisational settings, RM is expected to involve the systematic application of legal and organisational policy, considerations of responsibility and impact, procedures and practices appropriately designed for the recognition, analyses, evaluation, treatment (minimisation or eradication) of the risks under consideration.

2.7.6 **Risk in Organisations**

Organisations face and make many decisions involving risk. For example, the success (growth, prosperity, profitability, longevity) of businesses depends on taking opportunistic risks i.e. risk which could have positive or negative outcomes. From an accounting perspective, risk which can be translated into provisions for potential losses are most likely to be reflected in accounts. This is so for both private and public sector organisations. Unfortunately, many risks cannot be identified or measured objectively, for example the risks of natural disasters, the potential for accidents at work, litigation, loss of key employees, economic downturns all require subjective judgement albeit supported by knowledge, data and analyses. This means that there is strong reliance on managers to adopt appropriate and effective RM policies and methods, although legislation, regulators and external stakeholders increasingly shape institutional approaches to RM.

In mining opportunistic risk is associated with many decisions, such as where exploration funds are to be invested, the choice of the extraction method of a particular ore body, using new or potential more efficient production processes, whether and how to incentivise the production performance of employees, how best to extract optimal gain from contracts and sub-contracting arrangements, and how best to properly estimate the costs of meeting environmental and social obligations.

Other risks encountered in mining arise from routine operational activities and are, for example, associated with the quality of processes and outputs, the quantum of production output, waste streams, advertising, marketing, currency fluctuations, treasury management etc. The risks associated with safety and health, the environment and quality are called “pure” risks. This because these “pure” risks can only result in loss to the organisation unlike speculative risks – the category in which opportunistic risks fall - which can result in either a gain or a loss. Organisations generally act to eradicate or minimize the adverse effects of pure risks to which they are exposed.

A pure risk could be associated with the accumulation of combustible material in an underground store or waste area. Once an ignition source is present, there is likelihood of fire, damage to the environment and injury or death increases.

An example of a speculative risk is the purchase of large quantities of commodities or devices at a specific price which is considered favourable, with the expectation of a later cost saving when prices rise, or when an opportunity arises to sell the purchases at a higher price in the future.

Another example is buying and operating a cheaper machine to save costs without taking into consideration other factors. If the safety features of the machine are inferior or less effective, the operation of the cheaper machine could increase risks of injury or death, prosecution and business interruption.

The last example illustrates that the two types of risk, pure and speculative are not unrelated. While a decision to purchase a machine at lower cost is a speculative risk which could be positive or negative in financial terms, this purchase could also impact on employee safety and health and business continuity. If these impacts are significant and serious, these unrecognised pure risks could also precipitate financial failure.

Many of the disasters of recent decades such as the 1998 North Sea Piper Alpha disaster in which 167 people lost their lives; the 2005 explosion and fire at BP's Texas City plant in which 180 people died; the 2010 Deep Water Horizon Disaster in which 11 people lost their lives and which caused immense environmental damage to the Gulf of Mexico; and the 2011 Fukushima Daiichi nuclear power plant accident in Japan which resulted in the evacuation of 100,000 people from the area, were all linked to failures to identify and manage significant and interrelated risks. These disasters have resulted in greater pressure on private and public institutions to adopt comprehensive approaches to RM (U.S. Chemical Safety and Hazard Investigation Board, 2007; National Research Council, 2012; NASA Safety Center, 2013; Internationale Atomenergie-Organisation, 2015).

2.7.7 The Emergence of Enterprise Wide or Integrated RM

Comprehensive or unified approaches to risk are referred to variously as enterprise wide risk management (EWRM) or integrated risk management (IRM). EWRM or IRM legal requirements were established in the UK and the USA in the late 1990s and early 2000s, and in South Africa this approach to governance was similarly advocated through the King Code since 2016. The Code is now in its fourth iteration. In the UK, the first best practice guideline for RM, the 'Turnbull Report', was published in 1999. This report was updated in 2005 by the UK's Financial Reporting Council which issued the update under the title 'Guidance for Directors on the Combined Code' (FRC, 2005). In the USA the Sarbanes-Oxley Act which was promulgated in 2002 (European Association of Communication Agencies, 2016), aimed to improve financial disclosure by companies by requiring information on all issues which were likely to have a material financial effect. The South African King Code includes provisions for the consideration of stakeholder interests, and environmental and socio-economic impacts in its approach to risk governance.

EWRM or IRM systems are essentially structured processes designed to ensure that RM takes place continuously at all levels in the organisation and is integral to the way it is managed and operates (Harrington *et al*., 2002; Kleffner *et al*., 2003; Valsamakis *et al*., 2010). EWRM or IRM systems are premised on the following principles:

- **Comprehensiveness.** This means that risk governance should consider organisational policy and processes, people employed or affected by operations, and provide clarity about which risks are accepted and which are not, and about which risks are to be treated. Risk governance is also expected to consider culture, both internal and external, which may have a bearing on attitudes to risk, RM strategy and practice.

- **Inclusiveness.** The expectation in this instance is that people at all levels of the organisation are involved, and there is visible alignment between strategy and practice
- **Proactivity**. This means the promotion of proactive RM behaviour by including techniques and tools which anticipate rather than respond to unwanted events.

The risk model in Figure 2.7 below by Valsamakis, Vivian and du Toit, presents an example of the range of risk elements which ought to be considered in an EWRM or IRM, and show how these elements can be positioned within an overarching framework. In this model, the two main activities are risk control and risk financing, and within each there are sub-activities which rely on the expertise of a number of disciplines. In the risk control area activities include occupational safety and health. According to Valsamakis *et al.*, no RM system can be expected to prevent all the events and consequences of exposure to pure or speculative risk, and risk financing is thus a necessary part of the framework (Valsamakis *et al*., 2010).

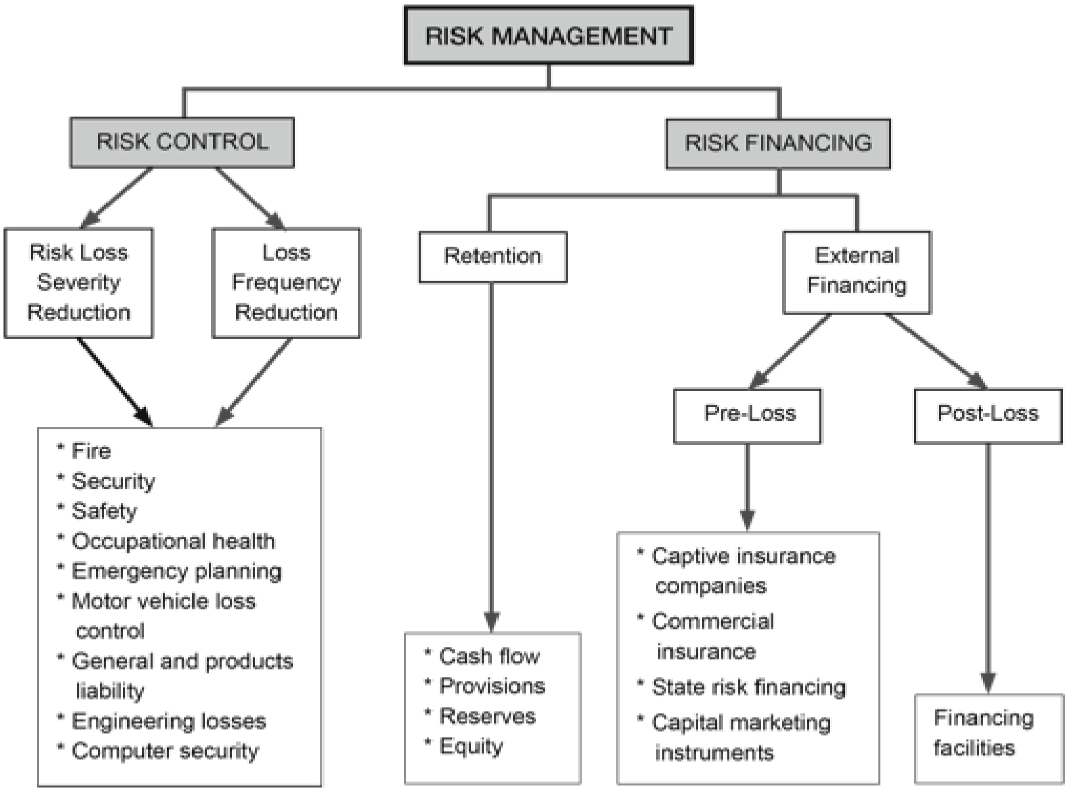

Figure 2.7 Integrated Risk Management

Source: Valsamakis *et al*., 2010.

While EWRM and IRM have been widely adopted and have become a standard offering of the management services industry, questions have been raised about the merits and effectiveness of these systems. Empirical evidence on the benefits and efficacy of EWRM or IRM systems is still scanty, and the 2008 financial crisis and recent catastrophic accidents raise scepticism about whether such systems can achieve their stated goals (Bromiley et al., 2015). Power, a leading academic and chartered accountant in the UK, argued that the RM rhetoric was well *'ahead of practice'* with consultants and professional services providers '*sensing opportunities for using risk to redefine their strategic significance.* As RM became an *'organising concept'* for both private and public sector managers, more events and activities were cast in terms of risk, and RM processes became more complex and demanding (Power, 2007). The scope of operational risk particularly kept expanding to cover a diverse and ever widening range of organisational threats. This occurred while consensus over the precise definition of the concept of RM was hard to pin down, and specialists continue to contest the definition and classification of risk. For example, there is uncertainty about how risk comes to be known, and which social and economic institutions hold this knowledge (Power, 2004). Power describes the expanding scope of RM to a shift in the discourse of RM '*from the logic of calculation to that of organisation and accountability'* (Power, 2007). He further argued that internal control systems, with their focus on process, created a charade of control and failed to address awkward uncertainties which were not amenable to mastery by layered control processes and auditing (Power, 2007). These systems were also seen by Power to inappropriately diminish the role of individual judgement. Such judgement by definition would involve making mistakes and offer the possibility of learning from them. *'Intelligent risk management'* systems would allow managers to make judgements safely, be mistaken and be appraised on what they could be expected to know at the time of a decision rather than with the advantage of hindsight (Power, 2004). Recommendations for improvements to RM offered by Power include preventing control systems from claiming too much of management's attention and crowding out critical thought and imagination; accepting that RM involved more disorder and ambiguity than many formal systems suggest; sustaining and building on RM practices which represent codified *'accumulated wisdom'* (Power, 2004) and allowing RM to face up to the challenge of control itself and become more identified by learning and experimentation than by quasi-jurisdictive processes (Power, 2007). Other researchers found that the success of EWRM systems depended on it being senior-management led, planned and co-ordinated, allowing for judicious implementation and rigorous discussion (Cormican, 2014; Kaplan and Mikes, 2016). In contrast to Power and Bromiley who raised fundamental questions about ERWM, these researchers pointed to flawed approaches which were poorly structured, formulaic and under resourced.

2.7.8 **Application of RM to OHS**

When the Robens Committee signalled a break with traditional approaches to managing workplace safety, and opened the way for the application of RM methodologies, it started with a description of the features which were baked into the existing system and which hindered progress:

- Prescriptive legislation could not keep up with changes in technology
- There was too much law (9 statutes and 500 statutory instruments, at the time)
- The body of law was poorly organised and constructed, and often intelligible with respect to the language used and its complexity
- Both employers and employees alike relied on the intervention and oversight of regulators
- Human and organisational factors were neglected, alongside of an overreliance on physical safeguards (Robens, 1972).

In light of this diagnosis, it sought to change the prevailing wisdom that accidents were subject to chance, were unpredictable and ultimately unmanageable; and to promote a systematic and "more scientific" approach to accident prevention. This should include, according to the Committee, an understanding of the full scope and cost of the problem of accidents; the use of '*diagnostic and predictive techniques'* such as hazard analysis, safety sampling, comprehensive examination of organisations and operations; and the implementation of systematic preventative measures (Robens, 1972). RM appeared to present the means to address the shortcomings identified by the committee and to enable its proposed changes.

Other reasons for the adoption of RM approaches to OHS include recognition that advances in technology could amplify and concentrate the consequences of failures. Examples are the effect of failures in ICT systems; the unacceptability of risk to people in modern society leading to higher litigation risks; and the increasing cost of risk financing leading to greater efforts to understand and manage risks (Valsamakis *et al*., 2010). Legislative requirements to apply RM techniques to H&S have also played a significant role. In terms of the MHSA, South African mining employers bear a primary responsibility for a safe and healthy work environment and RM approaches to addressing H&S hazards are mandatory.

2.7.9 RM Methods and Tools in OHS

In the OHS field, RM built on, and transformed traditional, experience-based practices by taking account of advances in accident investigation methods and increased understanding of how human factors come into play in the work environment. In addition, the well-established ideas, techniques and models for treating risks to operational integrity and safety, practiced in various engineering disciplines, were incorporated into OHS RM practice. Some examples of the tools "borrowed" from the engineering disciplines of systems engineering, civil engineering, chemical engineering and reliability engineering, are described below.

- **Systems engineering** gave rise to the concept of system safety. It relies on interdisciplinary techniques to address complexity in large scale projects and systems. The field was developed for design requirement in the rail, aerospace, space craft and robotics sectors (Estefan, 2008). Considerations in systems engineering include performance, maintainability, safety, human reliability, sources of error, and system life-cycles. Formal processes and procedures are intrinsic to systems engineering. Project requirements are established, design requirements are specified and tested with engineers, design compliance is demonstrated, and the overall process of design progresses iteratively, incorporating higher level parameters with each iteration. The systems safety aspects of systems engineering involve analysing early designs for potential faults or failures in order to treat problems at source. Systems safety engineering is also used to improve the safety of existing systems. The analytical methods employed in systems and systems safety engineering include lifecycle modelling, preliminary hazard analysis (PMA) and system hazard analysis (SHA). Techniques which are used in support of the analyses include "failure modes and effects analysis"

(FMEA), "fault tree analysis" (FTA), event tree analysis (ETA) and Hazard and Operability Studies (HAZOPS). These techniques are used to find potential faults and sources of failures and could be applied qualitatively or quantitatively as in Probabilistic Risk Assessment (PRA). One of the earliest PRA studies involved commercial nuclear plants. This study, the Reactor Safety Study (RSS), was led by Professor Norman Rasmussen who contributed significantly to the study of human factors and human error (Rasmussen, 1975).

- In the field of **civil engineering,** the safety of structures have long been of concern, and was initially addressed through trial and error, increasing understanding of the properties of materials, mechanical modelling, and ultimately, the application of sophisticated computational design tools (Delage, 2003; Petroski, 1994). These methods have enabled structural and civil engineers to assess the viability of designs and anticipate the behaviour of structures under extreme conditions. Examples are designing for 100 to 150-year floods, design for earthquakes and high winds.
- The **chemical engineering** field pioneered many of the strategies for designing safe plant and processes in which safety is addressed inherently, passively, actively and procedurally. These strategies have been incorporated into concepts like independent layers of protection. They have been applied to the particular vulnerabilities associated with vessels and pipes, ignition sources, fires, explosions, toxic gas releases and the actions of people. Techniques which have been developed and tailored to the needs of this discipline include “What if” methods, checklists, FMEA ,HAZOPS, and fault and event tree analyses.
- **Reliability engineering** is an interdisciplinary field focussed on preventing failure and building in tolerance of faults through the management of risk at strategic, tactical and operational interventions. The identification of critical control points is fundamental, and relevant concepts include inherent safety design, built in redundancy and containment. Key techniques include

reliability-centred maintenance, condition-based maintenance, common-cause analysis, Monte-Carlo analyses and life cycle costing.

In mining, many discipline specific RM tools, as described above, are applied. In addition, a number of frameworks and systems for addressing risk more comprehensively have been employed over time, as approaches to OHS and RM evolved. In South Africa, discipline practice largely mirrored, and, in some instances, led international practice (for example in the field of mine seismicity). The programmes employed in mining have included specific accident investigation methods based on Heinrich's models of how accidents come about (Marsden, 2017), the International Loss Control Institute's (ILCI) model, which added a managerial element to the Heinrich model and enlarged the consequences of accidents to include losses in addition to injury (Bird, 1974), and James Reason's 'Swiss Cheese' model of accident causation, along with his approach to human factors and errors (Reason, 2000). Rating and management systems which have been employed include the NOSA Five Star Safety Rating System (Hedlund, 2014), the NOSA safety management system, Frank Bird's Loss Control programme, and a range of RM-based programmes which were eventually pared down to a handful. One of the more widely used programmes in South Africa and internationally, was developed at the University of Queensland's Mining Industrial Safety and Health Centre (MISHC) under the tutelage of Professor Jim Joy (Sustainable Minerals Institute, UQ, n.d.). The development and practice of RM in South African mines is discussed in Chapter 7.

2.8 Mining Regulation in South Africa

The mining sector was central to the industrialisation of South Africa. This came at the cost and the destruction of the pre-colonial African social and economic system which, prior to mining, was rural and agrarian (Bundy 1988). Agrarian communities who worked the land successfully were independent and self-sustaining, and as such could continue to exist independently of industrialisation. However, as the traditional lands of African communities were progressively colonised, they could no longer subsist on the increasingly smaller parcels of land available to them. Thus, many people turned to wage labour "to supplement their declining rural income" and to pay the hut taxes imposed by the British colonial administrators (Innes, 1984). The mining sector with its need for substantial numbers of wage labourers accelerated the process of land dispossession and gave rise to a number of the most prominent features of the apartheid system. These include the pass laws, a form of which was first introduced in 1886; migrant labour which got underway formally under the Witwatersrand Native Labour Association (WENELA) around the turn of the 19th Century; job reservation which restricted black workers to lower level, poorly paid work, and which was first incorporated into Transvaal mining regulations in 1883; low wages for black workers which were cemented in 1897 with a 50% wage cut agreed between the Chamber, AMMSA and the Transvaal government; and single-sex compounds which were first introduced on the diamond mines in 1885 (Alexander and Simons, 1959; Wilson 1972; Muthien 1987; Innes 1984; Crush, 1994; Hocking, 1997; McCulloch, 2008; McCulloch, 2009). The impact of South African mining was felt across Southern Africa through the extensiveness of the migrant labour system, and the changes this system wrought on the social structure of rural communities which became depleted of adult men of working age (Mayer, 1980; Brown, 1983). The conditions in which migrant workers were housed on mines also affected labour sending communities. In mine hostels, diseases like tuberculosis spread amongst miners and through them into rural areas. Many scholars have investigated the complex relationship between the mining sector, government, and capitalism in South Africa (which took a particular form and was variously referred to as "colonialism of a special type" or "racial capitalism"). While there is evidence of dissent, this was largely on economic grounds, for example the COM opposition to the restriction of certain occupations to whites was based on the concern about escalating working costs (McNamara, 1985; Alexander and Simons, 1959), and with respect to the pass laws, mine managers expressed concern that the laws had led to the many mineworkers deserting the mines, causing companies to suffer heavy losses (Hocking, 1997). On balance, scholarly analyses point to a convergence of interests which served to maintain the apartheid system over many decades. Under apartheid, black South Africans were systematically marginalised, impoverished, disenfranchised and made landless. One of the consequences of apartheid policy was that black South Africans were not recognised as citizens of the country, but citizens of tribal "homelands". Today apartheid policy continues to shape social and economic outcomes in South Africa, affecting the prospects of individuals and communities who suffered under it (Gelderblom, 1987; Marais, 2001; Freund, 2018). These people and communities now make up the majority of the population and the electorate.

Nationalisation of the mines in South Africa was considered at the time when the apartheid system was being dismantled in the late 1980's to mid-1990s (M&G Staff Reporter, 1990; Coleman, 1991). Debate over the merits of nationalising the mines was part of an intensive discussion about the nature of the post-apartheid economy, and the means available to the new democratic government *'to overcome the gross inequalities and deprivation that resulted from the apartheid state'* (Roussos, 1990; Munck, 1994). The option of nationalising mines was set aside in favour of vesting mineral rights in the state, as the options available to the government and the associated financial and political implications were clarified (Brown, 1990; South African Government, 1997; DME, 1998).

The living and working conditions of black miners, reflected in the sector's poor H&S track record, and discussions about how to change these permeated debates about the future of the mining industry. Concerns about H&S were ultimately taken up in a separate initiative in 1994, when a "Commission of Inquiry into Mine Safety and Health" commenced its work. The brief of the Commission was both to investigate the state of H&S in mines, and to recommend measures for improvement. A principal recommendation of the Commission was that mine H&S legislation be modernised, and this led to the enactment of the Mine Health and Safety Act of 1996 (Leon et al., 1995).

State custodianship of mineral rights was realised in 2002, when the promulgation of the Mineral and Petroleum Resources Development Act (MPDRA) created the basis for returning private mineral rights to the state and changing the system of mineral right ownerships while minimising disruption of the industry (Mineral Resources and Petroleum Development Act, 2002).

Given the history of the sector and developments following the MPDRA, there are still questions and disputes over whether mining serves national, or narrower interests i.e. the interests of the population as a whole or a small elite; whether the benefits derived from mining are equitably distributed; and whether the health and the safety of people employed in or affected by the industry have improved. The debate over these issues continues, with ongoing unease over growing economic inequality, and increasing levels of unrest associated with the social and environmental impacts of mining (Reuters, 2010; du Plessis, 2013; Manson, 2013; Kahn, 2013; SAHRC, 2016; Forrest and Loate, 2017).

This backdrop explains how H&S in the South African mining industry is intertwined with a social legacy which is unique to the country, and that the instruments for improving H&S may require tailoring to the local context.

2.9 Mine Health and Safety Act Innovations

In 1996, the MHSA introduced a number of innovations to improve H&S in South African mines. These gave effect to rights enshrined in the Constitution and which were aimed at changing the way H&S hazards were identified and addressed. The innovations included:

- A general duty of care placed on employers, and duties for workers to look out for their own H&S and that of fellow workers
- The principle of reasonable practicability which applied to the standard of care to be provided by employers in addressing risk. The principle involves consideration of the severity and extent of a hazard or risk, the available knowledge and means to remove or reduce risk, and the costs and benefits of doing so

- Worker rights to refuse dangerous work, to information, representation, and to participation in processes and programmes to improve H&S
- RM processes as the means to identify, assess and control H&S risks
- Consultation and co-operation requirements which gave effect to duties and rights; and which supplemented the RM slant of the legislation. Managers were to consult workers on matters of H&S, and the two parties were to co-operate in deciding on and taking the necessary steps to address H&S. At national level, in the Mine Health and Safety Council, government, labour and employers were to work together on OHS policy, regulation and initiatives to improve working conditions in mining
- The concept of an encompassing system for H&S in which all of the above was situated and which would translate into operationalised OHS systems at mines.

All the innovations can be classed as enabling, and the primary stakeholders - labour, employers and government - were required to apply these mechanisms, and through their application, realise improvements in H&S.

Essentially the MHSA is positioned in a RM paradigm in which shared understanding of risks and controls, including who does what and when, and the available control options, are central to ensuring that the primary stakeholders play complementary roles in ensuring the H&S of people in mines and affected by mining. In this paradigm, disclosure of information is fundamental for the proper functioning of the MHSA.

The establishment in law of enabling mechanisms for H&S is consistent with approach advocated by the Robens Committee in the UK in 1972. They underscore assumptions that stakeholders have a shared interest in H&S; that stakeholders hold complementary knowledge, and that they can share information and tasks effectively. In the same vein, stakeholders would be able to undertake risk assessments jointly, and make appropriate decisions about managing risks in the workplace, and beyond when others outside of the mine boundary were affected by mine H&S risks.

CHAPTER THREE: RESEARCH METHODOLOGY – THESIS AND SUPPORTING PAPERS

3.1 Methodology in Overview

This chapter describes the methodologies employed in conducting the research for this thesis. Overall, a grounded theory approach was employed. The development of grounded theory firstly involves collecting relevant quantitative and qualitative data, and applying both deductive and inductive reasoning to this data with a view to identifying the key factors, issues and concepts which are pertinent to the research question, namely, 'Has the MHSA succeeded or failed? ' (Malina *et al*., 2010; Jost, 2016; Schoonenboom and Johnson, 2017). Secondly, the approach generates theory as relationships between the factors emerge and principles are uncovered, verified or discounted.

Data on OHS exposures and impacts are largely quantitative, as is the data on the growing environmental footprint that underlies impacts on community safety and health. But the analysis of quantitative data alone would have been insufficient to fully answer the research question. Such data was augmented with qualitative data drawn from observations, interviews, reports and peer reviewed literature. This combination of data sources was expected to provide a multi-faceted basis for examining (i) the social and political context of mining, (ii) the pros and cons of the regulatory tools which could be employed to address H&S, and (iii) stakeholder readiness for tripartism and RM. In turn, this examination would provide insight into whether the MHSA was appropriately designed, and successfully adopted and implemented. More specifically, the data set was expected to allow for conclusions to be drawn about the state of, and trends in, mine H&S before and after the advent of the MHSA. Qualitative data on the history of mining, mining conditions, laws and social mores, were expected to shed light on the relationship between societal norms and the sector's approach to H&S and stakeholder relationships. Theory about whether regulation was transferable from one setting to another, and the factors which affect such transferability could thus be developed. In this way the study was expected to reveal the underpinnings of any advances made, or limitations encountered, in drafting and implementing the MHSA, and to inform the development of a process for designing and implementing effective OHS legislation.

3.2 The Origins of the MHSA Study

The study involved interviewing the leading, and largely public figures in the Leon Commission and MHSA drafting process. Comments on seeking consent from these figures were received and addressed. Research tools included, information sheets explaining the objectives, the methods and focus of the study; the interview consent forms, and interview protocols. Study participants were entitled to withdraw from interviews or the study at any stage, decline to answer any questions and remain anonymous unless express permission was granted to quote them by name. The research tools and the ethics committee's comments are included in Appendix 10.2.

The study participants were individuals involved in the conception and drafting of the MHSA, and their perspectives on the origins of the MHSA, its goals, objectives and impact were explored. A semi-structured key informant interview protocol guided the interviews which were recorded and transcribed. Where possible, notes were also made of the participants' responses. The interview results were analysed to identify common themes and differences and were interpreted with reference to the analysis and the results of the literature survey. A constant comparison approach was used to analyse interview data in which each theme and finding was compared with earlier themes and findings as they emerged in the data analysis process (Boeije, 2002).

Ten (10) in-depth key informant interviews were planned but 9 were ultimately conducted. Study participants received a copy of the interview protocol ahead of the interview and were given opportunity to consent or decline being interviewed. Consent to the recording of the interview was explicitly sought. All study participants consented to the recording of their interviews and were comfortable with being quoted.

Study participants included representatives of the decision-making bodies and stakeholders at the time of the genesis of the MHSA. They included the surviving members of the Commission of Inquiry, Judge Leon and Professor Antony Davies; the Chief Inspector and a Principle Inspector involved in the drafting of the MHSA, Mr. Dirk Bakker and Mr. Terence Doyle[11] respectively; and relevant (past) representatives of the COM (now the Minerals Council of South Africa), Dr. John Stewart and Mr. Roger Dixon; Dr. James Motlatsi and Mr. Marcel Golding, past President and Deputy-General Secretary of the NUM; and the NUM's legal representative, Advocate Paul Benjamin. When the MHSA was being finalised Marcel Golding headed the Parliamentary Portfolio Committee for Minerals and Energy. The interviews took the form of face-to-face discussions which followed the course of the interview protocol, except for Mr. Doyle whose preference was to provide written responses to the interview questions which he was prepared to expand on in follow up conversation.

The interview protocol was designed not only to extract the views of the study participants on the reasons for legislative change and the factors that shaped the design of the MHSA, but also to obtain their insights on various issues pertinent to the development of the Act at the time of drafting and thereafter. For example, the interviews included inquiry on whether expert advice was obtained, how the proposed Act passed through various stages from inception to promulgation and to subsequent amendment, what policy choices underpinned the Act, and what provisions had worked well or fell short of expectations. The last line of inquiry extended to developments in the wider environment which affected the Act's reception and implementation up to the present.

[11] Doyle served as the secretary to the Commission of Inquiry, as a member of the initial MHSA drafting committee and as the first chairperson of the MRAC

The results of this study were incorporated into chapter 4 of this thesis. The chapter includes a review based on desktop study, which traces in broad outline the development of mine H&S regulation internationally and in South Africa.

3.3 The Mining Technology (Mining Redesigned) Paper

I am the sole author of this paper (Hermanus, 2017), supports Chapter 5, which explored the developments in mining technology and its relevance to South African mining, as well as the changing composition of the mining sector. The paper examines aspects of the context of the MHSA which entrench labour intensive mining, despite the associated OHS and economic risks. A desktop study provided the material for this paper.

International trends in mining technology were explored in the context of the economics of mining, and the structural changes such technology was likely to precipitate. While globally, the mining sector has been slow to invest in research and development for technologically intensive mining, South African mining, in addition, faces unique challenges. The challenges particular to South Africa were examined with reference to continued reliance on labour intensive mining of key commodities; and the factors which hinder technological advancement such as energy costs, loss of mining research and development skills and expertise, and systemic under-employment. The relevance of this study and paper for this thesis is that labour intensive mining has had a primary influence on mine H&S in South Africa, yet the institutions responsible for mine H&S were unable to discuss this issue openly.

The key issue remains that many of the largest of South African mines, gold and platinum, are still labour intensive. To improve H&S a transition to more technology intensive mining methodologies are required. But, in the absence of a widely accepted plan to transition out of labour intensive mining while expanding employment opportunities elsewhere in the economy, there is a tension between reducing the exposure of miners to significant OHS risk and maintaining levels of employment. The quandary draws attention to the nature of tripartite practice in South Africa.

More information on the scope of the desk top research referenced in this study is presented in Appendix 10.2

3.4 The Mineral and Petroleum Resources Development Act (MPDRA) Paper

This paper (Hermanus *et al*., 2015) supports Chapter 5 which examines the evolving context in which the instruments of the MHSA were further developed and implemented.

Specifically, the paper explored the effects of the MPDRA which came into effect in 2002 on the people affected by mining and also on the environment i.e. that changing composition of the mining sector. I am the lead author of the paper. Developments in coal and platinum mining in Mpumalanga, the North West Province and Limpopo were used to substantiate these effects. The paper is an example of interdisciplinary research which draws on several sources of secondary data on (i) the history of mining with attention to mining's effect on the environment and people, particularly the communities who supplied the labour workforce to the mines, (ii) the evolution of mining policy which culminated in the MPDRA, and (iii) recent disputes over the provisions of the MPDRA which apply to mining communities. One of the authors, Mr. Oliver Barker, who has tracked and mapped the development of mining in South Africa provided primary data in the form of maps in which the location, footprint of mines and mine sizes are presented. The paper provides evidence of the changing structure of the mining industry, its increased effect on people especially communities which subsist on the land. The relevance of this study and paper to this thesis is that these developments affect the scope of the work of the mine H&S Inspectorate. The Inspectorate is responsible for the H&S of both mine employees and people affected by mining.

The constant comparison method of research was employed in this study. Each contributor's disciplinary framework and findings necessitated re-examination of the overall data set and findings. In this way a comprehensive multi-faceted account of the impact of the MPDRA was developed. The backgrounds of the researchers included geology, environmental management, anthropology, engineering geology and mine H&S.

3.5 Review of the Mine Health and Safety Leading Practice Adoption Programme (MOSH)

This paper (Hermanus et al., 2015), supports chapter 6 which explores the practice and experience of tripartism in the sector. I led the review of the Mine Occupational Safety and Health Leading Practice Adoption Programme (MOSH) project and am the lead author of the paper on the findings of the review. The paper examines the programme in terms of three themes - oversight and governance; resourcing and capacity, and operational or mine site-level implementation of the leading practices. Essentially, it documented how an employer-initiated tripartite project fared in a low trust environment.

The review of MOSH was commissioned from the Centre for Sustainability (CSMI) by the COM. The request for the review originated from MOSH organisers and participants who sought an independent evaluation of their work to date. The main purpose was to evaluate the impact of MOSH intervention which was intended to involve the tripartite partners in a fundamental way.

The results of the review were to be communicated back to all involved and used to improve the impact of the programme. The assignment was accepted on the understanding that the outcomes of the review could be published and that the review team would adhere to established research practice. It was conducted by a multi-disciplinary team of researchers with backgrounds in mining engineering and geology, H&S regulation, public health and sociology. An experienced researcher able to work in indigenous languages, was a member of the team.

The content of interviews conducted in the course of the review were aggregated to ensure that specific comments could not be attributed to any one person. In addition, supervisors were excluded from discussions with their subordinates. The MOSH review methodology and tools are included in Appendix 10.2. Qualitative data was obtained through key informant interviews and focus group discussions. Key informants included senior industry leaders, technical experts and the teams of workers involved in the implementation of specific adoption methodologies. Perspectives of the strategic value and governance of MOSH were additionally obtained from representatives of organised labour and the DMR. The specific context for leading practice adoption was explored through visits to mine site facilities and operations.

Documentation reviewed ahead of the interviews and field visits included MOSH documents such as reports, minutes of meetings and education and communication tools. Fifteen people were interviewed about oversight and governance, and 20 individuals were interviewed about resourcing and capacity. Discussions with 118 individuals were secured during 8 mine site visits. Of these individuals, 55 workers were involved in focus group discussions.

The review provided insight into the response of the other stakeholders to a COM-led initiative to improve mine H&S, and the issues which mining companies, who were the target of the programme, were ready to address. Thus, the review revealed information about the practice of tripartism and the priorities given to particular H&S risks at the time.

3.6 The Achievements and Limitations of Statutory and Non-Statutory Tripartism in South African Mining (The Tripartism Paper)

This paper (Hermanus *et al*., 2019) which supports Chapter 6, was based on a review and analysis of historical material, relevant journal articles, and reports of the institutions representing various mining stakeholders. It also drew on the experience and insights of the authors who have been involved in the regulation of mine H&S and mining research; in the structures of the MHSC, and in the MQA's structures. The paper explored the mining sector's experience of tripartism, against the wider experience of tripartism in the country, and the ILO's position on the value of social dialogue of which tripartism is an important element.

It contributes to discussion in the wider literature on the adoption of tripartite approaches in a setting in which there are low levels of trust between the key stakeholders, and in which the institutional framework for tripartism is fragmented. I am the lead author of this paper, which was published in a special 2019 issue of the journal of International Development Policy's special issue reflecting on the 100 year anniversary of the ILO (Christophe and Carbonnier, 2019).

As with the study on the impact of the MPDRA, the study applied the constant comparison method of research. Each author's insights into mining and mine H&S contributed to constructing the arguments in the paper, and involved iterative re-examination of the data set, published literature and documents, and the authors' perspectives on their meaning. In this way a coherent, multi-faceted account of the practice of tripartism in the sector and in the country emerged. More information on the framing scope of this study is included in Appendix 10.2.

With reference to the preceding section, this paper revealed that the MOSH initiative was ultimately incorporated into the 2010 Mining Charter which is a regulatory tool associated with the MPDRA. In this way, mining companies were seen to be the party responsible for advancing MOSH rather a tripartite coalition which included labour or the mine inspectorate.

3.7 OHS Risk Management

This aspect of this thesis which is examined in Chapter 7 was based on tracing the development of RM practice in general and its application to mine health and safety globally and in South Africa specifically. The published literature and documentary evidence of how RM theory and methods originated and evolved was examined and analysed. Insights drawn from the investigations of the origins of the MHSA and the practice of tripartism in South African mining were combined to draw conclusion about the effectiveness of RM practice.

3.8 In Summary

As discussed and shown in the preceding sections, the basis for arriving at conclusions about the impact of the MHSA, which is the purpose of this thesis, is multi-faceted. The hypothesis was tested by drawing on theory, and conceptual and technical developments in a range of fields. Key occupational H&S hazards in South African mining were to be explored in light of prevailing and advancing knowledge about such hazards. Similarly, the impact on the level of risk posed by H&S hazards was to be considered with regard to evolving mining methods and technology. H&S outcome data were to be examined against the backdrop of the prevailing social and economic environment, which was antagonistic to the majority of mineworkers, and which was expected to have an effect on stakeholder relationships long after the removal of its legal foundations in 1994. Finally, the readiness for new regulatory concepts and practices such as enabling legislation, tripartism and RM, were to be examined with reference to the influence of all these factors. All of these factors and developments were expected to provide answers to the question of whether the MHSA succeeded in its aims and enable theorising about the transferability of OHS legislation.

CHAPTER FOUR: THE ORIGINS, DESIGN AND AFTERMATH OF THE MHSA

This chapter describes the origins and the design of the MHSA and, particularly, the preparedness of the tripartite stakeholders in the mining sector for the practice of tripartism and RM.

4.1 Overview

The Mine Health and Safety Act of 1996 (MHSA) marked a milestone in the history of South African mining, changing the way mine H&S was to be regulated and addressed in the workplace. This chapter examines the origins, design, and immediate aftermath of the MHSA which was the principal recommendation of the Leon Commission. It includes insights sourced from 9 key informants who made the case for the Act and who represented the key stakeholders during its drafting, several of whom were also involved after the Act was promulgated in the development of the regulations and guidelines which support the Act. The MHSA also brought into effect the practice of tripartism and the prioritisation of H&S hazards through risk assessment.

The MHSA is a standalone Act, designed to be governed by tripartite institutions, to be enforced by a dedicated Inspectorate, and to be operationalised through RM with substantive inputs from workers and their representatives.

The chapter opens with a discussion of the conditions – much of which was covered in the literature survey - and ideas which gave impetus to the design and implementation of the Act. The following factors played a role - the immense burden of death, injury and disease borne by mineworkers over the course of mining in South Africa; the mining disasters which took place in the 1980s; pressure brought by the National Union of Mineworkers in the wake of these disasters; the democratic ideals that informed South Africa's transition from apartheid; and changes in global thinking about how OHS ought to be regulated.

Although the stakeholders all supported tripartism and RM, they did not agree on how to implement these key concepts of the MHSA. Once the legislative framework was in place, leadership of the change process fell to the Mine Health and Safety Inspectorate (Inspectorate). The Inspectorate which had been severely criticised by the Commission was itself unsure of the way forward. There were differences over whether tripartism required the parties to reach consensus and whether binding decisions could be made in the absence of one or other stakeholder from meetings. It was also unclear how RM was to be undertaken. In addition to difficulties in establishing effective tripartite and RM processes, the Inspectorate was also weighed down by the immense task of preparing and managing the development of a new body of regulation, supplementary codes and guidelines. Difficulties with optimising and implementing tripartism and operationalising RM have been long-lived.

4.2 Health and Safety Context

This section explores the social context of mine H&S of relevance to the Commission, which revealed the gulf in understanding between the sectors' leaders -mining executives and government- of the living and working conditions of mineworkers, and the lived reality of mineworkers themselves.

4.2.1 Migrant Labour and Living Conditions

The Commission of Inquiry into Safety and Health in the Mining Industry (the 'Leon Commission") was established shortly after a Government of National Unity was inaugurated. It recognised that the H&S of mineworkers was bound up with South Africa's social policies; and its proceedings opened with a 'review of the state of the industry' (Leon *et al.*, 1995) which included evidence on social policy and social conditions in the industry. Francis Wilson, a professor and authority on migrant labour, led the opening evidence and explained that one of the primary objectives of the COM[12] was to limit *'native*

[12] Preceded by the 'Old Chamber' in 1887, re-established in 1889 as the Chamber of Mines (Lang, 1986, pp. 28–29, 39–42), and now the Minerals Council of South Africa (MINCOSA).

wages to a reasonable level' [13] by reducing competition between the mining houses and recruiting labour more effectively (Leon *et al*., 1995). The Commission considered and accepted evidence of how the migrant labour system gave rise to confining environments in which miners were corralled and controlled, and created the conditions in which occupational diseases, which lay latent for long periods, could go unrecognised or be ignored (Leon *et al*., 1995). A policy of labour stabilisation was adopted by the mining sector in the mid-1970s which allowed experienced miners to return to their previous jobs provided '*they return within a specified period'.* The Commission recognised that this policy which helped the industry to retain skills, also raised the risk of miners being injured or developing occupational disease. This in turn increased stress in mining communities to which mineworkers, too incapacitated to work, returned (Leon *et al*., 1995).

Senzeni Zokwana, the deputy president of the National Union of Mineworkers (NUM) in 1994, gave an account of the humiliations and difficulties he suffered as a mineworker and an occupant of mine hostels (Leon *et al*., 1995). He described a culture of work in which H&S was of little concern, in which workplaces were rectified before the arrival of mine inspectors who usually notified the mine of impending visits. He described mineworkers as being constantly under management control, underground, on surface and even in the hostels (McCulloch, 2009). Zokwana's experiences echoed in research which explored specifically how apartheid permeated the workplace and shaped workplace politics and relationships (Webster and von Holdt, 2005). He told the Commission that he was certain that the rights to participate in H&S decisions and to refuse dangerous work would reduce mine related injuries and disease.

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[13] The founding objectives of the COM, as documented, include: promoting mining interests, considering and promoting discussion on industry related issues; promoting legislative and other measures pertaining to the industry; collecting, procuring and circulating statistics and information on the industry (Lang, 1986, pp. 40–41).

Zokwana's experience of the living and working conditions of mineworkers mirrored the experiences of mineworkers as described in the literature survey and documented in many academic and popular publications on the mining sector by authors such as Francis Wilson (Wilson, 1972), Colin Bundy (Bundy, 1979), Duncan Innis (Innes, 1984), Jonathan Crush and Wilmot James (Crush and James, 1991), Wilmot James (James, 1992), Laurie Flynn (Flynn, 1992), Vic Allen (Allen, 1992; (Allen, 2003); Allen and Carey, 2009) and Dunbar Moodie (Moodie and Ndatshe, 1994; Moodie, 2005).

4.2.2 Divergent Views of the State of Mine Safety and Health

Evidence on the high rate of accidents on South African mines was presented to the Commission by the then Government Mining Engineer, Jan Raath, the trade unions and witnesses who were independent of the sector. Raath described the industry safety record as *'appallingly high'* and provided DMR data in support of his statement (Leon *et al*., 1995). Jean Leger, then an academic at the University of the Witwatersrand, gave an independent account of safety in the sector. His evidence expanded on a paper published in 1988 in which he and Herbert Eisner analysed the underground coal and gold mine accident statistics over a decade, 1976-1985 (Eisner and Leger, 1988). They found that the underground fatality rates on gold mines were not significantly different to that of underground coal mines in South Africa[14]. However, the country's underground coal mine fatality rates were eight times higher than those in the UK, four times that of underground coal mines in all EEC countries, and more than double that of the USA. In the same year in a written discussion of the paper, the Director-General of the COMRO, Horst Wagner, ascribed the differences in the safety performance of South African mines to mines in the UK and US to a number of factors. Differences were due to the distorting

[14] Eisner and Leger were interested in fatalities and fatality rates amongst the most exposed workers, i.e. those who worked underground as opposed to those who worked on surface. The number and rate of fatalities of the entire workforce on a mine which could considerably lower than that of the underground workforce. They argued that, at the time of their research, the underground rates on South African mines could be compared to the rates reported in other mining countries (which excluded employees other than underground workers).

effect on fatality rates of single, large accidents; differences in how countries recorded casualties; the nature of the mineral deposits exploited in South Africa (deep gold mining conditions being unique, and hard coals being the norm in South Africa); mining methods, and the mining technology and the labour employed (Wagner *et al*., 1988). Wagner suggested Eisner and Leger were unfairly portraying the industry *'as having little concern for the health and safety of its workers'* (Wagner *et al*., 1988).

The Leon Commissioners were disquieted by the perspectives of senior mining officials that the sector was beset by special problems related to the physical environment and human factors which were beyond their control. According to the Leon Commissioners, while South Africa could pride itself as being amongst the most advanced of mining countries in many respects, with regard to safety this assertion was not valid. (Leon *et al*., 1995).

4.3 The Case for Commission and ultimately the Mine Health and Safety Act

4.3.1 Scale of Death, Injury and Ill-health in Mining

The extent of death, injury and disease associated with South African mining was the primary reason for the establishment of the Commission and ultimately of the MHSA. Death, injury and disease rates had been high since the inception of mining in the country, and largely reflected difficulties encountered in gold mining, which relies on labour intensive mining methods. The industry has also been plagued by mining disasters in gold and coal mining. Mine disasters are defined in South Africa as mine accidents in which six or more people lose their lives.

In the decade running up to the Commission, four major disasters took place, three on coal mines and one on a gold mine. The coal mine disasters involved flammable gas and coal dust explosions in underground workings at Hlobane (1983),Middelbult (1985), and Middelbult (1993) coal mines. The gold mine disaster (1986) which occurred at Kinross mine, was due to a polyurethane fire in an intake drive resulting in the death of 177 people. These disasters gave impetus to the NUM's call for a commission of inquiry into mine safety and health. Table 4.1 and Figure 4.1 below present the available data on fatalities on all mines in that period.

Table 4.1 Mine Fatalities and Reportable Injuries in the Decade Prior to the Leon Commission

Year	**All Mine Fatalities (Reportable Injuries)**	**Gold Mine Fatalities (Reportable Injuries)**	**Coal Mine Fatalities (Reportable Injuries)**	**Coal Mine Explosion Fatalities** (Spencer et al., 2000)
1980	832 (21,058)	633 (17,756)	104 (1,200)	0
1981	861 (18,538)	608 (15,557)	112 (1,194)	12
1982	853 (17,406)	588 (15,173)	109 (910)	12
1983	831 (16,584)	604 (14,691)	129 (813)	69
1984	807 (15,745)	588 (13,736)	73 (840)	6
1985	706 (14,820)	540 (13,1680	93 (806)	34
1986	800 (12,709)	709 (11,625)	66 (709)	0
1987	753 (11,473)	547 (9 969)	121 (550)	35
1988	674 (1,357)	509 (9,576)	53 (435)	0
1989	735 (10,097)	557 (8,561)	54 (351)	1
1990	675 (9,858)	531 (8,195)	50 (404)	0
1991	604 (9,103)	461 ((7,571)	42 (361)	2
1992	552 (8,801)	407 (7,585)	46 (339)	7
1993	615 (8 532)	426 (7,375)	90 (289)	53

Sources: Leon Commission Report Vol. 1, DMR, Chamber of Mine Facts and Figures, STATSSA National Accounts

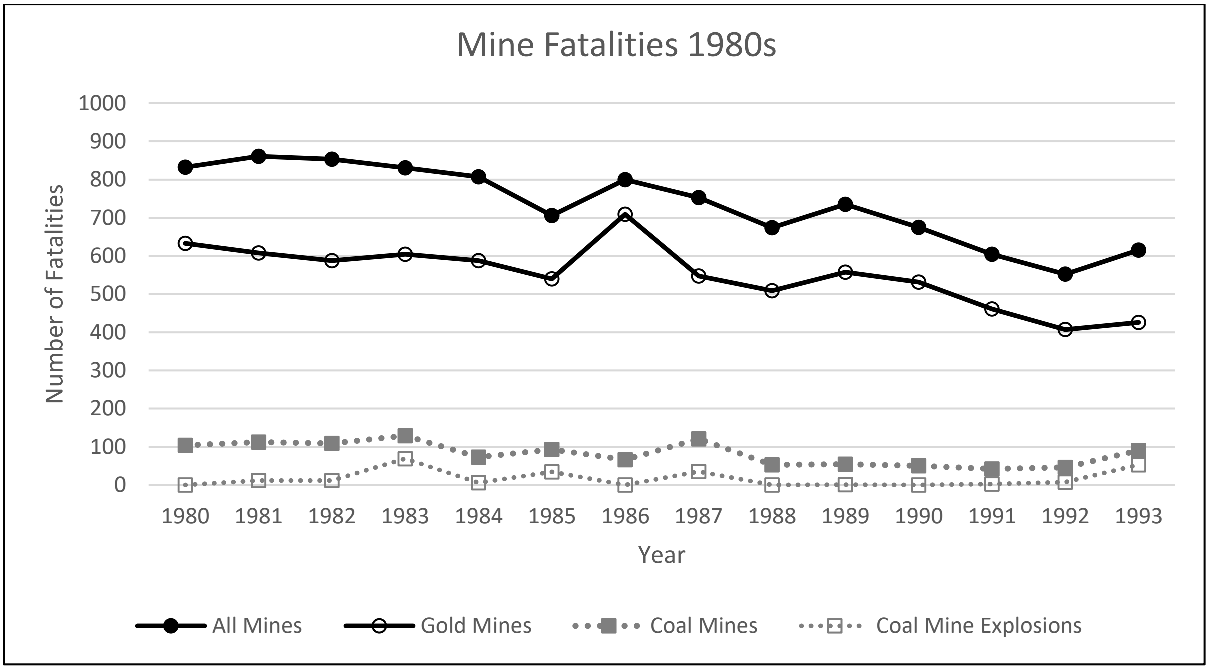

Figure 4.1 Mine Fatalities in the Decade Prior to the Leon Commission.

Sources: Leon Commission Report Vol. 1, DMR, Chamber of Mine Facts and Figures, STATSSA National Accounts.

