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# Improving Workers' Safety and Health in the Zimbabwean Mining and Quarrying Industry

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College of Management and Technology

This is to certify that the doctoral study by

Bernard Mabika

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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Walden University
2018

Abstract

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MS, University of Derby, 2000

BACC, University of Zimbabwe, 1994

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

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## Abstract

Lack of effective occupational safety and health (OSH) strategies is a reason that workplace accidents in the mining and quarrying industry remain high, making the industry one of the riskiest operations worldwide. The purpose of this multiple case study was to explore successful strategies mining and quarrying leaders in Zimbabwe used to improve OSH. The key research question addressed successful strategies leaders in the mining and quarrying industry use to improve employee occupational safety and health in Zimbabwe. Six successful business leaders from 3 mining and quarrying mines in Zimbabwe demonstrated an exception to unsafe practices, particularly through their exceptional OSH improvement records. The conceptual framework of the study was Deming's plan-do-study-act cycle theory. Data were gathered through review of company documents, and in-depth interviews with 6 mining and quarrying leaders in Zimbabwe who had successfully improved OSH strategies in the workplace. Transcribed interview data were classified, coded, and analyzed. Themes that emerged included organizational culture, compliance with rules and regulations, and accident prevention. The results of the study indicate that successful OSH leaders designed the workplace, trained and developed employees, and empowered and equipped employees with the relevant skills and knowledge. The findings support positive social change by providing mining and quarrying leaders with knowledge and skills to improve OSH strategies in the workplace, thereby promoting a safe workplace and zero accident tolerance in the workforce and the community.

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# Dedication

This doctoral study is dedicated to all business leaders aspiring for Zero Accident Vision in their workplace, and all those who had an input throughout this journey. You made this journey easier and achievable. To my wife Olivia, thank you for the unwavering support, encouragement and valuable time. To my wonderful daughters, Ancicaliah, Virginia, and Elizabeth, never give up on learning. I hope I have shown you the way.

## Acknowledgments

I completed this doctoral study through the support of others. Firstly, I want to express my sincere gratitude to my committee chair, Dr. Brandon D. Simmons. Thank you, for your patience and encouragement as you advised and guided me through the doctoral study process. I would also like to thank Dr. Isabel L. Wan, my second committee member, and Dr. Scott W. Burrus, University research reviewer. To the whole DBA faculty team, a special thank you for your unwavering support.

The business leaders in the mining and quarrying industry volunteering for the study interviews were wonderfully open with me and very willing to provide the data that is the foundation of this study. Thank you to everyone that participated; it is my hope that our work will make a difference in our industry. A special thanks to Sekuru Leonard Manjoro who helped with many aspects of the computer work and kept me sane when formatting problems threatened to make me crazy.

I would like to thank my family for their unwavering support during my doctoral studies. Even when it seemed like the journey was endless, you have been there with a lot of support. You insisted the journey was explorable and one day it would be accomplished. True, I have finally accomplished. Your invaluable support was pivotal in this journey.

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# Section 1: Foundation of the Study

Unsafe occupational safety and health practices may be hazardous to workers (Beus, Dhanani, & McCord, 2015; Blair, 2014). Zwetsloot et al. (2017) posited that despite many safety and health intervention studies, occupational hazards remain a challenge, especially in underground mining and quarrying. According to the National Social Security Authority (NSSA, 2014), in 2014, occupational deaths increased 49% to 106, and occupational injuries increased 36% to 5,390 from the previous year in Zimbabwe. Mining and quarrying industry attributed 20% of the deaths in year 2014 compared with 10% the previous year (NSSA, 2014). However, year 2014 had a 300% increase in mining fatalities compared to previous year (NSSA, 2014). The prevalence of occupational accidents in mining and quarrying industry remains a challenge to mining and quarrying leadership (Cooper, 2015).

Occupational hazards harm workers and adversely affect business activities by loss of revenue and rising operational costs (Leitão & Greiner, 2016; Yilmaz & Alp, 2016). Regardless of such adverse effects on business, Müezzinoğlu (2015) concluded that leaders either disregarded safety and health at the workplace or lack strategies and commitment. Getting safety and health skills is vital for industry managers because accident prevention is achievable by implementing strategies to reduce exposure to hazards (Blair, 2014). According to Anger et al. (2015), successful occupational safety and health strategies should appeal to the workers' mental status, including trust and reliability. Occupational safety strategies should be premised on understanding safe workplace environment to ensure the strategies address the right causes (Zwetsloot et al.,

2017). Exploring strategies that leaders use to improve occupational safety and health therefore becomes imperative from the organization sustainability perspective (Qian & Lin, 2016). Limited literature addresses strategies to improve occupational accidents (Zwetsloot et al, 2017). Therefore, empirical studies are needed to explore workplace strategies that improve occupational safety and health.

## Background of the Problem

The mining and quarrying industry is regarded as a risk industry worldwide because of the hazardous nature of its activities. van den Honert and Vlok (2015) observed the accidents death rate for mining and quarrying industry in South Africa at one death per 300 workers was exceeding double the worldwide fatality rate resulting from occupational hazards. Virchow (2015) opined that the mining and quarrying industry is one of the most risky occupational undertaking in the world. In the South African mining and quarrying industry, cowoker safety and health support have a direct relationship with safety and health performance compared with the influence of leader safety support and safety and health communication (Moyo, Zungu, Kgalamono, & Mwila, 2014). Accidents rarely happen promptly; near-miss events usually build up accident events (Gnoni & Saleh, 2017). Specific leadership strategies to improve occupational accidents should be fomulated, implemented, and evaluated (Blair, 2014). Reduction in occupational accidents save costs and improve business profitability and sustainability (Zwetsloot et al, 2017). Safety culture and climate are catalysts to organizational safety compliance and worker participation (Ali & Shariff, 2016a). Consequently, occupational safety is a result of leadership commitment, employees'

attitudes and behaviour (Saujani, 2016). Furthermore, organizational safety culture, and climate help reduce occupational accidents (Kim, Park, & Park, 2016).

Workplace accidents deprive socities, organizations, and famillies; organizational leaders need to enforce compliance to safety and health rules and regulations to improve occupational safety and health initiatives. Occupational safety and health exhibits through the reduction of work place hazards (Kim et al., 2016). Contrastingly, in Zimbabwe, the safety and health agency reported that in 2014, occupational deaths increased 49% and occupational injuries increased 36% from the previous year (NSSA, 2014). NSSA (2014) reported that 71% of the registered companies in Zimbabwe were compliant with occupational health and safety regulation, whereas 29% were not compliant, thereby exposing employees to occupational hazards risk. Although accident prevention strategies exist in Zimbabwe, limited empirical evidence addresses strategies to improve occupational safety and health, which is the focus of this study (Zwetsloot et al., 2017). Occupational safety and health include organization policies, regulations, procedures, leadership, and training that guide workers' behaviors and practices in the workplace (Kim et al., 2016). Improving workplace safety and health requires well-defined safety and health behaviors, attitudes, and commitment (Amponsah-Tawiah & Mensah, 2016).

## Problem Statement

According to Zimbabwe National Statistics (ZNS), occupational accidents are increasing at a high rate in Zimbabwe (ZNS, 2014). The NSSA reported that in 2014, occupational deaths increased 49% and occupational injuries increased 36% from the previous year (NSSA, 2014). The general business problem that I addressed in this study

is accidents at work have resulted in the loss of millions of dollars in revenue and productivity through absenteeism and injury. The specific business problem that I addressed in this study is that some leaders in mining and quarrying industry lack successful strategies for improving employee occupational safety and health.

## Purpose Statement

The purpose of this qualitative multiple case study was to explore the successful strategies that leaders in the mining and quarrying industry deployed for improving employee occupational safety and health. The population group target consisted of six mine executives at three mining and quarrying companies in Zimbabwe who successfully implemented strategies to improve employee occupational safety and health. Mining and quarrying companies may be influenced to adopt leadership strategies that reduce occupational accidents. The potential positive influence on social change includes promotion of a safety culture through knowledge sharing and training, thereby reducing accidents affecting workers' families and communities.

## Nature of the Study

I used a qualitative method to explore successful strategies leaders in the mining and quarrying industry used to improve workers' safety and health. Qualitative research is an important method of enquiry researchers use to explore issues related to management and build an understanding of the phenomena from the participants' viewpoints (Gergen, Josselson, & Freeman, 2015). I explored the lived experiences of successful mining and quarrying leaders' occupational safety and health (OSH) strategies. I conducted in-depth analysis from the participants' experiences relating to

OSH, and I used interviews, observations, documents, and audio materials as the data sources. Quantitative researchers use statistical data to test a theory or examine variables' relationships (Onen, 2016). Mixed-method research involves the collection of both quantitative and qualitative data to study a phenomenon (Halcomb & Hickman, 2015). The mixed method is most useful when one method does not provide a complete understanding of the study (Abro, Khurshid, & Aamir, 2015). In this study, the qualitative method was sufficient to adequately address the purpose for my study. Quantitative researchers use statistical data to answer the how many, or how much questions, which was outside the scope of this study and, therefore, was not suitable. Mixed-method design was not suitable because only the qualitative phase would be relevant, as the quantitative phase would not assist in answering the research question. Accordingly, I did not select a quantitative or mixed-method research design for the study as the multiple case study research design was appropriate because neither was expected to enable me to conduct an in-depth study of the organizations' successful occupational safety and health leadership strategies at different locations (Cronin, 2014; Sarma, 2015).