The high fatality and injury rates associated with mine accidents had life-changing impacts on mineworkers, their families and communities. Between 1900 and 1994, mine accidents accounted for an estimated 69,000 deaths, and in the decade running up to 1994, 6,917 mineworkers lost their lives and 112,278 suffered reportable injuries, i.e. injuries resulting in them spending 14 or more days away from work. In 1993, in the year prior to the Commission, as show in Table 4.2, six hundred and fifteen (615) people died in mine accidents while at the same time 8,532 reportable injuries were recorded. (Leon *et al.*, 1995). In both 1988 and 1989, over 10,000 workers sustained reportable injuries (Leger, 1991)

Many of these injuries were likely to have been permanently disabling. A 1987 study estimated that between 100-150 paraplegics and quadriplegics were *'produced by the mines annually'* (Arkles, 1987). Arkles' study drew attention to the difficulties which mine accidents presented to mineworkers, their families and communities in the rural areas. She pointed out, '*The transformative effect industrial* *accidents have on these people's lives has to be seen in the context of the underdeveloped nature of these areas; the lack of adequate healthcare facilities; the fact that most of these workers are the sole breadwinners in the family, and that the possibilities for re-employment as a disabled person are negligible'* (Arkles, 1987). As with occupational disease, compensation arrangements for injury were discriminatory. Until 1977, under the Workmens Compensation Act of 1941, only lump sum payments (not pensions) were made to black workers, the value of which depended on the extent of their disablement following injury.

That gold mining exposes workers to dust containing high levels of free silica was long known as shown in the literature survey, but the effects of such exposure on black workers was not known at the time of the Commission. Studies undertaken in the 1960s and 1970s had already pointed to high levels of respiratory diseases amongst gold miners such as simple chronic bronchitis, chronic airways obstruction and silicosis (Sluis-Cremer *et al*., 1967; Wiles and Faure, 1975; Beadle, 1970). These earlier studies mainly documented disease in white miners but by the 1990s large scale studies were underway on black ex-mineworkers in rural South Africa (Trapido *et al*., 1998). Past studies and contemporaneous research prompted the Commission to closely evaluate studies and information on the extent of occupational disease amongst mineworkers, and to recommend that mines systematically address occupational health. Evidence of shortcomings in properly understanding, monitoring and controlling occupational disease were provided to the Commission by Neil White, a specialist in lung disease, Jean Leger based at the Sociology of Work Programme at the University of the Witwatersrand, the Workplace Information Group and the Industrial Health Research Group.

Later studies confirm the conclusions of the Commission that the actual number of mineworkers who had contracted occupational diseases were far higher than the number of workers officially certified with clinically evident disease in terms of the provisions of ODMWA. One case study found that up to one in five black mineworkers with long service on a gold mine were likely to develop silicosis

(Churchyard *et al*., 2003). Labour migrancy was found to have enabled the spread of TB and raised the risk of contracting HIV among mineworkers housed in single sex hostels and among migrant labour sending communities (Stuckler *et al*., 2013; McCulloch, 2012; McCulloch, 2009). Mandatory medical examinations were required upon the exit of black migrant workers from the industry but were often not conducted. This practice, together with the period of latency after exposure and before the manifestation of disease, resulted in very high levels of undiagnosed and uncompensated occupational lung disease among former mineworkers, the so-named 'hidden epidemic' which claimed many lives and livelihoods (Trapido *et al*., 1998; Roberts, 2009; Ledwaba and Sadiki, 2016).

ODMWA did and still does not provide for the payment of pensions to mineworkers and until 1993 the race of a claimant determined the value of compensation, with inferior benefits paid to black miners (McCulloch, 2012).

4.3.2 **The Role of the National Union of Mineworkers (NUM)**

The NUM (Nyaka, 1987) brought intense pressure on government to review H&S on mines given the industry's track record, and the coal and gold mining disasters which occurred in the 1980s (see Table 4.2 below). The NUM which was established in December 1982, campaigned for a commission of inquiry into mine H&S, safety rights and also for improvements in compensation (NUM, 1989a). An agreement to establish the commission, the 'Leon Commission', was struck between government, industry and the mining unions at a mining summit (South African parlance for a high-level meeting). The Commissioners were formally appointed in terms of Government Notice R.899 on 6 May 1994 (Leon *et al*., 1995).

Table 4.2 Disasters in the decade prior to the Leon Commission

Date	**Mine Name**	**Disaster Type**	**Fatalities**	**Injuries** (Guild, SIM 02-09-02)
1983	Hlobane Coal Mine	Flammable gas and coal dust explosion	68	8
1985	Middelbult Colliery	Flammable gas and coal dust explosion	34	7
1986	Kinross Gold Mine	Polyurethane tunnel lining fire	177	235
1987	St Helena Mine	Flammable Gas Explosion	62	5
1990	Vaal Reefs	Flammable Gas Explosion	21	17
1993	Middelbult Colliery	Flammable gas and coal dust explosion	53	7

Sources: (Eisner and Leger, 1988; M&G Staff Reporter, 1998)

According to then President of the NUM, James Motlatsi (Motlatsi, 2014): *'When the National Union of Mineworkers was formed health and safety was one of its priorities. In fact, it was the first priority because lives come(s) first… we fought for mineworkers not always to be told that the area is safe…but also to be able to refuse to work under dangerous places. It was a policy to do what your supervisor instructed you to do and complain after. So many people have lost their lives precisely because of that, …mineworkers who did not have a right to refuse to work under those dangerous conditions. That is the starting point.'*

Motlatsi's views are echoed by Marcel Golding (Golding, 2014), then deputy General Secretary of NUM: *'Mine health and safety, along with wages and employment was one of the biggest issues for the union. Many mine accidents had claimed many lives… on gold mines and in coal mining explosions. Fatality rates were so high that it was clear that reform of the system of legislation was required to give effect to changes'*…Golding recalls: *'One big incident precipitated the Commission…think it was the Kinross disaster…. the Kinross disaster accelerated our thinking… there was a lot of campaigning... a confluence of types of activities and markers that led to the Commission.'*

'One of the key issues at the time was that *'if a worker who had substantial experience at the coal face, identified a place as unsafe to work, he had no authority to withdraw the crew from the site. If the foreman accepted that he was satisfied (*with the safety of the site)*, and he wasn't even at the coalface or rockface, he could insist that they work…*It was not recognised '*that workers knowledge about their immediate work environment and surroundings made it possible for them to identify potential rockfalls, cracking that they could be hearing , noises they could be hearing… if these things happened, workers could not do anything, were compelled to stay there even if they felt unsafe and unhappy about working in an unsafe workplace.'*

When the Government of National Unity was barely a month old, and a few days before the Leon Commission's report was made public, another disaster occurred on 10 May 1995. The disaster took place at Vaal Reefs Gold Mine where a locomotive plunged down a shaft onto a mine cage carrying 104 nightshift workers, all of whom died when the cage plunged over 550m to the shaft bottom. This disaster provided further momentum for the government to act on the findings of the Leon Commission.

The presiding Minister of Mines, Pik Botha, was criticised for immediately ascribing the accident to human error. President Mandela was shocked and angry but reserved specific comment '*until the facts become clear'*. The NUM and the Mine Workers Union (a white trade union) both called for *'immediate implementation of the Leon Commission's proposals'* (Koch, 1995).

4.4 **The Ideas Which Shaped the Act**

The MHSA drew on a number of ideas and developments which preceded it and was heavily influenced by the thinking of Lord Robens, the ILO approach to OHS, and developments in Canada, Australia and in South Africa where the Department of Labour had promulgated a new Act which covered industries other than mining. This chapter expands on the information presented in the literature survey.

4.4.1 **The Robens Report**

As already indicated, the report of the Robens Committee of 1972 on Health and Safety at Work (Robens, 1972) influenced the ILO and legislators in many countries and is often cited as the source of modern H&S legislation. Its emphasis on worker rights and involvement were particularly of interest in South Africa, given its history of exclusion and repression.

The Robens Committee commenced its work, two years after Robens' book titled 'Human Engineering' (Robens, 1970) was published. Robens set out his beliefs and approach to industrial relations in this book. He believed that Britain was very good at engineering but failed in human relations, particularly in realising the individual and collective talents of people to the full. Until workplace relationships were harmonised, *'human capabilities would be smothered in an atmosphere of conflict and unease'.* For him, trade unions played a necessary and a vital role in ensuring that workers' concerns were heard, and Britain would prosper if everyone benefitted from economic advancement. To Robens, partnerships between managements and trade unions were not only possible but absolutely essential, with tripartism marking *'a new era of co-operation'* (Robens, 1970). He was concerned about safety at work for humanitarian reasons, and the waste and cost that accidents presented to society, the economy and industry. He believed that a safety officer should be properly trained, and that he (sic) had a difficult job to *'inculcate the correct attitudes among the workmen'* and convince '*his management colleagues of his proposals'*. The latter were unfortunately inclined to regard the safety officer as woolly headed and an impractical do-gooder. He recognised that assumptions about safety were implicit in the decisions of high- level management and believed that most accidents were *'foreseeable'* (Robens, 1970). Robens brought these ideas into the work of the Committee on Health and Safety at Work.

The report of this Committee gave rise to the 1974 Health and Safety at Work Act (HASAWA) in Britain which created a unified statutory framework for workplace H&S. The HASAWA laid out a deliberative, structured role for employers who were to operationalise systems to proactively manage H&S risks with their employees participating actively (Walters, 2003). It imposed a general duty of care on employers and more specific duties, to identify, assess and limit risks to acceptable levels, and to inform, consult and seek the participation of workers. The HASWA also established rights for workers to be informed about the risks to which they were exposed, to participate in decisions about the arrangements to address and monitor such risks, and to stop work without the fear of reprisal when faced with risks which they believed to be immediate and grave. Workers also had a duty to look out for their own safety and that of fellow workers.

In Britain, this approach was described as “self-regulating” with its emphasis on an internal system of responsibility involving employers and workers, rather than a body of detailed and prescriptive standards and rules to be enforced by an agency of government. The Robens approach represented a major break with past practice (Sirrs, 2016). When the Robens Committee sat, both statutory and voluntary mechanisms for employer-employee engagement existed in the UK. Coalminers had, since *1872, ‘a statutory right to appoint representatives to inspect mines on their behalf’* and in 1954 this right was extended to all mines and quarries. In the manufacturing industry, joint safety committees were established in many workplaces during the 1960s. The Robens committee found evidence of *‘very close co-operation’* between workers’ inspectors, management and the Mine Inspectorate, but also observed that the effectiveness of the voluntary committees in industry varied considerably. In the British economy overall, the effectiveness of these arrangements was found wanting by the Committee, hence its recommendations for strong, specified roles for all parties.

The starting point for Robens Committee recommendations was that the ‘*single reason for accidents at work was apathy’*. While society reacted *‘keenly’* to major disasters, safety was mainly a matter of *‘day to day attitudes’* and occupational disease arose from a lack of awareness of the *‘more subtle hazards’* which caused them. In the eyes of the Committee, the promotion of H&S at work was *‘first* *and foremost a matter of efficient management'*; and workers could play a role in actively promoting H&S in their workplaces. The Committee saw a '*greater natural identity of interest'* between management and workers on *'health and safety problems than in most other matters*'. These views informed their deliberations on the role of state intervention, legislation and the roles of workplace actors, such as directors who had influence, resources and power to take the initiative and *'set the pattern'*, managers who could adopt a more scientific and systematic approach to preventing accidents, and workers whose representatives could *'act as a channel'* for communication with management. For the Committee, the problem was not just reliance on too much law [15] and state intervention, but also that much of the existing law was *'intrinsically unsatisfactory'*, unintelligible and too haphazardly demarcated. The mass of law conditioned people to think that workplace safety could be improved if inspectors *'visited more frequently'*. In the opinion of the Committee, *'the primary responsibility for doing something about present levels of occupational accidents and disease lies with those who create the risk and those who work with them'*. The Committee ultimately envisaged H&S attracting the same level of attention and specialist expertise as industrial relations through *'practical, co-operative organisation and action'.* (Robens, 1972). Criminal proceedings in the Committee's view should only be invoked for actions which were flagrant, wilful and reckless, which caused or could have caused serious injury. For other offences, the Committee recommended increased fines and higher penalties for repeat offences. In the Committee's view, the wholesale criminalisation of H&S infringements was inappropriate as the *'nature of industrial organisations'* was such that *'complete personal'* and direct responsibility could rarely be established. In addition, criminal courts in contrast to industry experts had little to offer in respect of identifying and preventing the underlying weaknesses that result in accidents (Robens, 1972) . Some of these assumptions led to serious

[15] 5 major Acts with supporting regulations and orders, Acts for specified industries and substances such as explosives and petroleum and nuclear installations, and Acts dealing with emissions and effluents from workplaces. (Robens, 1972, pp 6-7).

questioning of the "Robens philosophy", such as the notions that workplace injury resulted from apathy, that there was a natural identity of interest between employers and workers on matters of H&S, and that the criminal courts should be reserved for deliberate, reckless actions (Robens, 1972; Smith and Tombs, 1995; MacEachen *et al*., 2016).

In the UK itself, the recommendations of the Robens Committee were not universally accepted Writing in 1973, Woolf, a solicitor, argued that the problem was not too much law, but that laws were inadequately enforced by under-resourced inspectorates; it was doubtful whether workers and employers could be guided into cooperating *'out of natural goodwill and shared self-interest'*, and the restriction of criminal proceedings to *'flagrant, wilful and reckless'* actions was misplaced. Woolf questioned the Committee's reasoning that since regulation had failed to reduce accident and disease rates to acceptable levels, *'coercion, compulsion and regulation'* were largely irrelevant, and that reliance should be placed on *'improved knowledge and technical skill'*. He pointed out that voluntary self-regulation had been the norm before the introduction of legislation, so the argument was flawed that industry could not be '*more safe and healthy than voluntary self-regulation'* could make it. In addition, as a 1972 National Institute of Industrial Psychology report on a survey of 200 work accidents found, problems were not necessarily due to breaches of specific regulations. Rather most accidents involved employers breaching the common law duty of care to provide safe systems of work, safe premises, safe working environments and equipment, training to appropriate levels of competency, and adequate instruction and supervision (James and Woolf, 2005). Tombs, Whyte, Nicols and Walters have also called into question Robens' philosophy of self-regulation. They argued that the number of preventative inspections and investigations were too low, and that too low penalties were imposed on employers to little effect (Nichols and Walters, 2016; Whyte and Tombs, 2013; Tombs, 2001). The Robens approach nonetheless continues to apply in the UK and has been very influential in Europe in the ILO and in anglophone countries such as Canada and Australia. The experience of Scandinavian countries which have a very long history of tripartism, and workplace partnerships, albeit under unique political circumstances (Tucker, 2003; Hasselbalch, 2002), added weight to the ideas of the Robens' Committee.

In 1976, in Canada, Ham who led Ontario's Royal Commission on the Health and Safety of Workers in Mines (Ham, 1976) proposed similar principles as those advocated by Robens, which he described as the tenets of an *'internal responsibility system'* (IRS). The Ham Commission led to the promulgation of Canada's Occupational Health and Safety Act which translated the IRS concept into law. A recent review, while accepting the centrality of the IRS, highlighted the importance of enforcement in ensuring effective implementation of the system, which otherwise tended to rely on the attitude of the person in charge. Agreement was reached on developing a best practice guideline on a well-functioning IRS system in 2015 (Government of Ontario, 2015).

In 1984, a labour government of the commonwealth of Australian states established a tripartite National Occupational Health and Safety Commission. This government's election manifesto included a commitment to addressing H&S through *'union appointment of health and safety representatives'*, and the involvement of these representatives in the *'monitoring and control of workplace hazards with management'*. Guiding principles for the commission were *'prevention, equity, participation and responsibility'* (Edwards, 1993). By then, some states had already revised their legislation drawing on the ideas of the Robens Committee while others followed suite once the commission had published its recommendations. In 1991, the Occupational Health and Safety (Commonwealth Employment) Act was introduced which covered all commonwealth employees (Edwards, 1993; Raineri, 2003). A template for state level legislation, the model Work Health and Safety Bill, was published in 2011 and updated in 2016. The model act has since been adopted by 6 out of 8 states and territories in Australia except for Western Australia and Victoria. Key premises of the Act are RM; and employer duties to consult and take account of the views of workers in managing risk, including facilitating the election and activities of workers' H&S representatives (WorkSafe Australia, 2016; Sweeney, 2017).

In reformulating South Africa's mine H&S legislation, worker rights, and more fundamentally human rights, were of central concern and dominated most deliberations. However, the matter of self-regulation, so significant in the UK debates, did surface (Leon *et al*., 1995) albeit belatedly when the COM made recommendations on self-regulation in its closing arguments. The Commissioners dismissed the COM's proposal which involved creating a legislative framework though tripartite engagement, and thereafter leaving decisions on managing OHS outcomes to the discretion of mine managers. The Commissioners bluntly stated that self-regulation was '*unacceptable',* citing as evidence incidents of mine managers permitting incompetent or inexperienced people to work at mines; the polyurethane fire at Kinross Mine; failures to address the problems of radiation and dust at mines; and high levels of occupational disease among mineworkers. They also contended that the state of H&S at smaller mines was likely to be worse than at larger, better resourced mines under such a regime (Leon *et al*., 1995). The irony, of course, is that the Robens' model is a self-regulatory model although of a different nature. Stewart reflects that the COM's argument for self-regulation was not as simple as presented in the COM's submission to the Commission. He and Horst Wagner had examined and explored the concept of self-regulation with COM members. The conclusion was that the practice '*could not be credible, or indeed work effectively without a strong and credible system of independent audit. We rejected the soft notion of self-regulation in which employers simply held themselves to account'* (Stewart, 2019).

4.4.2 **ILO Conventions 176 and 155**

ILO conventions 155 (ILO, 1981) and 176 (ILO, 1995) on H&S in industry and mining respectively, open with statements that workplace accidents and disease create human suffering and economic burdens which are of serious concern to the ILO and its member states. South Africa ratified convention 155 in 2003 (c155) and convention 176 in 2000 (ILO, 2017). The mechanisms set out in these conventions required collective effort on the part of government, employers and employees to continually improve

H&S (International Labour Standards Department of the ILO, 2013). Preparations for the drafting of Convention 176 started while the first draft of the MHSA was being prepared in South Africa by the NUM's legal representative, Paul Benjamin. It was presented to the Commission by Benjamin and Edwin Cameron [16] as its hearings were coming to an end (Bakker, 2013; Benjamin, 2013). Many of the trade union, mining company and government representatives who participated in the ILO deliberations also contributed to the drafting of the MHSA. The Commission published its report in May 1995, while Convention 176 was adopted by the ILO in June 1995. The MHSA was signed by President Mandela on 14 June 1996 having been finalised by a tripartite working group and accepted by the Minerals Parliamentary Portfolio Committee (MPCC) on 29 April 1996.

ILO Convention 155 followed the trend established by the report of the Robens Committee. It focussed on principles and processes and moved away from prescriptive industry-specific laws, setting out cyclic and iterative methodologies to improve the management of H&S. The Convention required that ratifying states establish coherent national policy for H&S aimed at preventing accidents and occupational disease. This was to be done by the government in consultation with the '*most representative organisations of employers and employees*.' Such policy was to cover all employers, employees and workplaces; impose general duties on employers, employees and others to ensure workplace safety; establish workplace arrangements for employee participation in safety issues; and provide for the operation of an adequate system of inspection and enforcement. Certain functions which were part of the national policy could be implemented progressively. These included formulating principles for the design, construction, layout, and safe operation of workplaces; for the prohibition of certain work processes and substances; and for studies and research to inform the safe installation and operation of equipment and processes. In addition, procedures for the notification of

[16] A judge of the Constitutional Court of South Africa at the time of writing.

industrial accidents and diseases by employers and insurers were to be established; annual statistics were to be published; inquiries into serious occupational accidents were to be conducted; and information on measures taken in pursuance of national policy was to be published annually.

Employer responsibilities included ensuring, as far as reasonably practicable, that the workplaces, processes and equipment under their control were safe; and providing workers with adequate training, protective clothing and equipment. The responsibilities of workers and their representatives included co-operating with their employer in the fulfilment of their duties; and reporting hazardous working conditions. Workers were afforded the right to cease work in situations which presented imminent and life-threatening risks; and were not to be disciplined for exercising their rights or obligations. Communication and cooperation were envisaged at all levels. Convention 155 excluded activities in which '*special problems of a substantial nature'* could arise, such as in maritime shipping or fishing.

Convention 176, focussed on mining, included the practices and measures already established in Convention 155 but goes further. It recognises that mining is inherently hazardous and that *'it is desirable to prevent any fatalities, injuries or ill-health affecting workers or member of the public or to damage the environment arising from mining operations.*' The preamble highlights workers' rights, *'…workers have a need for, and a right to, information, training, genuine consultation on and participation in,* preparing and implementing *'safety and health measures concerning the hazards and risks they face in the mining industry'*. Additional requirements are that national laws provide for the *'supervision of safety in mines'*; for a competent authority to suspend or restrict mining activities on grounds of H&S, '*until the condition giving rise to the suspension or restriction'* was corrected. Provisions were furthermore to be provided for mine rescue, first aid and medical facilities; for self-rescue respiratory devices; for securing abandoned mine workings, and for the updating and availability of mine plans. The section of the convention (Part III) dealing with preventative and protective measures includes a hierarchy of controls, and lists measures to be taken to address specific risks or needs. These deal with the design and equipping of mines; communication systems; the stability of ground; the provision of two exits; monitoring of the mine environment for hazards and exposure levels; the adequacy of ventilation; the prevention and combatting of fires; evacuation to safe locations; emergency response; transportation to appropriate medical facilities, and provision of comprehensible instructions. Worker rights include the election of safety representatives, and access by these representatives to the inspection authority and independent experts. The convention recognised that specific procedures would be required for the exercise of rights by workers and their representatives. As with convention 155, the state was to encourage cooperation between employers and workers.

4.4.3 **Health and Safety Legislation under the Department of Labour**

As indicated, the MHSA was not the first Act to introduce an enabling approach to H&S in South Africa. It was preceded by the Machinery and Occupational Safety Act (MOSA), No. 6 of 1983 and the Occupational Health and Safety Act (OHSA) No. 85 of 1993 both of which fell under the jurisdiction of the Department of Labour (DoL).

MOSA followed two commissions of inquiry, the Erasmus Commission of 1975 into health in the South African industry, and the Wiehahn Commission of 1977 which investigated labour legislation, the resolution of labour disputes in particular, and recognised that safety had become an issue in industrial relations. The Erasmus Commission found that health hazards such as pneumoconiosis, silicosis and exposures to gas, chemicals and metal oxides were widespread, that workers had little say over their working conditions and that management appeared to be ignorant and lacking in concern. The Erasmus Commission recommended that new H&S legislation be introduced, cooperation between employers and working together on matters of H&S be encouraged, and that workers be regularly consulted on workplace hazards. Differences between the Department of Health and the then

Department of Manpower delayed the introduction of such legislation (Zwi et al., 1988; Maller and Steinberg, 1984; Green and Miller, 1979). While the Erasmus Commission had investigated conditions in mining, the legislation which followed did not extend to the mining industry.

When MOSA was promulgated in 1983, it drew on the provisions of the UK's Health and Safety at Work Act and provided for an advisory council, factory H&S committees and H&S representatives. The OHSA which followed MOSA strengthened workplace duties and rights. It directed employers to provide safe and healthy workplaces; allowed for the election of H&S representatives and increased their rights and duties; and allowed trade unions a role in organised workplaces. MOSA followed the international trends of the 1960s and 1970s (Myers and Macun, 1992) and OSHA which built on the philosophy accepted by MOSA by extending the worker rights and clarifying the general duties of employers.

The OHSA also introduced the topics of occupational health and hygiene into law, encouraged employers to adopt a RM approach, and strengthened measures to protect the public from H&S hazards which originated from workplaces (Benjamin and Thompson, 2003). The OHSA established and confirmed three key institutions which prefigured those established or confirmed the by MHSA - a tripartite Advisory Council on Occupational Health and Safety, an inspectorate, and a workplace-level system of H&S representatives and committees (Benjamin and Thompson, 2003).

4.5 Genesis of the Mine Health and Safety Act

In large part, this section is informed by information sourced from individuals involved in the events leading to the establishment of the Leon Commission; in the proceedings of the Commission; and in the implementation of the Commission's recommendations, including drafting the MHSA and its regulations. Among the key informants were Commissioners; advisors and representatives of the COM and of the NUM; and individuals from the Mine Inspectorate (past and present). Nine in-depth, semi-structured interviews of an hour or more in length were conducted using an interview guide. All of those interviewed consented to being quoted and named. The interviews were conducted between 2013 and 2018.

4.5.1 The Commission of Inquiry into Safety and Health in the Mining Industry

Following the Cabinet decision to establish a Commission of Inquiry, the Commissioners, Professor Miklos Salamon, Professor Albert Davies, Professor John "Tony" Davies, and Justice Ramon Leon (the chairperson) were formally appointed through Government Notice R889 (Leon *et al*., 1995). In terms of the notice they were tasked with investigating all the legal aspects of the regulation of H&S with reference to the recently promulgated Minerals Act of 1991, and to recommend improvements to existing standards to the State President based on the '*circumstances prevailing in the industry and of international standards.'* Given the broad scope of the terms of reference, the Chairperson of the Commission agreed to refine the scope of inquiry so that it reflected the outcomes of a tripartite summit which had taken place before the commencement of the Commission. This meant that questions related to the compensation for death, injury and illness were excluded from the brief and left for the attention of a second commission which was to be motivated afresh. The Commissioners also undertook not to investigate any *'accident, or other dangerous occurrences or conditions'* at any mine for the duration of the inquiry. The Commission called for written submissions which were to be received by 15 June 1994. Thirty-seven (37) interested parties submitted responses which ran to 3500 pages of text. Public hearings commenced on 18 July 1994 and concluded just over a month later, on 18 August 1994, after 33 witnesses had given evidence.

The Commission was conducted in the following way. The proceedings were open to members of the public and press; issues were addressed topic by topic; all proceedings were recorded and transcribed; witnesses could be cross examined, and *'one or two'* mine visits were planned. The Commissioners visited Western Deep Levels South Mine, a gold mine, and Matla Coal Mine. At Western Deep Levels

South, the commissioners observed workings over 2,000m underground, including the support and backfill arrangements; and on surface they visited basic adult education facilities, a hostel which housed miners, and listened to a presentation on seismic monitoring arrangements which had been prepared by a group of mines. At Matla Coal, the Commissioners saw two mining methods, bord and pillar, and longwall mining with powered support of a thick coal seam; the environmental monitoring system, and some miners' accommodation. Prior to the commencement of the public hearings the key parties agreed to form working groups which reported back to their principals, and which provided the Commission with a timetable of topics to be aired, issues for which there was *'common cause'* and others that were disputed. The legal representatives of parties to the commission are listed in the Table 4.3 below (Leon *et al*., 1995).

Table 4.3 The Legal Representatives of the Parties at the Leon Commission

Party	**Representatives**
National Union of Mineworkers	Senior Counsel Mr. E Cameron, instructed by Mr. P Benjamin of Cheadle, Haysom and Thompson
SASOL	Mr. J Viljoen
The Chamber of Mines (now Minerals Council of South Africa)	Senior Counsel Mr. C D Loxton and Mr. D M Antrobus, instructed by Mr. W le Roux of Brink, Cohen, le Roux and Roodt Inc.
Department of Mineral and Energy Affairs (formerly Department of Mineral Resources and Department of Mines)	Mr. J B Raath, Government Mining Engineer
The Chemical Workers Union	Mr. Richard Spoor
The Commission	Mr. R Chinner[17]

In the interviews which I conducted, Justice Leon and Professor Tony Davies, confirmed that they, the Commissioners, were not involved in the process of establishing the Commission (Leon 2014, Davies, 13). After being approached to serve, a few months elapsed before they received confirmation that

[17] Mr Chinner let the evidence of witness who were not led by the representatives of the parties. Source: (Leon et al., 1995)

the Commission would proceed. During this time, Tony Davies took the opportunity to write a critique of the Minerals Act which was included in the Commission's report as an appendix numbered 7, and which informed the Commission findings set out in Chapter 4. The critique dealt with neglect of occupational health and the haphazard way in which it was addressed, uninformed by disease data, and neither correlated to mine ventilation nor the *'environmental conditions in which work is done'*(Leon *et al*., 1995).

By the end of the Commission, the Commissioners were satisfied that all parties had had their say. According to Judge Leon, *'Everyone was heard, all got equal and as much time as needed, so there was no problem there.'*

The Chamber 'had quite a number of experts from Universities and from the Chamber and Loxton represented them, and then there was the National Union of Mineworkers and they, I think were led by Edward Cameron, and of course there would have been government itself, (led by) Dick Bakker.' (Leon, 2014). Frederik "Pik" Botha who served in the Cabinet of President Mandela from 1994-1996, was the Minister of Minerals and Energy (as the DMR was then known) when the findings of the Commission were released. He continued to serve until after the MHSA was enacted.

The Commission made many considered recommendations on a wide range of issues as shown in the Table 4.4, below. From the table, it is evident that many of the priority issues required research inputs, the generation of trend data and the sharing of information.

Table 4.4. Subjects of the Recommendations of the Leon Commission

	Issues Considered and on which Recommendations were made	Details	Page Reference, Leon Commission Volume 1
1	Housing and Accommodation of Mineworkers	Need for improving housing and accommodation arrangements for workers and those with families at mines, including substandard food preparation and serving observed in some communal kitchens, and accommodating living and not just sleeping.	13, 58-59, 167
2	Education and Training	Invest in adult basic education and training in English to improve communication and training standards in the industry. The involvement of experts in education and training. The need to emphasise the H&S aspects of mining activities in training.	14, 71, 74, 167, 168-169
3	Data and Recordkeeping	Improve the quality of data and recordkeeping, and the need for comprehensive and scientifically sound databases, and analysis thereof.	46-47
4	Mine Safety, especially control of ground, coal mine explosions and RM practice	Revisit approach to safety in mines including control of ground in gold mines with reference to stope and gully support, falls of ground, rock engineering training, the merits of stabilising pillars and backfill, the depth of mining and rock failure; coal mine explosions with reference to the control of coal dust explosions, face ventilation, learning from best coal mining practice in the USA, Europe and Australia; methodologies for targeting pressing hazards, possible use of RM tools to prioritize risks, improving safety on gold mining through improving productivity, the reformulation of regulations and the importance of data and research, the process of conducting of in-loco inspections and inquiries, publishing inquiry reports and non-placement of the onus of burden of proof on the accused in mining prosecution cases.	30-31, 33, 34-35, 39, 97, 107-111, 163-164, 169
5	Occupational health	Address occupational health including effective detection, accurate estimates and diagnosis of occupational disease, systematic identification and assessment of workplace exposures, effective methods and tools for medical surveillance, well designed protocols for data collection, amalgamation of databases the link between mine ventilation and occupational disease, clear occupational disease reporting procedures, access to benefit examinations by miners and ex-miners, the specific issues of tuberculosis, pneumoconiosis, HIV, silicosis, noise diesel fume and radiation exposure; the effect of labour stabilisation polices; the use of international standards reference to international practice in the revision of occupational health regulations, the need to match exposure and medical surveillance data, and the need for well-designed and	40-42, 44-46, 54-56, 61-62, 67, 83, 164, 168, 169, 170

	Issues Considered and on which Recommendations were made	Details	Page Reference, Leon Commission Volume 1
		ethical research. Specific recommendation of a coherent process based on the identification of the *'full spectrum'* of hazards, representative sampling, and quality control of measurements, and staff capable of auditing the process in the Inspectorate.	
6	Research	Research to promote the accident and occupational disease prevention, independent review of research, and the need for research expertise to avoid research become superficial.	95, 97, 99-100, 165
7	RM and tripartism competency	The, approach, structure and competencies, roles and responsibilities of management and supervisors at mines including the use of RM tools, including commentary on the conduct required of mine managers in promoting tripartism (Leon *et al*., 1995)	79-82, 166, 169
8	OHS regulation	Mine Inspectorate. Culture, accountability, competency, structure and organisation, staffing levels including the recruitment of assistant inspectors for initial auditing tasks and training for higher positions, scope of work, remuneration levels relative to industry, specialist staff for occupational health, in law and research, duties to make data and information public, publication of reports of accidents and investigations, and relationships with mine management (to be at arms- length). The transfer of the Medical Bureau of Occupational Disease back the mining department.	140- 156, 161-163, 167
9	Information dissemination and priority regulation	Critical issues for immediate attention: publication of the full details of accidents and disease records; fall of ground accidents especially in stopes and gullies and in gold mines; haulage and underground transport accidents; control of occupational health hazards; medical surveillance; and coal mine explosions. Systematic stope and gully support rules were to be implemented urgently against criteria set out by the commissioners, and an investigation was to be conducted in underground haulage and transport as soon as possible; and regulations to address occupational health hazards and coal mine ventilation were to be promulgated as soon as possible,	135-139, 157-161, 169
1	New mine health and safety act	A new law on mine H&S incorporating provisions for tripartite engagement and decision-making, including worker rights to information, to participation, to refuse dangerous work, and to representation by elected H&S representatives. Procedures for investigations and inquiries, the use of statutory complaint forms or books by safety representatives, non-use of the reversal of onus principle, and management responsibilities for risk	88-90, 90-91, 107-111, 113-135, 157, 164-165

	Issues Considered and on which Recommendations were made	Details	Page Reference, Leon Commission Volume 1
		assessment of all mining operations (with reference to applicable regulations) were also to be covered in the law.	

Source: Leon Commissions Report Vol. 1 (Leon *et al*, 1995)

The 1901 request by the Mine Managers Association to the Transvaal Medical Society for an explanation of the high mortality rates of rock drillers can be regarded as the earliest research question raised by the mining sector (Bluhm *et al*., 2010). Other early research efforts include the establishment of a dust department (later the Dust and Ventilation Laboratory) by the COM in 1904 following the 1903 governmental Commission's recommendations on wet drilling and mine ventilation; and the Applied Physiology Laboratory and the Biological and Chemical Research Laboratory also set up by the COM. However, the sector's most significant investment in technical research was made in 1962, following the appointment of a research advisor, Bill Rapson, by the COM (Austin, 2001). Rapson established the Mining Research Laboratory of the Free State and Transvaal Chambers of Mines two years later in 1964 (Durrheim and Riemer, 2015). It was renamed the Chamber of Mines Research Organisation (COMRO) in 1986 when it was at its peak, with nearly 700 people employed. In the early 1990s, the COMRO programmes were drastically scaled back as funding dried up.

H&S issues were not specifically investigated by COMRO prior to the Commission, although improvements in H&S were bound up with advances in technology and interest in improving productivity, and investments were made in tests and processes to enable the selection and acclimatisation of workers to hot working conditions in gold mines (Keilblock, 1992; Schutte, 2009). Notable advances in reducing rock fall and rockburst risk had been made by mid-to late 1970s. From

1974 onwards, following the appointment of Miklos Salamon as research advisor, the Environmental Engineering Laboratory of COMRO was established and began investigating the cooling of deep mines. Also, in 1974, mechanised stoping investigations began, followed by research into hydropower in the late 1970s (Pogue, 2008). From 1976 onwards, hydraulic props were introduced and these, together with stabilising pillars, reduced rock fall injuries (Stewart, 1995). The severe budget cuts of the early 1990s led to significant reductions in staff and infrastructure, and a trimmed back COMRO was transferred to the Council for Scientific and Industrial Research (CSIR) in 1993, where it became Miningtek. The staff complement at that time was 250 people. According to Stewart, the full range of COMRO capabilities were nonetheless intact at the time of transfer and diminished over time[18]. By 2009 when Miningtek became the Centre for Mining Innovation, the research staff complement stood at about 40 people (Durrheim and Riemer, 2015). In their report, the Commissioners expressed disquiet about the declining interest of the major mining houses in joint research from the 1990s onwards. The absence of health-related research was particularly troubling to the Commissioners. They recommended that health research be included in SIMRAC's remit and that SIMRAC establish a more representative management structure, inclusive of all stakeholders including mining companies outside of the COM.

While the Commission reflected on the objectives of research projects; the mechanism of levies used to fund research and a method to determine the size of the levies commensurate with safety risk, it did not reflect on the magnitude of funding required to support research equal to solving the problems in mining (Leon *et al*., 1995).

The principle recommendation of the Commission was that a new Act was required and that it was to incorporate provisions for tripartism, worker rights and a strengthened H&S inspectorate. Work on

[18] Discussion with Dr John Stewart, 05 June 2019.

the Act was to start immediately alongside of upgrading or rewriting of regulations. Tripartite principles applied to both the development of the Act and its regulations.

The quality and strength of the Inspectorate was a major concern and many recommendations were made on strengthening the Inspectorate through increasing remuneration, appointing additional staff and experts, and improving its competence in general. The MHSA included specific details on the criteria for appointing inspectors and the Inspectorates roles. Dixon, an industry representative and a senior consultant to the industry at the time of writing, comments*: 'Competence of the Inspectorate is a big problem for me. Pay is one thing. But these jobs come with a lot of baggage. If you are operating at a high technical level, expecting mines to operate at a high technical level, you must have the equivalent in the Inspectorate'* (Dixon Interview).

At the heart of the Commission was the concern for mineworkers' lives and wellbeing, especially that of black workers. After the Commission released its report in mid-May 1995, at a gathering of 5,000 workers at Vaal Reefs Mine to commemorate the lives of the 104 workers who had died in the 10 May disaster, President Mandela had this to say: *'There is a widespread perception among Africans, Indians and coloureds that whites do not care very much about the lives of black people in this country. That I may not believe that perception myself is not relevant ... it is only going to be reviewed by what the country as a whole, including the white minority, do on this occasion.'*

4.5.2 **Framing of the MHSA**

The Minerals Act of 1991 was under development when the NUM first proposed the commission of inquiry into mine H&S. The Minister who headed the Department of Minerals and Energy Affairs (later DMR), at that time was Daniel "Danie" Steyn. The 1991 Act aimed to simplify mineral law and reduce government intervention in the sector. It removed the classification of land and minerals into different classes, placed mineral rights in the hands of mineral holders, and only allowed the state to authorise prospecting in the interest of optimising the exploitation of the country's minerals under specific circumstances. It also incorporated provisions for safety and health which were previously part of the Mines and Works Act, as well as provisions for the rehabilitation of the land surface including vegetation and water resources disturbed by mining. In formulating the Minerals Act, the department consulted, along with the mining houses, SASOL and ESKOM who were not part of the Chamber of Mines. According to Dirk Bakker, a former acting Director-General (DG) of the DME and a director in the department reporting to the Government Mining Engineer when the Minerals Act was in development, the NUM was approached for comments and inputs, but its views were not given serious consideration. *'This Act was aimed at devolving powers so that government was minimally involved in the industry'* (Bakker, 2013). After the Kinross disaster, the NUM again pressed government on the matter of a commission of inquiry. According to Bakker, the National Productivity Institute (NPI) was called in to assess the appropriateness of the Minerals Act and after a period of 3 - 4 months it concluded that *'the Minerals Act was the way to go'*. But the outcomes of the NPI study did not cause the NUM to desist. Bakker further recalls: '*A major workshop took place between the Chamber, the NUM and the Department in 1992… lasting 2 or 3 days'* at which it was agreed the commission should go ahead. *'Marcel Golding*[19] *stalled the process, waiting for the new government, while Jan Raath* (the Government Mining Engineer) *wanted the commission to take place before the general elections. The Chamber was very unhappy with the (nominated) commissioners, Tony and Albert Davies. So, the unions reluctantly agreed to include Miklos Salamon'* (Bakker, 2013).

Bakker confirmed that the Safety in Mines Research Committee (SIMRAC) was already established by the time the drafting of the Act started. As Stewart explained in a report to the MHSC, SIMRAC which was funded through a dedicated levy, was originally created to ensure that OHS research continued after the restructuring of COMRO (Stewart, 2004).

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[19] NUM deputy General-Secretory, later elected to parliament where he served as chairperson of the Minerals Parliamentary Portfolio Committee after the first democratic election.

'The rudiments of the MQA were also established before the MHSA came into effect' (Bakker, 2013). Raath, the Government Mining Engineer, informed the Commission of the work of the Mining Qualifications' Forum in the department which was responsible for the syllabi of courses for mine officials and their certification (Leon *et al*., 1995). The Commission had also heard evidence from representatives of mining companies which were already offering substantial training to mineworkers, that they were engaged in developing a qualifications framework for the mining sector in anticipation of the promulgation of the South African Qualifications Authority Act in October 1995 (Leon *et al*., 1995). *'MOHAC (the Mines Occupational Health Advisory Committee) came out of the Commission'* according to Bakker.

The main ideas behind the Act were formulated by the NUM, and Bakker recognised the NUM proposal put to the Commission by the NUM as being *'based on or very similar to the Australian Act'*. While Commissioner Tony Davies was disappointed that the scope of the Commission did not include compensation, he ensured that the Commission gave considered attention to occupational health.

For members of the Chamber of Mines, the concept of tripartism was fairly novel. The Chambers' High Level Work Group, chaired by Johan Greeff, wrestled with the idea of tripartism but having recognised it as an emerging trend agreed that it was the *'way to go'*. The concept was accepted by the Chamber thereafter and included in its submission (Stewart, 2019).

According to Paul Benjamin, the attorney who was part of the team who represented the NUM at the Commission and who was a member of the team which drafted the MHSA: *'NUM, I think, throughout had a clear sense of what a sort of internationally acceptable statute would look like. There was simultaneously discussion on a Mine Health and Safety Convention.'* (It was) *'negotiated at the ILO around 1994/95. So that certainly gave some indication* (of what was required) ….*it was very much the British and European experience from the Robens' report onwards'.* Prior to 1974 regulation was *'very prescriptive'*. '*Then you had a move towards some more goal-setting with risk assessment and* *participation as (your) techniques; and then, even before the commission, by 1990 there was a sort of swing-back… you needed in fact much more immediate, more prescriptive regulation of management processes, decision-making processes, risk-assessment processes…so we put it in…the most recent articulation in the mine health and safety convention… No-one was arguing in the Leon Commission that the current framework was adequate. The Commission in many ways was a debate about the level of regulation required and, I think, in the course of that commission, the Chamber moved from an argument for self-regulation towards the current system… Those* (opposing) *arguments clearly weren't tenable, and I think by the end of the Commission certainly the Chamber's perspective was to emphasise tripartism'* (Benjamin, 2013).

After the Commission of Inquiry concluded, its report was considered by the PPC and all parties were invited to make submissions. The submission made to the PPC by the COM supported a separate MHSA, tripartism and the establishment of MRAC as confirmed by Stewart and acknowledged by Benjamin (Stewart, 2019; Benjamin, 2013).

MRAC was voluntarily and speedily established by the tripartite partners to draft the MHSA as recommended by the Commission (Leon *et al*., 1995).

4.5.3 **The Drafting Process**

The following people were formally appointed in June 1995 to draft the MHSA by Raath the GME: Mr. Terence Doyle from the inspectorate as Chairperson, Mr. L. Kugel, Dr. M. La Grange Dr. Neil White, Mr. Mulder, Mr. Johann Greef, Prof and Adv. Paul Benjamin. Dirk Bakker played an oversight role. Paul Benjamin and Johan Greef represented the NUM and the COM respectively.

In August 1995, the first draft of the MHSA was presented to Minister Botha and the Parliamentary Portfolio Committee (PPC). Afterwards, the initial draft of the MHSA was referred to Ken Gudmans[20] of the DMR who took it further with John Stewart[21], Gudmans and Stewart having succeeded Doyle and Greef respectively. In his leadership role Gudmans was supported by Doyle, and Benjamin was supported by Brendan Barry who often stood in from him when he was unavailable.

The Government team also included Dirk Bakker, who was ultimately responsible for mandating the DME's representatives. The Chamber's members on the drafting team obtained their mandates through a system of committees…*'mining companies used to meet on a Monday. They would consider all the Chamber issues that were due for consideration that week, and they would then mandate their people to come to those meetings… So, things were considered…the Chamber was well-capacitated to make input into the process'* (Stewart, 2013).

According to Benjamin, the committee also split into technical teams from time to time. For example, Professor Neil White from the University of Cape Town represented the NUM on occupational health, and staff of the NUM's H&S department were involved or consulted when necessary. Drawing on an example set in Canada, Benjamin initiated the appointment of a language expert to ensure the MHSA was drafted in accessible language – "plain English".

There were many differences of opinion and arguments during the drafting process, not just between the parties, but also between experts and their representatives, according to Benjamin. One involved a Chemical Workers' Union representative and the unions' advisor regarding the need *'for* (medical)

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[20] Messrs. Ken Goodmans and Dirk Bakker were Directors at Department of Mineral and Energy Affairs reporting to the Government Mining Engineer, Mr Jan Raath.

[21] Dr John Stewart worked with Dr Horst Wagner on the submission of the COM to the Commission of Inquiry. He was at COMRO at time and moved to the COM after the Council for Scientific and Industrial Research (CSIR), a state institution, took over COMRO. At the Chamber he headed the organisation's high-level working party on health and safety which included Johan Greef.

examinations and rights of privacy… the doctors tended to be more prescriptive as to what was required, and there was a sense that often that could be counter-productive… the extent to which workers could be compelled to undergo examinations' (Benjamin, 2013). Stewart recalls difficulty in reaching agreement over 14 or so issues during the second stage of the drafting process. Bakker, Benjamin and Stewart separately commented that the content and the wording of the ILO convention helped the parties to settle many of their disagreements (Bakker, Benjamin, and Stewart interviews). According to Doyle, the example of the Occupational Health and Safety Act was also helpful in preparing the initial draft of the MHSA.

The drafts of MHSA were not brought before NEDLAC, as agreed by the parties. The 14 issues of disagreement among the members of the drafting committee, including differences over the reverse onus, were brought before the MPPC where the legislation was reviewed before being finalised. Under the leadership of Golding, the MPCC directed the stakeholders to continue working on finding agreement and report to the MPCC on progress. Impromptu meeting places were organised near the parliamentary precinct and the deliberations continued. Agreement was reached on the 13 of the 14 issues bar the matter over the legal principle, *'the reversal of onus of burden of proof'* which the members of the drafting committee could not resolve among themselves (Doyle, 2018). The NUM envisaged that this principle would apply when administrative penalties were under consideration by the Inspectorate, and when prosecution cases were brought before the courts. It entailed, the respondent/s i.e. mine owners or mine management demonstrating that they had taken all reasonably practicable measures to avoid or prevent an accident or a harming situation from arising. This in place of the department or the Inspectorate having to prove negligence or inadequacy in these measures. Interestingly, the Commission had already considered the reverse onus, which had been proposed to it by the legal counsel of the NUM, and had recommended against it (Leon *et al*., 1995).

At the MPPC, chaired by Marcel Golding, the debate on the reverse onus of burden of proof continued without resolution. An interim solution was adopted to allow the Act to be promulgated as is[22] ,without agreement on the reverse onus, on the understanding that the matter would be resolved within a year of promulgation. According to Stewart, the Association of Mine Managers were prepared to take the matter to the Constitutional Court independently of the Chamber of Mines.

Stewart's recollection of the resolution of the reverse onus issue which was incorporated into the MHSA in the course of the following year: '… *we were at a meeting, and Paul Benjamin was there, and I remember saying to him something like, "Tell me, Paul, why do you guys want the reversal of onus clause?" And his answer was, because we want to make sure that a systems approach is taken to addressing the health and safety problem. I said, "But for goodness sake, that's what we want as well." Subsequently we had a high-level meeting which involved Gwede Mantashe*[23] *and Bobby Godsell*[24] *and it was agreed that we would get four independent opinions (I think it was four) on the issue. One was from Australia and I forget all the others. But we got these independent positions regarding those administrative penalties' arrangements, and it was finally agreed that we would draft something on administration penalties to replace the reversal of onus provisions. And so that was done, it was drafted, it was agreed, and it was introduced into the Act and the objections of the reversal of onus thing then went away. It was a really, really important step forward'* (Stewart, 2013). The final wording on this aspect of the MHSA was agreed through tripartite negotiation at the MHSC (Doyle, 2018).

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[22] The initial draft of the MHSA contained the reverse onus.

[23] General Secretary of the NUM at the time.

[24] Anglo American's Head of Public Affairs (including Group Industrial Relations and Corporate Communications) at the time.

A similar provision which had been in place in various states in Australia when new OHS legislation was first drafted, were later removed. A more recent development is that the reverse onus may be reconsidered in Australia, following the outcome of a recently conducted review of the model Workplace Health and Safety Act (Hegarty, 2018; Sweeney, 2017).

Another significant difference between the parties arose in the Commission and did not go any further. It did not arise in the drafting process as the parties accepted the recommendations of the Commissioners. This related to the positioning of the SIMRAC. The COM wanted SIMRAC to remain under the Minerals Act, while the NUM and the Government Mining Engineer (Raath) argued that it be made a subcommittee of the MHSC. The Commission recommended the latter.

4.5.4 Perspectives on the Advances Made

Employer and union representatives involved in the Commission of Inquiry and the drafting of the MHSA agreed on the importance of tripartism. Benjamin (NUM representative): 'There was certainly a lot of consensus between the State and NUM about the need for enhanced regulation. I think there was consensus about the tripartite structure, so I think the tripartite structures – everyone at that point wanted a greater role for them'. Roger Dixon (COM working party, chairman of SIMRAC): 'We were pretty well into union representation, representation of workers, safety representatives… some dissenters on that, but generally it had to come' (Dixon, 2014).