I used a multiple case study research design for this study to facilitate the investigation and description of the phenomenon within a particular contemporary context (Sarma, 2015). Although single-case studies can yield invaluable insights, multiple case study designs are likely to be stronger than single-case study designs (Lewis, 2015). I explored the phenomenon under exploration through one or more lenses that allowed for discovering and understanding multiple facets of the phenomenon (Bailey, 2014; Birchall, 2014). Because multiple case studies are rich in information from

multiple data sources, researchers can gain deeper insights into phenomena (Cronin, 2014; Gergen, Josselson, & Freeman, 2015). Other qualitative designs include phenomenology, ethnography, and grounded theory (Bailey, 2014; Sarma, 2015). In phenomenology, researchers collect data primarily only through interviews (Grossoehme, 2014), likely weakening the ideal depth and scope of exploration for the study. In this research, in-depth interviews and document reviews were critical to assure validity; thus, phenomenological design was a less suitable alternative. Research designs such as ethnography were not appropriate for my study because ethnography involves extended exploration of groups' culture (Green et al., 2015), which was not the focus of this study. In addition, a grounded theory design is inappropriate because it is primarily designed for developing theories through field data collection (Corbin & Strauss, 2014). Because the purpose of this study was to explore the rich case data and not to build a theory, grounded theory was not suitable.

## Research Question

What successful strategies do leaders in the mining and quarrying industry use to improve employee occupational safety and health in Zimbabwe?

## Interview Questions

1. What successful strategies are you using to reduce workplace injuries and fatalities in your organization?
2. What have been the effects of OSH successful strategy and process adoption and implementation in your organization?

3. What training, development, or processes influenced the successful implementation of the strategies for OSH?
4. What were the key OSH challenges you encountered to implementing the strategies for improving OSH?
5. What did you do to respond to the challenges to implementing the strategies for improving OSH?
6. What were the critical processes for implementing the successful strategies for improving OSH?
7. What else do you want to add that I have not asked about OSH in mining and quarrying?

## Conceptual Framework

I used the "Plan, Do, Study, Act" (PDSA) cycle theory (Moen, 2009) as the conceptual framework for the study. The model, designed specifically to learn and improve organizational systems, is an adoption of the Deming cycle theory of 1950 (Moen, 2009), which has been successful in continuously improving organizations' operational standards. The cycle begins with the plan step. The plan step involves identifying a goal or purpose, formulating strategies, defining success metrics, and putting a plan into action. The Do step follows the activities, in which implementation of the program takes place. The Study step comes next, where outcomes are monitored to test the validity of the plan for signs of progress and success, or challenges and areas for improvement. The Act step closes the cycle, integrating the learning generated by the entire process, which can be used to adjust the goal, change methods, or even reformulate

new strategies altogether. These four steps are repeated as part of a never-ending cycle of continual improvement. Deming's PDSA theory aligned with my study exploring the strategies that leaders used to improve occupational safety and health in the mining industry under the continual improvement cycle. As summarized by Moen (2009), the concept of the PDSA cycle enabled successful and effective organizational programs. Therefore, the PDSA conceptual framework provided a lens for understanding the findings from my study.

## Operational Definitions

I used the following key operational definitions throughout the sections enhancing understanding of the concepts in the study and providing operational clarity.

*National Social Security Authority* (*NSSA*): An agency under the ministry of labor and social welfare in Zimbabwe established to enforce regulations of the Factories and Works Act (20 of 1948), the Labour Act [Chapter 28:01] (Acts 16/1985). (S 2), the National Social Security Authority (Accident Prevention and Workers Compensation Scheme) Notice No. 68 of 1990 and the Labour Relations (HIV and AIDS) regulations S.I.202 of 1998, to provide safe and healthy workplaces (NSSA, n.d. b).

*Occupational accidents*: Occupational accidents refers to events that happen at workplace that cause disabilities, trauma, pain, and loss of life (Yilmaz & Alp, 2016).

*Occupational diseases*: Occupational diseases refers to chronic illness caused by occupational activity. An occupational disease is typically identified when it is shown

that it is dominant in a given body of workers than in the overall workforce, or in other worker populations (Rodriguez-Fernandez et al., 2016).

*Occupational safety climate*: Occupational safety climate refers to the perceived value accorded on safety in an organization over a particular period. The perceptions and beliefs can be influenced by the attitudes, values, opinions and actions of other workers in an organization, and depends on time and circumstance (Leitão & Greiner, 2016).

*Occupational safety culture*: Occupational safety culture embodies employees' beliefs, values, attitudes, norms, behaviors, and habits at workplace, and how the employees behave toward changes to the occupational safety norms (Kim et al., 2016). Occupational safety culture is often described as the "personality" of a company, because it is a mutual value of safety (Zivkovic & Ivanova, 2016).

*Occupational safety and health* (OSH): OSH refers to the safety, health, and welfare of people at work (Hermanus, Coulson, & Pillay, 2015).

*Occupational safety and health risks*: Occupational safety and health risks refers to occupational hazards accepted as a consequence of a particular occupation. Occupational and safety risks often arise associated with industrial accident and environmental impact risks (H. Wu et al., 2016).

*Occupational safety systems*: Occupational safety systems is a pseudonym given to describe the company safety systems include training, audits, instructions and other safety measures that promote occupational safety and health (Line & Albrechtsen, 2016).

## Assumptions, Limitations, and Delimitations

Assumptions in a research must be clearly stated to avoid ambiguity and misinterpretation (Wolgemuth, Hicks, & Agosto, 2017). On the other end, limitations to the study reinforce assertions to validity and generalization by separating facts from views (Bailey, 2014). Delimitations, however, states what is included and what is excluded from the study (Leedy & Ormrod, 2014).

### Assumptions

Assumptions are unproven ideas accepted as true or as definite to happen (Lewis, 2015). Wolgemuth et al. (2017) also defined *assumptions* as suppositions held true but not proven. For this study, I relied on NSSA for validity of the information. I assumed that the participants skilled and involved in strategic practices to improve occupational safety and health. I also assumed the data given was correct and free of errors, and that the participants were honest during the interviews. I assured confidentiality to the participants. Furthermore, I assumed permission to carry the study would be granted by the respective organizations. Finally, I assumed all participants spoke English and understood the interview questions.

### Limitations

Limitations are possible weaknesses in a study that are out of the researcher's control (Leedy & Ormrod, 2014; Lewis, 2015). Limitations detach the researcher's views from the facts embodied in the research findings and therefore inform validity and generalizability of the research (Finlay, 2014). The limitation of the study was that only three mining and quarrying companies in two regions were studied in Zimbabwe

excluding other regions. The generalizability of the research findings were therefore limited. Another limitation of the study was data coding was done by one person, thereby limiting strength of the analysis. In addition, another limitation was that some mining and quarrying companies could not avail all necessary documents that I required due to company policy restrictions.

**Delimitations**

The delimitations of a study are those characteristics that limit the scope and define the boundaries of the study (Yin, 2013). Delimitations are within the researcher's control. Delimiting factors may include the selection of objectives, the research questions, theoretical perspectives adopted, and the population chosen (Lewis, 2015). The scope of this study was a qualitative multiple case study to explore what successful strategies leaders in the mining and quarrying industry lack for improving employee occupational safety and health in Zimbabwe. Only leaders with experience in adoption and implementation of safety strategies from mining and quarrying companies in Zimbabwe participated.

## Significance of the Study

The findings of this study redounded the benefit of society, mining organizations, workers, and families considering that workplace safety and health plays an important role in organizational development, societal well-being, and employees' welfare. Furthermore, the findings positively affect business practice and social change. The findings probe further research in the field of workplace safety and health in mining and quarrying industry.

**Contribution to Business Practice**

Mining has been historically considered as a naturally high-risk industry worldwide (Bagherpour, Yarahmadi, & Khademian, 2015b). Leaders need to be proactive and consider safety risks in the same way they consider financial and other risks. Part of the mindset change is recognizing that it makes good business sense to put a high value on health and safety. Safe workers who feel valued are naturally going to contribute back to the organization and the communities they live and buy into the health and safety proposition (Kumar, Gupta, Agarwal, & Singh, 2016). Accident statistics showed a high increase in occupational injuries and deaths in the mining and quarrying industry, prompting a research to investigate the safety and health dilemma further. The reduction in occupational accidents could improve organizational performance (Akgün, 2015). Furthermore, safe and healthy workplaces potentially enhances the competitiveness of the organization on markets (Moura, Beer, Patelli, Lewis, & Knoll, 2016). Organizations that support safety and health at workplace may also obtain community and government backing and earn legitimacy, which further enhance sustainability (Fuisz-Kehrbach, 2015). The findings from this study may assist mining leaders in other countries to make informed decisions about OSH by adopting safety strategies in OSH practice. As previously observed by previous researchers, mine leaders can also leverage OSH strategies to improve productivity through worker participation (Kumar, Gupta, Agarwal, & Singh, 2016).

**Implications for Social Change**

Human and economic costs associated with workplace injuries are high and represent a substantial burden to employers, employees' families, and society at large (Kao et al., 2016). Conducting this study enabled exploration of current and future occupational safety measures to reduce workplace accidents. A safe workplace can result in a safe community through dissemination of safety and health knowledge and habits from the workplace to the households (Nwapi, 2015). The organizational corporate social responsibility could be enhanced through acceptance of safe work practices and communities could benefit through collaboration with the organization in its safety programs, thereby positively contributing to the broader safety and health norms and values (Sharma & Bhatnagar, 2015). Study findings catalyzed the benefits of OSH in mining and quarrying organizations. Leaders can minimize the rate of employee turnover by adopting a strong safety policy (Gunarathne et al., 2016). Benefits include improved OSH strategies and decision making, increased productivity and organization performance, reduction in OSH accidents, process and systems development as well as employees' welfare. Furthermore, the study contributed to positive social change by bringing the safety and health programs at the core of individual, family, and community life, as safety and health awareness increases (Gunarathne et al., 2016). The reduction or elimination of accidents at work enables leaders to provide a steady employment and ability to support families and communities (Amponsah-Tawiah & Mensah, 2016).