For the NUM's representatives (Motlatsi and Golding), the establishment of the right to refuse dangerous work, and the extent of support for it, were significant and represented the achievement of a longstanding goal of the NUM.

For Benjamin, the inclusion of specific requirements to prevent workers from acquiring occupational diseases was particularly noteworthy: '…the system probably changed more dramatically around health than in any other area… the regulations of MOHAC led to a number of required changes of practice' (Benjamin, 2013)

According to Doyle, 'The formulation of the MHSA and its regulations has caused stakeholders to work together in a tripartite manner' (Doyle, 2018).

4.5.5 **The Immediate Aftermath**

The MHSA not only established a new paradigm for OHS, but also required the parties involved to establish new institutions, to adopt new ways of working, and to redraft an extensive body of mining regulations, all at a time of transition under a government of National Unity which was led by the African National Congress[25].

For the Inspectorate, it was a particularly turbulent period, and not only for the reasons above. '*The commission was really scathing in its criticism'* according to Bakker, and the accounts of the Inspectorate's engagement with other stakeholders suggest that government officials were unsure of their role and tended to be brokers rather than leaders. They tried to achieve outcomes acceptable to both mine employers and labour while also affected by restructuring within the DME.

The DME which had already been reorganised to conform to the requirements of the Minerals Act of 1991 was restructured to meet the requirements of the MHSA. Under the Minerals Act, the government mining engineers who were responsible for most of the technical aspects of minerals governance, reported to regional directors who in turn reported directly to the Director-General (DG), the most senior civil servant in the department. Dirk Bakker who was appointed acting-DG for about a year and a half until the appointment of Sandile Nxogina, an advocate, as DG in 1998, remembered

[25] South Africa was governed by the Government of National Unity from 27 April 1994 to 3 February 1997. It was led by the ANC with President Nelson Mandela at the head. The Deputy-President was F W de Klerk of the previously ruling National arty.

this period as being very busy, with many competing demands. The MHSA created new structures, relationships and positions and after its promulgation in 1996, the H&S responsibilities in the DME had to be separated out from other roles, *'it was a shamble really. The amalgamated act was to separate again. But the government mining engineer's role was not only health and safety. It included mining leases, various economic aspects, the environment, health and safety, and mine survey.* The title of Government Mining Engineer was changed to Chief Inspector of Mines and the most senior inspectors in the regions, the Principal Inspectors were appointed at director's level. *'And I had to fight tooth and nail to get that. …There were only so many posts available in the government of National Unity'*. Under the Principal Inspector in the regions, all aspects of the inspectorate were represented, *'inspectors of mines, inspectors of machinery, occupational hygienists and medical inspectors and surveyor.'* Bakker continued: *'The problem was the database, and literally thousands of files had to be administered centrally….so I said we'd do that in the future...'* (Bakker, 2013).

Doyle reflects: '*The Commission recommended (Leon Para 11.1.2 page 142) that a restructured Mine Health and Safety Inspectorate should be a separate administrative agency within the Department of Minerals and Energy. This recommendation was not carried out to the detriment of the Inspectorate which continues to be understaffed and under resourced'* (Doyle, 2018).

4.5.6 **The Demands of Tripartism**

After the MHSA was promulgated, the stakeholders met at MINTEK in mid-1997, at which every member and alternative member of the tripartite committees established under the MHSA, received their letters of appointment (Doyle, 2018). The members of the Mining Regulation Advisory Committee (MRAC) changed at that point, with Doyle again assuming the chairperson's role. Other members included Roger Dixon and Anton von Achtenberg (representing the COM) and Brendon Barry (representing the NUM). At the same time, Stewart became the chairperson of the COM's High Level Working Group on OHS.

The Leon Commissioners had expressed concern about naïve expectations of tripartism. While the Commissioners were encouraged to find that all parties were in support of tripartism*,* they warned of *'formidable obstacles between the adoption of the principle and the achievement of truly participative strategies to deal with the hazards of the workplace',* such as the historical and political roots of the adversarial relationship between workers and management which were likely to be long lived; impediments arising from *'the economic gap between managers and workers'*; flaws in education and training at all levels, including on H&S; and *'cross cultural effects on fundamental concepts and attitudes'.* While they believed that the principle of tripartism would fundamentally change the way decisions were made, and that the role of the inspectorate would be central, they were concerned that simplistic approaches would be disastrous (Leon *et al*., 1995).

The parties very quickly encountered the problems foreseen by the Commission. They had different ideas about what tripartism meant in practice, and struggled to agree on priorities, process, their relative roles and responsibilities, and the substance of the work they were required to undertake.

Despite MRAC setting up a programme of work which was to run from November 1998 for just over four years, as well as protocols for drafting the legislation (Clappen Project Engineering Services, 1999; MRAC, 1998), Doyle, who chaired MRAC until 2006, '*many meetings were taken up by arguments on matters of MRAC processes and priorities'* and constraints on the time of committee members. When he relinquished his role on MRAC, the committee project plan was 95% complete (Doyle, 2018).

Government representatives (Inspectors) believed they '*should develop regulations and merely consult with stakeholders while employers kept pointing out the term, "consensus", in the Constitution as well as in the notion of "tripartism".* Doyle was concerned about the level of priority given to the work of MRAC, within and outside of the committee. *'Another stumbling block was that insufficient attention was given by stakeholders to proposed regulations.* A number of '*regulations were approved by both MRAC and the MHSC , and then after promulgation (were) found to be requiring further* *consideration. I was of the opinion based on the afore going, that stakeholders had failed to give the legislation the attention it required en-route through the various tripartite structures.'* (Doyle, 2018).

Referring to another tripartite institution, Bakker described the situation at the MQA as *'a nightmare'*. The CEO was a *'very highly regarded and competent individual'*, but he had to deal with a *'tit for tat'* board whose members barely saw eye to eye, and union representatives who were frequently unable to attend meetings. *'The problem was that when you made decisions without them, they didn't accept those decisions in subsequent meetings. And that really meant that you would have to argue about the same issue. Around again, time and time again. It became an absolute nightmare'* (Bakker, 2013).

Benjamin reflects: '*I think one of the difficulties which later emerged is that, you know, the devil is often in the detail, it is in the final instance in how you resolve disputes, and none of these issues were actually dealt within the drafting committee'* (Benjamin, 2013).

A general lack of capacity was also an issue. The trade unions, particularly the NUM struggled to participate on an equal footing given all the requirements to participate in MHSA, MRAC, SIMRAC, MOHAC and associated sub-committee meetings, many of which required the input of specialists. To overcome shortfalls in capacity in SIMRAC, the NUM turned to its legal firm, Cheadle, Thompson and Haysom who provided representatives who served on the main committees of SIMRAC for two years. The inspectorate who had to field representatives to serve on or lead most of the committees, struggled with the competing demands on its time. Initially, in respect of MRAC for example, the Chief Inspector of Mines (CIOM) was to meet weekly with the departments' representatives to agree on mandates. This meeting fell away within a few weeks as the pressure of work mounted.

4.5.7 **Drafting of the Supporting Regulations To the MHSA**

The Commission had recommended that, along with drafting a new principal Act for H&S, existing regulations were to be substantively rewritten, and new regulations were to be introduced to address, for example, occupational health which had been previously overlooked. A designated drafting committee assumed responsibility for the MHSA, and the Inspectorate led the process assigned to MRAC to rewrite the supporting regulations, codes of practice and guidelines.

Doyle explained that the inspectorate identified and reviewed all the topics for which regulation was required, and from its ranks appointed a "topic specialist' to draft the regulations in the appropriate order. Priority was given to the issues which the Commission referred to as '*matters requiring urgent attention'* and '*critical health and safety issues*' (Doyle, 2018; Leon, 2014).

To guide its work MRAC drew on article 17 of the MHSC's Constitution[26] which requires the MHSC or any of its committees to *'endeavour to reach consensus'* on any matter which requires resolution. It developed two process documents as already indicated, *"Process and Guiding Principles for the Formulation of Regulations under the Mine Health and Safety Act"* and a *"Regulation Implementation Schedule"* (Doyle, 2018). The former was endorsed and approved by all MRAC and MHSC constituencies. The implementation schedule of the DME is summarised in a document prepared by Clappen Project Engineering Service CC and dated 1 July 1999. It contains a list of 164 topics of regulation, each one of which was assigned to an inspector. Planned presentation dates for each regulation topic started in November 1998 and end in February 2002. Draft legislation on 64 topics was to be completed by the end of 1999 by approximately 22 inspectors, many of whom were drawn from the regional offices. At the time of the interview with Doyle – 2018 and 16 years on - the drafting process was still continuing, but close to completion. MRAC was chaired by Doyle until 2006 when he was transferred to another office of the MHSI. Mr. Anthony Coutinho took over his responsibilities thereafter and was appointed as the acting-chairperson in 2016. The current chairperson of MRAC is Mr. F. Nkuna.

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[26] The Constitution of the MHSA was drafted by the MHSC itself.

The drafting of regulations took place as follows. Representatives of organised labour and the employers served on the drafting committees established for each regulatory topic (effectively informal subcommittees of MRAC) which was chaired by the Inspectorate's "topic specialist". Once the committees developed the regulations assigned to them, it was presented to MRAC. At MRAC, the stakeholders were given another opportunity to consider and comment on the drafts. After the drafts were finalised and accepted at MRAC, they were passed on to a Legal Drafting Committee (LDC) which '*scrutinised the proposed regulations from a legal perspective'.* Anton van Achtenberg who was the MRAC employer convener, played a key role at MRAC in developing these regulations and the guidelines for Codes of Practice, at the interface between MRAC and the LDC (Doyle, 2018). When the LDC had completed its work, a proposed regulation would then be forwarded to the MHSC for approval. It was gazetted thereafter. According to Doyle, *'Generally consensus was reached at the cost of a heavily delayed implementation schedule'* (Doyle, 2018) .

Bakker said of MRAC: '*the rewriting of the regulations was a nightmare... and the problem was that we* (government / the inspectorate) *wanted to retain the methodology…regulations that you can directly enforce, …on stone dusting, ventilation requirements, dust prevention', etc.* And so after much debate the committees *'came up with the guidelines'* (Bakker, 2013).

Said Doyle of the decisions made to augment the regulations with codes of practice and guidelines, *'I am not that certain that Codes of Practice were a correct choice of a regulatory mechanism. Managers in the industry are divided in opinion concerning the effectiveness of this option. More responsible employers use the codes of practice effectively to almost self-regulate mine-site specific conditions at their mine, whilst others tend toward wanting more prescriptive regulations'* (Doyle, 2018).

This arrangement led to the augmentation, in many cases, of new regulations (19 out of 23 promulgated at the time of writing) with guidelines for the compilation of mandatory codes of practice (31), and in a few cases (9) guidelines and guidance notes (Lexis Nexis, 2019; DMR, n.d.). Together with the regulations issued under the Minerals Act and still in force under the MHSA (29 in total), the result is a much larger body of H&S law than that previously in place. The codes of practice, guidelines and guidance notes are published in separate booklets which are not widely available in hard copy, and while electronic copies can be sourced from the DMR website, the site is often inaccessible. Furthermore, as the codes of practice and guidelines conform to the requirements for writing enabling, outcomes-based and RM orientated rules, obtaining specific guidance on what needs to be done is not straightforward.

4.5.8 **The Challenge of Risk Management**

Bakker became Chief Inspector of Mines after the DG Nxogina was appointed in 1998. Implementing a systems-based approach to which RM was central, was one of the first challenges he faced. He recalled, *'No one in the industry knew about risk management. And by the way, in the Inspectorate, the same, so I arranged training but that didn't help much either.'* According to Bakker the training which was funded by the MQA was conducted by a British company with experience in applying RM. '*We had a week's training near Welkom. The Inspectors didn't quite understand what it was all about. But the industry was a major problem... and then I realised that we shouldn't have taken the MHSA to where it was at that stage ... and (we should have) kept some of the prescriptive things in. But that is in hindsight. Just personal. It is perfect sight'* (Bakker, 2013)

According to Doyle *'Hazard Identification and Risk Assessment (HIRA) existed in the mining industry prior to the introduction of the MHSA and was practiced in its most simplistic form by many occupations ….for example checklists for trackless mobile machinery operators.'* Furthermore, he noticed '*that risk assessments and COPs were often drafted by "consultants" without the participation of employees which is not the process intended by the MHSA* (Doyle, 2018).

Stewart wondered whether '*there was adequate communication to the industry about what was required'.* In his view that would have been '*the first thing'. 'And secondly, adequate training of people* *within the industry of what they would need to do so that they were well-equipped to do it.' 'So, the management of change, if you like, probably wasn't adequate. There are some really competent people in the industry who would have done that job well, and there would have been others who would have done a box-ticking exercise… so my assessment, not from deep knowledge, was that it would be very patchy because of the variation in the abilities of people'* (Stewart, 2013).

Dixon's who was closer to the operational practice on mines, perspective was *that 'its fine on company level but don't think it ever went down to grassroots level. To ask a shift boss to do a risk assessment or a team leader to do that...I don't think it ever went that far'* (Dixon, 2014).

The first risk assessment tool for OHS applications was developed by SIMRAC, following the visit of a tripartite delegation to Australia where Professor Jim Joy of the University of Queensland, among others, were consulted. The result was a risk assessment guide, the "SIMRAC Practical Guide to Risk Assessment", which included a simple 5 by 5 risk ranking matrix and, advice on how to go about identifying hazards and prioritising risks. In 1998 at the OHS summit, mines were urged to adopt this guideline to reduce the variation in practice and quality of assessments being carried out. However, uncertainty persisted as to who was to conduct risk assessments, when, where, and to what end. Ten years later, in 2008, an industry wide audit conducted by the Mine Inspectorate found that safety RM practice was still inadequate, with shortcomings in the fitness for purpose, scheduling and records of risk assessments, and the application of the "hierarchy of controls". The auditors also found that risk assessment results were inaccessible to workers and were rarely shared with them. The standard of occupational health risk assessment was found to be even lower, either inadequate or absent (DME, 2008). Investments by major companies in developing systematic and comprehensive tools for OHS RM, improved the quality and availability of the tools and resources to mines, but whether these tools have been adequately implemented across the sector is a moot point, discussed in Chapter 7 (the Risk Management chapter).

4.5.9 **OHS Education and Training**

Prior to the Leon Commission, the NUM provided training to its safety stewards. Training covered their roles as worker representatives and included case studies on the types of problems encountered by workers. Safety stewards were provided with advice on how to assist workers and/or engage mine management, and on points for discussion. Illustrated booklets which supported union training, dealt with topics such as the nature of mine accidents, compensation, and NIHL. Titles included "Compensation for Occupational Diseases" (NUM, 1989b), "A Manual for Safety Stewards; Accident Inquiries" , "A Miners Manual" (NUM, 1987), "Noise, A Safety Stewards Manual" (NUM, 1991), and "Compensation for Accidents, A Manual for Safety Stewards" (NUM, 1990). These booklets were produced by the NUM's Health and Safety Department in association with the Centre of Applied Legal Studies, the Sociology of Work Programme, both of the University of the Witwatersrand, and Learn and Teach Publications. They were produced in English, Sesotho and Xhosa, the latter being the home languages of many miners.

After the enactment of the MHSA, safety stewards became more commonly known as safety and health (SHE) representatives, and their training shifted from the NUM to the mine training centres which offered certified courses conforming to the requirements of formally registered unit standards recognised by the MQA and the South African Qualification's Authority (SAQA). SHE representative's courses are referenced to unit standard no. 259622. They are typically 3 days long and participants are trained to know the rights, powers and functions of representatives, to deal with SHE issues and participate in workplace committees (SAQA, 2018). The organisational context of representing and serving mineworkers eroded as these training courses replaced the education and training activities of trade union staff.

More broadly, with reference to training on the requirements of the MHSA, Doyle recalls that when the MHSA came into effect at the beginning of 1997, the Inspectorate convened "Road Shows" to explain the Act, which was also discussed at other forums, including at the first Mine Health and Safety Summit. He says however,

'All too often I still find there is a lack of understanding of the Act, and provisions are misinterpreted. So, my advice would be simply to ensure that all users are correctly and adequately trained in the MHSA' (Doyle, 2018).

4.5.10 A Unitary Health and Safety System for South Africa?

Shortly after the MHSA came into effect, the incumbent Minister of Labour, Mr. Tito Mboweni, established an inquiry to examine the case for consolidating all government OHS services, including compensation for work related injuries and diseases. The recommendations of the report of the Committee of Inquiry into a National Health and Safety Council in South Africa (Benjamin and Greef, 1997), which was prepared for the Department of Labour in February 1995, were approved by the Cabinet. The main recommendations were to develop overarching H&S policy for the country and establish a National Occupational Health and Safety Council.

That three government departments, Labour, Health, and Minerals & Energy were primarily responsible for regulating H&S, and that other departments, Transport, Environment, Water Affairs, Agriculture, and Safety and Security addressed either aspects of / or matters associated with OHS, was seen to lead to several problems. These included under reporting, under regulation, and weaknesses in the state's ability to direct OHS policy and obtain a full picture of the extent of harm to workers. Different approaches to OHS, and overlapping mandates and jurisdictions compounded the problem (Benjamin, 2005; Benjamin and Greef, 1997).

The committee reviewed practice in South Africa and in jurisdictions around the world. It noted the importance of *'bipartite collaboration between management and labour'* in all institutional models and described the experience of Denmark and the province of Ontario in Canada, with such systems.

Self-regulatory systems were not however found to be a panacea. Experience in Canada suggested that the work of safety representatives and joint committees were not necessarily prioritised by management, and that such work fared better in unionised workplaces where collective bargaining was well established. Unions and others contended that stronger mechanisms were required to enable workers to exert greater influence over H&S, and to receive greater support from the external system of enforcement, viz. the inspectorate (Benjamin and Greef, 1997).

The committee further observed that enforcement responsibilities in many jurisdictions were rarely situated in a single ministry, and that systems which involved multiple inspectorates which reported to different government departments, had developed for historical rather than functional reasons (Benjamin and Greef, 1997).

The recommendations of the report were prefaced with a warning against transplanting systems and rules from elsewhere in the world, and advice to the effect that those responsible for developing national policy would need more comparative information, especially from the UK and Zimbabwe[27]. The committee recommended that national policy be developed first by a newly established national council responsible for plenary policy. Policy objectives should be directed towards unifying the fragmented and uncoordinated system; and enabling government to meet its obligations including *'the challenges of technology, the expectations of employees,* (and) *the requirements for enhanced productivity and competitiveness'* (Benjamin and Greef, 1997). The work of the council would encompass prevention strategies, enforcement strategies, capacity building of the inspectors, unions, management and H&S professionals, the compensation system, rehabilitation, the harmonisation of legislation and regulations, research, statistics and data management, and cooperation with other government and international agencies (Benjamin and Greef, 1997). The recommendations of the

[27] Expertise on comparative OHS systems was available in Zimbabwe at the time.

committee of inquiry, to consolidate existing H&S legislation and institutions and establish a National Health and Safety Council, were never implemented. Their observations, however, on the factors critical to collaboration were instructive.

4.5.11 **Health and Safety Post-Leon**

Figure 4.2 below, starting with the period immediately before the MHSA was promulgated and extending to 2017, shows the controlling effect of steadily reducing fatalities in gold mining on the number and rate of fatalities in the industry. This decline also reflects declining levels of mining and employment underway since 1987 as discussed in the literature review, which continues (Dixon, 2019; Njini, 2018). It also shows the steep drop in coal mine fatalities. which was brought about by the implementation of technologies to prevent and control coal dust and flammable gas explosions.

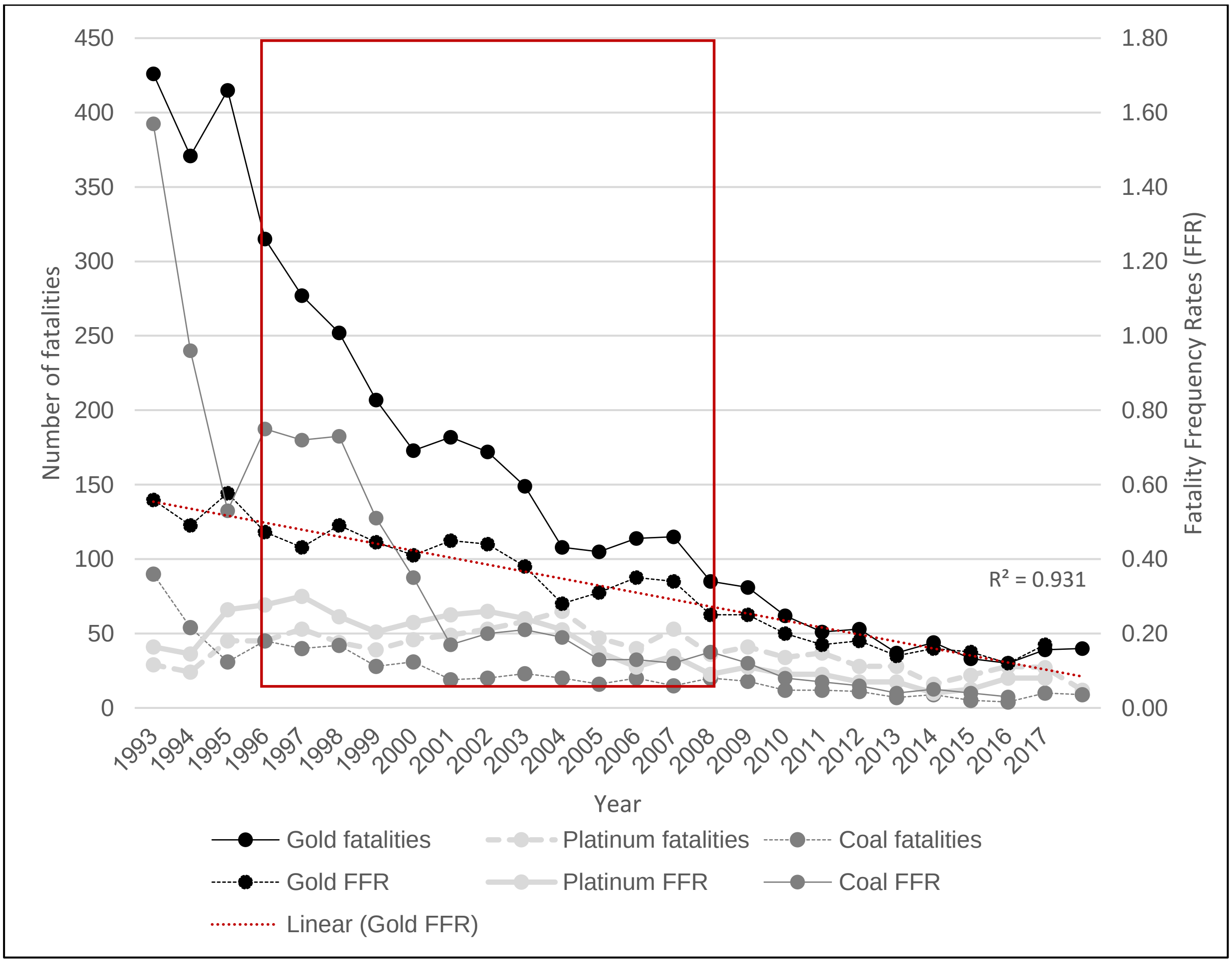

Figure 4.2 Fatalities and Fatality Rates for Gold, Platinum and Coal Mining 1993 – 2017. (No. of fatalities per million hours worked)

Sources: MHSI Annual Reports, MHSC Mining Summits Presentations and Annual Reports, COM/ MINCOSA Facts and Figures, Leon Commission Vol. 1.

Over the period 1993 to 2017 gold mining fatalities declined at an average rate of 0.19 per annum (trendline in Figure 4.2). Since the OHS milestones have been in place, from 2003 to the present gold mining fatalities declined at an average slightly lower rate of 0.16 per annum (trendline in Figure 4.3). In the first 12 years after the promulgation of the MHSA the fatality rate in gold mining showed greater variation that in the years that followed (see outlined section of Figure 4.2), indicative of the reduction in the number of accidents, classified as disasters, which claimed multiple lives. The trend is also seen in Figure 4.3.

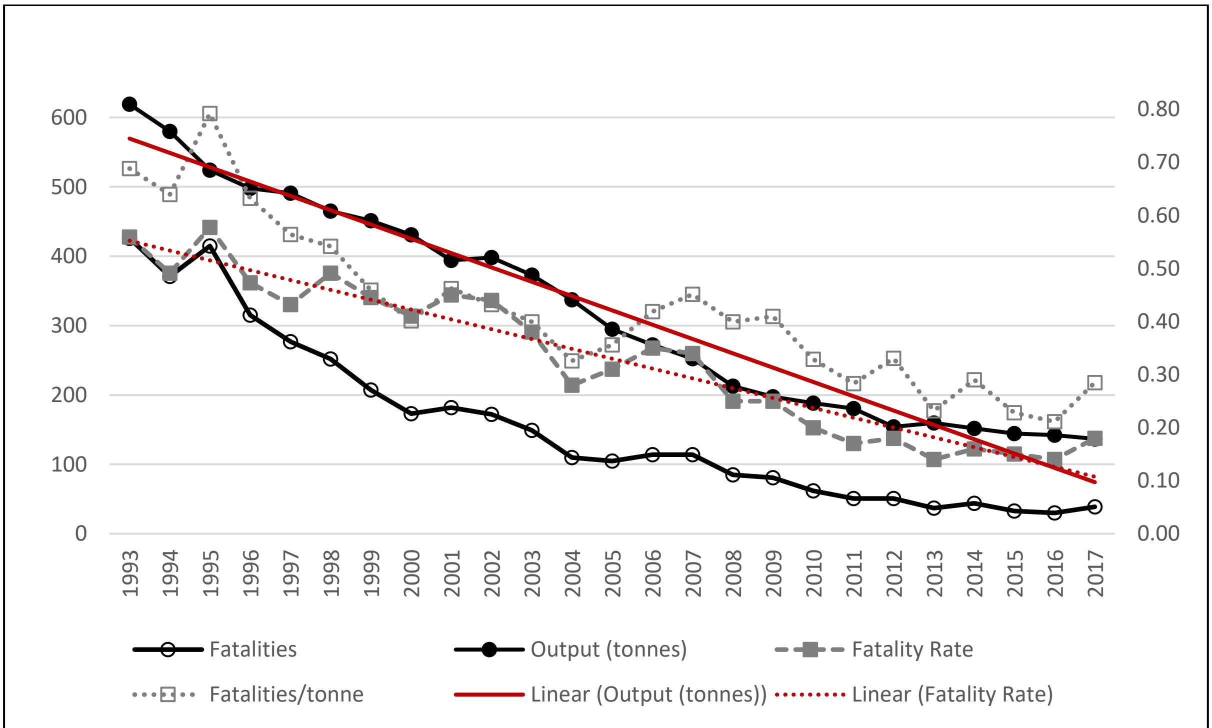

Figure 4.3 Gold Mining Output, Fatalities and Fatality Rates

Sources: MHSI Annual Reports, MHSC Mining Summits Presentations and Annual Reports, COM/ MINCOSA Facts and Figures, Leon Commission Vol. 1.

Figure 4.3 shows that although the overall fatality rate of the sector tends to follow that of gold mining, its sensitivity to the troughs and peaks of the gold mining fatality rate became less pronounced from

2012 onwards, as gold mining employment became more comparable to the levels of employment in platinum and coal mining. The fall of gold mining fatality rates with declining gold mining employment levels is also seen in Figure 4.4.

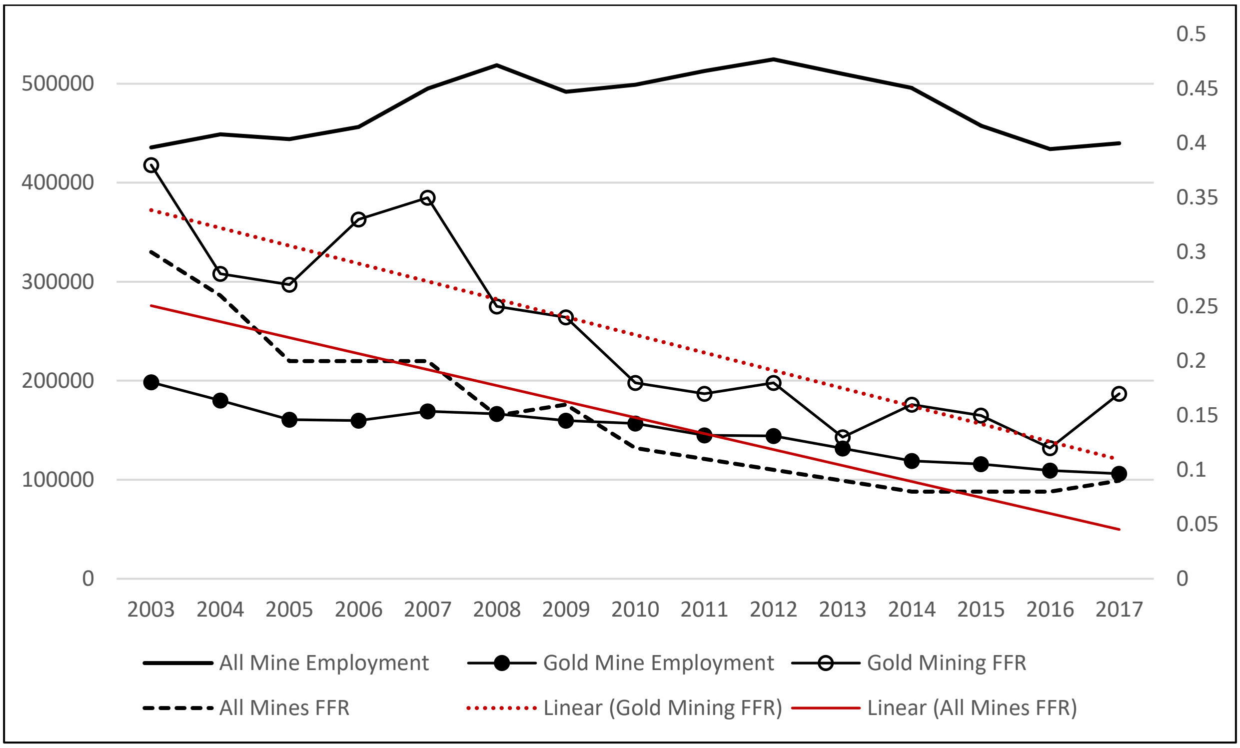

Figure 4.4 Fatalities and Fatality Rates for Gold, and all Mines 2003 – 2017. (No. of fatalities per million hours worked.)

Data Sources: MHSI Annual Reports, MHSC Mining Summits Presentations and Annual Reports, COM/ MINCOSA Facts and Figures, Leon Commission Vol. 1.

These observations do not imply that OHS risk mitigation in gold mines have not had a beneficial effect. Mining continues at ever deeper levels, mineworkers travel, often on foot, greater distances to reach their workplace, and the extent of retreat mining, which is more difficult, has increased.

In coal mining, the opposite effect is observed (Figures 4.5 and 4.6). Coal mining employment expanded over the period 1993 to the present, while the fatality rate declined significantly. In the five years after the MHSA came into effect in particular, fatality rates declined rapidly. The relevant factors were more effective management of flammable gas and coal dust explosions, and the increased number of opencast coal mines relative to coal underground mines.

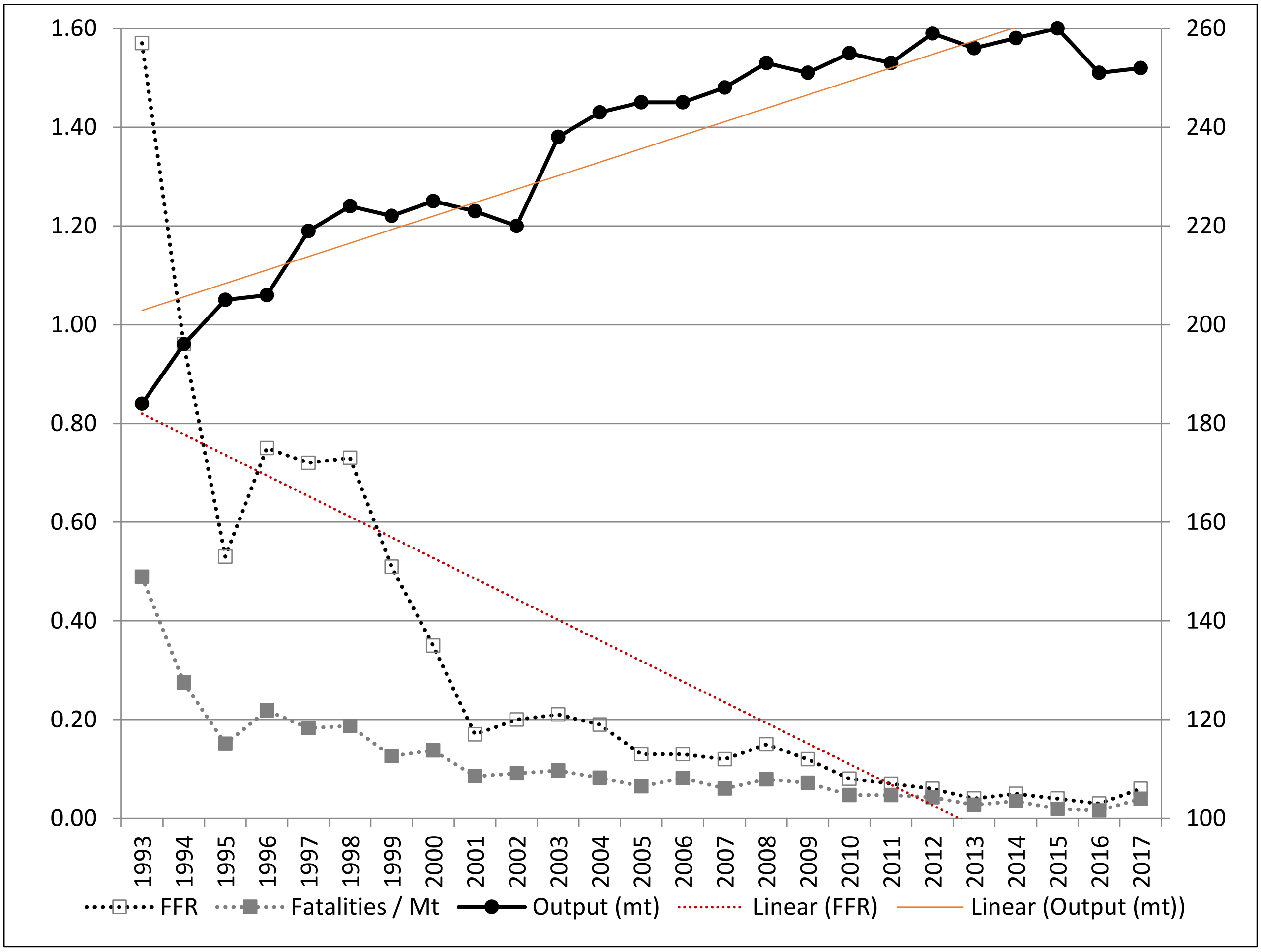

Figure 4.5 Coal Mining Fatality Rates, Fatalities and Outputs 1993-2017

Sources: MHSI Annual Reports, MHSC Mining Summits Presentations and Annual Reports, COM/ MINCOSA Facts and Figures, Leon Commission Vol.1.

From 2003 onwards, with the milestones in effect, coal mining fatalities rates continued to decline until they started plateauing in 2013. There was a significant deterioration in the coal mining fatality rate in 2017 when the number of fatalities doubled from 5 to 10.

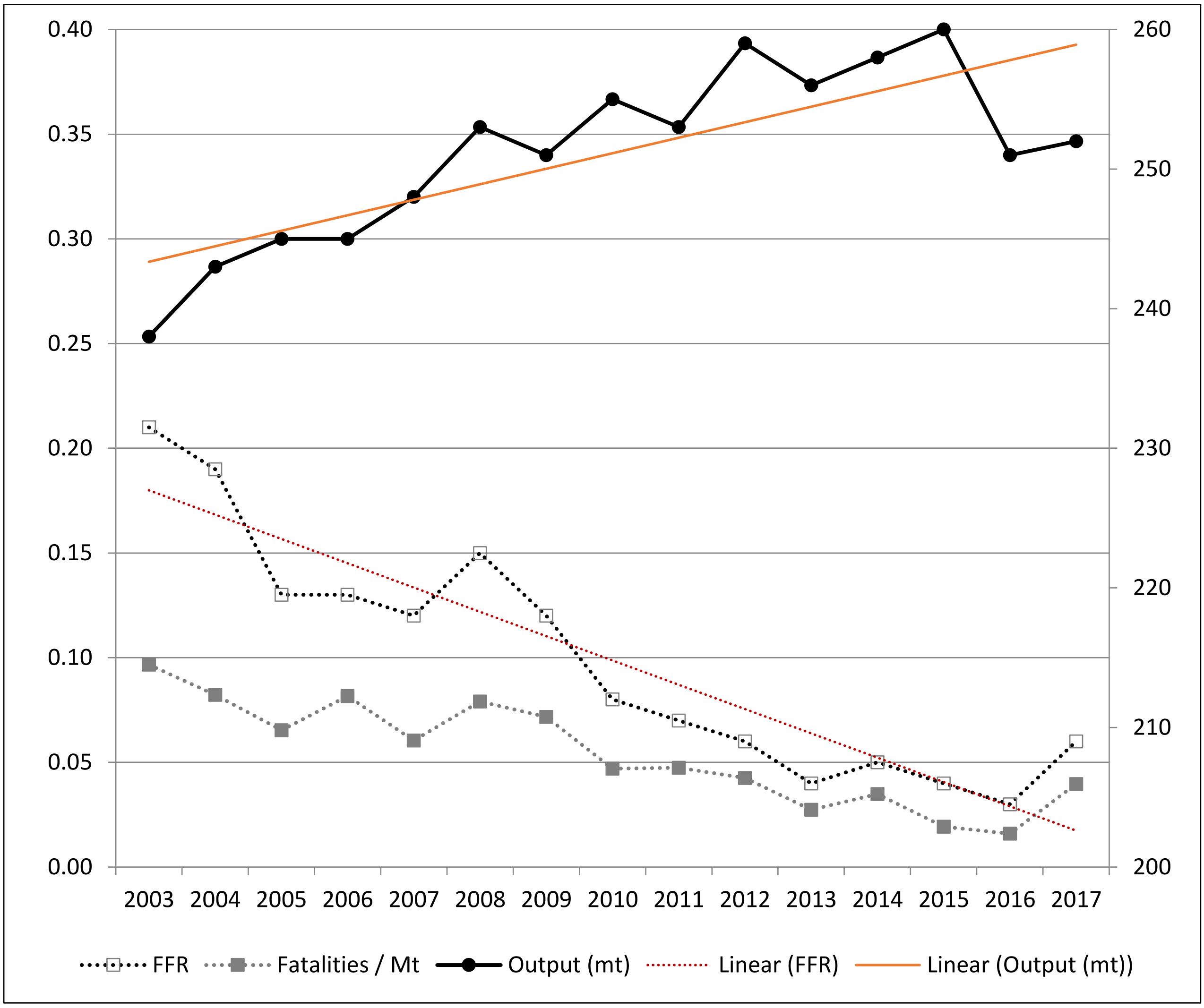

Figure 4.6 Coal Mining Fatality Rates, Fatalities and Outputs 2003-2017

Sources: MHSI Annual Reports, MHSC Mining Summits Presentations and Annual Reports, COM/ MINCOSA Facts and Figures, Leon Commission Vol. 1.

The fatality rate in platinum mines initially increased as production increased from 1996 to 1999. Thereafter it improved, more rapidly between 2001 and 2005, and then at a lower rate before plateauing out at an FFR of around 0.10. When the platinum output dropped in 2014, the rate reached its lowest level as shown in Figure 4.7.

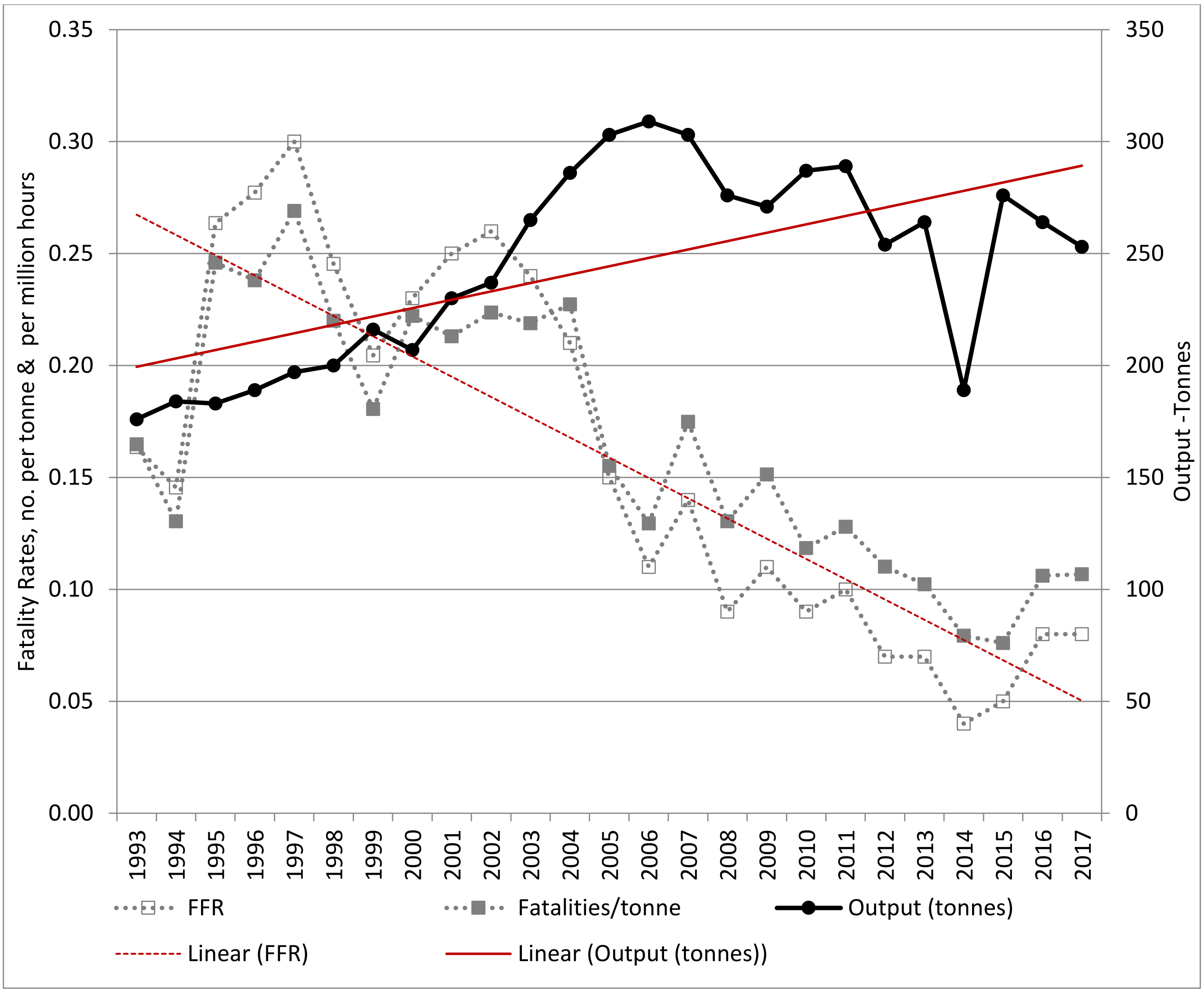

Figure 4.7 Platinum Output, Fatalities and Fatality Rates (FFR – fatalities per million hours worked)

Sources: MHSI Annual Reports, MHSC Mining Summits Presentations and Annual Reports, COM/ MINCOSA Facts and Figures, Leon Commission Vol. 1.

Overall, in the first five years after the MHSA came into effect, declining number of fatalities and declining fatalities rates on gold and coal mines had the greatest influence on the safety performance of the sector. As employment levels in gold mining fell in absolute terms, the controlling effect of gold mining fatalities on fatalities levels in the sector still dominant until well into the 2000s lessened. For gold mining these trends were consistent with long term trends of declining fatalities rates which can be traced back to the about 1916. Once the OHS milestones came into effect this fatality rate continued to fall, albeit at slightly lower levels that in the previous period. The long term decline of gold mining stems from the increasing unit cost of production which, currently, the mining Phakisa initiative aims to address (Macfarlane, 2018). In recent years pressure from the mine inspectorate and public intolerance of high numbers and levels of fatalities have added to cost pressures and reduced interest in investing in South African gold mines.

In the case of coal mining, the implementation of measures which significantly reduced the risk of coal dust and flammable gas explosions resulted in a significant change in coal mining fatality rates which underwent a step change in the late 1990s before declining more slowly and eventually plateauing. From the time of the Leon Commission, coal mining outputs increased while fatality rates declined. Employment in coal mining also generally increased during this period peaking around 2014 .

Platinum mining similarly to coal expanded while their fatalities rates decreased. Employment peaked in platinum mining in 2008 and 2012.

0verall for the major commodities in South African mining, fatality rates have continued to improve over the long term. Coal and platinum rates improved while mining expanded, while declining gold mining rates slowed in recent years, and levels of mining and employment declined.

Epidemiological data on the prevalence of occupational disease among ex-miners suggest epidemic levels of silicosis and pulmonary tuberculosis (PTB) as the effects of past exposures become evident, and greater efforts are made to find and identify workers with disease. Recently published sectoral data, on the other hand, indicates that the incidence of reportable occupational diseases has declined since 2008, but since the data is not normalised and there are gaps in reporting and surveillance, this inference cannot be conclusively drawn (MHSI, 2015) (MHSI, 2014). Incidence data however reflects the declining trend of employment in gold mining with fewer cases of occupational disease reported in gold, affecting the overall incidence of disease in the sector. The controlling effect of the declining incidence of silicosis, PTB and NIHL cases in gold mining, is evident in Figure 4.8 below.

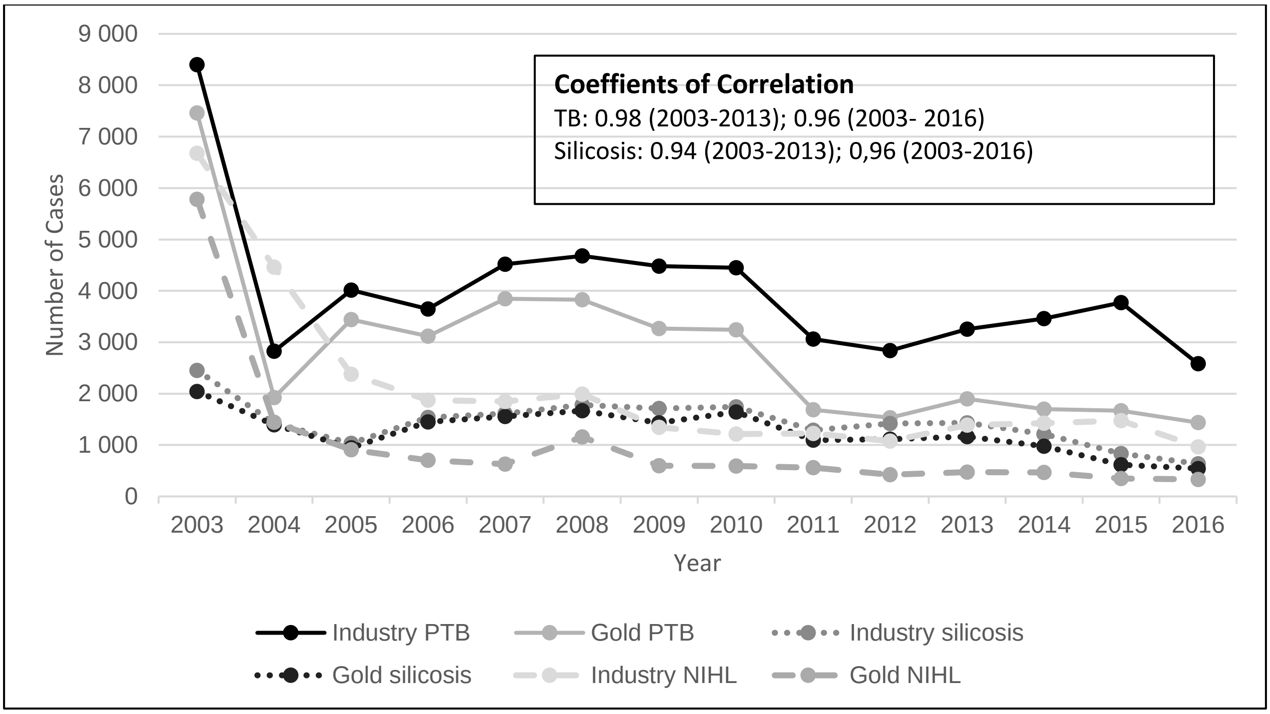

Figure 4.8 Incidence of Silicosis, TB and NIHL for The Industry Overall and Gold Mining

Sources: Expansion of Graph in ILO Paper. -MHSI reports, MHSC OHS Summit presentations, COM Facts and Figures.