## A Review of the Professional and Academic Literature

Mining and quarrying is considered as one of the most hazardous occupations all around the world, especially in underground mines (Bagherpour et al., 2015b; Verma & Chaudhari, 2017). Every year, 2 million fatal accidents occur worldwide translating to twp workers dying every minute because of occupational accidents (Yilmaz & Alp, 2016). As posited by Zwetsloot et al, 2017, organizations should deploy strategies to achieve occupational safety and health.

Mining and quarrying opportunities worldwide are offering new employment patterns, a development that presents new hazards, as well as variations in the boundary between workplace and home (Brinker et al., 2016). As a result, businesses need to look for new strategies to create safe and healthy work environments. In this literature review, I examined the challenges that mining and quarrying companies encounter when dealing with occupational safety and health (OSH) issues. I also explored the leadership role in OSH management at workplace and successful strategies that leaders used to improve OSH, particularly in developed countries such as the United States, Australia, and the United Kingdom. Peer-reviewed journal articles were the sources of information in this literature review.

As stated by Passmore, Krauesslar, and Avery (2015), literature review is a critical evaluation of scholarly works in relation to the research question. Evaluating scholarly materials enriches the researcher's skills and ability to synthesize data, deriving meaning through interpretation and analysis (Wolgemuth et al., 2017). The literature review for this study critically reviewed the following themes (a) history of OSH in

mining and quarrying, (b) industry approaches to OSH, (c) The PDSA cycle theory as a safety and health continuous model, (d) occupational safety and health in mining and quarrying, (e) occupational accidents in mining and quarrying, (f) safety systems in mines, (g) safety and health risks in mining and quarrying, (h) Mine transport and equipment, (i) technological advancement in OSH equipment, (j) diseases associated with unsafe mine operations, (k) legislative laws governing mining and quarrying industry, (l) occupational safety and culture, (m) occupational safety and climate, (n) mine leadership style, (o) strategies to improve OSH practice, and (p) safety and health training. An alignment of the literature to the conceptual framework was also done, followed by a review and synthesis of literature on the impact of OSH in the mining and quarrying industry. I dedicated the last part of the review to how mining and quarrying leaders could improve OSH through training. I accessed research materials in databases including ProQuest, EBSCOhost, Science Direct, Sage Publications, Emerald Management, ABI/INFORM Collection, and Business Source Complete through the Walden University Library. I performed additional searches using commercial search engines such as Google Scholar. The literature search design was made up of key words, the central research question, and inclusions and exclusions standards as elaborated by Finlay (2014). The history of OSH was the first theme that I reviewed. The entire study contains 247 referenced works with 229 (93%) peer-reviewed and 231 (94%) within the mandatory 5-year period (2014–2018). There are 209 peer-reviewed works cited in the literature review, of which 198 (95%) were published between 2014 and 2018.

## History of OSH in Mining

The study of OSH in mining and quarrying back dates to the 14th century (Pettinger 2000). According to Franco and Franco (2001), Ramazzini (1633–1714), later known as the father of occupational safety and health. is among the pioneers of occupational safety and health. Ramazzini wrote many articles on occupational safety and health in mining and quarrying industry and provided that occupational safety and health is directly related to organizational efficiency and effectiveness (Franco & Franco, 2001). Franco and Franco (2001) discussed and suggested several preventive strategies for reducing occupational disease and injury as recommended by Ramazzini. As posited by Zwetsloot et al (2017), safety and health remain a priority in industrial development.

Several OSH studies were carried out on old mines including Lion Curves mine to establish the continuous improvement in OSH interventions. Lion Curves mine is the oldest known mine on archaeological record in Swaziland, which radiocarbon dating shows to be approximately 43,000 years old. Early Egyptians, Greeks, and Romans were well known in mining and developed safety strategies that have been refined time and again to date (Atalay, 2015). Atalay (2015) posited that medieval Europe and America made strides in regulating mining and quarrying activities to ensure OSH to all miners by continuously monitoring OSH activities. Although the early pioneers of occupational safety did not dwell more on implementing safety strategies in the workplace, they certainly laid the basis for current approaches to reduce occupational hazards (Qian & Lin, 2016). Leaders in the mining and quarrying industry should continuously improve OSH strategies to reduce workplace accidents.

## Industry Approaches to OSH

The mining and quarrying industry's response to occupational safety and health incidents has developed over time, and diverse programs to improve safety and health are now common in mining and quarrying companies (Blair, 2014). As elaborated by Balderson (2016), safety improvement in mining organizations can be approached through safety management systems (SMSs), behavior-based safety (BBS), and safety culture changes. The approaches are not limited. However, the most effective approach is to use a combination of all three (Balderson, 2016). Many factors should be considered when observing safety controls, including level of safety maturity, strength of existing safety systems, organizational ability to undertake change, and strength of safety leadership and culture (Giraudo, Bena, Leombruni, & Costa, 2016). An overview of the three approaches is detailed below providing a background to practical approaches to safety and health improvements applied in the mining and quarrying industry.