The following figures (Figures 4.9- 4.11), show the number of cases of silicosis, TB and NIHL associated with the major commodities mined, gold, platinum and coal. Figure 4.9 shows the dominant effect of gold mining on the overall declining incidence of clinically evident silicosis in the sector.

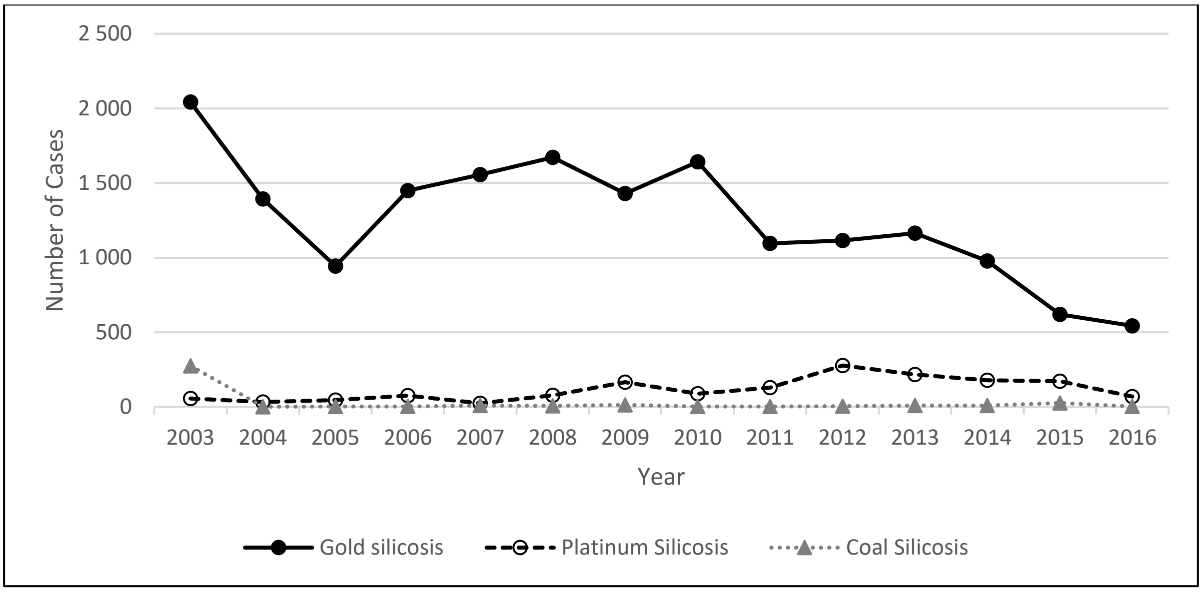

Figure 4.9 Incidence of Silicosis in Gold, Platinum and Coal Mining (2003-2016)
Sources: MHSI reports, MHSC OHS Summit presentations, COM Facts and Figures.

As silicosis is associated with gold, rather than platinum mining in which the risk of silica exposure is considered to be much lower, albeit that silica is present (Nelson and Murray, 2013; Biffi and Belle, 2003), the incidence of disease in platinum mining is likely to be consequent to the employment of former gold miners in platinum mines (Figure 4.9).

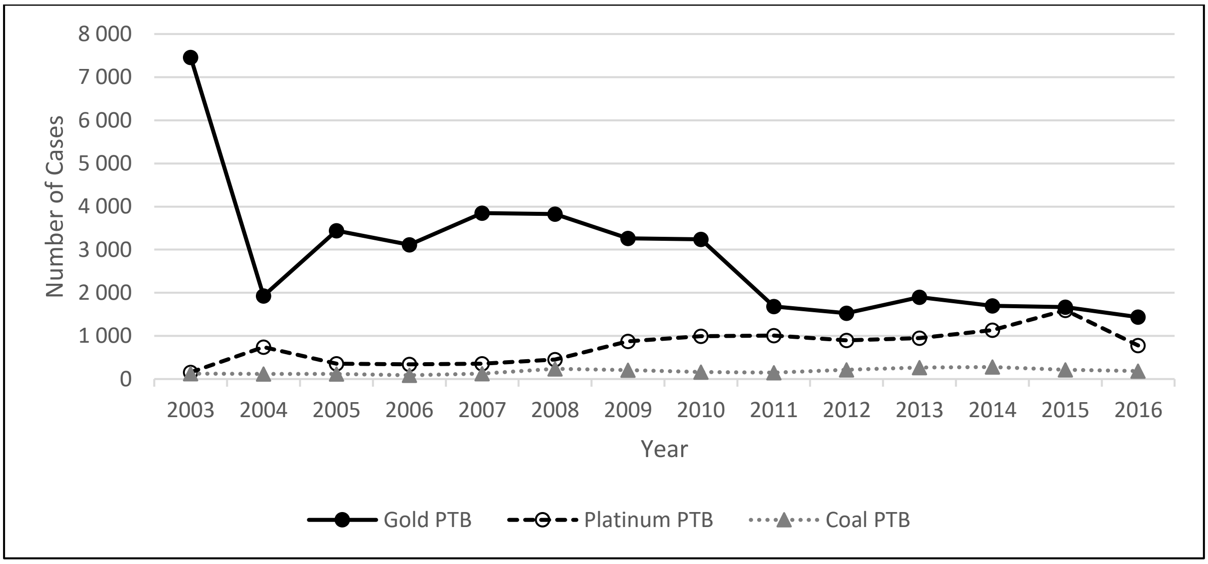

Figure 4.10 Incidence of Pulmonary Tuberculosis (PTB) in Gold, Platinum and Coal Mining (2003-2016)
Sources: MHSI reports, MHSC OHS Summit presentations, COM Facts and Figures

Figure 4.10 shows declining numbers of workers with TB in gold mining over the period 2003-2016. Over the same period, in platinum mining, the number of workers with TB rose, possibly as a result of the movement of miners from gold to platinum mines as well as the rise in the general risk of TB, with increasing levels mechanisation which generates more dust, and deterioration in housing conditions in the platinum regions. Figure 4.11 shows that gold mining's influence on the incidence of NIHL in the sector has declined over time while that of platinum has risen from 2008 onwards. This trend reflects declining employment in gold mining and rising employment in platinum mining.

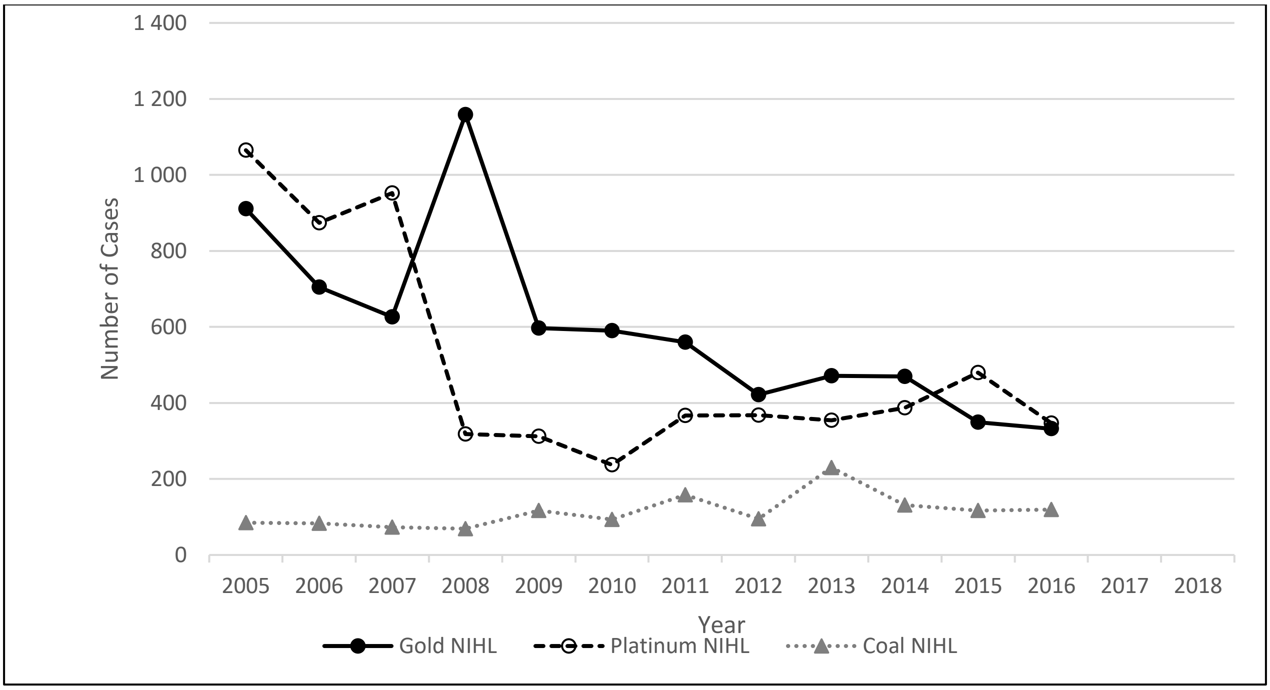

Figure 4.11 Incidence of Noise Induced Hearing Loss (NIHL) in Gold, Platinum and Coal Mining (2003-2016)

Sources: MHSI reports, MHSC OHS Summit presentations, COM Facts and Figures

4.5.12 **Conclusions and Contemporary Relevance**

This chapter explored the origins and immediate aftermath of the MHSA. Based on the evidence collected and data analysed the following conclusions are drawn:

(i) The MHSA emerged from the Leon Commission.

(ii) The NUM was instrumental in the establishment of the Commission and of the framing of the MHSA in terms of ILO conventions 155 and 176. Thus, the MHSA was premised on tripartism; included enabling rather than prescriptive mechanisms; and required evidence of continual efforts to improve H&S, and high-level periodic assessments of the status quo. NUM legal representatives successfully advocated for risk assessment, as a modern approach to addressing H&S hazards.

(iii) Priorities after the enactment of the MHSA were to establish the institutions of the MHSA and to thereafter revise the legislation and revamp the research programme managed by SIMRAC. That COMRO had been wound up, albeit that the spread and size of its expertise and resources were considered by sufficient for the organisation to system wide mining problems (Stewart, 2019), continued shrinkage limited the type, scope and scale of research projects which could be undertaken in support of improved H&S.

(iv) The institutions and forums established under the MHSA, namely the MHSC, MRAC, MOHAC, SIMRAC and the MQA demanded significant levels of capacity which stakeholder institutions were hard pressed to meet. For the Inspectorate this was also a time of major restructuring in the DME, with the technical role of the Inspectorate restricted to H&S and mine survey, while others took over their other responsibilities. Under the pressure of time, the need to extend and maintain various databases took a backseat.

(v) The gargantuan efforts required to establish and operationalise the work of new institutions and draft legislation, did not immediately translate into mine level interventions aimed at shifting the way that mines dealt with H&S.

(vi) The application of tripartism and RM, both fundamental to a systems-based approach to H&S, presented considerable challenges to all the parties and resulted in delayed decisions and missteps. The most concerning outcome is the increased number of H&S regulatory instruments, many of which were published in separate booklets which are not easily accessed in hard or electronic copy.

(vii) While formal rules for tripartite decision-making were established, they were routinely disputed, with difficulties arising when the tripartite parties could not agree. The Inspectorate did not have the authority to resolve such impasses. It had been severely criticised by the Commission, and as a result, lacked the authority to effectively influence debates over process, and the framing and scope of regulations. Other problems included unequal access by the parties to experts; attendance by the parties, especially union representatives of meetings, and the insistence by employer representatives on the parties reaching consensus.

(viii) Although, the Inspectorate was uncomfortable with regulations which could not be directly enforced, regulations were framed in terms of risk assessment without reference to the expected result. This meant that the actual level of risk posed by a hazard and its treatment was to be determined at mine level by mine personnel. As late as 2008, the Inspectorate found gaps and deficiencies in these practices following an audit of H&S practice.

(ix) The need for more specific guidance on what mines were expected to do was however recognised, and such guidance was incorporated into codes of practice, and guidelines on specific topics. This made necessary the drafting of another body of regulatory instruments, codes of practice and guidelines.

(x) As safety stewards morphed into safety representatives, the links between them and the trade unions weakened. Training was no longer orientated to representing and servicing workers, but to the tasks of identifying, monitoring, reporting and advising on risk.

(xi) The industry struggled to grasp that its H&S track record was unacceptable. The long term trend of decreasing rates of fatalities in gold mining (the dominant sector) were not sufficiently significant for most of the sector’s history to quell concerns and public outrage, and mine accidents continue to be trigger allegations of negligence (Robertson, 2018). Acknowledgment of the scale and nature of H&S problems emerged in the years after the Commission had completed its work, with concessions first made at the Truth and Reconciliation Commission.

(xii) Fatality rates in the industry declined in the first five years following the enactment of the MHSA. This improvement aligns strongly with developments in the gold mining, both improvements in the rate of fatalities (continuing earlier trends), and declining levels of gold mining and of employment in gold mining. Also reflected are noteworthy success in combatting flammable gas and coal dust explosions in coal mining. A long-term trend of lower levels of fatalities continued thereafter, continuing to coincide with the shrinking of gold mining.

Twenty years have lapsed since the MHSA came into effect, and the following observations can be made on the status quo.

Relationships between the stakeholders which were strained from the onset but nonetheless productive, became more dysfunctional in terms of the outcomes which tripartism was expected to deliver. But opportunities, formal and informal, remain available to the stakeholders to examine and work on improving this practice. This will require a willingness to explore the factors which enable tripartism; to examine the reasons why the practice is robust in some settings but not in others; to identify the factors that have advanced and detracted from commitments to tripartism; and last, but not least, confirm the relevance of tripartism to mine H&S, and agree on mechanisms to continually act to shore the process up.

Technological and operational changes have not been the primary drivers of OHS improvements until very recently. The OHS milestones and MOSH triggered OHS specific interventions. The full range of reasons for reduced fatalities and reported cases of occupational diseases are not properly acknowledged or discussed. If declining gold mining is indeed, as the evidence suggests, the most significant factor underpinning improved sector level OHS outcomes in absolute terms (lower levels of fatalities as reported by the DMR and lower numbers of cases of silicosis and TB in particular), then there is cause for reflection. While mines have a finite life, South Africa still has considerable gold resources, but the required radical technological improvements have not been made. Gold mine closure is, instead, the norm. As already shown this is in part due to difficulties in discussing how labour intensive gold mining can be mechanised or automated, and how this change could be directed to creating jobs elsewhere in the economy (Macfarlane, 2018). A new 'improved' baseline appears to be emerging as gold mining (and possibly platinum mining which is still significantly labour intensive) peters out to a few mines which remain viable by current mining methods (Ritchken, 2018). The tripartite stakeholders could consider whether declining employment in the most established parts of the sector is the chosen root to OHS 'success'. As discussed in chapter 6 (on tripartism), OHS and technology related discussions have historically taken place in different settings.

With reference to regulatory theory, this chapter has also shown how perceptions that the inspectorate had been captured by the industry diminished its authority and its ability to influence the drafting of regulations. The regulatory challenges associated with replacing specified requirements with system or process-based requirements were also examined. The former requires less interpretation and expert insight making for easier enforcement. This led to an emphasis on developing supporting codes of practice and guidelines which were more specific.

CHAPTER FIVE: MINE HEALTH AND SAFETY ACT CONTEXT

5.1 Introduction

This chapter, and the appended published papers examine the context in which the MHSA was developed and implemented. Three contextual aspects are considered:

- The socio- political factors, historical and evolving, relevant to mining, mine H&S and the provisions of the MHSA
- The changing configuration of the mining sector brought about by the MPRDA and other DMR initiatives[28]
- The "fit" of the MHSA to the changed and changing configuration of the sector.

In respect of socio-political issues, I show that:

- The culture, systems and practices in mining were shaped by the socio-political environment and affected mineworkers and their communities directly and indirectly. The factors considered include labour migrancy, the housing of the workforce, labour intensive mining systems, and the education and training of mineworkers.
- Pressures to maintain high employment levels conflict with pressures to improve H&S and productivity. The main problem is that high employment levels are associated with deep level mining in which seismic events, rockfalls, silica exposure, noise exposure and heat stroke risks are elevated. Changes required to reduce such risks involve mechanisation which would reduce employment levels.

The MPDRA and DMR interventions regarding artisanal and small scale mining affected:

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[28] Mining Petroleum Development Resources (MPDRA), Department of Mineral Resources (DMR)

- The configuration of the minerals sector, its footprint and the intensity of mining in certain areas of the country
- The number of communities and people exposed to environmental and OHS risks
- The range of activities requiring H&S oversight and support

The MHSA was designed to fit a sector that differs substantially from its present composition:

- The number of large, well-resourced companies in the sector have declined (Robinson, 2016)
- Small and medium sized companies have increased in number (Mitchell, 2016)
- The mechanisms of the MHSA, risk-management and participation in tripartite and bipartite processes require specialised knowhow and resources
- Informal, artisanal and illegal mining levels have increased, but their OHS impacts are unquantified (Rupprecht, 2015)
- The number of employer and labour organisations have increased, affecting tripartite engagement and decision-making (Khumalo, 2019; Hermanus *et al*., 2019).

My two published papers which support this chapter address technology trends in mining, and the impact of the MPDRA. The socio-political context of mining is explored in both papers, and augment the issues addressed in Chapter 5 on tripartism (Hermanus *et al*., 2019; Hermanus, 2017; Hermanus *et al*., 2015).

As discussed in the papers, mining started late in the Dutch and British colonial eras after the discovery of diamonds and gold; and was instrumental in the creation of the migrant labour system and a racialised labour hierarchy. These arrangements which predated apartheid, were subsequently cemented by apartheid policies of separate development viz. the pass laws, a differentiated education system and the forced removal of people from their land. Thus, mining which had laid the foundation for the development of key aspects of the apartheid system, was also regulated by apartheid law. This does not imply that the interests of the state and the mining sector always coincided, or that mining houses were always united in their positions. A summary of the socio-political history of the sector set out in the appended papers, is presented in the first section of this chapter.

5.2 The Socio-political Legacy and Context of the Sector

5.2.1 The Inheritance of the Past

In South African mining industry, H&S is regulated by the DMR, formerly the Department of Minerals and Energy (DME). This is a historical artefact, which underscores the centrality of mining in the South African economy, and the compromise, in 1911, between the government of the Union of South Africa and the mining sector on how the labour requirements of the mines were to be met (Leacock, 1910) .

Large scale mining in South Africa started in the diamond fields of the Northern Cape in the 1860s and expanded with the mining of gold from 1886 onwards. Mine employers established the COM, the forerunner of MINCOSA[29], to promote their interests in 1889. These interests included securing legislative measures favourable to the industry and co-ordinating the recruitment of mineworkers (MINCOSA, n.d.; McCulloch, 2012; Harington et al., 2004).

Arrangements between mining companies and the government were given force of law by the Mines and Works Act (MWA) and the Native Labour Regulation Act both of 1911. These laws gave rise to the "colour bar" in mining and the now deeply entrenched migrant labour system respectively, joining the recruiting efforts of mines to the aims of the State to regulate and control black miners (Jeeves and Crush, 1995; Yudelman, 1984) and ultimately the black population. This 'symbiotic' relationship lasted until the democratic era (Marais, 2001; Nattrass and Seekings, 2001; Yudelman, 1984).

[29] Chamber of Mines (COM), MINCOSA (Minerals Council of South Africa)

The specific details of the colour bar in the MWA changed over time, and ultimately specified that black people be barred from occupations such as blasting, the operating of mine shafts and the supervision of machinery and the workforce. The MWA reflected national policy by means of which the interests of white South Africans ("Europeans") of all classes were protected and enhanced through public education, welfare programmes, and job reservation (Seekings and Nattrass, 2002), while black South Africans were progressively channelled into a pool of cheap and surplus labour (Jeeves, 1985). While the mechanisms employed for controlling and subordinating black South Africans were symbolised by the job colour bar, they were more broadly imbricated in under investments in education and training; the loss of land which reduced the ability of rural communities to subsist; the migrant labour system and the pass laws. In mining, under the aegis of the COM, the effect of these measures were amplified by a centralised and forced system of recruitment[30] (Jeeves, 1985), lower wages than the norm, and the housing of black mineworkers in compounds under tight surveillance (Delius, 2018; Simkins, 1981).

Mining rapidly became central to the development of the South African economy. It remains a major employer, a major source of foreign exchange and is pivotal to the fortunes of many industries (Fine, 2008; Fedderke and Pirouz, 2000). Mining's role in the economy and its partnership with the state is described in terms of the formation of a Minerals-Energy Complex or MEC (Fine and Rustomjee, 1996; Fine, 2008). The MEC enabled the growth of apartheid capital through the establishment and growth of state entities in coal-based power generation, the manufacture of steel, and the development of rail infrastructure. Mining benefitted from the MEC through the apartheid labour system and the provision of key utilities and infrastructure. This arrangement, while driving growth, at the same time

[30] The centralised labour recruitment system drove independent labour recruiters and contractors out of the 'market'.

impeded industrial diversification; and maintained the system of apartheid which ultimately twinned economic development and underdevelopment.

In this context, the wellbeing of black South Africans and the health of black mineworkers was not of significance in the established social order (van der Merwe et al., 2010). Tightly controlled labour conditions were essential to the exploitation of South Africa's deep lying gold deposits (Delius, 2018; Innes, 1984 Jeeves, 1985; Wilson, 1972). On these mines achieving acceptable levels of production under harsh conditions presented significant challenges and the '*politics of white supremacy'* (Jeeves and Crush, 1995), obscured the human costs (May, 1987; Jeeves and Crush, 1995; Bolt and Rajak, 2016). Work on mines continued to be cruelly policed, until the mid-1960s when production incentives and a rational job grading system were introduced (Moodie and Ndatshe, 1994). The 1996-1997 president of the Association of Mine Managers described the dilemma of mine managers as follows, *'Throughout the century, though, one issue eclipsed all others. How should managers deal with labour? In South Africa that has taken on added urgency thanks to racial complications. Blacks and whites have been polarised completely as workers and employers'* (Hocking, 1997).

The apartheid labour system which allowed the gold mining industry to overcome labour shortages in its early and expansive years (Jeeves and Crush, 1995), created a structural framework which persists to the current day. The state and mining house interests did not always converge despite their symbiotic relationship. Skills shortages and the cost of labour were perennial problems in mining and mining houses voiced concern about state intentions to reserve skilled work for "Europeans". This policy prohibited mines from increasing the availability of skilled labour through stabilising a part of the black workforce. This concern did not translate into opposition to the apartheid government or the migrant labour system. The latter enabled mining houses to exercise inordinate control over the workforce and contain labour costs for nearly a century (Innes, 1984; Lipton, 1985). The Chamber of Mines' maximum wage policy which stopped mining companies from 'bidding up the wages' of black workers operated from 1900 into the 1970s (Kane-Berman, 2017), and job reservation which blocked the advancement of black workers in mining was abolished in 1988 (Cruise, 2011) over a century after the discovery of gold on the Witwatersrand in 1986.

By the 1960s South African labour policies had attracted international condemnation. In 1964, the country withdrew from the International Labour Organisation (ILO) following unanimous approval of a declaration against apartheid. The South African government was found to have violated the ILO's principal commitment to international peace and security, and persisted with 'legislative, administrative and other measures incompatible with the fundamental rights of man, including freedom from forced labour'. This declaration drew on earlier declarations for member states of the ILO in 1930, to phase out forced labour 'in the shortest possible period' and in 1957 to abolish it (ILO, 1998; Abolition of Forced Labour Convention, 1957; Convention concerning Forced or Compulsory Labour, 1930). South Africa re-joined the ILO in May 1994 after the election of its first democratic government (ILO, 1994).

From the late 1980s onwards, gold could no longer be mined profitably (Wagner, 1986). After companies started retrenching large numbers of workers, several interventions were launched to save jobs. These interventions which started in 1998 with DeepMine, included PlatMine, FutureMine and most recently the Mining Phakisa. While they involved the parties typically associated with tripartite engagement, when the MHSC's tripartite institutions were established in the mid-1990s, engagements on the future of mining continued without their involvement. The practice of tripartism in the country and in the mining sector is examined in Chapter 6.

Declining employment levels reflected the following trends. Job levels in the mining sector peaked at over 827,000 employed in 1987, largely due to employment in gold mines of 553,000 (67%). In 2018 mine sector employment stood at 453,543, having recovered from a low point of 406,000 employees in 2001, when the number of people employed on gold mines stood at 201,000. Since then employment on gold mines, approximately 100,000 people in 2018, continued to decline (MINCOSA, 2019). While employment in the mining of other commodities, platinum, coal, iron, chrome and manganese grew, it did not offset job losses in gold mining (Human Sciences Research Council, 2011; MINCOSA, 2018b). The declining gold price, the quality of gold reserves, difficulties of mining gold at depth, and a general shift towards higher paid skilled work, largely outside of gold mining (Seekings and Nattrass, 2002), have all contributed to lower employment levels. In addition, permanent mining jobs have been systematically replaced by short term contract jobs, particularly in the platinum sector's deep mines (Deloitte, 2013).

In essence, mining companies in increasing numbers found that labour intensive mining processes and the attendant social relationships required for gold and some platinum production, were no longer viable. More productive mining methods and new technologies were proposed as remedies which also supported improved H&S.

However, miners and mining communities carried the brunt of job losses, and the resulting discontent was exacerbated by disparities in pay for specific jobs, and differences between the employment arrangements for permanent and contract mining workers. By 2012, the level of contracting in mining was estimated at 28%, with contract workers earning less than workers in permanent jobs, living in poorer conditions, experiencing increased job insecurity, and encountering difficulties in securing fair labour practices and standards at mines. These factors contributed to tensions which precipitated the tragic events of 2012 at the platinum mines of Marikana in the North West Province. Seventeen (17) striking miners died and 78 others were injured by rifles used by the South African Police (Farlam, 2015; Deloitte, 2013) .

This historical and current context continues to bedevil relationships between mineworkers and mine employers.

5.2.2 **Health and Safety**

One of the consequences of this divided history is that, until the 1990s, few people in leadership roles in the mining sector appreciated the scale of death, injury and disease among black mineworkers and their communities. This does not imply that fatality and injury rates had not improved over time, but that by the 1990s accidents and disease was still at unacceptably high levels. The Leon Commission was required to bring focussed attention to the gravity of the OHS challenge. In 1997, in the foreword of a book on the history of the Association of Mine Managers of South Africa, the claim is made that that employees' H&S were a major consideration of the members of the association from the onset (Hocking, 1997). In the same year, the written submission presented by the Chamber of Mines to the Truth and Reconciliation Commission (TRC)[31] ascribed racism in mining to factors such as the law, common law and custom. It presented itself as instrumental in the development of South Africa's infrastructure, and in providing employment across the region. While it acknowledged that mining was dangerous, it made no mention of the deaths of tens of thousands of mineworkers in mine accidents (TRC, 2003). However, at the public hearings of the TRC, the Chamber and some of its members went further and *'apologised for its role during apartheid'*. COM representatives conceded that it should have done more and agreed that active steps were required to address *'the migrant labour system and the health and safety recommendations of the Leon and Myburgh commissions'* (SAPA, 1997; SABC, 1997; Nattrass, 1999). In the following year, during the 1998 presidential address to the SAIMM, on the future of gold mining, Roger Dixon stated that the prevailing fatality rates would not be acceptable to investors interested in deep level mining projects, no matter the reasons for higher levels of risk such as the depth of mining and rockbursts (Dixon, 1998). This statement signalled

[31] The Truth and Reconciliation Commission was established by Section 2 of the Promotion of National Unity and Reconciliation Act 34 of 1995. The TRC's purpose was to contribute to the '*pursuit of national unity*' to enable peace, reconciliation and reconstruction of South African society (Promotion of National Unity and Reconciliation Act, 1995).

acknowledgement by mining leaders of the sector's dismal H&S record. By the end of the 1990's, safety was firmly on the agenda of the COM.

In 2005, the COM convened the first employers' summit on health and safety. 'Led by Chamber of Mines president Dr. Con Fauconnier and vice-presidents Lazarus Zim and Bernard Swanepoel, the CEOs of most of South Africa's big mining companies signed a commitment towards the achievement of the milestones[32]. Fauconnier said these goals could only be reached if the members of the tripartite alliance continued to cooperate' (le Roux, 2005). In 2007, the outgoing president (Lazarus Zim) of the Chamber said that miners were 'not knowingly sent into mines to die' (Bridge, 2007). It had taken over a century for the sector to publicly acknowledge the unacceptability of its fatality, injury and occupational disease rates.

The state of H&S in the sector and the reasons therefor have already been discussed in the literature survey, in the chapter on the origins of the MHSA and in the appended paper on tripartism in the mining sector. To complete this account of the context of the MHSA and support the conclusions of this chapter, a short summary is presented here. The major causes of death and injury among mineworkers involve falls of ground, transport in mining, and contact with moving machinery. The majority of workers who have died on South African mines, have worked on gold mines. The sector has also been prone to disasters associated with rockbursts in deep level mines, flammable gas explosions in coal and gassy gold mines, mine fires, shaft related accidents on deep level gold mines, and rock falls. The migrant labour system compounded the problems of diagnosing and monitoring occupational disease. Occupational disease data are notoriously unreliable due to several factors, including the long latency periods associated with the development of many conditions, the difficulty

[32] Reference to the Health and Safety Milestones agreed to by all parties at MHSC.

of recognising occupational disease outside of the workplace, and the inadequacy of systems for diagnosing, documenting and recording occupational diseases.

Under apartheid, indifference to the wellbeing of mineworkers was the norm. Occupational diseases were systematically under diagnosed, and many became manifest only after miners had returned to their rural homes. At the time of the sitting of the Commission of Inquiry, no reliable statistics were available and occupational disease rates were estimated based on available research. The Commission concluded that rates of tuberculosis, NIHL, silicosis and coal miners' pneumoconiosis were very high, and possibly at epidemic levels (Leon et al., 1995, p. 17).

The Commission which was established by President Mandela was tasked with investigating 'all aspects of the legal regulation of health and safety in the mining industry' and making 'recommendations to the State President on improvements to existing regulations and implementation thereof, in the light of the circumstances prevailing in the industry and of international standards' It did not approach its task of assessing H&S separately from the country's social milieu. It opened with a review of the role of the COM to promote and protect the interests of its members, institutionalisation of the migrant labour system, the compound and hostel system, and the negligible training and education of mineworkers. It recognised that reform of mine H&S was linked to a larger project of social reconstruction, and for example proposed that mine housing become part of the 'Reconstruction and Development Programme'(Leon *et al*, 1995).

The stance taken by the Commissioners resonated with mineworkers' perspectives of their condition, evidenced in the songs they sung and the poems about their lived reality. For example, the song "Senzeni Na?", Mokitimi's poem about the pain of migrancy, and a song (not included herein) about the disaster at Coalbrook Mine in which 406 miners lost their lives (Coplan, 1987; Ralston, 1998), illustrate the chasm between mineworkers and their employers.

'Senzeni Na?

Senzenina? (x4) Sonosethu, ubumyama? (x4) Sonosethuyinyaniso? (x4) Sibulawayo (x4) Mayibuye i Africa (x4)

(Translation)

What have we done? (x4) Is our sin the fact that we are black? (x4) Is our sin the truth? (x4) We are being killed (x4) Return Africa (x4)'

'Banna, le nyale basali le tie le bone, (Men, marry women and you'll see,)

Banna, meleko e ata joale ke le siko… (Men, misfortunes multiply now in my absence ...)

Loale ke le siko ke le makhooeng koana, (Now in my absence at the mines,)

Lapa la ka le fetohile lithako, Paape, (My home became ruins,)

Paape, Bana ba ka ba fetohe lihase (My children became orphans,)

Kobo tsa ka li jeoe ke lifariki; (My blankets eaten by pigs;)

Banna, ke bolele tsa likonyana. (Men, I mean those of lambskin.)

Ke fihla ka Tsoane mabalane koana (I arrived at Tsoane there in the lowlands)

Ke fumane ntja ho se le e'ngoe. (To find a dog, there was not even one.)

Ke qalelle, ntata'a Tholang. (I began again, father of Tholang.)

Banna le beisini ho se le e'ngoe; (Men, even a bowl, there wasn't one;)

Banna le khaba ho se e'ngoe…(Men, even a spoon, there wasn't one ...)'

5.2.3 **Mine Housing**

Historically, black miners were treated as single men and accommodated in crowded rooms in mine hostels. They were separated from their families; and lived in cramped conditions which afforded no privacy. Hostel conditions caused ill-health. High levels of pneumonia were prevalent seasonally in the early 1900s, TB was easily spread, and poor nutrition and unhygienic conditions were the norm. These conditions were improved on the advice of Dr. A J Orenstein who pioneered mine medicine despite initially encountering stiff resistance from mine managers for interfering in their domain (Packard, 1989, p. 175). As the wretchedness of these conditions were acknowledged, the situation slowly improved between 1913 and 1939 (Packard, 1993, p. 291). More significant improvements made to living conditions in the hostels in the 1970s. In the 1980's, factors such as the unionisation of the workforce, the necessity of up-skilling, and the persistence of conflicts among hostel dwellers; led to the introduction of home ownership schemes and living out allowances (Hunter, 1991).

At the time of writing, the problem of adequately housing mineworkers remains a problem. This, as two significant studies indicate. The first, a SIMRAC commissioned study on mine housing, found that changes in the housing of miners from high density hostel rooms to low density rooms and family housing, had proceeded at different paces. This appeared to be due to institutional factors, long established policies and practices, and economic considerations (Lewis, 2003). The more recent second study found that while there were fewer single-sex hostels and hostel room occupancy rates had declined, more miners were opting for living-out allowances. So, while mine housing improved, higher levels of informal housing and problems with access to water, sanitation, and electricity grew with increasing utilization of living out allowances (Pelders and Nelson, 2018).

5.2.4 **Deep Roots of Distrust**

That there would be difficulty in establishing trust, robust plans and agreements in the mining sector is self-evident, given the circumstances of mining under apartheid; rising levels of unemployment and sub-contracted work; and the need to reconcile many competing needs and claims. In the literature, the findings of three areas of research have relevance, viz. the effects of national culture, the nature of the apartheid workplace, and the roots and dynamics of mistrust between groups of people in mining companies.

Research which explores the effects of national culture on workplace culture arises from inquiry into the challenges facing businesses which work across national borders (Khan and Law, 2018). It examines the effects of national culture on management practices and has relevance for understanding how the policy of apartheid, a national policy, shaped the workplace. It is generally accepted, in the context of international business, that 'national cultural systems' greatly affect corporate culture, norms, management decision-making, leadership style and human resources practice. National culture has been found to predict some, but not all workplace attitudes and practices. Behaviours and practices most predicated on national culture include group dynamics, perceptions of fairness, mechanisms for handling conflict, and work design (Taras *et al*., 2011). The findings of a study commissioned by the MHSC, *'Changing Minds, Changing Mines'*, point to this effect. The researchers expressed dismay at observed incidents of racism and disrespect which they observed; while blaming individuals for their injuries or for mistakes at work was found to be a '*strong feature*' of South African workplaces, it was particularly significant for those at the lower end of the organisational hierarchy; the general workforce felt substantially disadvantaged by racism; and concerns about the absence of training or appropriate training was especially an issue in respect of general workers (Shaw *et al*., 2010). Factors which moderate the effect of national culture include access to information technology, globalisation, and the internationalisation of human resources practices (Khan and Law, 2018), all of which are now more felt in the sector.

The second body of research originates from South Africa itself and concerns the post-apartheid workplace and the mechanisms employed to normalise it (Bezuidenhout, 2004, Webster and von

Holdt, 2005, Webster *et al*., 2008; Webster, 2013). Much of this research was originally commissioned by the DoL. The researchers found that many elements of apartheid in the workplace persist, such as managerial hierarchies that continue to reflect past practices; access to facilities that are based on position in the organisational hierarchy and which inevitably reflect racial divisions; inability to plan for and implement change; low levels of trust, and little ability to implement the arrangements set out in law which are aimed at changing the workplace.

The third strand of research is an Australian study conducted in two companies, of the effect of trust on the effectiveness of process- and management- based systems to improve OHS outcomes, (Gunningham and Sinclair, 2017; Gunningham and Sinclair, 2012; Gunningham and Sinclair, 2009). Both companies owned more than one mine site. At one company, OHS outcomes were found to be associated with mines at which trust levels were lowest, and where the reasons for mistrust were deep-seated and longstanding. Mistrust at the sites in this company could be traced back to adversarial relationships and the *'bitter history of mining'.* At the other company a different type of mistrust was at play. Between several groups in the organisation, levels of mistrust were high; between corporate and site management, groups of workers and middle managers, middle and senior managers, and between groups of workers. In this company, corporate managers appeared to be locked into a paradigm in which some site managers had little confidence, as it failed to address the needs of the *'increasingly complex organisation'*. However local and historical factors contributed to mistrust at both companies. Workers on contract felt particularly disempowered, and at the mercy of management initiatives. This study indicated that management-based regulation can fail for a variety of reasons. Corporate initiatives however well intended could be thwarted or resisted at site level; in the absence of supportive cultures, corporate initiatives could not bring about changes in behaviour; but where trust was high, management approaches driven from outside of the mine site, fared better (Gunningham and Sinclair, 2017; Gunningham and Sinclair, 2009).

All three areas of research point to the need to understand why engagement processes may not succeed, and to identify factors and interventions which promote cultural change and build trust. Focussing on adjustments which are realisable, and which could contribute to a strategy of sustained change may also be helpful.

To conclude, in the South African setting, labour relations continue to be hamstrung by the legacy of apartheid. While a new legal framework has been constructed, resources have been too limited to learn from similar initiatives taken elsewhere to effect change, and to enable research and investigation into how holistic change in the country's workplaces could be achieved. In addition, little has been done to identify modest interventions that support ongoing and systematic changes. Since the mining sector is a particularly well organised sector in South Africa, failures in this sector suggest that all of South African industries face deep-set challenges.

5.3 Deficient Training and Education

The Leon Commission interrogated the education levels of mine workers and the quality of their training. It recommended that workers be trained to undertake their specific responsibilities safely; that all mine personal undergo effective induction and periodic refresher training on the major hazards at the mine at which they were employed; and that adult education programmes be introduced to ensure that all miners were literate and numerate (Leon *et al*., 1995). The Mining Qualifications Authority was formally established by the MHSA to address issues of training and education in mining. In 1998 it was recognised by the DoL as a Sector Education and Training Authority (SETA). DoL oversight was transferred to the Department of Higher Education and Training in 2009. The registration of the MQA as a SETA, limited the resources which could be directed to basic education which the Leon Commission identified as a major concern. In 2016, the MQA's 2017 Sector Skill Plan report profiled the education level amongst mineworkers as follows:

Table 5.1 Mining Qualifications Authority, 2016 Figures

Educational Level Category	**Percentage of Mine Employees**
Higher Certificate to Post-Doctoral Degree	14%
Grade 10/ N1/NCV1 – Grade 12/ N3/NCV3	47%
Adult Education Training (AET) 1-4 – AET 9/Grade 9	22%
No Schooling	2%
Undefined	15%

Source: MQA, 2016

These MQA figures suggest that miners' educational levels have improved from the estimates made by the Leon Commission that over 66% of the mining workforce (excluding management and administrators) had not achieved standard 8 (grade 10) levels of formal education (Leon *et al*., 1995). Thirty-nine percent (39%) at most -if inclusive of the undefined category- have not achieved standard 8 or grade 10.

But no references were made to the OHS aspects of training in the 2016 MQA report. The 2008 DMR audit report found that H&S training fell far short of the requirements of the MHSA (DME, 2008).

A granular 2012 study conducted on 3 chrome mines and involving 873 participants presents a particularly grim view. Only 1.4% of the participants were found to be functionally numerate, the numerate participants were found to be females (more recently recruited) and participants aged over 41 years old and male, were the least numerate (Smit and Mji, 2012). These results could reflect differences between small and well-resourced mining companies, or the educational profile of rural workers as opposed to workers recruited from better resourced urban or peri-urban areas.

A paper published in the same year, suggested that adult education was a very poor vehicle for OHS training, as there appeared to be no link between such educational programmes and improved OHS.

Personal benefits do accrue, but the number of miners attending AET declined over the period 2005-2010, and the overall uptake and scale of AET at mines was poor. The authors proposed that the sector explore other methods of training mineworkers on the hazards of mining (Tuchten and Nkomo, 2012).

5.4 New Technology, Employment and Health and Safety

The DeepMine Collaborative Research Project which was initiated in 1998 to *'enable safe efficient and profitable ultra-deep level mining'* is an example of the practice of multiparty collaboration, which included tripartite representatives and operated outside of the formally established institutions. At the heart of the DeepMine Project was the fundamental problem in the underground mining system in South Africa, labour intensive mining, which could no longer be sustained. The problems experienced in deep-level gold mining included, high rock stresses at ultra-depth leading to increasing risk of seismic events, the high cost of cooling mines to levels at which people could work, and the difficulty of transporting miners, materials and rock over large vertical and horizontal distances (Durrheim, 2007). DeepMine was orientated towards generating knowledge about the nature of these problems and developing the capacity to address them. Initial participants in the DeepMine project were the Departments of Minerals and Energy, the Department of Trade and Industry, the National Research Foundation, the Chamber of Mines, the National Union of Mineworkers which represented all mine employees, and the University of the Witwatersrand. In 2001 this membership was extended to include Durban Roodepoort Deep Limited (a gold mining company), the Council for Scientific and Industrial Research, and the Mining Labour Caucus made up of representatives from unions other than the NUM. The DeepMine project was succeeded by the FutureMine Project which was more technology development orientated (Durrheim, 2007) and specifically aimed to reduce the costs of mining and improve H&S. Although a number of the tripartite partners and their technical advisors were simultaneously engaged in DeepMine, FutureMine and the MHSC, the aims and content of their respective interactions were never formally shared or aligned. In coal mining, the CoalTech Research

Association, which was established in 1999, is an example of an expanded form of tripartism in which government, labour and employers as well as research institutions were represented. CoalTech's mandate was directed towards securing the future of the coal sector through sustainability, competitiveness and safety (CoalTech, n.d.).

The most recent example of an expanded informal tripartite initiative is the Mining Phakisa. This initiative, as was the case with earlier initiatives, is centred on gold and platinum mining in which labour intensive methods are dominant, and in which low levels of productivity threaten the viability of a number of mines. A new mechanised and ultimately automated low-profile mining system is envisaged, which if also locally designed and produced would position the country for providing technology for such mining elsewhere in the world. The Phakisa also considered how the mining sector could be fairly and justly transitioned from labour intensive to mechanised / automated methods. This was seen to rest on a range of interrelated initiatives to develop the local manufacturing sector; to develop markets for platinum in particular, to attend to the wellbeing and livelihood of mineworkers, labour sending communities and communities affected by mining; and to address the negative of impacts of mining on the environment (Ritchken, 2018; Macfarlane, 2018; Singh, 2017). While the Phakisa initiative presents an opportunity for a holistic approach to the problem of mining, thus far, only the technical aspects are advancing, but it has yet to make an impact. At the end of 2017, according to MINCOSA about 50% of South African gold mines, which currently employ about 25% of the workforce are marginal. In 2018 11,127 jobs were lost in the industry as a whole with 3% and 10.5% of platinum and gold employees losing their jobs respectively. Projections are that by conventional mining methods gold resources will be exhausted by 2033 (MINCOSA, 2019).

5.5 More Mining Affected Communities

The Constitution of South Africa gives everyone the right to an environment that is not harmful to their health or well-being; and mandates the state to protect the environment for future generations by preventing pollution and ecological degradation. Conservation and ecologically sustainable development are to be promoted albeit that the use of natural resources *'in justifiable economic and social development'* is permitted (The Constitution of the Republic of South Africa, 1996, p. s24).

Mining which inherently involves the disturbance of land and the disruption of local ecosystems, immediately falls into the category in which the state needs to strike a balance between justifiable economic and social development on the one hand; and the protection of the environment and people from the harmful effects of environmental degradation on the other. Given the scale at which communities have been affected by mining, the state has not found the right balance. The South African Human Rights Commission (SAHRC) concluded after a hearing on the problems facing mining affected communities that *'the benefits of mining operations disproportionately favour mining companies and the state … often to the detriment of local communities.'* Poor local infrastructure and *'inactive'* local governments exacerbate the problem. Findings highlighted many deficiencies. These include shortcomings in the level of co-operation between government departments on land use and development, and in mine licencing processes that were often blind to the same considerations. Furthermore, there were flaws in the basis for compensation, for example, taking only physical infrastructure into account and relocating communities before the conclusion of compensation agreements; problems with mining in sensitive and protected areas; disquiet with the DMR's inability to provide crucial information about mining in such areas; a lack of information about post-mining land use, and insufficient funds for the management of land post closure (SAHRC, 2016).

The footprint of coal and platinum mining in particular have expanded. The coal resources of interest are concentrated in the Mpumalanga province in which significant water catchments are located and where there is a high concentration of South Africa's limited arable land (McCarthy, 2011; Forrest and Loate, 2017). Platinum resources are concentrated in the Bushveld Igneous Complex which straddles the North West and Limpopo Provinces (Godfrey, 2011). Both of the latter are extremely poverty stricken areas into which black South Africans had been forcibly relocated under apartheid. A 2003 report issued by Matthey documents the expansion of platinum mines from the eastern limb to the western limb of the complex where a different seam, UG2, is mined from that in the east. The eastern limb's Merensky Reef contains more platinum and was the first seam to be exploited (Johnson Matthey, 2003).

The appended paper – '*Impact of the South African Minerals and Petroleum Resources Act on Levels of Mining, Land Utility and People'* (Hermanus *et al*., 2015b) – which supports this chapter, highlights shortcomings in mining licensing processes, and the consequences of the increased footprint of coal and platinum mining. It draws attention to the growing number of companies with small coal mining leases, and which are unlikely to raise income sufficient to cover rehabilitation. Also documented is increased conflict within communities in platinum mining areas over access to mining rights, including access based on tribal affiliation, differences over the impacts of mining on land and water, and over the influx of job seekers. In well-established mining areas such as the Free State, municipalities as well as mining companies were found to be ill-prepared for mine closure, and engagement processes were compounded with a lack of trust, a lack of integrated planning and political infighting. We (the authors') recommended reviewing the provisions of the MPDRA in respect of its impacts on the rural poor in particular and public goods; reconsideration of the use it or lose it principle; and revisiting mining licensing procedures to enable improved planning and land management (Hermanus *et al*., 2015b).

MINCOSA reports raise related concerns. Rising levels of discontent among the members of communities around existing mines create uncertainties and risks. According to MINCOSA, among the challenges faced by gold mines in 2018, are unfulfilled community expectations, protests, and a lack of capacity in local government. At the same time, coal mines were also confronted with community unrest related to jobs and the award of tenders, and access to services which should be the remit of the struggling local governments (MINCOSA, 2018b).

5.6 Rising Artisanal, Informal and Illegal Mining

The distinctions between artisanal, informal and illegal mining are unclear. While artisanal and informal mining are not legally recognised, it is both the source of desperately needed income and of *'social, health and environmental ills'* (SAHRC, 2015). In 2016 about 14,000 people were estimated to be involved in this type of mining then valued at between R5bn and R7bn per annum, many of whom are non-South Africans (SABC, 2017; Fin24, 2016). In 2017, the estimated number of people involved had risen to 30,000 with lost sales, taxes and royalties estimated at R21bn by MINCOSA (Martin, 2019). Crime fighting agencies are primarily responsible for addressing the country's rapidly growing illegal mining problem. While the DMR promoted artisanal mining activities, it was not catered for in the MPDRA. Furthermore, H&S in artisanal, informal, or illegal mines are not regulated or monitored or documented by the mine inspectorate. Artisanal miners tend to use rudimentary tools and often work on the surface. The continuum into informal mining is associated with the greater use of machinery and larger excavations. Abandoned, closed or mothballed mines, particularly gold mines, are the main sites of illegal mining. It is estimated that there are about 6,000 abandoned mines in South Africa (Olalde, 2018). Along with gold, coal, chrome and diamonds are also illegally mined. In a number of cases, illegal mining also takes place within operating mines. As indicated in the tripartism paper which supports this chapter, illegal mining is often located in areas in which decommissioned mines and operational mines share boundaries, leading to situations in which illegal mining takes place alongside of, or intertwined with, legal mining activities. The miners, often destitute ex-mineworkers, tend to be drawn into crime syndicates. Stripping of closed or mothballed mines for scrap metal and other valuable materials is an associated activity. Harmony Gold and Sibanye-Stillwater mining companies are particularly affected (McKay, 2017; Reuters, 2018). In its 2017 report, PwC estimated that *'illegal* *mining and dealing of metal and diamonds'* cost the country over R7bn per year (Kotze and Rossouw, 2018, pp. 31–32).

The full nature and scope of H&S problems and incidents associated with artisanal, informal and illegal mining is unknown. The table below presents some information sourced from newspaper reports.