### Safety Management Systems

Mining and quarrying organizations attempting to improve safety and health performance has mainly focused on the development of SMS. According to Årstad and Aven (2017), SMS helps ensure hazards are identified earlier, effective controls are put in place, people are adequately trained and empowered, and work processes are designed and carried out in a manner that delivers more consistent safety and health performance. It is a methodical approach to managing safety risk, including the necessary company structures, accountabilities, policies and procedures. More safety risk systems need to be

integrated to build a strong safety foundation (Zwetsloot et al, 2017). There is need to integrate the current academic, analytical and pragmatic approaches to develop an SMS that will provide a future focus and framework giving meaning and direction to safety and health actions (Kim et al., 2016).

In particular, mining is a high risk industry (HRI) that need effective systems to manage risk (Årstad & Aven, 2017). HRIs are defined by the dangerous conditions they operate within and strictly report incidents, accidents and near misses and views 'failures' as learning opportunities (Gnoni & Saleh, 2017). HRIs are frequently quoted as examples of companies with effective safety and health culture (Saujani, 2016). Saujani (2016) suggested that HRI effectiveness can be attributed to the creation of collective mindfulness, essentially keeping safety and health top of mind by being wary of possible failures and structuring groups and systems to be flexible to risks.

**Behavior Based Safety**

BBS is another safety approach used to improve OSH in mining and quarrying industry. As observed by Hagge, McGee, Matthews, and Aberle (2016), the BBS approach depends on the cognitive dissonance concept, which describes a state of psychological tension in individuals, produced by two opposing cognitions. The tension is uncomfortable and people are encouraged to lessen the tension by changing or declining one of the cognitions. For example, a worker might have two thoughts about safety measures that do not align; the first thought being that safety procedures reduce occupational risk, and the second being that safety procedures are cumbersome and cause delays. To reduce cognitive dissonance, one of the thoughts should be rejected or

changed to align with the other. Action can be taken simpler as the behavior follows the attitude. BBS have defined steps that include defining the desired behavior; setting behavior performance goals; providing feedback and evaluation of the results (Martinez-Onstott, Wilder, & Sigurdsson, 2016). BBS influence safety behavior first, and hopes to change attitudes to align with the dominant safety behaviors through cognitive dissonance. The BBS approach is useful because it aligns safety behaviors with workers' attitudes (Beus et al., 2015).

**Safety Culture Change Programs**

The other useful method is the safety culture change approach that combine the organizational safety programs to strengthen OSH strategies. According to Zivkovic and Ivanova (2016), safety culture change programs are broad organizational programs aimed at continuously improving safety management. In contrast to BBS approaches, Kim et al. (2016) concluded that safety culture approaches focus on articulating safety principles with a top-down approach. The aim being to create a self-sustaining environment based on a comprehensive understanding of the causes of occupational safety performance (Hagge et al., 2016). Safety system need continuous improvement to match with organizational changes and demands. The "Plan, Do, Check, Act" (PDSA) cycle theory, that I used as the conceptual framework of this study, best explain needed continuous organizational safety and health improvement.

## The PDSA Cycle Theory as a Safety and Health Continuous Model

The model, designed specifically to learn and improve organizational systems, is an adoption of the Deming cycle theory of 1950 (Moen, 2009), which has been successful

in continuously improving organizations' operational standards. The cycle has four steps as follows: (a) the *plan* step involves identifying a goal or purpose, formulating strategies, defining success metrics and putting a plan into action; (b) the *do* step follows the activities, in which implementation of the program takes place; (c) the *study* step comes next, where outcomes are monitored to test the validity of the plan for signs of progress and success, or challenges and areas for improvement; and (d) the *act* step closes the cycle, integrating the learning generated by the entire process, which can be used to adjust the goal, change methods or even reformulate new strategies altogether. The four steps are repeated as part of a never-ending cycle of continual safety and health improvement (Arntz-Gray, 2016). Moen (2009) observed that successful and effective organizational programs evolve around the PDSA cycle, a theory that emerged in the 16th century.

**Emergence and Advancement of the PDSA Cycle**

According to Moen and Norman (2006), the history of the PDSA cycle back dates to year 1610 when Galileo Galilei started the scientific method through pragmatism of the early year 1900 and the evolution of the PDSA cycle through year 1993 (see figure 1). Galileo Galilei is considered by many scholars as the father of modern science (Moen, 2009). Galileo Galilei's works inspired many other scholars like Francis Bacon, Charles Peire and William James, John Dawey, Clarence Irving Levis, Walter A. Shewhart and finally Edwards W. Deming who came up with the PDSA cycle theory which have been picked as the most appropriate theory for this study. The PDSA cycle theory helps

leaders deploy safety and health interventions efficiently and effectively in the workplace (Haas & Yorio, 2016).