Table 5.2 Sample of Mine Accidents Affecting Illegal Miners

Date	**Incident/s**	**Impact/ Casualties**
2008	Barberton, fall of ground. Gold mining	35 deaths
June 2009 (SAPA-AFP, 2009; Parliamentary Monitoring Group, 2009)	Mine Fire at Harmony Gold Mine in the Free State	61 deaths first reported, 87 bodies in total recovered.
May 2012 (Etheridge, 2018)	Kleinsee Diamond Mine. Tunnel Collapse	10 deaths
October 2014 (Govender and Stoddard, 2015)	3 underground fires associated with illegal mining of gold	Harmony's Kusalalethu Mine closed for two weeks to remove illegal miners.
April 2016 (New 24 Correspondent, 2016)	Klipwal Gold Mine, KZN	5 deaths
September 2016 (Pijoos and Pretorius, 2016)	Disused, Langlaagte Mine. Miners trapped	2 deaths
May 2017 (Huffington Post, Staff Reporter, 2017)	Flammable Gas Explosion, decommissioned Harmony Gold Mine	40 deaths
May 2018 (Etheridge, 2018)	Kleinsee, collapse of 'hole'	2 deaths
February 2019 (Grobler, 2019)	Gassing, Gloria Coal Mine, Mpumalanga	6 deaths at least

In addition to deaths in mine accidents, rivalry between groups of informal or illegal miners has also resulted in fatalities. For example, the bodies of 14 informal / illegal miners were found in a town east of Johannesburg in March 2017. Their deaths were ascribed to rivalry amongst competing groups of miners (Pijoos, 2017). Police in Mpumalanga have described the area in which illegal mining takes place as a war zone (South Africa Today, 2018). GroundUp, an NGO, reports that between 2012 and 2015, at least 312 people mining informally have died in a combination of mine accident and conflicts over "turf" and with the police (Johnson, 2016).

Recommendations made by the SAHRC to improve the situation of artisanal and informal miners include:

- The need for further research to properly understand and characterise the components, scale and drivers of artisanal mining;
- Collaboration between government, mining companies and civil society on how best to respond to the opportunities and problems of such mining;
- The need for clear and unambiguous policy and regulation which supports and recognises rather than criminalises artisanal mining, and the need to address its human and environmental impacts (SAHRC, 2015).

5.7 Tripartism Under Pressure

The NUM dominance in representing mineworkers has been broken by AMCU, greatly complicating management-union relationships at mines, and deliberation and decision-making in tripartite institutions.

The Associated Mineworker and Construction Union (AMCU) rose to prominence in 2012 as disenchantment with the NUM peaked. Remuneration arrangements for full-time officials elected by NUM structures encouraged self-interest and led to gatekeeping by these officials of positions and opportunities for advancement. AMCU was formed by workers who broke away from the NUM and registered a new union in 2001. Workers' committees later invited AMCU rather than the NUM to represent them in disputes on the platinum belt (de Lange, 2012; Hartford, 2012; Munshi, 2017).

Rivalry for membership between the NUM and AMCU turned to enmity when armed conflict between members broke out (Montsho, 2017).

In 2018, membership of the NUM was estimated at 187,000, and on the platinum belt the NUM represented only 31,000 of the 172,000 strong workforce (Mahlakoana, 2018). AMCU membership currently outnumbers that of the NUM on the platinum belt and on a number of other mines.

In respect of employer groups, MINCOSA which is still the main representative of mine employers, is not the only employer body in the sector. The South African Mining Development Association (SAMDA) which was established in 2001 to represent junior miners (mainly black) often took positions at odds with that of MINCOSA and was influential in national policy debates. SAMDA influence waned after its offices closed in 2011 due to political infighting and the withdrawal of its largest member companies, but is still spoken for, by one of its prominent leaders (Mitchell, 2016).

5.8 Conclusions

The impact of the context of mining on the activities of the sector have been significant, wide ranging and systematically corrosive:

- The legacy of apartheid has diminished prospects for robust tripartite relationships, effective tripartite processes, and the capacity of mining stakeholders to follow through on their agreements. This context has remained unchanged and has possibly become more difficult as the complexity of the social environment has increased. Black workers were united under the NUM when the MHSA came into effect. The emergence of AMCU has split the affiliation of mineworkers, increasing the difficulties of engagement between stakeholders. While SAMDA is not active in the committees of the MHSC, it has influenced decisions on mining policy (SAMDA, 2015).
- Whether education levels amongst the most exposed members of the mining workforce have improved substantively is unclear. The effect of adult education appears to have had minimal

impact on the understanding of OHS hazards. Training and education interventions seem to have largely departed from the recommendations of the Leon Commission which underscored the importance of developing mineworkers' skills.

- When the MHSA came into effect, the sector was dominated by large well-resourced mining companies. The profile of the sector changed as smaller and less resourced companies took up mining. These companies have less capacity to follow an RM approach to H&S as required by the MHSA and its regulations.
- The footprint of mining has increased with the enactment of the MPDRA expanding the number of communities affected by mining. Mine management is required to address the H&S risks to people affected by mining and concurrently the MHSI is required to protect such people. The impacts are however unmonitored and undocumented.
- The MHSA did not and still does not cater for artisanal mining which the DME /DMR itself promoted. The provisions of the MPDRA, similarly, does not cater for such mining. Thus, this "sector" has grown in extent without being regulated.
- Illegal mining has burgeoned with declining mine employment. It was not a major activity when the MHSA was developed and was not foreseen. Such mining now affects established mines and those involved in illegal mining are at serious risk. Clear policy and plans to respond to the challenges of illegal mines have not been formulated.
- The expansion of the mining sector's footprint brought about by the MPRDA increased the potential for tension between mining companies and communities affected by mining. For these communities, mining's environmental effects also translate into H&S effects. Communities are also affected by declining gold mining employment and the absence of new employment opportunities, which have encouraged informal and illegal mining. The full extent of H&S consequences for those involved and those affected by informal or illegal mining activities is unknown.

- When the MHSA was conceived, the structural changes which subsequently took place were not anticipated.

As suggested by Fauconnier in 2005, the mechanism of tripartism in the MHSA offered opportunities to create a shared perspective of the sector's priorities and prospects. However over twenty years since the MHSA came into existence, a social compact remains elusive. With continued mine deaths in formally established mines, albeit at significantly lower numbers than in the past, mine management is still regarded as indifferent to the dangers faced by the workforce. This rift persists, despite substantive obligations to manage risks in which worker representatives should be involved, biannual assessments of the state of mine H&S in which all stakeholders participate, and evidence of declining fatality and disabling injury rates. Workers and their representatives feel disempowered in spite of the rights long established by the MHSA (Pijoos, 2018; Spies, 2018; Coulson, 2018; Coulson, 2017).

The possibility exists to review and renew the basis of tripartite engagement in mining, but as the behemoths of the sector withdraw, time is against the industry.

In summary, this chapter presented evidence of the many sources of social division and mistrust among mining stakeholders and showed how these limited prospects for meaningful engagement, shared understanding or co-operation in dealing with OHS risk. Evidence of how the structure of the sector has changed, and how the increasing footprint of mining has increased the number of people affected by mining has also been provided, pointing to the changed environment to which the MHSA now applies, and the need for new regulatory measures.

CHAPTER SIX: THE PRACTICE OF TRIPARTISM

This chapter examines and evaluates the policy and application of tripartism in mining; the links between tripartism in the mining sector and tripartism in the country, and the outcomes to date. It draws on archived material, the published papers included in this chapter and recent studies on the effectiveness of workplace structures.

Most institutions with labour related mandates are located in the Department of Labour (DoL), with the exception of those dealing with mine H&S, and the education and training of mineworkers which are located in the DMR. The DoL is also the custodian of South Africa's relationship with the ILO. The tripartite institutions established for mine H&S are the only ones dedicated to mining, although tripartite engagement in the sector has a long history outside of these and the DoL structures.

The first of the two papers which inform this chapter – *'The Achievement and Limitations of Statutory and Non-Statutory Tripartism in South African Mining'* (Hermanus *et al*., 2019) traces and assesses the history of tripartism, and tripartite practice in and outside of mining. The second paper – *Mine Occupational Health Leading Practice Adoption System (MOSH) Examined – The Promise and Pitfalls of this Employer-Led Initiative to Improve Health and Safety in South Africa* (Hermanus *et al*., 2015) - examines the implementation and fate of the MOSH adoption system which was developed to address significant risks. The developments that have taken place since the papers were published are discussed.

The definition of tripartism is key to the analysis presented in this chapter, thus it opens with an abbreviated version of the information presented in the literature survey. This is followed with an account of how tripartite engagement was situated and practiced in the political and labour relations environment of South Africa, in South African mining in general, and in mine H&S. Possible parallels with the experience of other developing countries with tripartism are also discussed.

6.1 Tripartism as defined by the ILO (recap) (ILO, n.d.)

For the ILO, effective social dialogue and tripartism is *'a means to promote better wages and working conditions as well as peace and social justice'.* The expectation is that these processes could advance good governance and cooperation, and lead to economic growth, which in-turn could enable the realisation of decent work which is the goal of the ILO (ILO, n.d.).

Figure 6.1 ILO Logic of Social Dialogue and Tripartism

Social dialogue and tripartite engagement can take many forms such as the exchange of information; consultation; negotiation including collective bargaining, dispute prevention and resolution; deliberations on the appropriate content of corporate responsibility programmes, and the interpretation of international framework agreements.

The conditions for successful social dialogue and tripartism depend on the commitment and political will of all parties to the process; respect of rights to freedom of association and collective bargaining; an enabling framework of law and institutions; and organisations – workers' and employers' – that are strong, independent and technically competent.

6.2 Tripartite Engagement at National Level

By the time South Africa's first democratic government was elected in 1994, 50% of the workforce were members of trade unions, and membership was concentrated in three federations - COSATU, NACTU and FEDSAL. The leading trade union federations of the time, COSATU and NACTU, were powerful enough to induce the apartheid state to hear their views before making changes to labour legislation (Gostner and Joffe, 1998). In this way, stakeholder discussion over labour law - '*social dialogue over labour legislation*' became the norm (Benjamin and Cooper, 2016). The practice of multi-stakeholder policy-making led to the establishment of the National Economic Development and Labour Council (NEDLAC) in 1994, before the MHSA was promulgated. NEDLAC's mission was to, through social dialogue, create a broad social accord on the post-apartheid economy, which would bring stability to the country, improve the workplace, and enable inclusive and sustainable economic growth.

As discussed in the tripartism paper (Hermanus *et al*., 2019), the NEDLAC Act (National Economic, Development and Labour Council Act, 1994) made provision for membership by four groups - government, organised business, organised labour, and representatives of community and developmental organisations. NEDLAC was mandated to consider all proposed labour legislation and all significant changes to social and economic policy before these were introduced in parliament. The policy intent of the NEDLAC Act, in respect of the transformation of the workplace, was given effect by new laws governing labour relations, conditions of employment and skills development.

Questions about whether NEDLAC could deliver on its mandate were raised within a few years of its founding (kaNkosi, 1997). In 1996, the government itself by-passed NEDLAC to introduce the Growth, Employment and Redistribution Programme (Bassett, 2004). Both labour and business did the same on issues when they believed that they would be better off dealing with government directly (Adler, 1998). Ultimately, the ambitions for NEDLAC were never realised, and in the absence of an overarching accord, deliberations were conducted piecemeal, reflecting tactical manoeuvres rather than shared goals. Representation was also an issue. The employer organisations and unions represented in NEDLAC were never broadly representative of society. Large numbers of South African workers did not belong to unions, and the interests of smaller employers did not align with those of large employers (Dibben *et al*., 2015). In addition, all parties, including government, were relatively disorganised (Adler, 1998).

Nonetheless, NEDLAC's work on the reform of the basic conditions of employment, decent work, workers' compensation, minimum wages and youth unemployment continued. But the positions of the participant organisations were often poles apart, and the exchanges between them tended to be adversarial rather than consensus- seeking. Bitter battles were waged within different camps - within the business group and amongst the trade unions; government officials failed to turn up for meetings, and disagreements over aspects of the Basic Conditions of Employment Bill, the Skills Development Bill, the youth wage subsidy and other issues constantly arose (kaNkosi, 1997; Menon, 2017). Overall, few agreements were struck in NEDLAC and another structure, the Millennium Labour Council (MLC), was founded in 2000 to hammer out agreements which could thereafter be brought before NEDLAC for consideration (Dibben *et al*., 2015, p. 465). The MLC was not particularly successful. After the events that took place at Marikana, a review of NEDLAC was commissioned with the support of the ILO, in the face of concerns over whether NEDLAC could deliver a viable social compact (Joffe, 2013; Webster and Joynt, 2014).

Differences within the stakeholder groups continued to beset NEDLAC. The was little agreement on either the premises or conclusions of the positions put to the body. Business Unity South Africa (BUSA) represented employers including the COM, until February 2017 when the Black Business Council split from NEDLAC. Among the organisations representing labour, COSATU, NACTU and FEDUSA; COSATU has been most affected by the splitting off of a number of member unions, most notably the National Union of Metalworkers of South Africa (NUMSA) in 2014. To date, no alternatives to NEDLAC have emerged and efforts continue to address its shortcoming and limitations.

Changes in the global economy also hampered NEDLAC. The advent of democracy and the institutionalisation of tripartism coincided with the rise of globalisation, which increased the insecurity of work and the mobility of capital in South Africa as elsewhere. It enabled the establishment of global corporate structures and global supply chains; and created different *'worlds of work'* which were favourable to a section and not the whole of the global workforce (Webster, 2005; Carmody, 2002). Mining opportunities elsewhere in the world presented better opportunities than those in South Africa, with its legacy of ills. A number of mining companies moved off-shore and created more diversified mining portfolios (Robinson, 2016). Private investments in mining research and development dropped off, as it appeared that expertise could be sourced from anywhere in the world. At mine level, subcontracting arrangements increased, compounding the precariousness of work, and divisions between workers in the formal and informal economy. At the same time new prospects for promotion and in business became available to the leaders in the labour movement.

The state of tripartism at national level, did not set an encouraging tone for sectoral level tripartism, and many of the individuals involved in the national forums also served on sectoral forums.

6.3 Tripartite Engagement in Mining and Mine Health and Safety

Tripartism and tripartite engagement in mining did not start with the establishment of the MHSA and its institutions. In 1990, the National Union of Mineworkers (NUM) called for tripartite discussion over the economic future of the mining industry. While the first of these talks, so-called "mining summits", failed, the NUM put forward a demand for an inquiry into mine H&S which eventually resulted in the Leon Commission which gave rise to the MHSA (Masilo and Rautenbach, 2008). Further "mining summits" and initiatives such as Deep Mine, PlatMine and FutureMine were convened following the first failed discussions on the future of hard-rock mining and continued to be normatively tripartite. The common theme was to stave off mine closure and prevent job losses. Underpinning these initiatives were rarely openly acknowledged issues - declining productivity and stalled technological innovation. Discussions in "summits" and forums continued in parallel to the formally established forums of the MHSA, despite deep structural linkages between the issues discussed at the summits and mine H&S. For example, maintaining job levels in labour intensive operations meant continued exposure of workers to severe H&S hazards, and while removing workers from the working face through mechanisation would reduce such exposures, it would also result in the loss of mining jobs. Consequently, the MHSC and the Mine Health and Safety Inspectorate (MHSI) largely avoided grappling with the fundamental problems of the sector. While the MHSC was the legally constituted tripartite body for any matter bearing on H&S, multi-stakeholder engagements on issues germane to its responsibilities continued outside of it.

As indicated in Chapter 5, the most recent multi-stakeholder initiative outside of NEDLAC and removed from the MHSC, was the Mining Phakisa which adopted a holistic perspective of the changes needed in the sector. It was part of a *'cross sectoral'* national programme, Operation Phakisa, launched by national government in 2014 (Government of South Africa, 2014). The initiative has been particularly concerned with gold and platinum mining in which labour intensive methods are dominant. The low levels of productivity associated with these methods make them no longer viable. A new mechanised and ultimately automated low profile mining system is envisaged, which if also locally designed and produced, would position the country for providing technology for such mining elsewhere in the world. The Phakisa acknowledged that South Africans paid a very high price in the form of migrant labour, pass laws, disenfranchisement, land dispossession and low wages to make gold and platinum mining viable. The proposed solution was to embark on a range of interrelated initiatives. These are to (i) develop new technologies in partnership with the local manufacturing sector, (ii) to attend to the wellbeing and livelihood of mineworkers, labour sending communities and communities affected by mining, and (iii) to address the considerable negative impacts mining has had on the environment including arable land and water resources . To date however, only the decisions on the technical aspects of the Phakisa have been taken forward (James, 2018a; Macfarlane, 2018; Parliamentary

Monitoring Group, 2016). In the meantime, the closure and mothballing of uneconomic mines carried on, leading to higher levels of informal and illegal mining which, as seen in the preceding chapter, have created new risks, including risks to H&S.

6.3.1 **Tripartism Under the MHSA**

To Recap. The MHSA formalised tripartite arrangements in mine H&S. It introduced new rights for workers - for representation, participation, information, training and the right to refuse dangerous work. The MHSC, set up under the MHSA, was responsible for designing appropriate legislation, and formulating policy to end the high levels of death and injury and occupational disease among workers on the mines. The MQA was mandated to advance the development of skills amongst mineworkers, previously rudimentary, but clearly central to improving H&S. While the MQA was established by the MHSA it is also a registered Sector Education and Training Authority under the Skills Development Act of 1998. The primary responsibilities of the MQA include producing and implementing sector skills development plans every five years (updated annually) and, establishing and overseeing the planned programmes. The MQA has a specific mandate to improve H&S skills and qualifications in the mining sector.

Government's responsibility for mine H&S resides with the MHSI located in the DMR. Employers are represented by COM and the South African Mining Development Association (SAMDA), which respectively represents established and junior mining companies. Major unions include NUM, AMCU which broke away from the NUM in 1998, Solidarity and UASA. These organisations represent government officials, employers and workers, all of whom have designated and complementary roles under the MHSA.

The Chief Inspector of Mines in whom overall authority for mine H&S vests is responsible both for H&S at mines and for the effects of mining on people in surrounding settlements and communities.

In mining operations, the tripartite requirements of the MHSA were given effect through the following arrangements and practices:

- Company and mine level agreements on H&S that include arrangements for information sharing, joint planning and decision-making, training and auditing.

- Organisational structures such as H&S committees, and safety representatives who represent workers in the workplace and who are members of H&S committees or sub-committees. The remit of these committees includes consideration of concerns raised by workers, of managerial concerns, of levels of compliance, training, interventions to improve H&S, and of incident investigations and reports.

- Individual workers are required to look out for their own H&S and that of others.
- Suppliers to the industry are required to ensure that their equipment is fit for safe use.

6.3.2 The Mine Health and Safety Council

The Chief Inspector of Mines is the chairperson of the MHSC. It is funded by the DMR which pays for the administration of the Council.

The MHSC is supported by administrators in developing policy, legislation, and programmes to promote improvements in H&S. The MHSC's tripartite structure is carried through to its subcommittees, which are responsible for the development of the regulations (MRAC), occupational health policy (MOHAC), and the development and oversight of a programme of research (SIMRAC). SIMRAC predates the MHSA and was established by the previous government and employers to conduct fundamental research into the problems of mining. It is funded through levies collected from the mines, based on a combination of measures of H&S performance and employment numbers.

6.3.3 The Effectiveness of the MHSC

The MHSC is not fully representative of the sector and participant organisations do not have equal capacity. Details of the main organisations involved, or which should be involved, in MHSC related activities are set out in table below:

Table 6.1 Tripartite Participants of the MHSC. (AMCU is the most recent)

Organisation	Tripartite Group	Section of Tripartite Group	Membership / Strength
Department of Minerals Resources, Mine Health and Safety Inspectors	Government	n/a	n/a
Chamber of Mines (now MINCOSA)	Employers	Established Mining Companies (typically large)	69 members accounting for 90% of the minerals produced in South Africa (Chamber of Mines of South Africa, n.d.).
South African Mining Development Association (SAMDA)	Employers	Junior mining companies (typically led by black entrepreneurs)	Not available and inactive in the MHSC
National Union of Mineworkers (NUM)	Employees	Mineworkers Energy workers Construction	Founded in 1982. 195 000 members in 2016 Membership down from 310 000 in 2012.(Bloomberg, 2016)
Association of Mining Workers and Construction Union (AMCU)	Employees	Construction, Mineworkers, Security personnel, Cleaning staff	Registered union since 2002. Approximately 200 000 members as at March 2017 (AMCU, n.d.) Recently active in the MHSC. Limited participation.
Solidarity	Employees	Mining, Agriculture Metal & Engineering Chemicals, Communication and Defence	First established at the Transvaal Miners Association in 1902. Current membership 140 000 in total across many sectors. Membership initially whites only until a few decades ago.
UASA Previously the United Associated of South Africa	Employees	Mining, Engineering, Construction, Health Care, Forestry, Motor, Security etc.	Initially founded in 1894. Membership approximately 75 000 and 60 000 (response to personal query, January 2019)

Since the inception of the MHSA national tripartite initiatives were launched as described in the table below.

Table 6.2 National Initiatives

<table>
<tr><th>Tripartite Initiatives</th><th>Lead Institution</th></tr>
<tr><td>2003 to 2013, Safety Milestones (Journey towards Zero Harm. The main thrusts were to:
• Reduce fatalities to international sector leading levels
– In the Gold Sector: By 2013, achieve safety performance levels equivalent to at least current international benchmarks for underground metalliferous mines.
– In the Platinum, Coal and Other Sectors: By 2013, achieve constant and continuous improvement equivalent to at least current international benchmarks.
– To achieve international benchmarks, an annual reduction milestone of 20% was agreed to by stakeholders.
• Eliminate silicosis
– By December 2008, 95% of all individual exposures to be below the occupational exposure limit for respirable crystalline silica of 0.1mg/m3
– After December 2013, using present diagnostic techniques, no new cases of silicosis will occur amongst previously unexposed individuals (Previously unexposed individuals = individuals unexposed prior to 2008, i.e. equivalent to a new person entering the industry in 2008).
• Eliminate Noise Induced Hearing Loss
– After December 2008, no deterioration in hearing greater that 10% amongst occupationally exposed individuals
– By December 2013, the total noise emitted by any equipment must not exceed a sound pressure level of 110dB(A) at any location in the workplace</td><td>Mine Health and Safety Council</td></tr>
<tr><td>2008, Tripartite action plan to achieve 2013 milestones, and formation of Regional Tripartite Health and Safety Forums</td><td>Mine Health and Safety Council</td></tr>
<tr><td>2008, Occupational Health and Safety Learning Hub established</td><td>Chamber of Mines</td></tr>
<tr><td>2011, Culture Transformation Framework approved</td><td>Mine Health and Safety Council</td></tr>
<tr><td>2014 Milestones on Health and Safety
• Elimination of Injuries
– Zero fatalities by December 2020
– 20% reduction in serious injuries by December 2016
– 20% reduction in lost time injuries by 2017
– Rehabilitation of injured workers
• Elimination of Occupational Diseases</td><td>Mine Health and Safety Council
As at November 2018 – fatalities at 80 (instead of 42).
Reduction in injuries behind desired targets.
More silicosis, pneumoconiosis, and NIHL</td></tr>
</table>

Tripartite Initiatives	Lead Institution
– By December 2024, 9%% of all exposure measurements to be below the limits (0,05 mg/m^3 for silica dust, 1,5 mg/m^3, 1,5mg/m^3 for platinum dust, 1.5 mg/m^{3}for coal dust – No new cases should occur amongst previously unexposed individuals • **By 2024 Noise emitted by equipment not to exceed 107 dB(A)** – By 2016, no employee Standard Threshold Shift > from the baseline – Integrate and simplify compensation systems • **Reduction and prevention of TB, HIV&AIDS** – By December 2024, the TB incidence rate should be at or below the National TB incident rate – 100% of employees offered HIV counselling and testing (HCT) annually and all eligible employees to be linked to an anti-retroviral (ART) programme	cases diagnosed than expected. 100% HIV counselling, and 66% tested of HIV.
2016, signed pledge to improve health and safety	

Sources: MHSC Mining Summit Presentations, Learning Hub website

The agreed goals were not met in the initial decade in which the milestones were in force, leading to carryover. OHS trends and reports for the period indicate tardiness in acting on the goals; unrecognised health impacts, and a strong association between declining employment in gold mining and H&S outcomes. Further research could shed light on the actions and activities which stakeholders took, or could have undertaken, to support the sector goals; as well as the extent to which MHSC decisions were taken up and cascaded through the stakeholder organisations.

Through MRAC and MOHAC, the MHSC has produced a prodigious body of regulatory instruments which have replaced some, but not all, of the regulations incorporated into the MHSA from the Minerals Act (34 Chapters in total of which 5 chapters have been repealed). In total 23 new regulations have been produced, along with mandatory codes of practice (21 estimated), guidelines for the compilation of mandatory codes of practice (19 estimated), codes of practice (3 estimated and guidelines (1 estimated).[33] The accessibility of these codes and guidelines to everyone who has legal responsibilities for mine H&S warrants further investigation.

In addition, a change appears to have occurred in how the MHSC operates. The Council now has a chief executive officer and staff who report to the CEO. In practice, the tripartite MHSC appears to have taken on the form and role of a board. The while the tripartite partners appear to have become board members who govern the MHSC, the secretariat appears to have become an executive. It is unclear where policy emanates from in the MHSA. This change appears to have taken place prior to or during 2008 (MHSC, 2009; MHSI, 2014;MHSC, 2016). It appears to mirror the merger of the HSC and HSE in the UK at about the same time. The effect of this change is still to be evaluated.

6.3.4 **Safety Committees and Representatives**

As documented in the tripartism paper (Hermanus *et al.,* 2019) , MHSA's tripartism requirements translate into the following arrangements in companies and at mine sites

- Agreements on H&S which include provisions for sharing information, OHS related planning and decision-making, and OHS training and auditing.
- In large mines, shaft level H&S committees have also been established, and full-time safety representatives have been appointed. These structures and the full time representatives are to review the concerns that have been raised by the workers and managers, consider the state of H&S in their areas of responsibility, discuss training needs and interventions to improve H&S, and review major incidents and mine accidents.

It is unclear whether these committees have functioned as envisaged. The information available suggests that there are significant shortcomings and differences between envisaged and actual roles.

[33] These estimates are based on the documents located on the DMR, ASPASA, MHSC, and law firm websites.

A sector-wide audit conducted by the MHSI in 2008, found in two thirds of mining companies the committees were properly established (DME, 2008). A study conducted by Coulson found H&S representatives had essentially taken on the role of safety officers, with responsibilities for risk assessment, worker education, compliance, reporting and administration. The representatives did not have role in trade union structures, who conducted OHS discussions without their input. Many representatives felt disempowered in their roles, and that being a safety representative, involved more risks than benefits. Coulson likened the predicament of safety representatives to the process of 'responsibilisation'. This term was coined to describe the shifting of H&S responsibilities in Canadian mines from managers to workers who were increasingly being blamed for non-compliance (Coulson, 2018); Fidler, 1986).

Interestingly, the regulations of the Minerals Act on the duties of '*responsible persons'* and *'workmen',* which are now regulations of the MHSA, assign the following H&S responsibilities to safety representatives and workers (Mine Health and Safety Act, 1996 (Minerals Act Regulations)):

- For safety representatives – to report to the person in control of the working place or machinery any threat to the safety or health of any employee identified by him/her or reported to him/her in the area for which they are responsible; when accompanying the safety officer to report the same to him; to perform functions assigned to him in terms of Chapter 2 of the regulations which deal with the responsibilities of person including safety officers, environmental officers and safety representatives.
- For workmen – to record in the record book any information dust, fumes or defective ventilation.

These regulations indicate that the association of H&S representatives with safety departments of mines precede the MHSA. Thus, the current predicament of safety representatives may in part be due to the fact that the regulations of the Minerals Act dealing with safety representatives have not been repealed, and these position representatives as the 'eyes and ears' of supervisors and safety officers.

6.3.5 The Mine Occupational Safety and Health (MOSH) Initiative

The MOSH Leading Practice Adoption System was initiated by the Chamber of Mines to identify, document and transfer best OHS practices in the sector. The paper (Hermanus *et al.*, 2015) which examines MOSH in the context of tripartism, gives an account of how the system was designed and implemented, the initial reception to it by stakeholders, and the process of transfer of best practice at the mines. MOSH was planned as a tripartite initiative but failed to secure direct involvement from the MHSI and the major trade unions – NUM and AMCU. Transfer of best practice through the mechanisms of MOSH were however taken up at regional meetings. Subsequently, the programme became an aspect of the amended 2010 Mining Charter. Progress made in reducing falls of ground, dust levels and noise in mines is ascribed in part to the effectiveness of MOSH.

The MHSI did not engage with the MOSH formally but recognised its value, particularly in engaging workers and the possibility of avoiding what it described as 'repeat accidents'. MHSI representatives also expressed concern that all mines were not adopting the leading practices identified, and that some practices were low down on the hierarchy of controls. The MHSI ensured that MOSH was included in the Mining Charter of 2010 to compel the sector to take uptake seriously. That the MHSI opted for a formal mechanism which gave it oversight of MOSH rather than involve itself in shaping or informing the process, is indicative of the nature of the relationship between the MHSI and the COM (mine employers).

The MOSH programme involved identifying a leading practice at a 'source' mine; developing the tools and mechanisms for transferring and confirming the practice at another mine (the demonstration mine); and promoting uptake at other mines (the adoption mines). The review examined three key levels of activity of MOSH*: governance and oversight* in which several parties were involved including representatives of some labour unions*; resourcing and capacity* of the adoption and transfer processes; and *mining operations* at the source, demonstration and adoption mines, which represented the key steps in the MOSH process. At mines, managers, supervisors and workers were involved in volunteering as the source mine, choosing to be the mine which demonstrated transferability, and thereafter choosing to adopt the leading practice on the basis of the lessons learnt and with the support of the relevant MOSH adoption team. The review identified the successes of the programme as, the clear commitment of programme participants to understanding the leading practice fully, and to identifying and overcoming the challenges of embedding it elsewhere; its ability to check whether a leading practice had the necessary effect or not; and its capacity to share experiences on the leading practices through dedicated communities of practice established in mining districts. Challenges included difficulties in following the very detailed adoption process to the letter (the process was adapted at mine site); documenting the rollout of leading practice as planned (quite onerous); difficulties in embedding leading practice due to high levels of management turnover; competition of many issues for attention at mine sites; and sustaining communities of practices (which seemed to have a 'shelf-life'). Another outcome of the review were short case studies of the leading practices examined, viz the use of the Hilti-rock drill (a quiet drill), installation of a dust suppression system which atomised water; treating footwalls and sidewalls to surfactants to allay dust; installing netting with bolts to the roof to prevent rockfalls; and training on the effective selection and use of hearing protection devices.

The MOSH programme continued after the review, absorbed lessons as it unfolded, and appears from the H&S data to have played a role in reducing fatalities, injuries and exposures in the formal mining sector. It has its own website, https://www.mosh.co.za/index.php. The MHSI continued to maintain its an arm-length approach (still evident at the time of writing), and the NUM and AMCU have remained uninvolved.

6.3.6 **Initiatives Taken-Up Outside of the MHSC**

As indicated, important initiatives which have a bearing on H&S have been routinely taken up without the involvement of the MHSC, despite having a bearing on OHS. These include DeepMine, PlatMine, FutureMine and more recently the Mining Phakisa.

The DeepMine Collaborative Research Project which was initiated in 1998 to *"enable safe efficient and profitable ultra-deep level mining"*. At the heart of the DeepMine Project were fundamental problems in the labour intensive system of deep-level mining, including high rock stresses at ultra-depth, leading to increasing risk off seismic events; the high cost of cooling mines to levels at which people could work; and the difficulty of transporting miners, materials and rock over large vertical and horizontal distances (Durrheim, 2007). DeepMine was orientated towards generating knowledge about the nature of these problems and developing the capacity to address them.

Initial participants in the DeepMine project were the Departments of Minerals and Energy, the Department of Trade and Industry, the National Research Foundation, the Chamber of Mines, the National Union of Mineworkers which represented all mine employees in this forum, and the University of the Witwatersrand. In 2001, membership was extended to include Durban Roodepoort Deep Limited (a gold mining company), the Council for Scientific and Industrial Research, and the Mining Labour Caucus made up of representatives from unions other than the NUM. The DeepMine project was succeeded by the FutureMine Project which was more technology development orientated (Durrheim, 2007), and specifically aimed at reducing the costs of mining and improving H&S.

Although a number of the tripartite partners and their technical advisors were simultaneously engaged in DeepMine, FutureMine and the MHSC, the aims and content of the innovation initiatives were never formally shared or aligned.

6.3.7 **The Challenge of Occupational Health**

A number of occupational health related disputes were not brought to the MHSC and required legal action outside of the MHSC to bring relief to affected miners and their families. In 2004, litigation against Cape PLC resulted in a settlement in favour of asbestos miners and mining communities. This settlement was managed through the Asbestos Relief and the Kgalagadi Relief Trusts established *'to pay compensation to qualifying claimants'* (Asbestos Relief Trust & Kalagadi Relief Fund, n.d.). In 2016, litigation to secure compensation for 4,365 claimants for silicosis and silico-tuberculosis contracted in gold mines resulted in a settlement, R464m in value, with Anglo American SA and AngloGold Ashanti. This settlement was achieved after 12 years of litigation and paved the way for an industry-wide compensation scheme for all gold miners with silicosis (Meeran and Martin, 2016). Two years later, in May 2018 a gold mining sector- wide agreement was reached between the representatives of the claimants - Richard Spoor Inc, Abrahams Kiewitz Inc and the Legal Resources Centre –- and the Occupational Lung Disease Working Group which represented African Rainbow Minerals, Anglo American SA, AngloGold Ashanti, Gold Fields, Harmony and Sibanye-Stillwater. The agreement provided for compensation to all eligible workers suffering from silicosis and/or tuberculosis who worked in these companies' mines from 12 March 1965 onwards. At the time of writing, the settlement has still to clear a final hurdle before coming into effect. This involves potential claimants opting out of the settlement. If 2000 or more claimants opt out, the settlement has to be reconsidered or set aside. In the intervening period since agreement was reached, the Trust Deed has been lodged with the Master of the Court and, on 26 July 2019, the settlement was approved by the South Gauteng High Court (Khumalo, 2018; Silicosis Settlement Parties, 2019) . No party or person presented a dissenting position to the court. A Trust Deed will come into effect in mid-October 2019 if fewer than 2000 claimants opt out.

6.3.8 The Challenge of Implementing the Right to Refuse Dangerous Work

The use of the right to refuse dangerous work has been the source of much controversy. The right is usually exercised when risks appear to be serious and/or imminent or when the workers are unable to rectify a significant problem. In conflict-ridden environments, workers fear retribution from employers for rightfully exercising the right, while employers fear workers using the right to sabotage production. But the formal exercise of the right is likely to be the last resort taken following informal efforts in the workplace to resolve concerns about risks to H&S.

Research in Canada which investigated how hazards in the workplace were addressed confirmed an escalation of efforts, from discussion within the work team, through discussions with the direct supervisors, formal or documented reports of the concerns, and in the last instance use of the right to refuse dangerous work (Gray, 2002). In South Africa, research commissioned by the MHSC found that knowledge of the right to refuse dangerous work was widespread and that concerns about workplace hazards followed a similar course to that described in the Canadian studies. However, nearly one third of the South African study participants reported that they returned to work despite having misgivings, due to pressure from peers or supervisors (Coulson *et al.,* 2019). In contrast to this account of disempowerment, a recent study in Australia found that worker representatives made strong contributions to workplace safety, even in environments in which industrial relations were poor (Walters *et al*., 2016).

Following completion of the MHSC's commissioned research into the right to refuse dangerous work, the Mine Inspectorate issued guidelines for a mandatory code of practice on the right, expanding on provisions made in Section 23 of the MHSA (Mine Health and Safety Act: Guideline for Mandatory Code of Practice on Rights to Refuse Dangerous Work and Leave Dangerous Working Places, 2016). From 1 July 2016 onwards, mining companies were required, in consultation with H&S Committees to draw up site specific guidelines. In certain respects, the directive was largely retrospective given that the commissioned study has showed that the provisions of Section 23 had been widely communicated to mineworkers in gold, coal and platinum mining, and virtually all study participants were found to be aware of the right and had received training on how to exercise it. The pressures felt on the shop floor to return to work and the underlying reasons, appear to be key to understanding how and why the right to refuse dangerous work is exercised and apparently settled.

6.3.9 **The "Section 54" Controversy**

In terms of Section 54 of the MHSA , mine inspectors can stop a section of a mine or an entire mine when there is a serious and imminent threat to the safety of mineworkers. Differences have emerged between the Inspectorate and the industry over the interpretation of this section of the Act, when the Inspectorate started issuing notices to stop mines for a wide range of infractions which did not present an immediate, serious threat in all workings.

The Department of Mineral Resources argued that Section 54 directives were an effective tool for securing H&S, and that such directives were part of a resolute approach to enforcement (DMR, 2012).

According to industry executives, mine stoppages were often justified but, for infractions confined to a single workplace, a specific section of a mine or single misdemeanour, shutting down an entire mine was unjustifiable.

An example cited, was a mine shut down for two days following the injury of a vehicle driver who had failed to brake (under undisclosed circumstances). One company reported over 100 work stoppages in 2015, and stoppages cost "a half a dozen" producers about R2bn between January and August of 2015. Mining CEOs, reported that they themselves stopped work at mines for safety reasons when necessary, so they weren't opposed to the intervention per se, but how it was applied (Stoddard and Skweyiya, 2016) .

In the same year, AngloGold Ashanti successfully challenged a Section 54 directive in court. The judge pointed out that directives ought to be proportionate to the infraction (COM, 2016). The total cost to mines of section 54's for all of 2015 were of the order of R4.8bn (Secombe, 2015; McKay, 2016). Some mining executives ascribed the increase in Section 54 directives to mine inspectors' inexperience, as Section 54s were 'changed' to Section 55 directives when challenged. Section 55 directives are instructions to employers to take steps to comply with specific provisions of the MHSA.

In 2016, reports started circulating that safety audits had been stepped up at mines which had cancelled contracts with the Gupta family - a family deeply implicated in corruption and 'state capture' in South Africa (McKay, 2016). Later, it emerged that the improper application of Section 54s were indeed a problem, and in 2018, mine inspectors were suspended and a regional office closed as a result (Faku, 2018; Odendaal, 2019).

6.4 **Conclusions and Ideas for Further Research**

Overall, the practice of tripartism in South Africa has fallen short of the high expectations riding on it. The structures and mechanisms to advance tripartism are in place, but other factors are either missing or skewed such as trust, human and other resources, access to expertise, willingness to co-operate, and difficulties in envisioning and carving out common ground. Given the history and complexity of South Africa, and structural changes in the global and local labour markets, it is unsurprising that tripartism in the mining sector and the country as a whole, proved less effective than envisaged. The words of Minister Gwede Mantashe upon his appointment as Minister of Mineral Resources in 2018 aptly described the state of tripartism. He said that he found an industry *'in self-doubt, believing that it is about to die, with suspicion and mistrust at a high level'.* That the appearance of functional tripartite relationships and an operational tripartite system has been maintained despite the many stresses, is both a triumph of sort and cause for concern.

In the MHSC, while goals were set from 2003 onwards, discussions over the roles of the parties in ensuring how these were to be met, did not take place. It was left to individual mines to take actions of their own. Mine employers' actions became more co-ordinated after the establishment of the Mining Hub in 2008 and launch of MOSH. In addition, other than setting goals, the stakeholders did not discuss complementary roles in implementing initiatives to achieve them. The uptake by stakeholder of goals agreed at the MHSC and across the sector is worth investigating – what efforts were and are being made to advance uptake, and what factors at mine level are responsible for uptake or indifference?

Tripartism, as applied to mine H&S, delivered mixed results, with H&S initiatives by and large unfolding alongside of, and disconnected, from other efforts. These efforts involved addressing deep rooted problems in mining, as well as more recently, ambitions to catalyse sustainable development. Key issues and changes in the sector not addressed at the MHSC include how best to address the legacy of occupational disease, the impact of contract work, increased levels of informal housing of miners on H&S, and mechanisation. The existence of multiple forums in which tripartite partners could interact independently of the MHSC appears to have limited its strategic mandate to tactical rather than substantive issues.

MOSH as an employer initiated programme was unable to attract voluntary participation of the MHSI and major unions in the design and planning of the programme when it was initially launched. The initiative was ultimately incorporated into the 2010 Mining Charter – both recognition of its value and indicative of the role -subordinate to the regulator- that the MHSI was comfortable with.

The studies quoted in this section raise questions about the effectiveness of H&S representatives in South African mines and also about reasons, which are worth investigating further, that lead Australian representatives to be more forthright about their roles than representatives in either Canada or South Africa.

The Section 54 debacle could have been taken up within the MHSC mandate but was not. Given the number of concerns raised and losses incurred by mining companies, and the Inspectorate's public stance on the necessity of departing from the MHSA's and other legal provisions in the use Section 54 directives, the need for a discussion was clear. Further research into how and why this situation came about, could be very helpful in avoiding similar situations in future.

A change also appears to have taken place in how the MHSC operates. In practice the tripartite MHSC has been transformed from a body responsible for its work to a governing body. While the Council has become a board, the secretariat has become an executive structure. This change seems to reflect the shift in the UK in 2007 when the independent Health and Safety Commission merged with the Health and Safety Executive (UK's executive authority). How this shift has affected the functioning of the MHSC is a possible topic for future research.

This chapter demonstrated that the successes of the MHSA primarily find expression in the formal structures of the MHSC, in the establishment of mine level committees and in the formulation of regulatory instruments and formal agreements. In contrast, there is little evidence of engagement on key issues such as how best to address the legacy of ill-health in the sector (pursued instead through the courts), on the issues underlying the mine inspectorate's adoption of punitive regulatory measures, and on the prospects of holistic efforts to address the H&S and productivity challenges of the sector (to the least detriment of mine workers and mining communities). The model of tripartism promoted by the ILO and entrenched in the MHSA thus did not translate into greater cooperation or shared concern about the quality and future of mining livelihoods.

CHAPTER SEVEN: RISK MANAGEMENT PRACTICE IN SOUTH AFRICAN MINING

7.1 Introduction

This chapter tracks the developments in the formal methods employed to manage H&S in South African mines, from the mid-1960's onwards which culminated in the adoption of RM after the enactment of the MHSA.

As indicated in section 2.1.4 of the literature survey, approaches to safety RM in South Africa largely reflected international practice, with some modifications made by local service providers. Models which guided accident investigations included Heinrich's model of accident prevention, which was followed by the International Loss Control Institute's (ILCI) ' cause-consequence' model, and thereafter by James Reason's 'Swiss Cheese' model of accident causation. Reason's model was later augmented with another model of his for identifying human factors and errors, and Sydney Dekker's 'just culture' model. Assessment systems which have been employed include the Five Star Safety Rating System of NOSA[34] which drew on Frank Bird's loss control philosophy and more latterly NOSA's Five Star Grading System. Bird's Loss control system was the main programme employed in mining from the mid-1970's to the late 1990s (Vice and Nel, 1987). After the MHSA was promulgated, SIMRAC, the research sub-committee of the tripartite MHSC, issued a RM manual, which provided some, but not nearly sufficient, information on how OHS risk management ought to be undertaken. The nett result was that mining companies started experimenting with, and implementing, different RM programmes which were still under development. With time, the number of OHS RM programmes in use coalesced into a few generic programmes with similar terminology and elements. The most

[34] The National Occupational Safety Association (NOSA) was established in 1951 and was originally funded by the Workmen's Compensation Commissioner of the Department of Labour. NOSA is now a private company owned by Micromega Holdings from 2005 and the Carlyle Group from 2018 (https://www.nosa.co.za/about-us/about-nosa/).

influential of these originated from the University of Queensland's Mining Industrial Safety and Health Centre (MISHC) which was then led by Professor Jim Joy. The development of what eventually became the G-MIRM programme was funded by the Anglo American PLC and directly supported by Cynthia Carroll, the corporation's CEO from October 2006 to October 2012. This support enabled Joy and others involved in developing the programme to incorporate insights from the operational managers of many mines, as well as a wide range of practitioners and discipline experts.

7.2 OHS Risk Programmes

In general, OHS Risk Management programmes represent efforts to systematically address H&S risk and reflect the requirements of regulation. Earlier programmes were arranged around managerial and supervisory duties and safety topics while later programmes reflected a RM systems approach. Most programmes initially dealt with safety only.

Frank Bird's International Loss Control Institute (ILCI) developed one of the best known voluntary programmes, the eponymous Loss Control programme. It became a standard in industry and mining in North America, Australia and South Africa in the 1970s and 1980s. The NOSA 5-star rating system is a Loss Control derivative. ILCI's programme evolved into the International Safety Rating (ISR) programme, and later the International Safety Rating System (ISRS). ISRS is currently offered by the company DNV (Det Norske Veritas) which started out as a company which inspected and technically certified Norwegian merchant ships.

Other companies and institutions developed programmes which competed with ILCI's offerings. In Britain, the British Standards Institute developed OHSAS 1800, the Canadian Standards Association produced CSA Z1000, the International Maritime Organisation developed the International Safety Management System, the chemical industry set up the Responsible Care programme and New Zealand created AS/NZS 4801 (Frick and Kempa, 2011; Hedlund, 2014). The main purpose of these programmes was to integrate H&S responsibilities and functions into a company's management system and operationalise OHS processes. Usually, most incorporated OHS regulations established in law. Advantages of such programmes to companies were that they provided for certification by external assessors which in the investment environment could be reputation enhancing, supportive of a company's 'social licence to practice'; and if well implemented, they could provide real opportunities reduce risk. An added bonus was that in jurisdictions in which regulators were satisfied with the efficacy of voluntary programmes, regulators would inspect operations less frequently (Frick and Kempa, 2011, pp. 15–16).

The OHS risk management programmes, accident investigation tools and assessment mechanisms employed in South African mining, are summarised in the Table 7.1 which follows.

Table 7.1 OHS Management Programmes, Accident causation models and Assessment Methods

No	OHS Risk Management Programmes	Accident Investigation Tools	Assessment Methods
1	Pre-Loss Control various theories on work safety were informed by beliefs that accidents were part of the job, some workers were accident prone (a disproved psychological theory), and domino theory which start with the idea of "human ancestry", the idea that people have innate and learnt quality which are at the sharp end of accident causation.	Heinrich's Domino Model of Accident Causation Linear sequence of events.	Heinrich Safety Pyramid which purported to predict likelihood of future fatal event from the ratios of minor, disabling and fatal injuries in the pyramid (300:29:1)[35]
2	Loss Control 1975-1996 This approach builds on the ideas of Taylor (Taylor, 1919) and Ford (Ford and Crowther, 1922) who pioneered scientific management – the idea that managers should analyse and optimise the flow of work. Loss control focuses on improving efficiency through close specification and oversight of tasks which were to be undertaken by workers exactly as specified in terms of the physical actions to be take and their pace.	Expands and adapt Heinrichs linear sequence of events. Loss Control Accident Investigation Methodology involves consideration of: Probable reoccurrence rate, losses and costs in respect of body part injured, property damage, task performed, days lost. Immediate causes, basic causes, temporary and permanent remedial action. Incident investigation specifics (description and sketch of incident, instructions, investigation team details. Checklists included for the identification of immediate and basis causes. Incorporated the ILCI Cause - Consequence Model for the accident investigation tool.	Planned Task Observations (PTO) against task analysis worksheet. General Planned Inspections and Physical Condition Ratings. External assessments by accredited agencies including NOSA. NOSA 5-Star Rating System and OHS training courses.

[35] The National Institute for Occupational Safety and Health (NIOSH) in the USA showed using MHSA safety statistics (Heinrich's pyramid was similarly based on empirical evidence i.e. accident records) that lost day measures fitted the pyramid, but other definitions of severity did not (Yorio and Moore, 2018). The Heinrich pyramid was later found to be too simplistic to be used a predictive and prevention tool by practitioners and researchers (Anderson and Denkl, 2010; Gallivan et al., 2008; Manuele, 2011).

No	OHS Risk Management Programmes	Accident Investigation Tools	Assessment Methods
3	Risk Management Approaches post-MHSA, 1996 onwards. First focus on occupational health.	Accidents represented in bowtie diagram with triggering factors or events on the left hand side and consequences on the right hand side of central described unwanted event. Further analysis of each factor or consequence possible using appropriate tools including human factor analyses	Standard training methods in some countries e.g. Australia

In South Africa, Loss Control became the dominant programme for managing safety, used by NOSA and many industrial and mining companies. It is still in use and has evolved with time. Loss control was first adopted by general industry from the mid-1960s onwards, before being adopted by the mining sector (Will, 1979; Vice and Nel, 1987). The accident cause-consequence model developed by Frank Bird of the International Loss Control Institute (ILCI), commonly known as the ILCI model, was an element of the Loss Control System and was (and is) widely used as an accident investigation tool.

ILCI published a safety and loss control guide for mine managers in 1980 in response to a need expressed by the COM in South Africa. It contained a foreword written by the chairman of the Mine Safety Division of the COM which acknowledged Bird's contribution to modernising the *'management of safety and loss control'* in South African mines. Accidents which killed or injured employees were described as unacceptable and the conservation of resources, human and material, as '*vitally important'* (Bird, 1980). Key aspects of the loss control approach advocated by Bird are discussed in the next section.