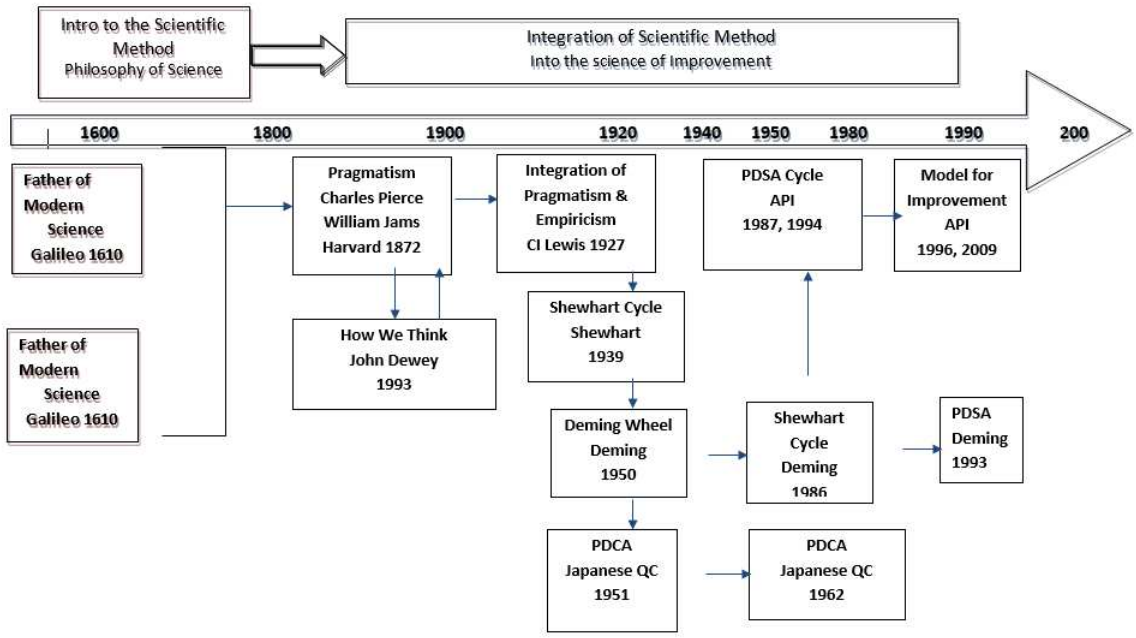


*Figure 1*. Evolution of the PDSA cycle theory (Moen & Norman, 2006).

Leaders and workers in the mining and quarrying industry should show commitment in workplace safety and health to prevent occupational accidents. As observed by Deming (1986), people are the agents of their own destinies. This ideology was in line with this study's research question which was to establish successful strategies that mining and quarrying leaders use to improve safety and health to pave way for accident-free destinies. Both leaders and workers need to comply with safety and health regulations and procedures to improve workplace safety (Zwetsloot et al, 2017). Workplace safety and health should be priority for organizational excellence.

As organizations strive for business excellence, continuous improvement of safety and health processes become important and safety models like the PDSA cycle are necessary. Doctor Shewhart displayed the version known as the Shewhart cycle in 1939 that emphasized specification, production and inspection as the continuous cycle in any business process (figure 2).

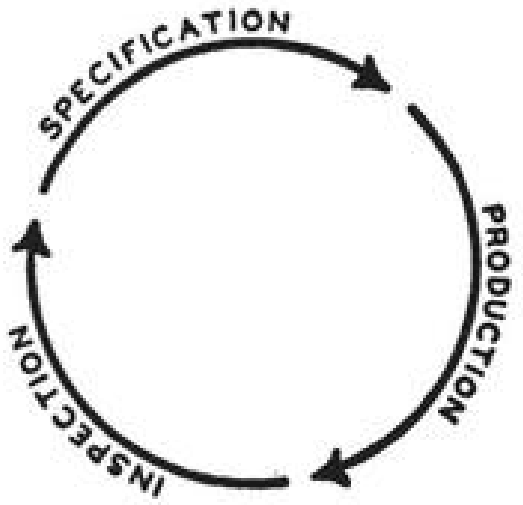


*Figure 2*. The Shewhart cycle, 1939 (Moen, 2009).

Doctor Deming modified the Shewhart cycle in year 1950 and renamed the cycle to "Deming cycle" or "Deming wheel" (Imai, 1986). Imai (1986), stated the Japanese executives recast the Deming Wheel into the PDSA cycle. According to Imai (1986), the Japanese interpretation of the "Deming wheel" in doctor Deming's lectures of 1950 and 1951 lead to the PDSA cycle. The PDSA cycle emphasized the prevention of error recurrence by establishing standards and the continuous modification of those standards (Moen & Norman, 2006).

Complying with established safety and health regulations and standards improves workplace safety. Establishment of standards and the ongoing modification of the standards is key to organizational safety and health excellence. According to Deming (1986), any step towards safety improvement may need guidance of statistical methodology for economy, speed, and protection from faulty conclusions. Safety regulation and standards are key to a safe workplace environment (Zwetsloot et al, 2017). Leaders should continuously improve safety and health strategies to prevent workplace accidents.

The PDSA cycle theory sums up the safety and health continuous improvement necessary to improve safety and health strategies at workplace. Deming modified the Shewhart cycle in 1993 and called it the PDSA cycle (Moen, 2009) (see figure 3).


*Figure 3*. The PDSA cycle (Moen, 2009).