In 1986 (reprinted in 1987, 1989 and 1990), ILCI published a book entitled Practical Loss Control Leadership aimed at industry in general which is very similar to the book designed for mine managers. Information on managing health hazards was included but limited to the value of completing material safety data sheets, knowing the work process, and the use of an occupational health checklist by frontline supervisors (Bird and Germain, 1990).

7.3 The Loss Control Programme in South African Mining

Bird's guide for mine managers was prefaced with an account of the history of safety management in industry. It recognised that attitudes had changed over the course of the industrial revolution. Initially safety was seen as an extra 'frill' and drain on resources which could be put to better use; accidents were ascribed to accident proneness or worker carelessness; and dangers were believed to be inherent in industrial work. As public sentiment changed, legislation for inspecting mines, compensating workers and promoting safety was successively introduced from the mid-1800s to the mid-1900s, when occupational health hazards were being gradually recognised, first through compensatory provisions, and from the 1970s onwards through legislation aimed at preventing and reducing exposure to health hazards. Factors which Bird believed would influence attitudes to mine safety were union activism, attitudes of the courts, medical research, technological developments, legislation, rising equipment costs, ability to deliver without interruption, new facts about accidents, increasing professionalism of the field of management, and the economic energy shortages such as the petroleum shortages which were experienced when the guide was written (Bird, 1980).

7.3.1 Key Elements of the Loss Control Programme

This section establishes a reference point for identifying and evaluating the changes which occurred after the MHSA was introduced. The key elements of the ILCI loss control programme are summarised below in the order in which they appear in the guide designed for the mining industry. There are 15 elements in the guide in total (see Table 7.2).

Table 7.2 Key Elements of ILCI Loss Control Programme

No	Loss Control Element	Comment
1	Accident/ Incident Causes, Effect and Investigation	These elements relied on strong, mutually respectful relationships between workers and supervisors, and assumed that supervisors could offer real insights into how work methods could improve. Barriers in South African mining included deep social divisions, language barriers, the likelihood that supervisors had very little experience of doing the jobs they were offering advice on (due to job reservation laws).
2	Planned Inspections	
3	Job Analysis and Procedures	
4	Planned Job Observations	
5	Group Communications	
6	Personal Communications	
7	Job Pride Development	Shared identify of purpose presumed (above remarks apply)
8	Management Control	Focussed the detailed documentation and classification of work, its measurement and improvement.
9	Special Problem Solutions	Topics are housekeeping, protective equipment and compliance.
10	The Exceptional Employee	Focus on assisting employees with health problems (limited advice) and at odds with historical mining practice
11	Occupational Health in Mining	Limited and non-specific advice for mining setting
12	Fire Loss Control	The advice very limited for mining environments
13	Incident Recall Techniques	Dependent on good recordkeeping
14	Family Protection	Not part of the industry's historical approach to mineworkers
15	Hiring and Placement	Mass recruiting of mineworkers was a common practice and physical criteria were key
16	Recordkeeping	Many records are kept at mines and systems were for a long time paper-based

A key point to note is that the elements of a programme do not amount to system. In the workplace, these elements should be integrated, should interact over time and space and should be responsive to environmental influences enabling adjustment and improvement (Robson *et al*., 2005). Evaluation of each element in isolation, does not amount to an evaluation of how a system performs, or its embeddedness or sustainability.

Accident/ Incident Causes, Effect and Investigation

Central to ILCI's loss control philosophy was an accident ratio study based on 21 industrial groups employing 1,750,00 people. It had been conducted by Bird in 1969 when he worked in the insurance sector. The study suggested that the ratios of no-impact incidents, property damage incidents, minor injuries and major injuries were fixed, i.e. a case could be made for incidents with different consequences having common causes. Bird's accident ratios are presented in Figure 7.1 below:

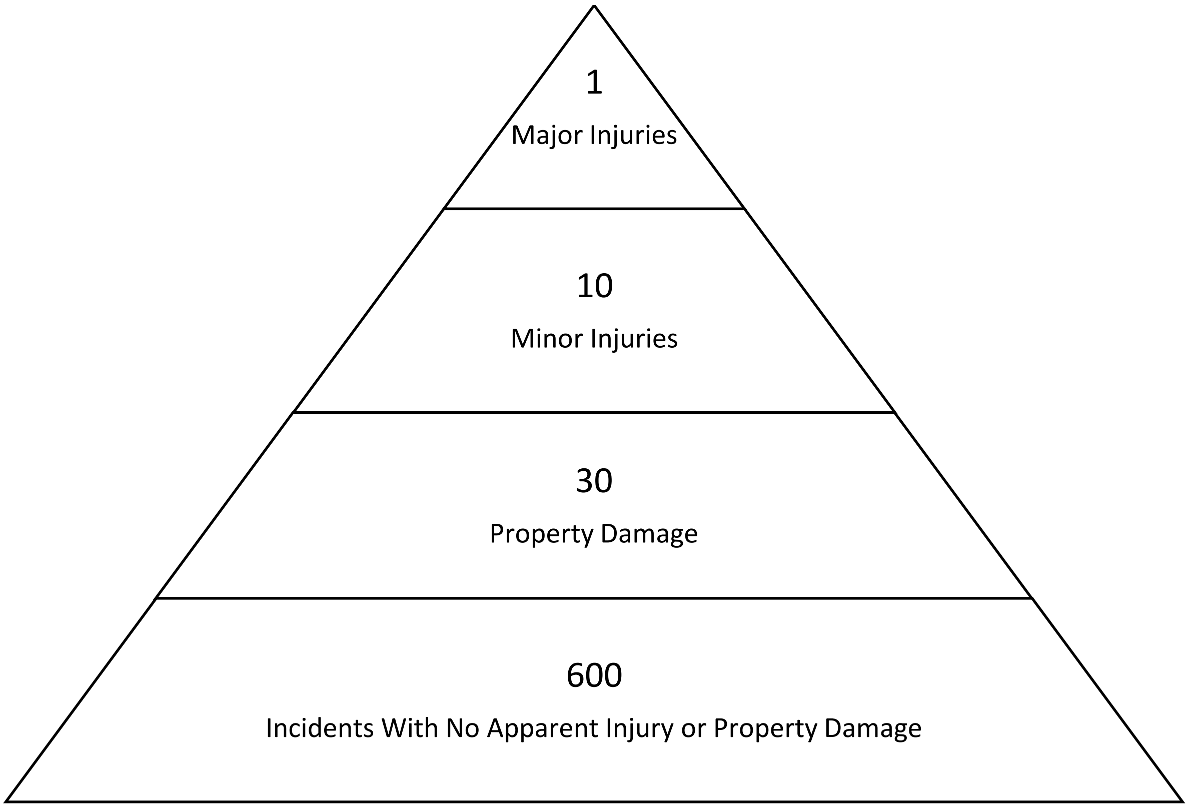

Figure 7.1 Ratios of Incident Types
Source: Bird, 1980

According to Bird, it was folly to investigate serious or disabling injuries alone when there were many opportunities to prevent losses by investigating events which had less significant outcomes. Bird's triangle expanded Heinrich's theory of 1931 which suggested that the ratio of major injuries to minor injuries to no-injury accidents were 1:29:300, and that 88% of all accidents involved people deciding to take an unsafe action. Heinrich had postulated that by acting to reduce no injury accidents, major injuries could be reduced. Heinrich's and Bird's theories, although called into question by later research, have had a lasting influence on the management of safety and health. A recent study by Yorio and Moore suggested that *'a disciplined effort to reduce'* low or no severity incidents '*can help decrease the probability of more serious OSH incidents in the future'*, but found no evidence of a fixed ratio between fatalities or serious disabling injuries, and low or lower severity injuries (Yorio and Moore, 2018). Further research findings are that the ratios proposed by Heinrich did not hold true for many categories of fatal accidents. Focusing on the highly identifiable hazards associated with minor incidents did not necessarily eliminate the hazards or identify the activities associated with fatal accidents. The injuries involving high numbers of lost days were more likely to be predictive of fatal incidents than any other categories of injury (Anderson and Denkl, 2010; Martin and Black, 2015; Yorio and Moore, 2018). In essence, a literal interpretation of Heinrich's and Bird's theories erroneously suggested that the exposures which led to slips, falls, sprains and strains were the same as the exposures that caused fatalities (Johnson, 2011). The validity of accident ratios was further examined in a study in which ratios were produced based on the *causes* of accidents and not only their consequences. This study found qualified support for common cause theory in the railway sector (Wright and van der Schaaf, 2004).

While the application of the accident ratio triangle was a tool for providing insight into the areas in which companies could direct their improvement efforts to avoid major losses, the accident investigation model dealt with the thoroughness of investigation processes. The accident model was essentially an updated version of Heinrich's domino sequence and is summarised in Figure 7.2. The model incorporated ILCI's key ideas about the sources and effect of incidents and accidents, such as people or 'the human element'; equipment including tools and machinery; the materials in use which could be toxic, sharp, heavy or hot; the work environment which involved factors such as lighting, noise, ground conditions, temperature, dust, fumes, humidity, aerosols and water. Accidents were described as events that were unexpected, unplanned and undesired, and which usually, but not always involved contact with an energy source.

The types of accident and incidents to be investigated included those which had resulted in major losses or had the potential to result in major losses. Accidents were to be investigated with a view to preventing similar accident or incidents and their associated losses. Bird pointed out that prevention measures could include amending features of the management system. A detailed description of the accident investigation process and sample forms was provided for use during investigations, major loss reviews, and the announcement of major events or losses. The front line supervisor was identified as a key person in the investigation of accidents. The necessity to create broad appreciation in the organisation of the value of thorough accident investigations was underscored. Given the high level of failures to report accidents or incidents, Bird surmised that workers failed to report for fear of discipline, concern about a production or safety record, concern about reputation / personal record, fear of medical treatment or medical personnel, and desires to avoid interrupting work. More recent research supports this position. Senior management was advised to review and analyse all reports, participate in major investigations, and follow up to confirm completion of remedial actions (Bird, 1980).

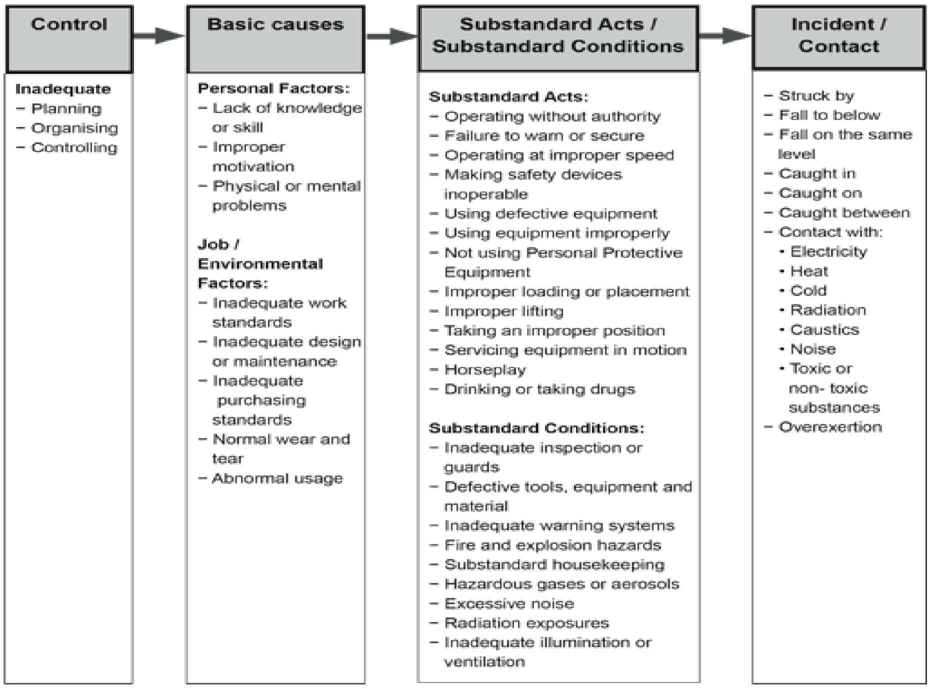

Figure 7.2 Accident / Incident Domino Model – Causes and Effect.

Representation of Bird's diagram, 1980

The ILCI model, like Heinrich's domino model, presents accidents as the outcome of a linear sequence of events which occur in a given order, and concentrates on factors within and proximate to the workplace.

Over time it became clear that different accident models draw attention to different aspects of accidents, and lead to different recommendations for improvement. In general, accident causation models have shifted from sequential models which include fault and event trees, and failure mode and effect criticality analyses (FMECA), hazard and operability analysis (HAZOP) which are successfully applied in well understood, established engineered systems, towards system level models which to different degrees take account of the interactions between the component parts of a system. These may operate within a band of acceptability and may interact in ways that create unsafe conditions, the effect of which may not be immediately apparent.

Early accident models are more suited to investigating technical failures, while the later models consider socio-technical interactions in which human, technological and environmental components interact in complex ways. Accident causation models have been categorised in different ways by different researchers.

Hollnagel for example, classifies accident investigation models into three categories, sequential, epidemiological and systemic, while others propose four or five categories (Katsakiori *et al*., 2009). In Hollnagel's schema, epidemiological models describe latent and active failures which emerge over time and combine to unfortunate effect. Latent failures include deficiencies in design, training and supervision; while systemic models describe accidents as emergent phenomena which are expected outcomes of systems which are tightly coupled and complex. These models take account of the essential functions in the system and their objectives, their variability and dynamic interactions, and the range within which their performance is acceptable. Under these conditions it is important to monitor performance variability in order to detect significant changes, and to anticipate their likely effects (Hollnagel, 2011; Hollnagel, 2008; Hollnagel, 2005). According to Underwood and Waterson, a systems approach to accident investigation is more likely to be used in academics by in accident analysis research, than by practitioners than in workplaces in accident investigations (Underwood and Waterson, 2013). This simplicity of linear models, while attractive, may thus provide a false sense of security in industries in which catastrophic events may occur.

Planned Inspections

Two types of planned inspections were envisaged, a general inspection and a critical parts inspection. Both required experience and professional judgement. The first was a general inspection of the workplace, usually to be conducted by supervisors, who were to look out for suspected problems which could lead to *in*jury, loss or theft of material, *s*tream or air pollution, *p*roperty damage, *e*nergy loss or leaks, *c*areless use of time, defects in equipment or *t*ools, potential for *i*ncipient fire or explosions, *o*ccupational illnesses, alcohol or *n*arcotic abuse, and wasted or inefficiently used space. These items were arranged to spell out the anagram INSPECTIONS. Housekeeping assessment forms and a list of 28 groups of typical items which could be inspected were provided. Typical items included pressure vessels, handling equipment, warning systems. The second type of inspection was of specific equipment, machinery or facilities such as shaft conveyances, locomotives, workshops and shafts. Immediate action was to be taken when dangerous conditions were discovered, and the classification of observations into 3 categories of hazard was recommended, with Class "A" hazards having the most serious outcomes.

Senior management was advised to streamline risk decisions, maintain planned inspection standards, conduct management tours to reinforce the importance of inspection, measure the performance of planned inspections and persistently reinforce positive supervisory performance (Bird, 1980) .

As can be seen, inspections require both specific and general insight, knowledge and expertise, both from those undertaking inspections and those responsible for oversight of them. In addition, they generated a great deal of data to be documented and analysed.

Job Analysis and Procedures

The purpose of analysing the jobs undertaken by workers in different occupations was to establish the most effective procedure for doing the job, and for teaching people to do the job. A miner, for example, would be responsible for several jobs such as charging a hole or a face; inspecting the roof, sidewall or floor conditions; and overseeing the installation of support. Job analysis was to be restricted to critical jobs. The aspects of a job such as safety, quality, and productivity, were to be taken into consideration and were understood to be interrelated. The steps in job analysis were identifying critical jobs; breaking down the job into a sequence of logical steps; assessing the potential of job related incidents and their seriousness; checking the efficiency of every step by posing questions about the purpose of the step, its necessity etc; determining the recommended controls, and writing up a standard job procedure. Tools and sample forms for critical job records, efficiency checks, job analysis and standard job procedures were provided in the guide. Senior managers were expected to endorse and reinforce the processes, ensure that personnel were trained to produce the requisite results and measure the impact of standardised work.

It is apparent that job analysis is premised on the idea that all jobs, in this case in mining, lend themselves to standardisation, and that those responsible for the analysis had high levels of insight into how jobs could be performed more effectively.

Planned Job Observations

Supervisors were responsible in the ILCI system for planned job observations (PJO) which they were assumed to observe daily on an hour-to-hour basis. The prerequisite was that they had *'superior knowledge'* of the work to be done and of best methods to undertake the work. PJOs were distinguished from informal job observations which were assumed to take place routinely, with supervisors complimenting workers on tasks done well, and setting workers right when improper methods were used. They were intended to enable supervisors to systematically review the way in which critical jobs were undertaken, and to maintain and/or improve standard job procedures. The PJO process involved selecting the worker and the critical task to be observed, preparing for the observation, undertaking the observation, reviewing, evaluating and recording the employee's execution of the task, and following up. When selecting the worker to be observed the supervisor was to decide whether he or she was a poor or good performer, a risk-taker, or someone with an ability problem. Discussion with the employee to be reviewed was to be informal with the exchange of sincere comments, and a promise to return to discuss the result once the job observation was formally evaluated. Sample job observation forms were provided. Senior management roles were to encourage PJOs and recognise that they and standard job procedures could raise the quality of on-the-job training and improve efficiencies. In respect of the management system the following was required, training of management personnel, establishment of PJO objectives and follow up on the procedures which required change.

Group Communications

This aspect of the system addressed the quality, content and desired impact of communication with groups of workers. Communication was seen as a two-way process in which supervisors *'give'* information to *'get understanding'*. Guiding rules were to keep communications brief, simple, to express the value of the topic in personal terms, ensure that ideas were put to work, and to keep repeating, reviewing and reinforcing messages. Guidelines were provided for talk techniques, designing safety talks, making notes, presentation, analysis in terms of 5 points (prepare, pinpoint, personalise, picturise, and prescribe). Aids could be used, visual or mock-ups etc. Senior management responsibilities included creating a climate for productive communication and establishing evaluation processes, and procedures to ensure the communication was taking place as planned.

Personal Communications

Personal communications were described as discussions which were person-to-person, face-to-face and one-to-one, and directed towards training and learning. Similar principles to group communications applied, with additional advice on recognising individual differences, motivating people by taking personal interest in them, hearing their viewpoints, clarifying the process, expecting '*ups and downs*', and following up and learning how to instruct. Various tools were provided on job instruction, inducting new employees and coaching. Senior management's role was to set the tone, set expectations, hold people accountable and give recognition. The importance of policy on various subjects was stressed, such as the orientation of new and transferring employees, proper job instruction, professional training of supervisors, leadership training and training on subjects like communication, motivation, the development of people, counselling and coaching.

Job Pride Development

This was a motivational element in the loss control system inspired by Maslow's Hierarchy of Needs, in which social, ego and self-actualisation needs come into view, after physiological and security needs have been met. Various guidelines were provided. The key messages were that workers could be motivated to work safely and efficiently through ensuring the they were properly informed about what matters and why, they were encouraged to make well thought out decisions, their participation and contributions were valued, considered and recognised. As short term pressures to hurry or minimise effort, and distracting personal concerns may create unsafe conditions, the necessity to reinforce (motivate) safe work practices was emphasised. Senior management was to encourage a climate of growth and development in which the managerial climate was moved along the spectrum between *'controls and directives'* at the one end, and *'goals and objectives'* on the other. In the supervisory sphere, this climate was seen to translate into a continuum on viewing people as instruments to get work done, to being concerned about employees needs in the production context.

Management Control

This element focused on managerial responsibilities, described as the identification and classification of work, its measurement and improvement. The elements of the loss control programme were to be operationalised with reference to these criteria. Safety and loss control measurements to be monitored included disabling injury rates, severity rates, property damage rates and fire costs. Key principles cited by Bird included reciprocated interest (for example, the achievement of bonuses enabled through adherence to safety programmes), focus on the critical few, recognition of excellence, tracking and analysing trends in performance, recognising that multiple causes were mostly likely at play, understanding that results were achieved through others, and the importance of repetition through communication and follow-up. Three stages of the linear model for accident investigation were identified as tools for preventing accidents or incidents (lack of managerial control, basic causes (the actual problem caused by the lack of control), the substandard acts or conditions (work practices; work environment, tools and equipment, or a combination thereof). Senior management's role was to create mine wide loss control policy and set the standards for management work, and mechanisms for performance appraisal (self and independent of self). Sample forms and pointers were provided.

Special Problem Solutions

Challenges such as maintaining compliance, effective utilisation of protective equipment, maintaining good housekeeping practices, ensuring that tools and equipment were used with care, reducing the effects of labour turnover were all referenced back to the fundamentals of the loss control programme, viz. planned inspections, standard work procedures, job observations, communication in groups and one-on-one, with emphasis on building respectful and reciprocal relationships between workers, supervisors and management. The quality of supervisors being a central theme.

The Exceptional Employee

Exceptional employees were people with health problems, chronic or otherwise, which affected their physical and mental capabilities, as well as routinely fatigued people and people with drug use problems. The remedy in these instances was to seek professional or medical intervention. While fatigue was recognised as a possible problem, it was something which the worker himself or herself was expected to resolve. The supervisor had a counselling role. Responses to drug use, including alcohol, which affected health included counselling, professional intervention and ultimately disciplinary measures.

Occupational Health in Mining

The chapter on occupational health was directed at educating managers on the long term effects of health hazards.

Fire Loss Control

This chapter of the guide focused on the prevention of fires, by noting the presence of fuel sources (and their ignition characteristics), the availability of oxygen, heat sources and likely chain reactions. Advice on fire classification and extinguishers was also provided.

Incident Recall Techniques

This element focussed on the need for, and methods of reviewing incidents which could have been significant or catastrophic, with an eye to prevention and improved controls.

Family Protection

The focus was on understanding, quantifying and reducing the effects of off the job accidents which occurred at home, in the traffic or in other settings. Supervisor-worker relationship, first aid training and community organisation were central to reducing such losses.

The final elements (xv) and (xvi) dealt with hiring and placement, and recordkeeping.

7.3.2 **Auditing Mine Safety and Loss Control**

The mine safety management guide was supplemented with an auditing programme, *the 'International Mine Safety Rating'* in which the highest award was 5 stars. To achieve five stars, the fifteen safety elements were to be rated, an average score of 80% was to be achieved (with no one element scoring lower than 60%, and a minimum score of 65% for physical conditions. The rating system was first launched in 1978 and the elements listed below appear in the 1984 revised edition of the system. Elements of the loss control / safety and health system were audited under the heading shown in Table 7.3 below.

Table 7.3 ILCI 5 Star Safety Rating Programme Elements

Element No.	Element
1	Leadership and administration
2	Management training
3	Planned inspections
4	Accident / Incident investigation
5	Emergency preparedness
6	Organisational rules
7	Accident/ Incident analysis
8	Employee training
9	Personal protective equipment
10	Health control and services
11	Personal communications
12	Group meetings
13	General promotion
14	Hiring and placement
15	Records and reports

Source: Bird and Findlay, 1984

NOSA's five star system was inspired by ILCI but it was not identical. It contained a number of prescriptive standards, referenced to legislative requirements, for example on stacking heights in storage areas. Five key elements made up the early NOSA system, viz. premises and housekeeping; mechanical, electrical and personal safeguarding; fire protection and prevention; incident recording and investigation, and H&S organisation. The five elements were further divided into 72 sub-elements against which compliance was measured (Hedlund, 2014).

A review published in 1998, by the ILO of OHS management systems found the NOSA system inadequate. It did not take proper account of issues such as management commitment and resources, goals and objectives, performance measures, system planning and development, continual improvement and the integration of OHS into the general management system (Dalrymple *et al*., 1998).

7.4 Criticism of the Pre-1996 Systems and Practices

The NOSA 5-star system, and ICLI's loss control and ISRS programmes were all implemented on various South African mines. At the time of the sitting of the Leon Commission, NOSA systems were applied on 27% of mines, and the International Safety Rating System (ISRS) and the Mine Safety Management System (MSMS) were *'operated'* by the Chamber of Mines (Leon et al., 1995, p. 77)

In 1988, the ISRS, was criticised on the basis that its adoption did not lead to fewer fatalities on mines, and that safety was unlikely to have improved although other measures such as lost time injuries appeared to have halved (Eisner and Leger, 1988). According to Eisner & Leger, lost time accident rates probably declined due to mine personnel being pressured not to report lost time accidents. Fatalities, on the other hand, could not easily be underreported. Wagner and others argued in response, that Eisner and Leger had not provided any evidence of the coercion described in their paper, and that since the differences between gold and coal injury trends had not altered since the ILCI system had been introduced, coercion could not be a factor in the improvement of injury rates in either sector (Wagner *et al*., 1988).

The Leon Commission did not see any reason to encourage the adoption of the NOSA and ILCI systems and ratings, since approximately 80 percent of mines had achieved 4 or 5 star status despite unacceptable levels of accidents and fatalities. Even mines at which disasters had occurred such as Hlobane, Kinross and Middelbult Colliery had achieved high ratings. The Commission concluded that these systems had been discredited in the eyes of labour and the public. Mines were free to continue using these systems however, if they believed the systems were helpful in improving H&S (Leon *et al*., 1995).

In 2011, Frick and Kempa concluded after reviewing several voluntary OHS systems that these systems were ambivalent about worker representation and participation. Information flow tended to be top down, focussing on compliance and motivation. When workers were consulted, it was usually to obtain information. Voluntary systems did not thus address worker rights and therefore did not assess the level of involvement of workers or their influence or inputs to OHS decisions (Frick and Kempa, 2011, p. 28).

In 2013, Hedland reviewed the NOSA 5-Star Rating System from two perspectives, whether implementing the system affected OHS fatality and disabling injury outcome measures; and how sensitive the Star rating system was to the rates of serious injuries. He found that fatality and disabling injury rates of companies committed to properly implementing the system, were lower than the rate for the manufacturing sector as a whole; and that the Star rating was inversely related to the disabling injury rate. He concluded that the 5-Star rating system was sound, although it predicted injury rates imperfectly. It was possible to cheat, but this problem was generic to voluntary systems and naivety about the *'intrinsic viability of self-regulation'*. He postulated that such systems could not replace the enforcement activities of a regulator (Hedlund, 2014).

7.5 **Risk Management Practice post-1994**

Once the MHSA came into effect, the industry's focus turned immediately to the process of assessing risk. The existing ILCI system was never formally abandoned, and differences between it and the new RM approach were never clearly articulated. After a very muddled start, over the course of the following two decades, the application of risk assessment and RM processes were refined on the basis of experience and learning from outside of the country. While ILCI and other proprietary systems increasingly reflected RM thinking, significant differences between legislated and established proprietary systems (the latter often deeply embedded in long-standing practice) co-existed for many years, and probably still do.

The need to address OHS through RM, opened up new entrepreneurial opportunities. Before the enactment of the MHSA, International Risks Control Africa (IRCA) developed the first publicly available course on risk assessment in South Africa. This three day course introduced the risk matrix, subsequently published by MHSC, and explained the application of hazard identification tools such as checklists, preliminary hazard analysis (PHA), hazard identification (HAZID) and cause-consequence analysis. Other tools covered in the course included HAZOPs, event tree analysis (ETA), fault tree analysis (FTA), success trees, structured what if checklists (SWIFT), failure mode and effect analyses (FMEA) and failure mode criticality analyses (FMECA), methods to deal with toxic emissions, cost benefit analyses and fraud risk assessments. Concepts introduced included ALARP (as low as reasonably practicable), risk matrices and human factors (IRCA, 1995) .

The content of the IRCA course was indicative of the challenges that arose when a RM approach to OHS was suddenly required. By 1990s, a definitive and coherent RM process had not yet been established for the mining sector. Safety and health were separate considerations. Occupational hygiene, epidemiological methods and occupational medicine practices, long established and central to addressing health hazards, were ancillary rather than mainstream concerns and would remain so for years. What was available from a range of disciplines - science, engineering, finance, insurance and psychology - was a plethora of discipline-specific tools and concepts which were well-established and proven in the fields in which they were employed, and which invoked workplace safety in many or certain respects. But the order in which they could be applied, and which were interchangeable, superfluous or overly demanding, was uncertain.

The first official South African version of the hazard identification risk assessment (HIRA) process was published as a guideline in 1997. It addressed safety but not health risks. Almost immediately, it was found wanting in respect of the use of terminology and the descriptions of various RA processes. The

COM suggested modifications (which also overlooked consideration of health risks) which were published in 1999.

Subsequently many efforts were made to (i) clarify the different types of RA process -baseline, issue based and continuous- required in law; (ii) standardize terminology; (iii) simplify decisions over the choice of RA tools and methods; (iv) improve approaches to controlling risks; (v) and, finally properly accommodate occupational health. These shifts in RM processes are described in the following section.

7.5.1 **SIMRAC Practical Guide to Risk Assessment (RA)**

The first guide on how to conduct a RA was issued by the SIMRAC committee of the MHSC in 1997. The guide was prepared by a tripartite team led by Dirk Bakker, the Chief Inspector of Mines at the time, who travelled to Australia to seek assistance from Professor Jim Joy, then the Director of the Minerals Industry Safety and Health Centre at the University of Queensland. By then Joy was presenting a popular course on RM, known as the 'G3', in Australia.

The guide provided general advice on conducting *'suitable and sufficient assessments of risks'* to enable compliance with Section 11 of the MHSA, highlighting key elements and pitfalls. It indicated that there were no 'fixed rules for RAs and set out principles therefor. The guide was not intended for experts, and novices intending to conduct RAs were advised to seek further training.

The glossary of terms provided in the guide are presented in Table 7.4 below.

Table 7.4 SIMRAC 1997 Risk Assessment Guide: Glossary of Terms

TERM	DEFINITION
CONSEQUENCE	The potential degree of harm, the potential severity of injuries and/or ill health, and/or the number of people potentially affected
EXPOSURE	How often and for how long employees are exposed to a hazard
FREQUENCY / LIKELIHOOD	Chance per unit time, (usually per year); Exposure X probability
HARM	Injuries, occupational diseases *or losses*[36]
HAZARD	Conditions, circumstances or objects with the potential to cause harm
PROBABILITY	Chance that a person or persons will be harmed during the exposure
REASONABLY PRACTICABLE	Means practicable having regard to: a) the severity and scope of the hazard or risk concerned; b) the state of knowledge reasonably available concerning that hazard or risk and of any means of removing or mitigating that hazard or risk; c) the availability and suitability of means to remove or mitigate that hazard or risks; and d) the cost of removing or mitigating that hazard or risk in relation to the benefits derived therefrom
RISK	The likelihood that harm from a particular hazard will occur ('the chance of harm or loss'). Consequence X frequency

Baseline, Issue-based and Continuous risk assessment were distinguished by their purpose:

- Baseline assessments were to be comprehensive and by identifying major risks would establish the priorities for further in-depth examination of such risks and the risk control programme to follow. The in-depth RAs would in all likelihood involve highly specialised and detailed techniques.
- Issue-based risk assessment were to be conducted as the need arose and were usually associated with the management of change.

[36] Authors' emphasis

- Continuous risk assessments were ongoing and part of day-to-day management of risks. It was to be conducted by frontline supervisors and was described as **the most powerful and important aspect of risk management**[37] ((SIMRAC, 1997).

The different types of RA could be scoped in terms of geographical areas, functional activities, hazards or issues, or be discipline centred.

In this guide conducting suitable and sufficient RAs involved considering risks likely to arise, RA outputs which could be translated into RM actions, and outputs which would remain valid for a reasonable period of time. Safety professionals were to facilitate RAs.

Hazard identification techniques could start with the identification of an event or involve analysis of the failures which could be associated with the individual components or steps / transfers / sequence of activities in a system or operation.

The level of risk associated with a hazard was measured by using a 4x4 risk matrix which axes were severity and frequency as shown in Figure 7.3, with severity being the exposure and the frequency being the probability that the harm would be realised in particular period. Priorities were established by the value of the product of severity x frequency (1 =high, 7 = low for example).

[37] Authors emphasis

Severity					
	Multiple Fatalities	1	2	3	4
	Fatality	2	3	4	5
	Reportable Incident	3	4	5	6
	Loss time Incident	4	5	6	7
		Once a month	Once a year	Once every ten years	Once in a lifetime
Frequency					

Figure 7.3 1997 SIMRAC RA Guide Risk Matrix

Risks were to be prioritised in the order shown in Table 7.5

Table 7.5 SIMRAC 1997 RA Guide: Ranking Risk

Prioritising Risks	**Importance**
High Consequences, High Frequency	
High Consequences, Low Frequency	
Low Consequences, High Frequency	
Low Consequences, Low Frequency	

Controls were to be devised in a sequence starting with the consideration of the *reasonably practicable* methods of eliminating the risks. Thereafter, other types of controls were to be considered starting with the installation of controls at the source of the risk and ending at the point at which the risk was reduced to a tolerable level. Employees and particularly those affected were to make sure the controls were working, and the universal acceptance of the commitment to avoid, prevent and reduce risk was to be inculcated at all levels of the organisation and in all activities. Records of the RA process and follow up were to be kept and shared. Reviews were to be conducted periodically, and when a control or protective measure was observed to be ineffective or following an incident or accident. If an incident or accident had not been identified as a possible outcome, then the RA process was to be revised. If a risk was tolerated, the validity / reasons therefor were to be reviewed, and confirmed or addressed as necessary.

The effectiveness of a RA rested on meeting the following criteria:

- The risk assessment process was practical and realistic
- As many people as possible were involved, especially those at risk and their representatives
- A systematic approach was adopted so that all risks and hazards were adequately addressed
- The aim was to identify the major risks, and not waste time on the minor risks or complicate the process with too much detail
- Information on all aspects of the work was gathered such as equipment, substances used, work organisation or process, controls already in place, and analysing it before conducting the risk assessment
- The RA started with hazard identification
- Risks arising from the hazards identified were assessed, taking account of the effectiveness of existing controls
- The actual work process and conditions were evaluated rather than the ideal, and non-routine operations were included
- All employees, visitors and contractors were considered
- Written records of the RA were kept

That the severity level scale counted multiple fatalities as its most severe event was indicative of the state of safety in the South African mining industry. The measures of severity in the risk matrix to be applied in South African mining and the HSE's definition of intolerable risk were far apart. In 1999, the actual fatality rates in the most hazardous industries in the UK were usually well below 1 in 10,000 deaths per annum compared to 5-6 deaths per 10,000 workers in South African at the time (HSE, 2001) .

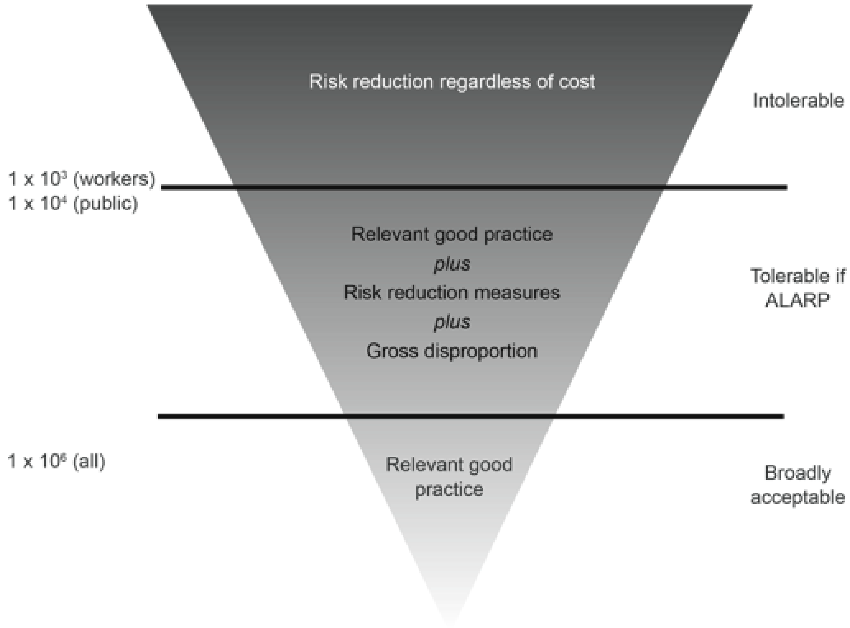

Figure 7.4 'Guidance on ALARP Decisions' after COMAH, Health and Safety Executive
Source: HSE,2001. UK

7.5.2 **The COM Note on the Hazard Identification and Risk Assessment (HIRA) Processes**

Shortly after SIMRAC published its practical guide to risk assessment, through the COM's Policy Committee, employers submitted a document aimed at improving the guide to the MHSC, which was later posted by the MHSC as a note expanding on the SIMRAC guide (COM, 1999). The intention of this note was to harmonise terminology, viz, the term hazard identification and risk assessments (HIRA) replaced the term Risk Assessment (RA) used in the SIMRAC guide; and to explain the treatment of risk in terms of successive controls, each applied to the risk remaining after implementing a control measure, in accordance with the hierarchy of controls (see Figure 7.5). It advised that there were 3 types of HIRA rather than 3 types of RA and drew attention to the responsibilities of manufacturers and suppliers (section 21 of the MHSA). A further point was that the term RM was not equivalent to risk assessment, and included all the standards, codes, practices, training and education programmes that contributed to addressing risk as well as reviews and other monitoring processes to assess progress and compliance.

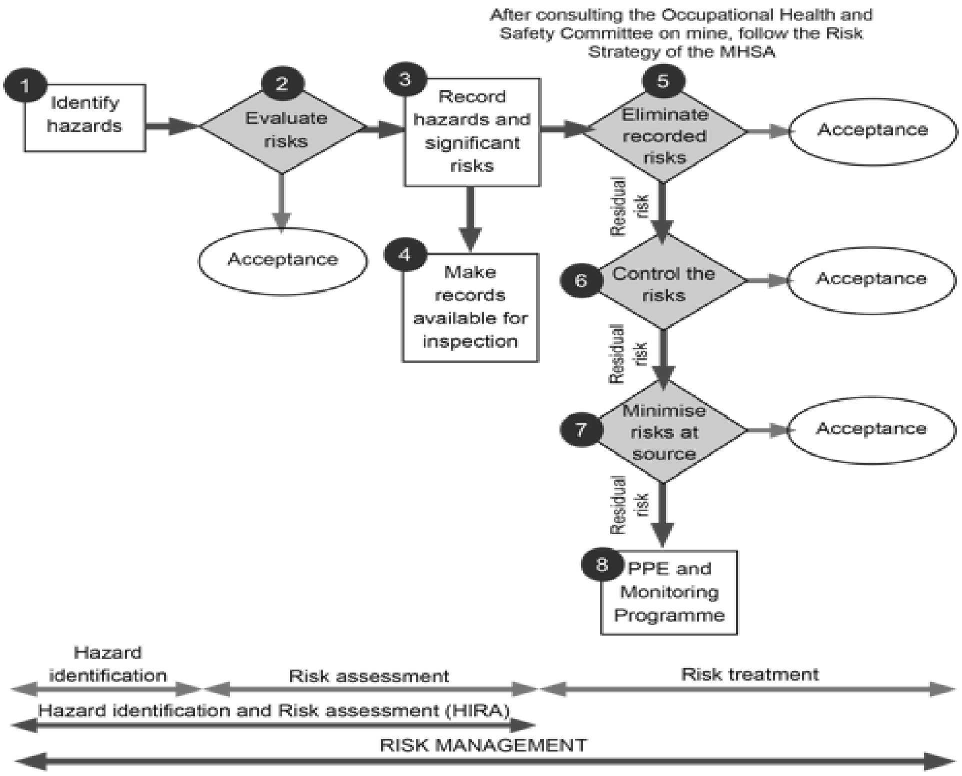

Figure 7.5 COM's 1999 Interpretation of Risk Management Requirements of the MHSA

The linkages between the 3 types of HIRA was to establish a risk profile for issue based risk assessments as depicted in Figure 7.6. Issue based HIRA resulted in the development of action plans for the treatment of significant risks. The purpose of continuous HIRA was three-fold: to identify OHS hazards with the immediate purpose of treating significant risks, gather information to feedback to issue and baseline HIRAs. Continuous HIRA's included inspections and observations, medical surveillance, occupational hygiene measurements, planned maintenance systems, pre-work assessments and OH&S audits.

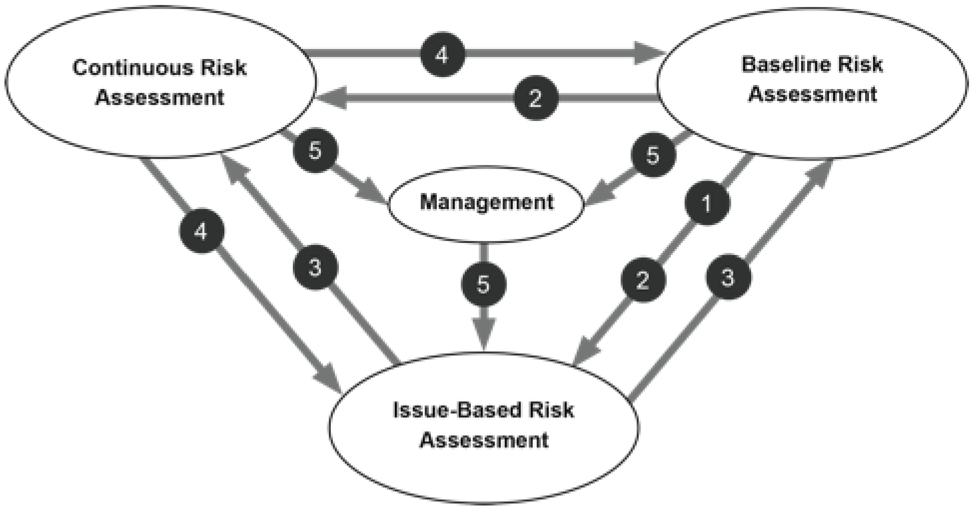

Figure 7.6 COM's 1999 Interpretation of Relationships Between HIRA Processes of the MHSA
Source: (COM, 1999)

The following advice was offered in the note: 'Keep the process simple, realistic and practical; steer away from difficult probabilistic statistical techniques during risk estimation, rather use subjective techniques; ensure and demonstrate total transparency; focus on the significant OH&S risks first; follow the risk management strategy prescribed by the Mine Health and Safety Act, ensure participation of as many employees as practically possible, never underestimate the contribution of even the lowest level of employee; and be systematic in your approach while recording the steps taken and motivation for recommendations and decisions' (COM, 1999)

The note concluded with a section on definitions of terms, which were drawn from ISO/IEC Guide 51 of 1999 which was later withdrawn (International Standard Organisation (ISO) and International Electrotechnical Commission (IEC), 1999). No evidence was found of efforts to address the differences between the 1997 SIMRAC guide and the subsequent note of 1999, both made available by the MHSC.

Since the note did not replace the previous advice issued by the MHSC, it served to create further uncertainty about the interrelated of processes and the definition of terms.

7.5.3 Subsequent Risk Management Related Developments associated with the MHSC

In 2001, SIMRAC produced a handbook on occupational health practice which has been well received world-wide and which contained contributions from many well respected occupational health practitioners and academics.

However, from an RM perspective it added another layer of complexity. It contained another version of a RA diagram specific to occupational health, which uses the term HIRA in the diagram and RA processes in the diagram title. A new diagram on the relationship between baseline, issue-based and continuous HIRA was also presented (Figure 7.7).

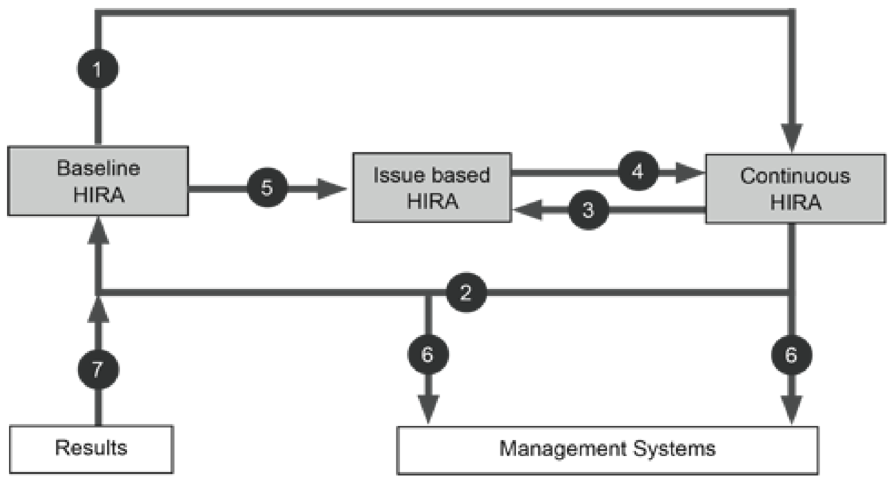

Figure 7.7 SIMRAC's 2001 Interpretation of Relationships Between HIRA processes

The SIMRAC occupational health practice handbook also provided guidance on how to conduct an occupational health baseline risk assessment, and when and how an issue based assessment may become necessary. See Figures 7.8 and 7.9 which follow. Health specific considerations were included such as biological and epidemiological verification steps. The terminology used in the diagrams were not aligned with that of the initial guidance document issued by SIMRAC. Figure 7.8 presents this proposed risk assessment process and included RM aspects such as implement *'protective action'* and monitor.

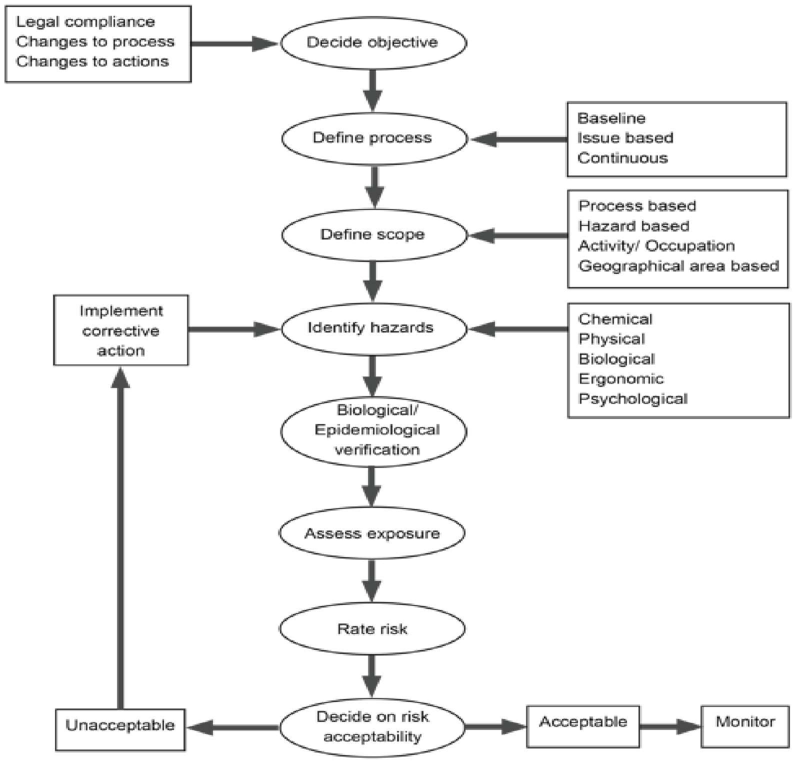

Figure 7.8 SIMRAC's 2001 Occupational Health Risk Assessment Process

Figure 7.9 depicts the baseline risk assessment process, the hierarchy of scoping elements and examples of what these might entail and how the results could be presented.

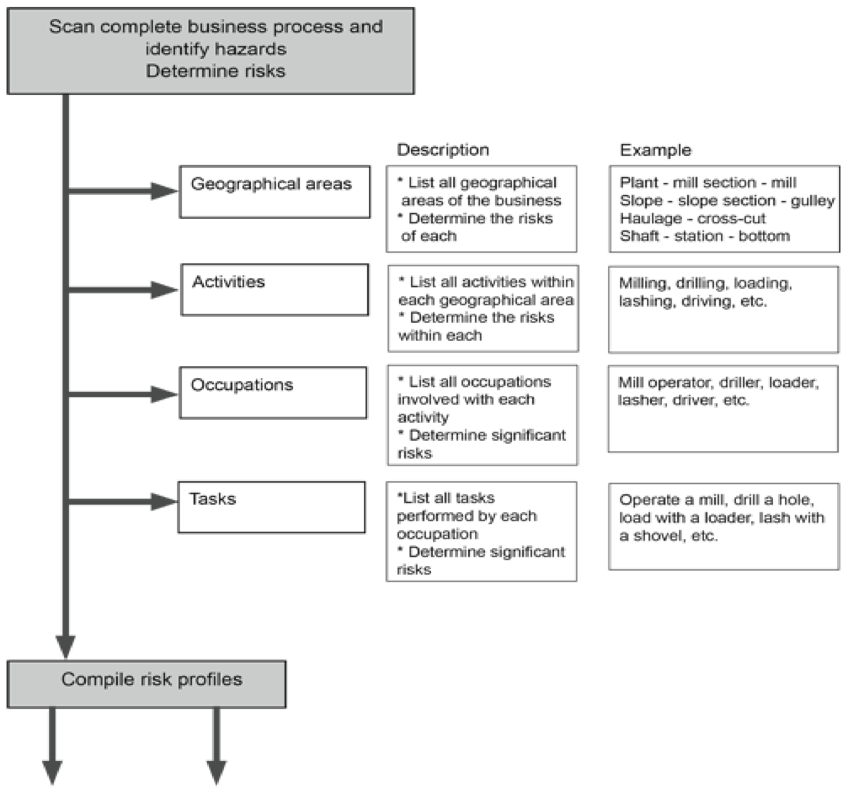

Figure 7.9 SIMRAC's 2001 Baseline Risk Assessment Process

These diagrams, Figures 7.8 and 7.9 and their associated terminology added to the complexity of pinning down the RM process, the terms to be used, and their precise meaning.

In 2007, the MHSC published a handbook on occupational hygiene measurement which was produced by the Mine Ventilation Society of South Africa and the South African Institute for Occupational Hygiene. This book contained a RM diagram based on the HSE's 5 step model (Badenhorst, 2002). All of these diagrams, provided in official guidance, co-exist.

The occupational hygiene handbook, nonetheless, captured and built on a long history of experience and expertise. It was based on a Chamber of Mines publication, last revised in 1998 and first produced in 1947 as the *' Quality of Mine Air: Dust Content and Cooling Power'.* The title of the handbook changed several times over the years, in 1965, 1972, 1982, 1998 and 2007. The successive titles since the first edition were, *'Quality of Mine Air: Routine Measurements in South African Gold Mines';*

'Quality of Mine Air: Routine Measurements in South African Gold Mines'; 'Routine Mine Ventilation Measurements'; Measurements in Mine Environmental Control' and in 2007 the *'Handbook on Mine Occupational Hygiene Measurements'.* The content of the handbooks changed with the use of measuring instruments and techniques – the first instruments being the konimeter for collecting dust particles in a measured volume of air and the kata thermometer for measuring the cooling power of circulating air. The 1965, 1972, and 1992 editions included information on a broader range of ventilation measurements, with conformance from the 1972 onwards to international measurement system. The 1988 version followed the adoption of gravimetric sampling in the industry, and the 2007 version expands the ambit of the handbook from mine ventilation to the wider range of topics associated with occupational hygiene and safety. New chapters addressed issues such as stone dust sampling, biohazards, ergonomics, diesel particulates, vibration, welding fumes, ionising and ultraviolet radiation, skin and dermal exposures, and report writing.

7.5.4 **Risk Management Guidance in the Global Mining Sector**

Several conceptual additions and refinements in established concepts helped to create a more coherent scheme for the organisation of H&S related RM activities in mining. Movement towards common terminology and a comprehensive standardised approach has not been smooth as the preceding discussion showed and is not yet complete.

A major step towards coherence took place when the Department of Primary Industries in New South Wales, Australia set up a working group under the leadership of a department official to develop a handbook on RM in the mining sector which was published in 1997 (Tweeddale *et al*., 1997). The handbook created the foundation for the development of standardised terminology and process. It emphasised the importance of properly establishing the context, strategic and organisational, of RM; and amplified the aspects of RA. The role of mathematical or statistical methods in RM were described as limited, except for when specific focus was required for resolving particular problems. The ever present confounding issue that there was no one correct way to undertake RM was acknowledged upfront, along with the necessity to adhere to key principles (Tweeddale *et al*., 1997). The NSW's handbook presented 6 key steps in the process of RM, pointing that common fallacies were insufficient attention to defining objectives and scope. As with the IRCA course it also referred to several methods for identifying hazards and evaluation risks.

The handbook was revised and published in 2011 by the NSW Trade and Investment Department (Terrey *et al*., 2011). It replaced the 1997 handbook and drew on the content of newly available reference documents such as the Australian and New Zealand ISO standard on RM(AS/NZS ISO31000;2009). Materials which further advanced systemic approaches to addressing risks in the mining sector were included in the handbook which also dealt with the cultural aspects of RM.

Further investment in developing mining specific RM guidance in Australia came from Anglo American PLC , leading in many countries to the adoption and refinement of the terminology and foundational concepts already established in the MDG 1010 documents. This guidance also started addressing the vexing concern about the plethora of RA tools and advised on which tools were best used for specific types of RA.

Jim Joy, who had been involved in the working groups which produced the 2011 and 1997 MDG 2010 handbooks played a leading role. By 2010, he had moved to the Mining Industry Safety and Health Centre (MISHC) within the Sustainable Mining Institute (SMI) at the University of Queensland where he was appointed as Professor and Director of the MHISC.

This centre became the epicentre of Anglo American PLC's and later industry-wide efforts to standardise RM practice. The company committed resources to developing industry-wide practice and launched the programme in 2010, with the involvement of a global network of universities (Anglo

American PLC, 2010). This initiative, and its leading personality won a number of awards (The University of Queensland, 2009; International Mining Technology, 2018; Cunningham, 2015).

The work pioneered by Joy at MSHIC and co-ordinated on behalf of Anglo American PLC, resulted in the Global Minerals Industry Risk Management Program (G-MIRM) which has been offered by a number of universities in Africa, Europe, North America, South America and Australasia (University of Queensland, n.d.) G-MIRM certification satisfies the requirements of the '*RIIRIS601D Establish and Maintain Risk Management System'* industry competency standard as defined by the Coal Mining Safety and Health Advisory Council, and the Mining Safety and Health Advisory Council in Queensland. It is a prerequisite for appointment as a Site Senior Executive (SSE) and for sitting the Queensland's mining inspectorate's SSE exam.

Standardisation of training through a network of universities delivering G-MIRM on 4 continents contributed to the development of a standardised vocabulary for RM in mining. While there are slight variations in the definitions employed in the engineering disciplines whence these concepts and terms originated, fundamentally the concepts are the same, and are also aligned with the terminology of ISO 31000, the Risk Management Standard (International Organization for Standardization (ISO), 2018). G-MIRM content also influenced the design of proprietary and in-house mining company programmes, and the guidance offered by the ICMM. In South Africa, where three universities have offered the course, trade unionists, corporate and mine level executives and a number of mine inspectors have attended the course. In the 2011, MDG 1010 handbook definitions of terminology are presented on pages 96-100 (Terrey *et al*., 2011)[38].

[38] Terms defined include: acceptable risk, ALARP, assumed risk, BTA, consequence, cost, criticality, EBA, ERM, Event, ETA, FMEA, FMECA, FTA, FSA, frequency, HAZAN, HAZOP, hazard, JHA, JSA, LTIFR, likelihood, loss, MIRM ladder, monitor, OHS, PHA, probability, QRA, RCM, residual risk, risk, risk acceptance, risk analysis, risk assessment, risk avoidance, risk-benefit analysis, risk evaluation, risk identification, risk management, risk management framework, risk reduction, risk treatment, SOP, SWP, TARPS, and WRAC.

While these efforts clarified for all the disciplines involved in OHS, the fundamental principles and processes central to systematic RM, if did not address the specific character of occupational health risks. These are that many conditions became evident after employees had ceased work, that occupational hygiene and medical surveillance data could not be treated in the same way as safety data, and that successful treatment of health risk often required changes in design and technology.

7.5.5 **Key Conceptual Issues**

Framing

How to order the unstructured assemblage of RM activities into a coherent framework which could be confidently described as systematic and comprehensive posed a significant challenge. Ideas about the framing of RM activities in mining advanced between the two editions of MDG 1010, and the content of the 2010 edition incorporates these advances. The successive elements of the broad framework of OHS RM includes clarifying (i) the context of mining – the physical and social environment in which a mine is located; (ii) the sequence of operations over the entire mining life cycle from exploration through to mine closure; (iii) flow diagrams which depict the sequence of activities including the inputs and outputs associated with each operation in the mining lifecycle[39]; and (iii) lastly referencing each operation (and, as required the critical activities) to a single diagram which summarises the OHS RM requirements to achieve safe production, depicted in Figure 7.10 below. The term 'safe production' describes a state in which OHS risks are well controlled, with each component having been adequately designed and operationalized, and well-integrated.

[39] The mining cycle includes the following phases conceptualization of the mining concept, acceptance (or not) of mining project feasibility, project design, construction or acquisition, commissioning, operations (including waste management), maintenance, modification, disposal or closure, post-closure responsibilities.

Figure 7.10 Nertney Wheel or Work Process Model

Source: (Terrey *et al*., 2011)

The "Nertney Wheel" was derived from the work of Dr. R J Nertney, a senior engineering specialist who worked in the nuclear sector and who described process safety as a *'collective state of readiness'* in which hardware, procedures and people come together '*in accordance with system operational requirements*' (Nertney, 1987). The wheel was also helpful in checking the completeness of risk assessments and accident investigations. Specific criteria are associated with each element of the wheel (Terrey *et al*., 2011).

Integration into Existing Management Systems

Three issues arose in this respect, clarifying the steps in the RM process; clarifying how they line up with existing management processes; and clarifying the relationship between RM processes at different levels in the organisation or at different stages in the operational process. Three diagrams which appear in the MGD1010 and the GMIRM courses present the flow and logic of these processes. Understand the hazard does not only require identifying the source of potential harm but also the destructive potential of the source, the mechanism of release, the amount of energy released, and situation into which it is released. Sources of energy, including chemical sources, are a useful way of identifying hazards.

The following diagram (Figure 7.11) presents the sequential steps in the RM management process which is a modified version of the AS4360:2004 process. It starts at the *'establish context and scope'* step and follows the central arrows to *'treat the risks'* and then feedback information through the monitoring /review and the communicate / consult loops (right and left). The feedback loop from controls/barrier back to analyse and *'evaluate the risks'* is indicative of the iterative nature of this steps checking existing controls, considering additional or new controls if the residual risk is unacceptable (Terrey et al., 2011, pp. 26–37).

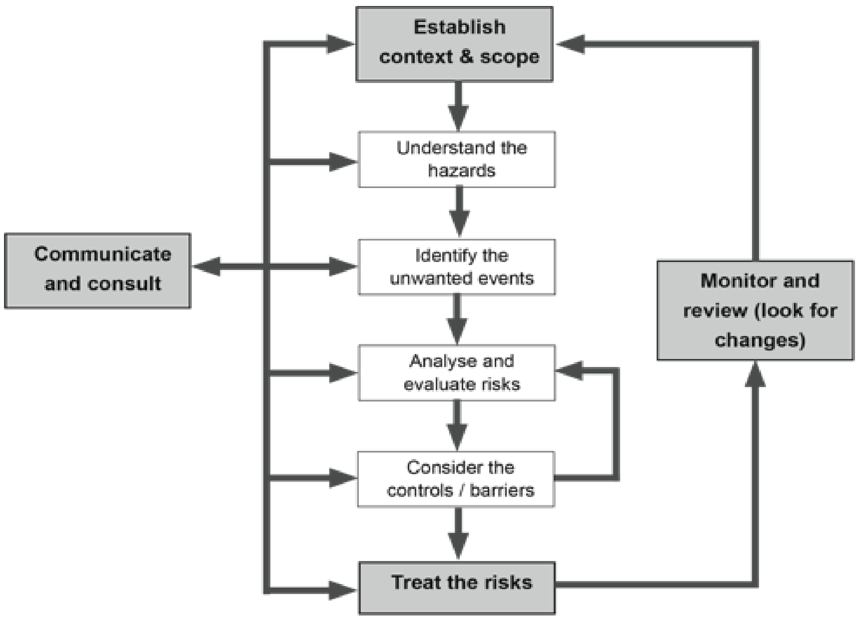

Figure 7.11 The MIRM Risk Management Process
Source: (Terrey *et al*., 2011)

The adoption of safety management systems (SMS) have not always led to improvements in OHS because the activities associated with the SMS are not embedded in operational and line management activities; SMS activities run parallel to operations management; SMSs are adopted to facilitate trade or satisfy customer demands rather than to improve OHS; employees are not involved, and what employees do does not alter after SMSs are introduced. The generic *'plan, do, check, act/ adjust'* problem solving model of Deming, which was restated by Drucker in the 1970s, provides a template for mapping RM activities to the general activities of managers (Terrey *et al*., 2011).

Figure 7.12 The Deming Model of Operations Management

RM activities are mapped to the diagram as follows. Establishing the context, scoping, and risk assessment are mapped to the plan step, implement controls is mapped to the do/ direct step, investigation, monitoring, consultation and review are mapped to the check step, and adjust refers the *'treat the risk'* RM requirement.

The final diagram, Figure 7.13, is a hierarchical representation of the RM process undertaken in the operational environment. It was derived from the practice of Phelps Dodge, which was documented by Jim Joy. The arrows did not originally indicate diminishing risk as they now do now. Design, resourcing, monitoring, and creating a safety culture are all senior management responsibilities which have a fundamental impact on the level of risk in an organisation.

The layers are distinguished by the RA objectives associated with the RM activities which are undertaken at different levels.

- Overall site RM to identify, assess and manage major, principal, or catastrophic risks
- Once-off risk assessments for new projects, changes, or following incidents

- Risk assessments to develop procedures or guidelines such as standard operating procedures (SOPs) and safe working practice documents

- Informal risk assessment tools which are used before starting a new task or upon being confronted with changed conditions. This RA is carried out to establish whether it is safe to proceed by reviewing the status of the hazards, risks and controls in the G-MIRM / jkTEK scheme (Anglo American PLC, 2017).

This model can be likened to that described in the MHSA which refers to baseline risk assessment, issue-based risk assessment, and routine risk assessment. The model is explicit about when the different types of risk assessments are triggered, and the range of tools suited to the level of assessment to be done. The tools to be employed were eventually simplified into a bow-tie depiction of unwanted events at the first 3 levels, and a tool to be used by workers on the job which allow them to assess whether they were dealing with a go / no go situation.

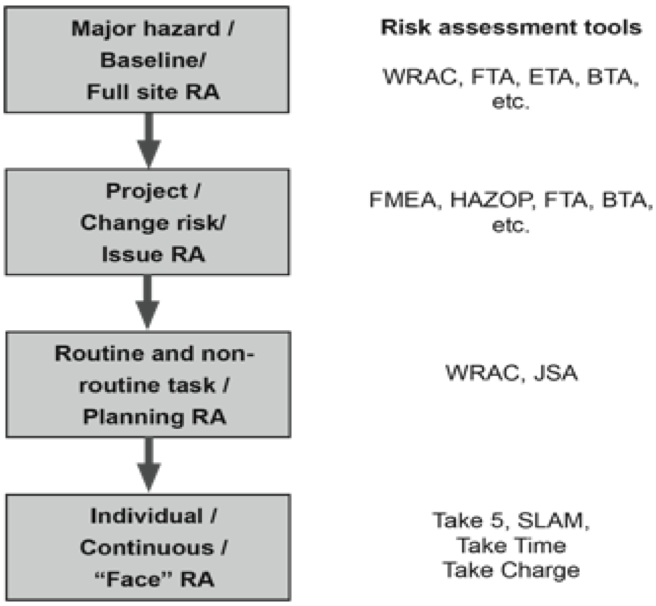

Figure 7.13 The Layered RA Model aligning to RM Activities at Different Levels in the Organisation

Safety Culture

Research into organisational culture and development resulted in the idea that leaders can 'engineer' the culture of the organisations for which they are responsible. Humanistic values underpin organisational development theory which at its heart proposes that people seek personal development and growth, and *'wish to be accepted and to interact co-operatively '*. This has led to insights into how leaders enable or hamper organisational effectiveness (Schein and Schein, 2016).

As the roles of leaders in developing and shaping organisational culture crystallised, competing notions of what constitutes safety culture have coalesced around what people *do* rather than what they *think*, albeit that the two are related. Both practitioners and academics have contributed to the knowledge base on how organisational culture supports or undermines safety.

Schein and Reason argue that collective practices define safety culture. Edgar Schein's perspectives are summarised as '*the way we do things around here'* and in his later formulation '*shared basic assumptions'* (Schein and Schein, 2016). Reason considered the characteristics of safety culture. For him, it is an informed culture in which reporting is a norm; '*people are prepared to report their errors and near-misses'*; blame and punishment is handled justly; organisations learn from reports and investigations; and people confidently make decisions as warranted by an unexpected situation i.e. the culture is flexible (Reason, 1998; Reason, 2000; Reason, 2016). Expanding on Reason's work, Hopkin's who analysed a number of major accidents, concluded that building a safety culture involves understanding '*organisation characteristics'* and '*changing organisational practices*' among various groups and at various levels in an organisation; as well as appreciating the sources of culture in the wider social environment (Hopkins, 2002; Hopkins, 2006). Hudson, who worked in the petrochemical industry and Shell, in particular, and who is at present based at Delft University of Technology, developed the evolutionary model of safety culture, known as Hudson's Ladder, which is very influential. The model is essentially a roadmap, with two sets of co-ordinates, operational processes and systems, which work in tandem. Both require attention as company culture progresses from the lowest stage, a pathological culture, through two stages of cultures described as reactive and calculative before finally arriving at the generative stage which is the highest. The middle stages are very system-dependent and demanding, and it is possible for companies to regress (Hudson, 2014; Hudson, 2007). Hudson's ladder was incorporated into the guidelines of the HSE, the MDG 2010 Handbook, the G-MIRM programme and Anglo American's Safety Way programme (Hudson *et al*., 2000; Hudson, 2001). Another influential model of safety culture is Du Pont's Bradley Curve, the oldest model, which has been applied by a number of companies in South Africa (Csontos, 2016). The Bradley Curve, which was formulated in 1995, draws on self-improvement concepts outlined in Stephen Covey's book, the *'Seven Habits of Highly Effective People'*. Individuals' progress towards effectiveness can be mapped to three stages of maturation, dependent, independent and interdependent (Covey, 1989). The stages towards effective safety culture are located on the x-axis of the Bradley curve (reactive, dependent, independent and interdependent). The status quo is described in terms of changing mindset, relative levels of self-responsibility and teamwork (Hess, 2018).

The 2011 and 2010 MDG Handbook and the G-MIRM programme both include exercises on assessing the status of an organisation's safety culture and both provide advice on how to advance to the next stage (Terrey *et al*., 2011). These models reflect Patrick Hudson's thinking.

The images of the various safety models which have been employed in the mining sector are presented below. All models bar, the Du Pont model, draw on the work of Hudson.

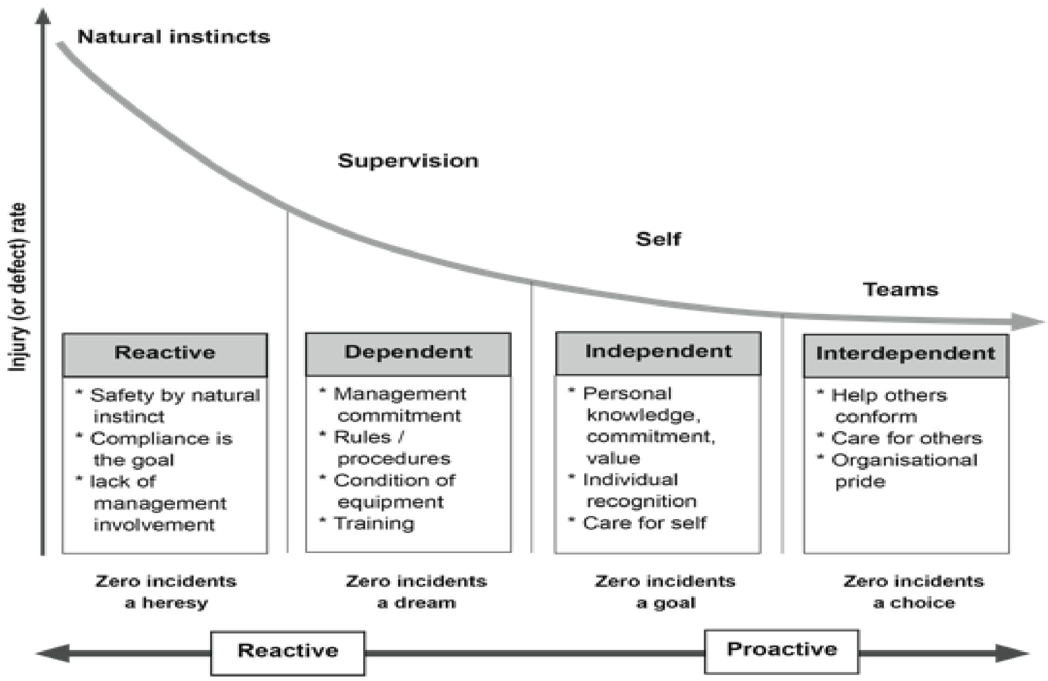

Figure 7.14 Du Pont's 1995 Safety Culture Model

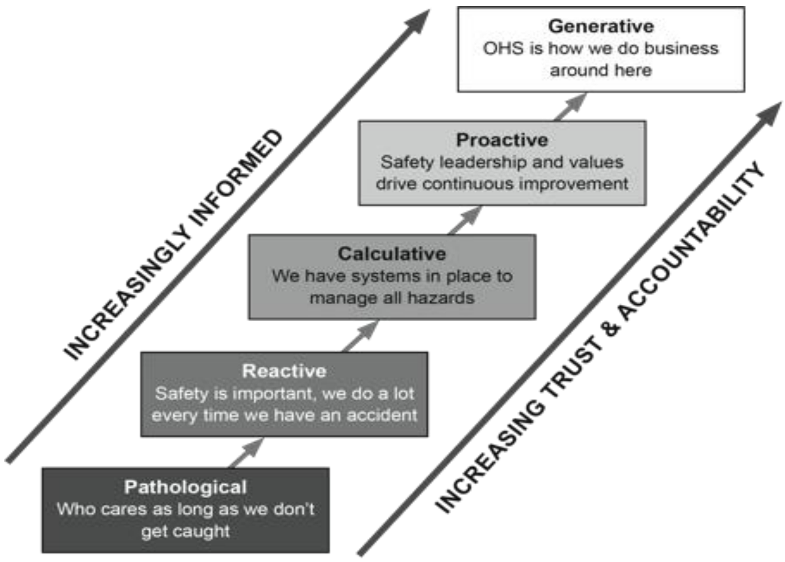

Figure 7.15 Patrick Hudson: Evolution of Safety Culture (2000 & 2007)

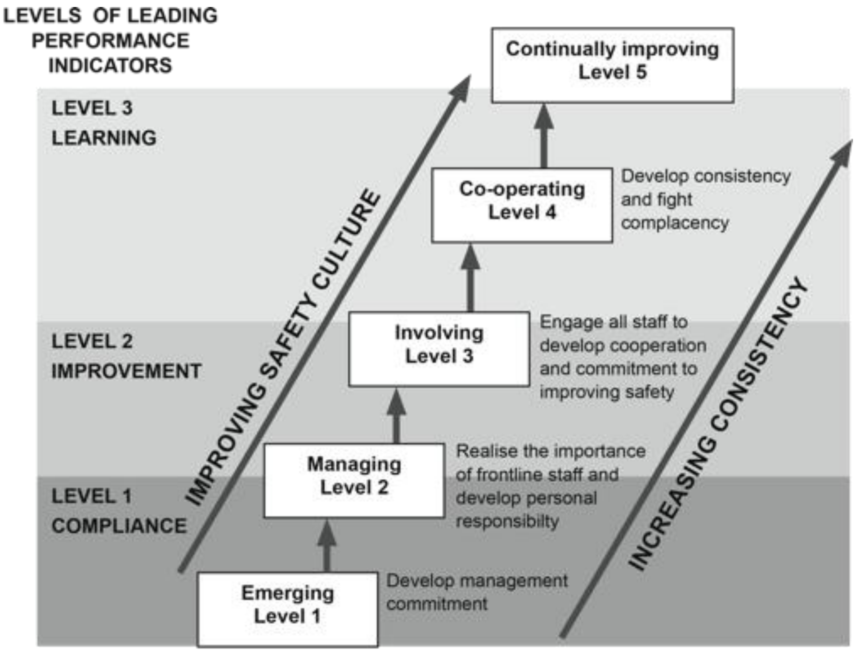

Figure 7.16 HSE's 2000 Safety Maturity Model

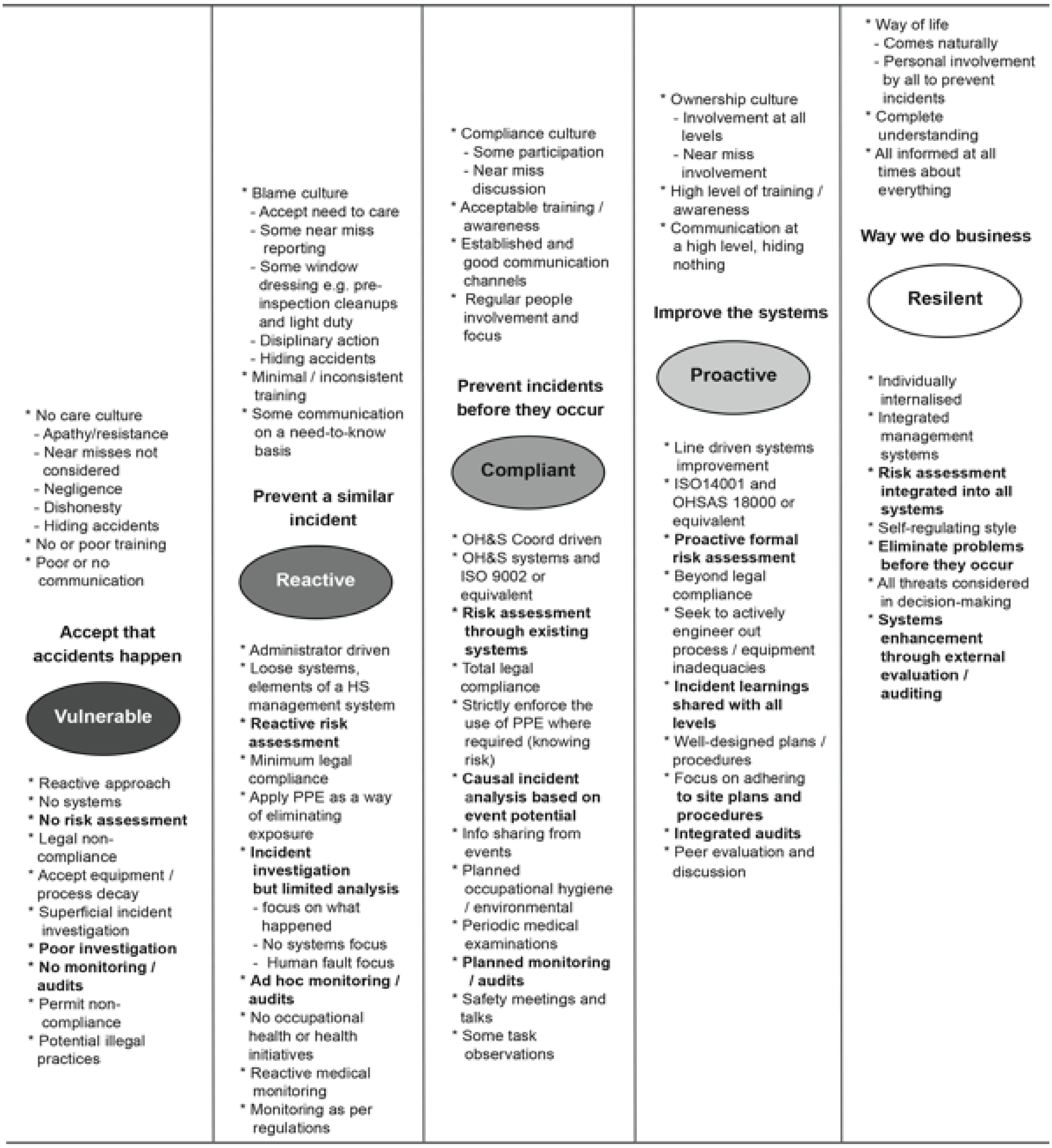

Figure 7.17 GMIRM: Minerals Industry OHS Maturity Model

Source: (Terrey *et al*., 2011)

Accident Investigations

Another major contribution to the development of RM practice in mining came from BHP Billiton (now BHP) in the field of accident investigation. In response to the ok Tedi environmental disaster in New

Guinea (1984) and the Maura Coal Mine disaster in Australia (1986), BHP revised its approach to governance, ethics, H&S and the environment (O'Neill, 2012; Hanson and Stuart, 2001).

The Moura disaster revealed several deficiencies in the management of safety at the mine: a lack of attention to a significant hazard, spontaneous combustion in this case, which caused the disaster (a low frequency but catastrophic event); failures to identify and monitor critical controls; the absence of mechanisms to confirm that controls were effective and active; failure at senior levels to make decisions about the situation (decisions were passed down the managerial hierarchy to the miners themselves); informal and unstructured communication; and poor understanding of the spontaneous combustion hazard (Chapman, 2007; Tucker and Hopkins, 2000; Windridge, 1995). The disaster led to BHP reconsidering its approach to major hazards. One result was the Incident Cause Analysis Method (ICAM) which drew on the work of James Reason. ICAM was developed by a team led by Gerry Gibb who was then at BHP-Billiton (Gibb, 2007). The company's focus on eliminating workplace fatalities and understanding the nature of industrial accidents, led to improvements in accident investigation methods, more detailed attention to systemic issues and clear responsibilities, implementing the findings of such investigations more assiduously. BHP-Billiton also adopted the concept of critical controls as a safety management mechanism. These controls were required to meet certain performance standards and to be routinely assessed (BHP-Billiton, 2010). Further outcomes included direct assignment of safety responsibilities to line managers in 2008, accompanied by instructions to eliminate fatalities, simplify work procedures and improve safety culture (Broomberg, 2014).

James Reason, whose work inspired ICAM, was the originator of the *'swiss cheese'* accident model (Figure 7.18), and the concept of *'defences in depth'* (Reason, 1997; Reason, 2016; Long, 2017). As understanding grew that major accidents resulted from decisions, conditions and factors originating from different sources and locations in an organisation; accident investigation processes were increasingly informed by insights on decision-making, human error, organisational culture, safety culture, the notion of just culture, and the influence of the roles and responsibilities of senior and site management (Tucker and Hopkins, 2000; Hopkins, 2002; Hollnagel, 2008; Hollnagel et al., 2006; Dekker, 2007; Dekker, 2009).

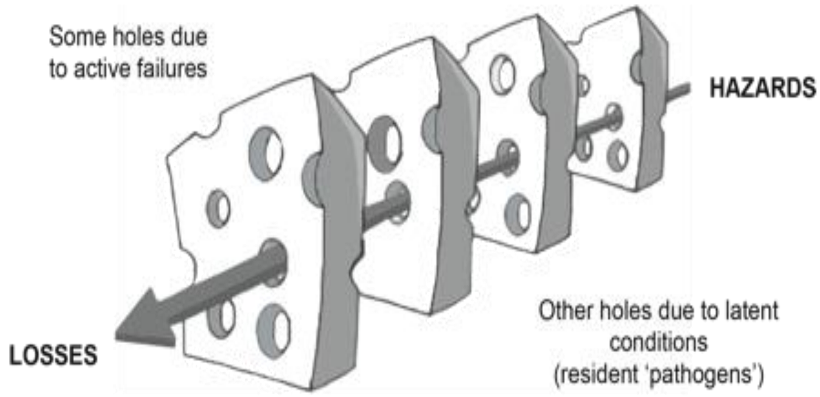

Figure 7.18 James Reason's 1997 Swiss Cheese Model

Changes in the way accidents were investigated influenced the way in which the origins of hazards and risks were understood. One result has been the increased use of the 'bowtie' analysis (BTA), a combined fault and event tree, to summarise the causes and consequences of accidents and major events, and to map critical controls (ICMM, 2015a; ICMM, 2015b). Hopkins has also shown that diligent analysis of an accident investigation can also provide evidence of the characteristics of organisational culture (Tucker and Hopkins, 2000, Hopkins, 2005, Hopkins, 2006).

7.5.6 Other Developments Affecting Risk in South African mining

Labour Market Changes

Since 1995, employment in mining has not been stable with adjustments due to downsizing and sub-contracting.

By 2016, the industry lost 140,000 jobs due to both downsizing and technological change. All labour intensive mining has been affected including gold, platinum, iron, coal and manganese. The number of jobs lost have been especially high in gold mining (Malherbe and Segal, 2000; Eunomix Research, 2018).

Since mining is concentrated in certain provinces, declining mining employment has had acute effects in the North West, Free State, Mpumalanga and the Northern Cape provinces of the country, (Standing *et al*., 1996).

The number of mineworkers employed on contract relative to those in full-time employment has also increased, stratifying the mining workforce further and introducing new layers or nodes of mine management. The nature and scale of sub-contracted work on mines changed over time. Traditionally, shaft sinking, access development and construction work has been contracted out on mines. In the 1980’s and 1990’s catering, the maintenance of grounds and office cleaning work was increasingly out-sourced. From the mid-1990s, sub-contractors became directly involved in mining activities such as diamond drilling, clearing vamping and cleaning backlogs, construction and rehabilitation of haulages, timber reclamation and tailing dam construction (Diering, 1993).

These trends mitigate against effective RM due to the effects on communications and monitoring systems (more complex) ; HIRA processes (which ought to involve contractors), industrial relations (more stressed) and coverage of training and workforce development programmes (often limited to direct employees).

Rising levels of Artisanal Mining (AM)

Artisanal mining is a long standing practice in South Africa. Policies which informed the MPDRA advocated for the development of a vibrant and efficient small mining and junior sector. Artisanal mining specifically was not mentioned in support policy, however since the promulgation of the MPRDA, artisanal mining has been recognised and supported through DME/DMR programmes. There is no reliable data on the scale, extent, and exact location of artisanal mines. While it is recognised as a legitimate mining activity, the MHSI does not report on the state of OHS in artisanal mines and little is known about the effects of such mining on those involved or affected. However, in 2011, the MHSC commissioned research, which confirmed the existence of at least 1,030 artisanal mines. Many of these were found to be located in areas of extreme poverty and unemployment in the North West, Northern Cape, Limpopo and Eastern Cape Provinces, and activity levels increased over time (Ledwaba, 2017).

The problems encountered by informal miners and associated with informal mining are well documented despite the paucity of numerical data (Ali, 2018; Intergovernmental Forum on Mining, Minerals and Sustainable Development (IGF), 2017; Mutemeri and Ledwaba, 2017). Amongst the problems are a lack of training, governance and support, ecological stress and very limited resources. Under these circumstances, H&S risks are not likely to receive formal attention or oversight.

The line between artisanal and illegal mining is thin and inadequately addressed in South Africa albeit the effects on land use, the environment and H&S are likely significant. As many as 30,000 artisanal miners some of whom are mining illegally could be active in South Africa (Hoadley and Limpitlaw, 2004) .

“Illegal” Mining

Illegal mining is broadly understood as mining which is unauthorised. It may be poverty driven or organised by criminal syndicates or both. Many minerals and metals including silica sand, coal, diamonds, chrome and gold are vulnerable to illegal mining, and the effects on public safety, water resources and arable land can be substantial (Yende, 2018). Closed or abandoned mines have often been identified as illegal mine sites, as have closed off areas of operating mines (News 24 Correspondent, 2018; Solomons, 2017) . Illegal sand mining is a significant problem which affects riverbeds, estuaries and beaches in South Africa and the case has been made for better enforcement and prohibition of river and estuarine sand mining (Chevallier, 2014).

Illegal mines fall outside of the mandate of the DMR. Artisanal mining although promoted by the DMR, is not properly provided for in policy and legislation. Although the distinction between artisanal and small mines are unclear, small scale miners can be granted permits to mine (Hoadley and Limpitlaw, 2004; SAHRC, 2015). The MHSI is rarely involved in the regulation of artisanal or illegal mines, although organisations such as MRS have been called on to assist when illegal miners have become trapped. According to SAHRC Commissioner, Janet Love, in the absence of '*any comprehensive framework for improving the practices of AM, current characterisation simply as "illegal", will have the effect, in terms of the panel's prediction, of making AM become more dangerous rather than causing it to disappear'* (SAHRC, 2015).

People Affected by Mining

The recent report by the SAHRC on the challenges facing mining affected communities concluded that the mining sector was beset with problems related to impacts on land, water, the environment and the housing of its workforce. Furthermore, access to information and participation in decision-making were deficient. The SAHRC recommended that government, traditional leaders and mining companies in particular, take steps to '*move away from'* adversarial relationships with civil society and take account of the concerns of communities about the nature, duration and intensity of mining (SAHRC, 2016). Many directives and recommendations were made on the range of issues heard by the commission. About 35 protests are estimated to take place in South African mining communities every month according to the Benchmarks Foundation. Issues raised by communities include demands for jobs, concerns about infrastructure or local investment, safety and environmental concerns, corruption, land ownership, illegal mining and mine ownership (James, 2018b). Specific data on the number of communities and people affected by mining, the nature, locations and extent of impacts including impacts on H&S, are unknown. The MHSI does not record community related data although the MHSA's risk management requirements apply to both mine employees and people affected by mining (Mine Health and Safety Act, 1996, p. s5(2)(b)). It is likely that a large number of communities and people are affected by mining, given the extent of mining in the country.

7.5.7 **Missed Opportunities**

Learning from the HSE

Despite the Robens lineage of the MHSA, South Africa stakeholders did not consider seeking advice from the HSE which had by dint of the outcomes of the Robens Committee's report been grappling with risk assessment shortly after the enactment of the HSAWA in 1974. This was an opportunity sadly missed, and probably related to the decline of mining in the UK. Providing oversight and advice on the control of risk had been part of the HSE's mandate since its establishment, given its oversight of high hazard industries such as nuclear, offshore and mining.

The most popular guide issued by the HSE, HSG65, dealt with OHS risk management. The first edition was published in 1991, and since then it has been revised twice, in 1997 and 2013 (HSE, 2013). It included advice on aligning OHS risk management activities with the routine plan, do, check, act responsibilities of managers, covered issues such as OHS management systems, leadership, competence, worker consultation and involvement, and provided information and additional resources. However as indicated earlier, the UK, along with South Africa and many other countries, was late in absorbing the particular character – latency and extent - of occupational health risks which started receiving serious attention from the HSE over the course of the 1990s - still timely for developments in South Africa. The expanded understanding of these risks is reflected in the text of the successive editions of the guide (HSE, 2004).

Dismissing 'Pit Sense'

Mining has a craft aspect to it, and miners develop pit sense as a means to make sense of and deal with the uncertainties in mining. It is defined as a form of knowledge which is practiced but not taught.

It is acquired in situ, informally, experientially and through close interaction. Another description is that it is situated sensory knowledge, which is difficult to codify and incorporate into JSAs, and amongst the workforce it tends to be seen as having stood the test of time. Kamoche and Maguire in a 2001 UK study found that workers who live and experience pit sense were reluctant to abandon it for codified procedure. In essence *'externally validated work practices'* were resisted because they *'had not benefited from an understanding of underground realities'* (Kamoche and Maguire, 2010). This was a clash of two cultures - on the job craft-learning and expert/ professional opinion.

Leger and Mothibeli pointed out in a 1998 paper, on his study of pit sense in four gold, one coal, one chrome and one diamond mine which had not been hitherto documented in South Africa, that only team leaders (head of the mining crew) had formally assigned responsibilities for identifying and responding to hazards. It fell to the team leader to bar down the face and make the working place safe while drill operators, who were most exposed to the rockfalls and rockbursts, were required to assist him (Leger and Mothibeli, 1988, p. 226).

Leger found that there were constant disputes over rockfall hazards in the mines between the then white miners and officials who visited the workplace during the course of the working shift, and black workers and the team leader (who was also black) who were present from the start of the shift. Mineworkers described dust and small stones falling from the roof, noises, cracks in the roof and sidewall, supports showing signs of strain as precursors to rockfalls, and acknowledged that rockfalls also occurred without warning. In these mineworkers' experience, rockbursts most often occurred without warning. While most workers left the workplaces upon observing the precursors, some did not, for fear of disciplinary action from the miner, for not first bringing the situation to his attention, and for not obtaining his permission. Often miners instructed the team to go back into the face when they were still unhappy about the condition of the workplace. Mineworkers felt that the reason for this was that blasting (production) was often the miners' primary concern. (Leger and Mothibeli, 1988, pp. 230–235). Miners were paid bonuses for the achievement of a certain number of blasts but were not directly at risk.

The recognition of workers' skill in recognising rockfall hazards had the potential to reduce conflict between management and the workforce, save lives, and enrich the hazard identification and risk assessment process. As such it remains a missed opportunity for improved safety and co-operation.

7.5.8 **Conclusions**

Prior to the introduction of the MHSA, OHS risks were addressed through a loss control framework promoted by ILCI in many South African mines. The loss control approach to RM was not consistent with the principles of MHSA. At the time, it drew heavily on the ideas of scientific management advanced by Frederick Taylor, and its primary focus was the workplace – supervising workers, standardisation of jobs and housekeeping.

Developing clear ideas and procedures on how RM might be applied to H&S presented significant challenges. A very wide range of tools and experience was available but often limited to specific disciplines and practices. The application of RM to OHS demanded a model that could speak to any level or aspect of mining. Sorting out terminology and the applicability of various tools or combinations of tools to particular activities and tasks took time. The management of occupational health risks were among the last to be properly considered both in South Africa and elsewhere. The tortuous process of developing robust RM methods may have been short circuited, by drawing on the British experience with RM after Robens' recommendations were adopted.

South African and ILCI practice was influenced by the experience of the Australian mining sector primarily, the learnings of which were either directly transferred to South African mines through major mining companies, or through programmes provided by private companies such as NOSA and IRCA to South African mines which gradually incorporated these learnings. This resulted in a broader conception of RM, starting with the decisions made in the planning, decision and construction phases of mining, which could lock operations into a specific level or type of risk.

Programmes championed by Anglo American PLC and BHP Billiton shaped RM and accident investigation practice respectively, in the global mining sector, as well as in their subsidiaries who were required to adopt their company's new standards. These programmes mirrored the expanded appreciation of RM by including factors contributing to accidents which arise from high-level decisions and actions. In the case of BHP-Billiton, their approach to RM evolved from the way in which the company considered accident investigations.

While it is apparent that RM practice has advanced theoretically and practically within the environments of large mining companies, the uptake by smaller or struggling mining companies is less clear.

In South Africa, some but not all mine inspectors have been exposed to formal programmes offered through universities, and some but not all are informally exposed to practices during regional meeting with stakeholder representatives. In contrast, in Australia such training is compulsory, while in the UK, detailed guidance is provided to inspectors who, while novices, work under the guidance of more experienced colleagues.

The RM guide published in 1995 by SIMRAC which is the most succinct, has not been updated, suggesting the sector as a whole may not be exposed to more recent developments in OHS risk management.

Of significance for South Africa is the fact that these RM processes do not explicitly address unionised environments or social contexts in which tripartite relationships are fragile. The ramifications for safety representatives, safety committees and trade unionists are serious, as they have not had the opportunity to develop their own perspectives on how they should engage with RM processes.

The practical insights and experiences of addressing workplace risks developed by mineworkers i.e. pit sense has still not been brought to bear on RM practice. This may be an opportunity missed.

In tracing the development of effective RM practice, this chapter has shown how long after the MHSA came into effect, nearly 20 years, clarity on this crucial aspect of the regulatory system emerged, and probably still remains out of the reach of small mining entities. Also shown is the transition from emphasising the role of individuals in OHS failures, to emphasising the importance of robust systems and the creation of a safe workplace culture.

CHAPTER EIGHT: SIGNIFICANT RESEARCH FINDINGS, AND SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

This chapter summarises the key findings on the impact of the MHSA on H&S in the South African mining sector and sets out recommendations for improving H&S policy and practice. These findings and recommendations have relevance for South African mining as well as for mining in other developing countries, where ILO Conventions 155 and 176 apply or are likely to apply. I also consider how my findings might contribute opening up new avenues for future research.

8.2 Synthesis

The MHSA which came into effect in 1996 emerged from the Leon Commission and operates in an everchanging and complex in environment, affected by long-standing problems and a changed minerals sector with new needs.

The sector had little experience and insight into the full ramifications of the concepts of tripartism and RM introduced by the MSHA. The application of these concepts to H&S presented considerable challenges to all the parties and resulted in delayed decisions and confusion over what constituted appropriate practice. It also introduced provisions for proactively managing occupational health, a practice which was not well established world-wide. While formal rules for tripartite decision-making were established, they were routinely disputed, with difficulties arising when the tripartite parties could not agree (Hermanus *et al*., 2019; Hermanus *et al*., 2015a). The Inspectorate did not have authority to resolve such impasses. It had been severely criticised by the Commission, was unable to exercise authority debates over process, and framing and scope of regulations. The institutions and forums established under the MHSA, namely the MHSC, MRAC, MOHAC, SIMRAC and the MQA demanded significant levels of capacity which stakeholder institutions were hard pressed to meet.

Nonetheless, despite all the challenges, these institutions have endured, and significant capacity is still invested in them.

Priorities after the enactment of the MHSA were to establish the institutions of the MHSA and to thereafter revise the legislation and revamp the research programme managed by SIMRAC. That COMRO (then Miningtek) had been transferred to the CSIR where it continued to decline, and that OHS research was separated out into SIMRAC, limited the type, scope and scale of research projects which could be undertaken in support of improved H&S especially in respect of the fundamental problems of deep-level mining (Hermanus, 2017).

For the mine inspectorate specifically, the MHSA represented a change in approach in how it was to regulate the industry. The regulatory approach shifted from a command and control regime to one which was enabling i.e. a less prescriptive regime supported process or outcomes-based standards. From a theoretical perspective, under the former arrangement, regulators rely on a close relationship with the regulated in order to obtain the level of information and insights necessary for command and control (see Table 2.1, in literature survey), while under the latter arrangement, companies were to have more freedom to tailor responses to OHS risks to specific circumstances, and regulators were expected to evaluate the measures adopted by at different mines against their experience, general practice and principles, and their own expertise. As discussed by Baldwin (Baldwin *et al*., 2012), the command and control approach can lead to capture of the regulator by industry and this is exactly what the mine inspectors and the DME was accused of going into the Commission Inquiry into Mine Safety and Health. The mine inspectorate was uncomfortable with the enabling approach which underpinned the MHSA because it relied on interpretation of principles and processes then also unfamiliar - such as the hierarchy of controls, the evaluation of risk-management practices, and assessments of the adequacy of controls and stakeholder engagement. In addition, the inspectorate was wary of further allegations of regulator capture. This led to efforts to include more specification in the regulatory framework through codes practice and guidelines (Bakker, 2013).

However, the application of RM processes to H&S presented significant challenges to everyone. For MRAC, the industry, the Inspectorate and the unions there was little local experience and tools to go on, and international experience in the application of such processes were also in their infancy. The long journey towards effective applications involved many detours and experiments which were ill-fated. Although, the Inspectorate was uncomfortable with regulations which could not be directly enforced, regulations were strictly framed in terms of risk assessment. This meant that the actual level of risk posed by a hazard and its treatment was to be determined at mine level by mine personnel. As late as 2008, the Inspectorate found gaps and deficiencies in RM practice.

Nonetheless, the need for more specific guidance on what exactly the mines were expected to do in respect of particular hazards was recognised. Further guidance was incorporated into codes of practice (some mandatory) and guidelines on specific topics. The body of regulatory instruments has thus expanded to include codes of practice and guidelines. In theory, therefore, more guidance than in the regulations is available. However, the codes and guidelines are still framed as enabling documents and do not specify requirements.

The gargantuan efforts required to establish and operationalise the work of new institutions and draft legislation, did not immediately translate into mine level interventions aimed at shifting the way that mines dealt with H&S. The adoption of sector level milestones in 2003 were aimed at addressing this deficit and the milestone concept gained traction from 2008 onwards.

MPRDA came into effect after promulgation of the MHSA and changed the mining landscape (Hermanus *et al*., 2015b). The number of small and medium sized companies increased, the footprint of mining increased, and environmental and OHS impacts on communities proximate to mining increased. In addition, as mines closed or were mothballed informal and illegal mining took off. With the increased intensity of mining in some provinces of the country, the impacts on public H&S have also increased.

8.3 Did the MHSA Succeed as a Regulatory Instrument?

The NUM was instrumental in the establishment of the Commission and framing the MHSA in terms of ILO conventions 155 and 176. The result is that the MHSA is premised on tripartism; promotes enabling rather than prescriptive approaches to regulation and continual efforts to improve H&S; and requires periodical assessments of the status quo. The NUM representatives also advocated risk assessment as a modern approach to addressing H&S hazards. The policy and principles embedded in the MHSA were accepted by all parties.

The enabling approach which the MHSA reflects is based on two key tenets highlighted by the Robens' Committee, as discussed in Chapter 4 on the origins of the MHSA, that:

- Enabling legislation would lead to 'less law'
- Employers and employees (workers) had a natural identity of interest on matters related to H&S.

Neither tenet has held true in South African mining. A greater body of law is now applicable to mine H&S, and tripartite / bipartite engagement has advanced in fits and starts, with little evidence of relationships and communication. This is a significant finding that has not been made elsewhere and opens up the possibility of comparative research.

In addition, the application of enabling legislation, which centres on RM requires dedicated resources and expertise. As smaller mining companies have grown in number since the advent of the MHSA, the fit of the legislative framework to the mining sector has reduced.

Finally, the practice of RM at a system level was not well established when the MHSA came into effect. The Department of Primary Industries in New South Wales, Australia developed a handbook on RM in 1997 which started the process of standardising RM terminology and the application of RM to mine H&S. This process matured much later in 2010 and 2011 with the development of the GMIRM programme and investments in its development by Anglo American (PLC). Specific approaches to RM have not however been formally adopted in South African mining and is possibly worth consideration.

8.4 Did the MHSA Impact on OHS Performance?

Since fatal accidents and disasters, and high numbers of fatalities due to acute occupational diseases, were highly disruptive to mining operations, the mining sector started investing in addressing the underlying causes of these events in the early 1900s. However, the scale and significance of death, injury and ill-health amongst black workers were not recognised by the sector for much of its history, with the COM launching its first leadership summit on mine H&S in 2005. When the H&S milestones were first launched, the formal sector's perspectives on the state of H&S were at odds with those of others - historians, sociologists, epidemiologists, the miners, mining communities, the trade union movement and civil society. Improving accident rates (underpinned by gold mining's decline), invisible health impacts, and the political culture of the country appear to have contributed to this disconnect. Once, acknowledged, more resources and efforts were applied to improving OHS.

As discussed in the literature review (Chapter 2), a wide range of H&S hazards are encountered in the mining sector, some of which became the subject of specific interventions long after the MHSA had been promulgated. After the advent of the MHSA, sector level agreements were reached in 2013 to reduce the absolute number and rate of fatalities and eliminate silicosis and TB. The legacies of asbestosis and silicosis were addressed through legal action. The major hazards discussed in Chapters 2 and 4 (the literature survey and on the genesis of the Act, respectively) and the timing of interventions to address them, are presented in Table 8.1.

Table 8.1 Major Hazards and the Timing of MHSA Related Initiatives

Hazard	Type	Initiatives	Before or After MHSA
Coal Dust	Health and Safety	Elimination of pneumoconiosis associated with coal dust.	After MHSA. 2014 Milestones. Preparation of a class action suite underway. Available data may underestimate the extent of pneumoconiosis
		Elimination of Disasters associated with Coal Dust Explosions	Before MHSA, intensified after the MHSA was promulgated. Efforts successful but rising concerns about resurgence of mine fires
Asbestos Fibre	Health	Rehabilitation of Asbestos Mines	After MHSA. Many sites still not rehabilitated
		Compensation of miners and other qualifying claimants suffering from asbestos.	After MHSA. Asbestos Relief Trust established after legal action in 2003
Silica Dust	Health	Concerted efforts to reduce exposure to below TLVs.	After MHSA. 2003 Milestones which remain in force. Evidence of success reported by the MHSC. Decline in gold mining has significant impact.
		Compensation of affected miners and dependents	After MHSA. Settled through a class action lawsuit in 2018. Compensation to follow registration of the trust (expected towards end of 2019)
Tuberculosis	Health	Effective treatment of TB and elimination of conditions in which TB spreads	After MHSA. Subject of 2014 milestones. Evidence of success reported by the MHSC. Decline in gold mining has significant impact on reported cases of silicosis.
Noise-induced hearing loss	Health	Prevention of Noise-Induced Hearing loss	After MHSA. Subject of the 2003 milestones. Still in force. Improvement in personal protection devices and in equipment design apply.
Heat	Health	Acclimatisation or exclusion from hot areas if acclimatisation fails.	Ongoing issues in mining. Acclimatisation methods introduced well before the MHSA. Heat exposure a factor in the recruitment of female miners. Improved ventilation and cooling are the underlying problems
Accident related fatalities	Safety	Prevention of mine disasters (in which 6 and more miners lose their lives)	Prior to MHSA following major disasters in coal-mining. New technology and practices introduced by early 1990s. Concerns resurfacing about the maintenance of industry knowledge and practice. Work on understanding and reducing seismicity in goldmines started before MHSA promulgation. Problem not fully understood. Seismicity related disasters have reduced. May resurface as knowledge disappears from the sector and as informal / illegal mining increases
		Prevention of accidents which result in fatalities	After MHSA. Subject of 2003 milestones. Still in force. Fatalities have been reduced significantly. Improvements significant in coal and platinum mining. There is also evidence of improvements in gold mining. Decline in gold mining has been a major factor in declining of levels of fatalities.
		Prevention of accidents which result in disabling injuries	After MHSA. Subject of the 2014 milestones. Measurements are problematic. A 14-day threshold applies, at which time such injuries are formally

Hazard	Type	Initiatives	Before or After MHSA
			captured in the MHSI database. Improvements in data capture is a long standing problem. Number of injuries resulting in paraplegia or loss of limbs unknown.

Safety risks were, and remain, mainly associated with deep-level gold mining, followed by underground platinum and coal mining. The most common causes of fatal accidents and injuries were, and are, falls of ground, seismic events and heavy transport equipment and machinery. Coal dust explosions were a major cause of disasters in the 1980's when the coal mines were mechanising.

Coal mining disasters which were prevalent during the 1980s were largely eliminated in the 1990s as the problems of mechanising coal mines were resolved. During this period, the differences between mining the soft coals of the northern hemisphere, from which coal mining equipment was imported, and the hard coals of South Africa became better understood. In addition, the systems required for preventing flammable gas and coal dust explosions were researched, designed and implemented. In general, coal mining fatality rates in South Africa have fallen to levels comparable to those of Australia, Canada and the USA.

Seismic events in gold mining and falls of ground in platinum and gold mining do not only pose fatal and disabling injury risks but are also major disruptors of the production process. Such events accounted for the majority of fatalities in these sub- sectors, and in the case of gold, the majority of fatalities in the South African industry as whole. Hence, objectives to improve productivity and OHS converged in this case and are reflected in the sectors' long history of initiatives to combat mine seismicity and falls of ground,

While platinum fatality rates have improved significantly, they have plateaued in recent years, from 2014 onwards (Figure 4.2). While gold mining fatalities have declined, the rate of decline closely follows declining output. Nonetheless, it is clear that the effect of MOSH related interventions have also contributed to the reduction in gold mining fatalities and as mining has become more arduous (Dixon, 2019). As with platinum mining, fatality rates in gold mining have plateaued, from 2010 onwards (Figure 2.4). As the effects of a reduced gold mining sector on fatalities and injuries became less pronounced over time, the effects of initiatives undertaken through MOSH and set in motion by the milestones have become evident in reduced numbers of falls of ground and transportation accidents.

Major health risks include exposure to silica dust, coal dust, TB through living and working in close quarters and heat. TB and silica exposure are on ongoing concerns, albeit that employment on gold mines where the risk of exposure is highest, has declined. That the legacies of silicosis, TB and asbestosis were addressed through legal action rather than dialogue within the MHSC points to limitations in the tripartite process in which committee mandates and topics were tightly circumscribed. These lawsuits resulted in a greater appreciation of the extent of silicosis and its effects on mine labour-sending communities. A similar picture may emerge in respect of coalminers' pneumoconiosis, which may become the basis of another class action lawsuit. High levels of silicosis, TB and NIHL in gold mining affected the sector as a whole and has declined with gold mining employment (Figures 4.9 - 4.11).

While current exposure data suggest that exposures have been reduced to safe levels (below the TLVs), the jury is still out on whether silicosis, coal miners' pneumoconiosis, and the conditions which encourage the spread of TB have been eliminated. A significant uncertainty is whether safety and health data are comprehensive – i.e. whether the health status of the growing contingent of contract workers employed at many mines, and the effects accommodation in informal settlements of increased numbers of workers are fully reflected in the data.

In aggregate, OHS data trends support the hypothesis that the MHSA has been partially successful in improving H&S outcomes. While additional interventions were required to direct attention to H&S these were ultimately aligned with goals and processes of the MHSA.

8.5 Did Context Enable or Hamper the MHSA?

As concluded in Chapter 5, the impact of the context of mining on the activities of the sector have been significant and wide ranging.

The legacy of apartheid diminished prospects for robust tripartite relationships, effective tripartite processes, and the capacity of mining stakeholders to follow through on their agreements. This context has remained unchanged and has possibly become more difficult, as the complexity of the social environment has increased. Black workers were united under the NUM when the MHSA came into effect. The emergence of AMCU has split affiliation of mineworkers increasing the difficult of engagements between stakeholders. While SAMDA is not active in the committees of the MHSC, it has influenced decisions on mining policy (SAMDA, 2015).

Whether the education levels amongst the mining workforce have improved is unclear, and the adult education initiatives have been found to have had minimal impact on the understanding of OHS hazards amongst mineworkers. Other more formal training interventions have largely departed from the recommendations of the Leon Commission which were primarily concerned about the training and development of mineworkers.

When the MHSA came into effect, the sector was dominated by large well-resourced mining companies. The profile of the sector changed as smaller and less resourced companies took up mining. These companies have less capacity to follow an RM approach of the MHSA.

The expansion of the mining sector's footprint brought about by the MPRDA increased the potential for tension between mining companies and communities affected by mining. For these communities, mining's environmental effects also translate into H&S effects. Mine management is required to attend to any H&S risks to people affected by mining, and the MHSI is required to protect people so affected. These impacts are however not systematically monitored, documented or regulated.

Declining gold mining employment and the absence of new employment opportunities have spurred on informal and illegal mining. The full extent H&S consequences for those involved and those affected by informal or illegal mining activities is unknown. The MHSA does not cater for artisanal mining which the DME /DMR itself promoted. This "sector" has thus mushroomed without being regulated. Similarly, illegal mining has burgeoned with mine closure or mothballing. It was not a major activity when the MHSA was developed, and its rise was not foreseen. Illegal mining now affects established mines, and those affected face serious risks.

When MHSA was conceived, the above structural changes to the sector were not foreseen or anticipated and the provisions of the MHSA do not address or adequately address these changed circumstances. Consequently, current OHS data does not reflect the entire range of mining activities in the country. Discussions at the OHS Mining Summits have yet to extend to these issues but should. The scale of change may require that the ambit of the MHSA be revisited.

8.6 Was Tripartism Practiced as Envisaged in the MHSA?

Twenty-three years have lapsed since the MHSA came into effect. Relationships between the stakeholders remain fraught. Declining employment levels, general dissatisfaction with living conditions and wages, and the way in which the MHSI has used s54 directives have raised levels of distrust. The reflection of Fauconnier in 2005, captured in the conclusions of chapter 5 hold true. He said that the tripartite mechanisms of the MHSA offered opportunities to develop shared perspectives of the industry's priorities and future. But these opportunities have not been fully realised. Over twenty years later, there is little evidence of a resilient social compact between the stakeholders.

Current concerns include less than optimal functioning of the MHSC, variable success with regional level engagements, and the functioning of safety representatives.

In the MHSC, decision-making is slow, and the seniority of organisational representatives involved in the MHSC has declined over the years. In addition, the structure of the body changed following amendment of the MHSA in 2008. The effect of these amendments was to transform the MHSC, made up of tripartite stakeholders, into a board of a council staffed by individuals with executive authority. Prior to this, the tripartite councillors were supported by a secretariat, who in their current executive and managerial roles, appear to have taken on many of the substantive functions of the council members.

A significant finding, also discussed in the paper *on 'the achievements and limitations of tripartism*' in mining, was that MHSA structures have been unable to address the fundamental and systemic challenge of labour intensive deep-level mining (Hermanus *et al*., 2019). The Leon Commission Report also raised concerns about these challenges which were taken up in unofficial tripartite initiatives such as Deepmine and Platmine which operated alongside of the MHSC. Labour intensive mining and difficulties in creating viable alternatives which do not pit OHS objectives against employment, persist. The formal structures of the MHSC have still to consider this conundrum and should find the where-with- all to do so.

The experience of other H&S stakeholder engagement structures has also been mixed with advances made in some mining regions where experiences and learnings could be shared, and not in other regions where relationships were failing or had failed. The factors and conditions which make for success could be documented and emulated.

In the workplace, research and reports indicate that workers and their representatives continue to feel disempowered (Pijoos, 2018; Spies, 2018; Coulson, 2018; Coulson, 2017). The rights to representation established by the MHSA have ironically translated into a cadre of safety representatives more connected to mine safety departments than the organisations that represent workers – the trade unions. As indicated in Chapter 6, this may in part be due to the fact that the regulations of the Minerals Act dealing with safety representatives have not been repealed and these position representatives as the 'eyes and ears' of supervisors and safety officers. As the safety stewards associated with trade union structures prior to the enactment of the MHSA became safety representatives, they became isolated. Training which was initially conducted by trade unionists shifted to MQA-accredited service providers. The orientation of OHS training changed from representing and servicing workers, to the tasks of identifying and monitoring risks. The institutionalisation of generic training of safety representatives, the absence of trade union training, and their marginalisation by the workforce and the union movement, are likely contributors to the disempowerment of safety representatives and the difficulties experienced in their roles. As documented by Coulson the workplace safety representatives themselves described difficulties in fulfilling their designated roles and their exclusion from OHS discussions with the union representatives. This is a matter which warrants attention as safety representatives could be more effective in their roles at the interface between workforce and frontline supervisors. A safety representative convention may be an appropriate place to start. In addition, further comparative research on the experience of safety representatives in enabling regimes may cast light on reasons why their roles evolve in different ways.

Despite all of the above problems, however, the tripartite mechanisms of the MHSA have delivered a number of meaningful outcomes. These include an ongoing research programme, the development of a new body of regulation and guidelines, the publication of authoritative textbooks on occupational health and hygiene, and the formulation of H&S milestones in 2003 and in 2014 which have ultimately influenced operational practice.

8.7 Did Risk Management Practice Reduce Exposure to OHS Hazards?

Prior to the introduction of the MHSA, OHS risks were addressed through a loss control framework promoted by ILCI in many South African mines. The loss control approach to RM was not consistent with the principles of MHSA. It approached H&S as a series of topics and not systematically, and its primary focus, when first rolled out, was the workplace i.e. the supervision of workers, the standardisation of jobs and processes, and housekeeping.

Developing clear ideas and procedures on how RM might be applied to H&S presented significant challenges. A very wide range of tools and experience was available but often limited to specific disciplines and practices. The application of RM to OHS demanded a model that could be applied at any level or to any aspect of mining. Clarifying terminology and the applicability of various tools or combinations of tools to particular activities and tasks took time. The tortuous process of developing robust RM methods may have been short circuited by drawing on the British experience with RM after Robens' recommendations were adopted in the 1970s. The management of occupational health risks were among the last to be properly considered in South African and elsewhere.

South African and ILCI practice was influenced by the experience with RM of the Australian mining sector primarily. Lessons learnt in Australia were either directly transferred to South African mines through major mining companies, or through programmes provided to South African mines by private companies such as NOSA and IRCA which absorbed these learnings with time. This resulted in a broader shared conception of RM, which appreciated that the decisions made in the planning, decision and construction phases of mining, could lock into the operational phase specific levels or types of risk.

Programmes championed by Anglo American PLC and BHP Billiton respectively shaped RM and accident investigation practice in the global mining sector, including in their South African subsidiaries who were required to adopt their company's new standards. These programmes mirrored the expanded appreciation of RM by including factors contributing to accidents which arise from high-level decisions and actions. BHP-Billiton's approach to RM evolved from the way in which the company considered accident investigations.

While it is apparent that RM practice has advanced theoretically and practically within the environments of large mining companies, the uptake by smaller or struggling mining companies is less clear. In South Africa some, but not all, mine inspectors have been exposed, formally or informally, to developments in RM thinking and practices. In contrast, in Australia, RM training is compulsory, for inspectors and senior mine managers. In the UK detailed guidance is provided to inspectors whom, as novices, work under the guidance of more experienced colleagues. The RM guide published in 1995 by SIMRAC has not been updated, suggesting that the sector as a whole may not be exposed to more recent developments in OHS risk management.

Of significance in the South African context is the fact that most RM processes do not explicitly address unionised environments, or social contexts in which tripartite relationships are fragile. The ramifications for safety representatives, safety committees and trade unionists are serious as they have not had the opportunity to develop their own perspectives on how they should or could engage with RM processes.

The practical insights and experiences of addressing workplace risks developed by mineworkers i.e. pit sense, has still not been brought to bear on RM practice. This may be a significant gap as mineworkers are confronted with changing conditions every day and respond on the basis of the tools provided by management as well as their own work experience and practical knowledge.

Overall RM has been successfully applied in some environment but not in others, suggesting that different approaches may be warranted in some mining companies, particularly smaller ones. The involvement of the workforce and worker representatives in RM programs warrants further attention both for the enhancement it could unlock for H&S but also potential to build better workplace relationships and workplace culture.

Given the challenges which RM presents to smaller companies, further research into how these companies implement RM requirement of the MHSA and access best practice is warranted. Such research may also provide insight into how enabling legislation could be designed for a sector which is increasingly stratified.

8.8 Success or failure of the MHSA in Summary

Overall, the effect of the MHSA has been mixed. Successes and shortcomings are evident. The major concepts of the MHSA have been put into effect albeit slowly. Gains have been made in addressing specific H&S risks such as seismicity, falls of ground, transport and exposure to airborne hazards and noise appears to be decreasing. Essentially, a new, improved, mine H&S baseline appears to be emerging in the formal sector, albeit as gold mining (and labour intensive platinum mining) peters out. However, other emerging factors have an impact on OHS in the sector - more small and medium mines, more impacts on public H&S, and more informal mining – may outweigh the gains that have been made. Rebuilding damaged tripartite relationships which have always been fragile is central to developing a holistic view of the sector and the priorities for OHS. Findings on the enabling and inhibiting factors which affected the prospects of the MHSA are summarised in Table 8.2 below with longstanding issues appearing at the bottom of the table and those which are more recent at the top.

Table 8.2 MHSA Enabling and Inhibiting Developments and Factors

ENABLING DEVELOPMENTS AND FACTORS

1. Technical know-how now reduced, but focussed on holistic problem-solving.
2. Emergence of accident investigation leading practice (not formally adopted).
3. Emergence of risk management leading practice (not formally recognised).
4. Increasing involvement and committment from mining company CEO's.
5. Completion regulatory drafting programme despite differences.
6. Administrative capacity to oversee transition despite difficulties.

INHIBITING DEVELOPMENTS AND FACTORS

1\. Dissatisfaction with punitive approach adopted by the Mine Inspectorate

2\. Increased footprint of mining and more health and safety impacts on communites affected. No mechanism to support mine inspector's responsibilities to affected communities.

3\. Structural changes in the mining sector- smaller mines and more informal and illegal mining. Increasing dissonance with MHSA.

4\. Low levels of risk management know-how until mid-2000s (a global problem).

5\. Traditional approaches to addressing OHS well entrenched - retrospection and focus on the individual.

6\. Safety representatives increasingly detached from labour / the workforce and increasing associate with mine's safety departments.

7\. Separation of research on mining technology and on OHS.

8\. Legacy health issues not discussed in MHSA.

9\. Tripartism dominated by bargaining rather than consensus seeking.

10\. Differences over degree of specification required in regulation resulting in large body of codes of practice and guidelines. (Inspectorate concerned about uncertainties in regulation andisadvantages to small mines, labour concerned about clarity of standards).

10\. Suspicians of capture of the mine inspectors by mining companies at time of MHSA drafting and inception.

11\. Mining sector's association with migrant labour and rural empoverishment.

12\. Legacy of high levels of fatalities and injuries and unquantified high levels of ill-health.

8.9 What Questions Does the MHSA Experience Raise for Theory and Research?

Tripartism is promoted as a means to strengthen social dialogue and build social cohesion. The experience of the MHSA, the sector and indeed the country contradicts this assertion. Tripartism has been practiced more in form than substance, and it has not contributed to more social cohesion, and rather reflects social divisions. More research is required into the practices and processes that build cohesion at different levels in a society or sector to better understand the factors that affect and enable tripartism.

Enabling and prescriptive regulatory regimes are not alternatives but part of a continuum. Further research on how these concepts could helpfully shape the design of legislation arises from the experience of the MHSA. The swing to enabling legislation has revealed that not all entities are in a position to adopt this approach, that the absence of specification in law inhibits the adoption of good practice as much as it may inhibit innovation, that regulators by be disempowered rather than empowered by such legislation, and that the enabling legislation may contrary to expectations actually increase the body of regulation rather than decrease it. The need to augment such legislation also results in more regulatory material which may not be easily accessible. More research into the implementation of the MHSA by the Inspectorate and by a range mining companies would enrich understanding of its challenges, benefits and limits.

Similarly, further investigations of how trade unions and safety representatives are engaging with the requirements are of the MHSA could shed light on how important aspects of the MHSA have or could be put into effect.

More detailed research is required to understand more about how small and medium sized companies access information about the MHSA , interpret and implement its requirements.

Codification of mining work, first advocated by Fredrick Taylor, lies at the heart of RM. Yet experience and research suggest that both experiential knowledge and procedural mechanisms are important in workplace decision-making, especially in mining in which changing conditions are the norm rather than the exception. The accumulated knowledge of South African mineworkers has not been seriously considered and further research may throw light on how miners learn their craft and internalise procedures. Such research could influence training methods and initiatives to diversify the workforce.

As unemployment levels continue to rise and major mines close, artisanal and illegal mining is likely to increase. Better understanding of the drivers, features and enablers of these types of mining are urgently required, not only to understand the OHS and environmental risks, but also to understand their effects on communities. Such insights may also lead to more concrete planning around mine closure.

8.10 **Recommendations**

The following recommendations arise from the findings and observations made in the course of this study. They may have relevance beyond South Africa, particularly in environments in which society is divided, and where the fault lines between the workforce and managers coincide with social divisions.

Clearly the MHSA represented a major break with past practice in the mining sector. However, concerns about the level of readiness for tripartism, raised by the Leon Commission and investigated in this study, were not taken into consideration. In hindsight, this was an oversight. Tripartite practice, particularly extending it beyond bargaining, could be enhanced with the assistance of facilitators, and advice secured from independent experts as needed.

It may have emerged that a two-tiered approach to legislation was required, which included (i) a framework in which there is greater specification of standards, and (ii) a second formulation which was enabling and based on RM practice to be implemented by larger, well-resourced mining companies. The former could involve a larger body of regulation which could be updated as improved methods and technologies were developed. As requirements and standards were incorporated into the more specified framework, system requirements for risk based regulation or for the preparation of a safety case, as described in Chapter 2, could be developed. If a safety case approach is an option, then these cases would necessarily be made public.

There is a need to take stock of capacity to implement new practices and support changes in approach. This includes consideration of the context in which changes are to be affected. Historic factors and entrenched practices hampered the implementation of the MHSA. Identifying and explicitly engaging with the issues that are likely to impede or advance the implementation of new OHS legislation could enhance prospects for making more practical improvements shortly after enactment; for surfacing factors that fundamentally constrain H&S; and improve prospects for drawing on established experience in other sectors or in other mining jurisdictions.

The mining sector as with any industrial sector does not remain static. Changes may be progressive or regressive. There is a need to consider how the sector is likely to change when developing new legislation. This is likely to have implications for legislative design and may enable the recognition of emerging trends and interventions to temper or enhance them.

With increased population growth, mining activities are increasingly impacting on the prospects of other primary industries, the availability and quality of other important natural resources, and on public H&S as shown in Chapter 5. There is a need then for H&S regulators to take a wider view of their role and consider impacts on public health and safety in the short and longer term.

Finally, the activities of informal and illegal miners should be properly acknowledged. At the very least the mine inspectorates should play a role in tracking and monitoring the impacts of this sector, and promoting interventions, drawn from local and international experience, to manage its activities and reduce its H&S effects.

The above recommendations which arise from South Africa's experience of the development and implementation of the MHSA, are captured in Figure 8.1. A process for legislative design and implementation is presented which includes opportunities to recognise, pre-empt or reduce problems likely to be encountered. The aim is to increase common ground between the stakeholders through facilitated and supported social dialogue which could have beneficial effects beyond H&S.

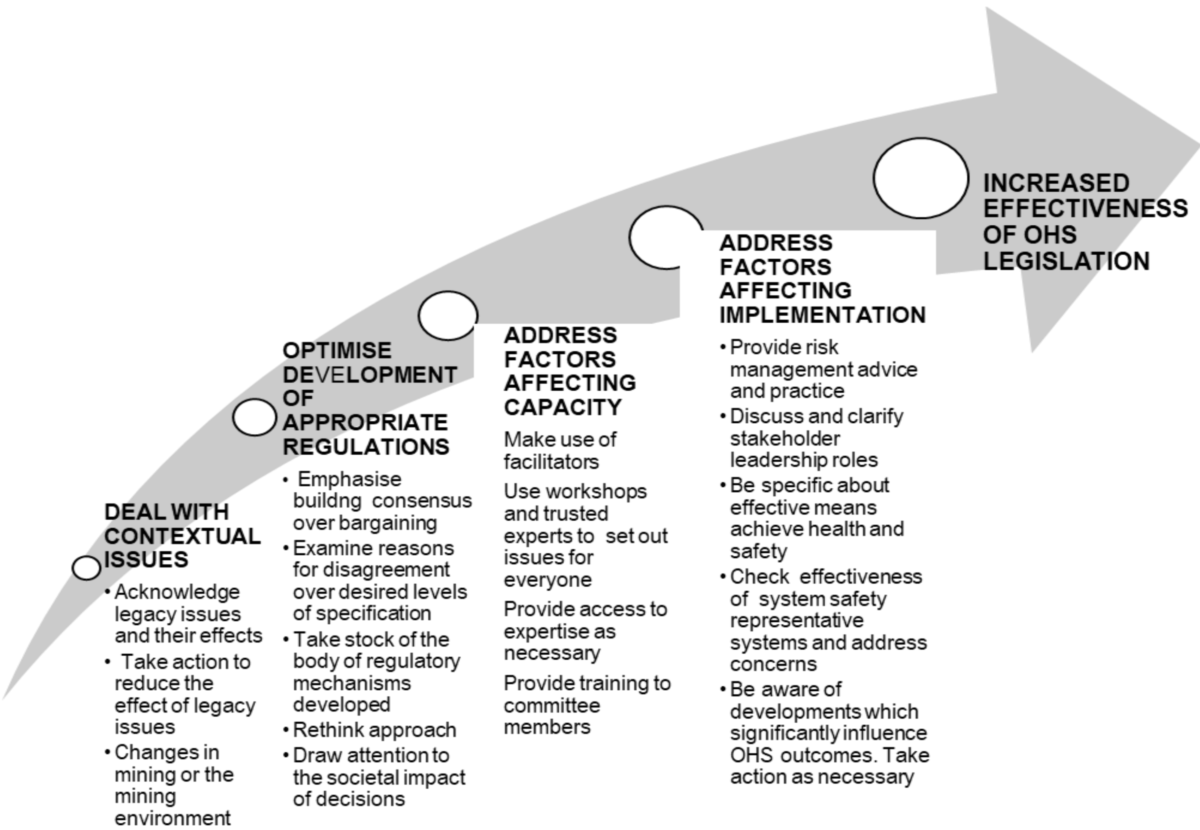

Figure 8.1. Process for Enhancing Impact of Stakeholder Designed OHS Legislation in Socially Divided Environments

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10 APPENDICES

10.1 **Research Tools**

10.1.1 **MHSA – Origins, Design and Aftermath of the MHSA**

Information Sheet: About the Study

HAS THE MINE HEALTH AND SAFETY ACT SUCCEEDED OR FAILED?

A Critical Assessment of the Aetiology and Impact of Mine Health and Safety Act of 1996 with Reference to Risk Management

I am May Hermanus, a visiting Prof and associate of the Centre for Sustainability in Mining and Industry (CSMI), which is located in the School of Mining Engineering at the University of the Witwatersrand. My contact number is 0823028520 and my email address is mayhermanus@mweb.co.za or MHermanus@csir.co.za. I am currently registered for a PhD and this is my research project. I would like you to consider participating in the study.

The research which I am conducting today is part of a wider PhD study, titled as above. The purpose of the wider study is to document and assess the policies and practices introduced by the Mine Health and Safety Act, and their effect on mine health and safety. The results of this research could inform decisions about what could be done, including changes to policy and legislation, to improve the health and safety outcomes of the sector. The study should also provide insight into the transferability of regulatory models from developed to developing countries.

The full study encapsulates the following:

- The policy decisions which informed the drafting of the original MHSA and the reasons for the selection of particular policies such as risk management
- Whether and how such policies shaped health and safety practice

- The causes of ongoing dissatisfaction with health and safety performance
- Whether unsatisfactory health and safety conditions and outcomes are due to deficiencies in policy or shortcomings in practice?
- Current concerns and arguments over the acceptability of health and safety performance

The interviews which I am conducting at present refer to the first aspect of the study (the first bullet point). This part of the study involves the following:

Key informant interviews which shed light on the origins and conception of the MHSA, its goals and impact. The study participant are individuals who contributed to the formulation and development of the original act such as the surviving members of the Commission of Inquiry, the Chief Inspector at the time of drafting, and relevant (past) representatives of the Chamber of Mines and the trade unions.

Issues to be explored and documented include the reasons for legislative change, what inspired the specific design of the MHSA, any expert advice obtained, the passage of the Act from inception to promulgation, subsequent changes and insights into the various policy choices which underpinned the Act, and perspectives on what has worked well and what has fallen short of expectations. Opinions on the current state of health and safety in mining will also be obtained.

Ten (10) key informant interviews are anticipated. The interviews will be recorded and transcribed to facilitate analysis. Study participants will receive a copy of the interview protocol ahead of the interview and will be given an opportunity to comment on the interview transcripts.

Interview findings will be discussed and analysed against the outcomes of the desktop study of policy options available to crafters of Occupational Health and Safety legislation.

You are welcome to contact me about further information which has come to light or any concerns which you may have about the interview which I have conducted with you.

May Hermanus

Centre for Sustainability in Mining and Industry, University of the Witwatersrand

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Consent Form: Participation in Interview-Based Research

"A Critical Assessment of the Aetiology and Impact of Mine Health and Safety Act of 1996 with Reference to Risk Management" – PhD Research Project

I consent to participate in a research project conducted by May Hermanus associated with the Centre of Sustainability in Mining and Industry (CSMI) at the University of the Witwatersrand. I understand that this aspect of her research is designed to document the conception, design, promulgation and implementation of the Mine Health and Safety Act (MHSA). I will be one of approximately 10 people being interviewed.

1. My participation in this research is voluntary.
2. I understand that I will not be paid for my participation.
3. I understand if I feel uncomfortable in any way during the interview session, I have the right to decline to answer any question or to end the interview or to withdraw my consent to participate.
4. Participation involves being interviewed by May Hermanus of the CMSI.
5. The interview will last approximately 1 hour and may be extended with your permission.
6. Notes will be written during the interview.
7. I agree / do not agree to audio taping of the interview and any subsequent dialogue. (Delete one option).
8. I understand that I may be identifiable by the leadership position which I held in respect of the process which led to the promulgation of the MHSA.
9. I agree / do not agree to be quoted by name in the resultant thesis and/or paper. (Delete on option)
10. I understand that this research study has been reviewed and approved by the Research Ethics Committee of the University of the Witwatersrand.
11. I understand the objectives of this research project which have been explained and provided to me.
12. I have been given a copy of this consent form.

Study Participant Name and Signature: ____

Researcher Name and Signature: ____

Date: ____

Key Informant Interview Protocol

Has the Mine Health and Safety Act Succeeded or Failed? - ***A Critical Assessment of the Aetiology and Impact of Mine Health and Safety Act of 1996 with Reference to Risk Management***

Introduction

I, May Hermanus, am investigating, in my personal capacity as a PhD candidate at the University of the Witwatersrand, the origins of the Mine Health and Safety Act (MHSA) and risk management practice in the South African mining industry. This research will hopefully contribute to improving the choice and design of health and safety policies, the methods by which such policies are implemented and risk management practice.

This part of my research, the first section, involves me speaking to people who were part of the decision-making and drafting processes that lead to the promulgation of the MHSA. I understand that you played an important role which I would like to explore and document. I would also like to obtain your insights into how the MHSA was initially rolled out, and your perspectives on whether the MHSA has met expectations or not, and why?

Given your leading role in the process as a member of a small select group, with individually designated and often public responsibilities, please consider carefully whether you wish to participate in this study or not, and the consent issues.

Consent (Introduce Consent form)

- I have an informed consent form and an information sheet, for your consideration and signature.
- The interview will be recorded as indicated on the consent form.
- The information I obtain from you, for example, the notes I take and the transcript, will be kept confidential and you will not be quoted by name unless you specifically agree to be. Check for

concerns about playing a lead role and identifiability if interviewee does not which to be quoted by name or named.

- I wish to transcribe, analyse and synthesize interview results at a later stage.

Check notes for the Interviewer
Questions are open-ended and require further probing and expansion. The questions serve as a guide to ensure that all points are covered. Examples of probes are:
• Can you give me an example?
• Would you elaborate on that idea?
• Would you explain that further?
• I'm not sure I understand what you're saying.
• Is there anything else?
• Ask for relevant documentation, or references to relevant documentation, during the interview and the names of other individuals who may be important to speak to.

Interview Questions

1. The Origins and Development of the MHSA

1.1. Can you explain your involvement in the conception and development of the MHSA?

1.1.1. When did you first come to know that a new law, focussed on mine health and safety, was on the cards? Can you elaborate?

1.1.2. What was your response to the idea of this Act? Please explain.

1.2. How did the Mine Health and Safety Act take shape from the point of conception onwards? Can you please elaborate? What were the crucial steps? How did the process unfold? What role did you play? (The first draft? Role? Committees? Mandating? Advising?)

1.3. What were the main ideas which informed the drafting of the MHSA? Why were these considered to be important? By whom?

1.4. Were all the important stakeholders involved at each step of the process? Please explain. Who were the stakeholders? How were they involved?

1.5. Were stakeholders adequately involved in the initial drafting of Act? Why? Why not? And subsequently (as the final draft emerged)? Please elaborate.

1.6. Where there points of complete agreement between stakeholders? Please explain.

1.7. Were there any particular points of disagreement that you remember? Please explain.

1.8. How were the disagreements settled? What provisions in the MHSA were affected?

1.9. How did the Act compare to what went before? What is your assessment of the change? What is your assessment was required to implement the Act? Was this done? Why, why not?

1.10. In retrospect, what would you have done differently (if anything), if you were rewind the clock and restart the entire process?

2. Implementation of the Act?

2.1. Please describe what steps were taken to ensure that the Act was implemented as intended? Please elaborate (i.r.o. government, labour and employers)
2.2. What aspects of the implementation process worked well? Please explain?
2.3. Were there any aspects of the implementation process that were deficient? Please explain? (Health? Major safety hazards?)
2.4. What was done to ensure that the necessary resources / tools to support implementation were available? Can you elaborate?
2.5. What impacts, if any, has the Act made on mine health and safety? Can you elaborate?
2.6. Based on your experience with the MHSA, what advice would you offer to implementers of new health and safety legislation?
2.7. Anything else?

3. Risk Management

3.1. Were risk assessments made of mine safety and health hazards *before* the promulgation of the Mine Health and Safety Act? Please explain?
3.2. How did mining companies go about assessing risk after the Act came into effect? Please elaborate? Do you have examples? Do you have documentation?
3.3. Was risk assessment applied to health as well as safety? Please explain (Ask whether there are documents available which show this? Examples?)
3.4. Who provided guidance and expertise (How? What?)
3.5. Did you refer to any risk assessment guidelines? Please explain – initially, subsequently? Where did these originate from?
3.6. Was a distinction made between risk assessment and risk management? Please elaborate and give examples if possible.
3.7. How did risk assessment practice evolve over time? Please elaborate?
3.8. What do you know of current risk assessment and /or risk management practice? Please explain.
3.9. Have the risk assessment / risk management requirements of the MHSA made a difference? Why? Why not?
3.10. Would you advocate a risk management approach to other mining countries in Africa? Why? Why not?
3.11. Anything else?

4. Are you open to me following up on any interview questions at a later date?

Thank you!

From: Iain Burns

To: May Hermanus

Subject: Ethics Protocol No. 13/02/12

Date: 20 February 2013 06:41:12 PM

Professor Hermanus

The Ethics Committee met on 15 February.
Please consider the reviewers' comments below.
Mr Iain Burns

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First reviewer:

Participants must sign assent form, should have been clearly stated in application. Need clarity on whether voice recorder will be used or not – states that it will on interview protocol but needs to have been in application form too

Participants should see and comment on interview transcripts?

Second reviewer:

Proofread the documents to be given to participants. They are generally fine, though I picked up "policies decisions" on the first page of the Participant Information Sheet.

Point 8 on the consent form could be clearer. Identifying "position" an individual held could be construed in a way that effectively identifies the individual. The intent seems to be something more vague, e.g., "senior official of the Chamber of Mines."

Authors Note: The above concerns were addressed in the introduction to the project and consent form. The text of all the document used was checked for clarity and grammatical errors.

10.1.2 **MOSH Leading Practice Adoption Review Tools**

The commissioned review of the MOSH Leading Practice Adoption System involved examining the programme's documents and conducting interviews. The documents included data, reports and guidance notes associated with the different stages in the adoption process, such as identifying and sourcing leading practice, and the demonstration and adoption processes. The operationalisation of MOSH was examined through interviews and involved the use of 10 interview tools which explored governance, oversight, resourcing and capacity (34 people), and activities at 8 mining operations (115 people who included mine, H&S, production and technical support managers, and workers who participated in focus group discussions.) Supervisors of the persons interviewed individually or as part of focus groups were excluded from these interactions, and trade union representatives were present depending on their availability. The results of the interviews and focus group discussions were aggregated so that no one person could be identified. The tools were both generic and specific to the leading practice under review. The generic tools and an example of one of the leading practice tools are presented here.

The members of the research team, before starting the interviews with individuals and focus groups, introduced themselves and the CSMI, explained the review assignment, and explored the interviewees knowledge of MOSH and MOSH activities as a whole. Each person was reassured that their experience and views would be incorporated into the evaluation, be kept confidential and would not affect them in any way. Researchers than checked for any questions and concerns the review participants might have.

Introduction and Process

My name is ______________________________ from the Centre for Sustainability in Mining and Industry (CSMI) at the University of the Witwatersrand. I am part of the CSMI team that is conducting a Chamber of Mines (COM) commissioned evaluation study of the MOSH Leading Practices that are aimed at significantly reducing the levels of noise, dust and fall of grounds (FOG) in underground mining workplaces.

You may decline to participate, answer a question, or withDr.aw at any time. Your participation in this discussion will not affect you in anyway. Your views will only be used for the purposes of this MOSH evaluation study and what you say will remain confidential. There are no wrong or right answers.

Sample of Interview Protocols………/

Interview Protocol: Persons Responsible for Governance and Oversight at the COM

Chamber of Mines CEO, Chamber of Mines President, Chairperson of the Gold Producers Committee and the Colliery Committee, MOSH Task Force, Chamber of Mines Specialists (Conveners of advisory groups).
Name of Interviewee:
Name of Interviewer:
Date of Interview:

Strategic Objectives and Role

1. In your opinion what is the MOSH Leading Practice Adoption System trying to achieve?
2. How will you know whether the MOSH project has been successful or not?
3. What do you understand as the current impact of MOSH? How do you measure / assess impact? (what measures do you find most useful?)
4. How have you been involved in developing the MOSH strategy / aspects of the strategy such as defining outcomes, leading practice selection, approach, resourcing, positioning, obtaining by in, advocacy, finding sponsor for the various leading practices?
5. Specifically, have you engaged role players such as labour, the MHSC, the DMR about MOSH? Explain?
6. What are the strengths and weakness these stakeholders' involvement in leading the MOSH project?

Governance and Oversight

1. Who is accountable for what in MOSH? –vision, rollout, impact, quality assurance
2. From the perspective of governance, what are the key issues, and have they changed over the life of the project?
3. How do you see the governance issues for MOSH into the future?

Communication and time commitments

1. How are you kept informed about the developments in MOSH?
2. How do you communicate with others about MOSH?
3. Are there any changes you would like to see made to communication in MOSH?
4. How much time do you invest in MOSH?

Implementation Role (as appropriate)

1. Do you play a role in managing the project?
2. If so, please explain your involvement in respect of resourcing –time, money, staffing (secondments, selecting experts), signoff of outputs or handover

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Interview Protocol: Mine Managers at Source Mines

Name of Mine:
Name of interviewee:
Name of interviewer:
Date of interview:

Occupational Health and Safety

1. Describe your mine's health and safety performance in the recent past and now.
2. What are the major challenges?
3. How are you dealing with them?

Leading practice

1. Tell us about the MOSH leading practice in your mine. What is it?
2. How did this intervention come about?
3. Why were you able to do this ahead of everybody else?
4. How has implementation impacted on OHS performance? Do you have before and after measures of impact?
5. Have interventions been rolled out across your mine or only in parts of your mine?
6. What are your current OHS plans and priorities in relation to this intervention (now recognized as a leading practice)?
7. What the investments you make to sustain this practice, if any? Please explain.

Mine Occupational Safety and Health Leading Practice Adoption System (MOSH)

1. Tell us about MOSH. How did you get to be a source mine (incentives involved / voluntary)?
2. What was the process of sharing your experience with the MOSH team?
3. How was the leading practice documented for MOSH?
4. Do you have a relationship with a demonstration, adoption mines and or the communities of practice for adoption (COPA)?
5. Do you have knowledge of the other leading practices promoted by MOSH?
6. Have you considered adoption any other leading practices? If yes, what is happening?

The MOSH Process Approach and Tools

1. Describe what you understand as the purpose of the MOSH Project
2. Describe the steps of the MOSH process
3. Which of the MOSH tools are you familiar with, The handbook, the Website or the portal site, the brochure, the DVD? Are there any comments you would like to make about these?
4. During the documentation of the leading practice at your mine were there any aspects of this documentation process that you found useful? (probe)

Interview Protocol: Mine Managers at Leading Practice Demonstration and Adoption Mines

Name of Mine:
Name of interviewee:
Name of interviewer:
Date of interview:

1. In your own words describe the value case for your leading practice area in this mine
2. In what ways have you used the value case?
3. Two MOSH tools, the "Mental Models of Workers "and "Leadership and behavior" are considered very important to the MOSH process. Can you talk about how you understand and apply these tools?
4. Have you implemented the leading practice across your entire mine? Please elaborate.
5. What is /was the involvement of MOSH in this rollout?
6. What are /have been the time frames for this?
7. How did you arrive at a plan for rollout?
8. What have been the financial, resource and procurement implications of implementing the leading practice?
9. How do you measure and monitor success and impact?
10. In your opinion, how far are you from embedding or institutionalizing this in your work process?
11. Is there anything else that needs to happen to support implementation?
12. What is the one standout learning point for you from the implementation of this leading practice area?
13. In your opinion what is the value of the MOSH Project to you?
14. Do you have any concerns about the MOSH process?
15. Do you have any concerns about other adoption mines using this leading practice?
16. Is there anything else you would like to add?

MOSH Underground Supervision Focus Group Interview Protocol: Entry Examination and Making Safe. The Fall of Ground (FOG) Leading Practice: Entry Examination and Making Safe

Name of Mine:

Name underground section:

Underground section:

Date:

1. What do you see as the major safety challenges are on the mine?
2. Describe what you understand as the purpose of the MOSH Project: entry examination and making safe?
3. Could you tell me why your mine decided to demonstrate the fall of ground (FOG) leading practice for the entry examination and making safe?

4. Please describe your experience of the demonstration of the entry examination and making safe leading practice? (prompt – how did it come about at the mine, where etc.?)
5. How is the leading practice for entry examination and making safe different from the previous entry examination and making safe practices implemented at this mine. Please elaborate on the differences.

10.1.3 Scope of Desk Top Studies

(i) Scope of the Mining Technology Study

The study and the resultant paper were designed to support the chapter on the context of the MHSA. The largest of South African mines, both gold and platinum, are labour intensive. To improve health and safety more technology intensive mining methodologies are required. In the absence of a widely accepted plan to transition out of labour intensive mining, while expanding employment opportunities elsewhere in the economy, tension exists between reducing the exposure of miners to significant OHS risk and maintaining levels of employment.
International trends in mining technology were explored in the context of the economics of mining and the structural changes new technology is likely to precipitate. The changing business model of mining was explored against the context that mining companies are believed to have captured more than their fair share of returns from the exploitation of minerals. Increased demands on mining companies to support infrastructure development, industrialisation and education; reduce workforce and public H&S and environmental risks to acceptable levels and, develop post-mining activities at mine sites / in neighbouring communities were examined. The study reviewed the literature on the relationship between these demands, and innovation - technological and social - in the sector, focussing on the unique challenges of innovation in South African mining. Evidence was sought on the impact of the continued reliance on labour intensive mining of key commodities, and the factors which enable or hamper South African mining companies from responding to pressures on the sector.
The relevance for this thesis is that labour intensive mining has a primary influence on mine H&S in South Africa, yet the institutions responsible for mine H&S have been unable to discuss this issue openly. The way in which global sectoral pressures affect local developments was examined.

(ii) Scope of the MPDR.A study

This study was conducted by the lead author (thesis author) in collaboration with Ms Ingrid Watson, Dr. Joshua Walker and Mr Oliver Barker. It resulted in a paper (Hermanus et al., 2015b) which formed part of a special issue of the Journal Capital et Societe (Capital and Society) published in collaboration between the Journal and the Sociology Work and Development Institute (SWOP) of the University of the Witwatersrand. The study examines the unintended consequences of the MPRDA on the footprint of mining and on communities. Developments in coal and platinum mining in particular are examined against the back drop of the MPDRA's policy intent to ensure that mineral extraction benefited South Africans as whole, and that the sector was transformed and opened up to black South Africans who had been restricted to the lower echelons of the sector and prevented from owning or operating mines.

The study provides evidence of how the MPDRA affected the ambit of the MHSA and the scope of the mining inspectorate's work. The key points are that more companies operate small mining leases and more people are affected by mining. For the Inspectorate these developments raise the questions about the regulation of small miners and the protection of people affected by mines as provided for in the MHSA.

(iii) Scope of the Study on Tripartism

This study examined the practice of tripartism in the South African mining sector in the context of the practice of tripartism in the country as a whole.
Papers, documents and research reports provided evidence of the extent to which tripartism has been practiced in South Africa, and the issues which have emerged. I was the lead author of this study which led to the paper included in this thesis. Contributing authors were Dr. Sizwe Phakathi, Ms Nancy Coulson and Dr. Paul Stewart, all of whom have conducted research into mining and mine H&S in their own right.
The study explored the achievements and limitations of statutory tripartism as practiced under the Mine Health and Safety Act (MHSA), and related developments in the establishment and functioning of NEDLAC, the country's premier tripartite body.
It argued that fundamental issues in the South African mining sector relate to the resolution of problems in the underlying system of production, namely labour intensive mining methods, and workplace practices and arrangements shaped by apartheid. Strategies to address mine H&S could consequently not be separated from efforts to change the system of mining and the consequences of its legacies. The lead tripartite body of the MHSA, the MHSC, however stuck to a narrower agenda of addressing key H&S issues such as seismicity, falls of ground and setting occupational health standards, without referring to mining methods and the prevalence of occupational disease amongst miners. The issue of mining methods and productivity were addressed through well-organised but adhoc initiatives, such as Deep Mine. The paper documented the advances made by MHSC and also explored the consequences of separating discussions about mining methods and levels of occupational disease from efforts to improve H&S.
The role of the ILO in supporting tripartism in South Africa was also explored with a view to strengthening mechanisms that encourage inclusive, robust and ultimately effective tripartite partnerships.

(iv) Scope of the Risk Management Study

This study was designed to track the development of risk management tools and practice in South African mining. The results form the basis of the risk management chapter of this thesis. The main features and elements of risk management programmes were examined, and evidence on the key shifts in risk management policy and practice was sought.
The chapter was redrafted in the form of a paper to be submitted for publication and the draft is included in Chapter Seven.
The scope included a review of the international and local literature on risk management relevant to mine H&S. Papers and documents which dealt with the management of H&S risk, risk management methods and their implementation were sought.
Papers and documents were reviewed and analysed for the following:

- Risk management principles and methods, including the main elements of H&S risk management methodology, such as that proposed by SIMRAC, IRCA (NOSA, ILSI), MISHC (GMIRM)
- Changes and the reasons therefor, over time
- Present day (at the time of writing) approaches to H&S risk management
- The uptake of RM approaches
- Advances and limitations

10.2 Mining Redesigned: Published in the Journal of the SAIMM.

http://dx.doi.org/10.171579/2411-9717/2017//v117n8a12

10.3 Impact of the MPDRA: Published in Labour, Capital and Society. Special Issue: New Frontier of Mining in South Africa. Vol 48, No. 1 & 2, 2015.

http://dx.doi.org/10.171579/2411-9717/2017//v117n8a12

10.4 The Achievements and Limitations of Statutory and Non-statutory Tripartism in South African Mining: Published in the Journal of International Policy. International Development Policy series. Special Issue: The ILO @ 100. Vol 11, 2019. Chapter 4.

https://journals.openedition.org/poldev/2953

10.5 Mine Occupational Safety and Health Leading Practice Adoption System (MOSH). Published in the Journal of the SAIMM.

http://dx.doi.org/10.17159/2411-9717/2015/v11n8a8