Leis and Shojania (2016), stated in 1996 and 2009 publications, the PDSA cycle was broadened to include strategies and methods to develop, test, and implement changes that

would result in improvement. This version was called the "model for improvement." see Figure 4).

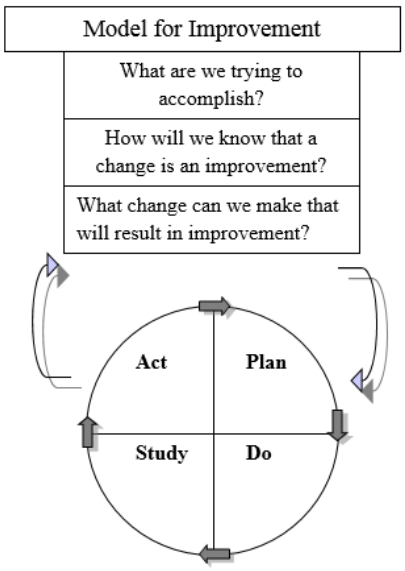


*Figure 4*. The continuous improvement model (Moen, 2009)

The PDSA cycle expands on the model for improvement as a basic framework for the science of continuous improvement (Vaněk, Špakovská, Mikoláš, & Pomothy, 2015). Leaders, specifically in the mining and quarrying industry, need to craft safety and health strategies that evolve within the PDSA concept of learning and continuous improvement in safety and health procedures and processes.

Apart from the PDSA theory, there were other theories which could help answer the research question but they were not most appropriate for this study. Other relevant theories that could help answer the research question included the Hazard Theory (HT), the Domino Safety Theory (DST), the Normal Accident Theory (NAT), the Reason Model of Human Error (RMHE) and the High Reliability Organization (HRO) theory.

The HT divides mine accidents into three categories, that is, accidents caused by technological defects; safety management misconducts; and the inherent hazards (Liang, Liu, & Wang, 2011). The theory partially answers the research question and was not the most suitable for the study. As observed by van den Honert and Vlok (2015), the DST was developed by pioneer industrial safety experts H.W. Heinrich and Alfred Lateiner in 1931 to provide a graphic sense of how industrial injuries can occur and be avoided. However, it does not pursue on what business leaders can do to craft effective safety and health strategies as an ongoing process. From the evidence reported by Yorio, Willmer, and Moore (2015), the NAT, RMHE and HRO theories rely on SMS but does not evolve over the learning and continuous improvement of the organization as a whole. The PDSA, therefore, remains the most appropriate theory for the study, evolving within the principles of learning safety precautions, crafting and implementation of safety strategies and continuous improvement of the process (Yorio et al., 2015).

The PDSA model has become a successful improvement intervention in organizational development strategies. Despite the existence of rival models, PDSA cycle has been widely used in different industries, including mining, as a continuous improvement and quality control tool in matters of environment, safety and maintenance (Botín & Vergara, 2015; Haas & Yorio, 2016). Botín and Vergara (2015) and Moen and Norman (2006) concurred the PDSA is the key model for organizational systems improvement, emphasizing its broad applicability to many fields of study. As an introduction to a framework for improvement, Moen (2009) observed that the PDSA model support improvement efforts in a full range from the very informal to the most

complex. It is therefore important for business leaders to ensure that safety controls are monitored by aligning safety and health operations with the PDSA cycle theory (Arntz-Gray, 2016). As opined by Vaněk et al. (2015), mining and quarrying companies, despite some of the idiosyncrasies, are just enterprises where the application of the Deming tenets of continuous improvement are advantageous.

Despite the fact that not all injuries can be prevented since they are unpredictable in nature, and that accidents do occur at times for reasons that are unpredictable mostly through human error; leaders should reduce the rate of occupational fatalities and injuries through strategic safety planning. The planning need to incorporate human error as the most common cause for accidents in mining and quarrying (Kumar et al., 2016). Kumar et al. (2016), argued it is an established fact that human error plays a crucial role in accidents and needs to be addressed adequately in risk and safety management. It is therefore necessary that managers embrace themselves with adequate safety measures. According to Mohammadfam et al. (2016), further research in areas such as process changes in safety and health systems, measure of unintended results in different parts of the system, investigation of risk and its relationship to objective outcome measure could be adopted using replication schemes and research methodology to address extraneous factors that weaken validity of observational studies to enhance OSH.

## Occupational Safety and Health in Mining and Quarrying

Mining and quarrying operations are considered risky and hazardous entailing the application of high safety and health standards to build organizational safety capabilities. Gunarathne et al. (2016), observed the mining and quarrying industry faces some of the

toughest challenges in terms of industrial safety because of the industry's extractive nature. Mine worker safety and health is a persistent and costly problem, even in countries with well-developed regulation and enforcement (Pagell, Veltri, & Johnston, 2016). For example, in developed countries like USA, Australia and UK, OSH has been, and continues to be, a priority area for policy-makers and workers (Shea, De Cieri, Donohue, Cooper, & Sheehan, 2016). Balderson (2016), argued the way leaders define safety affects its application in the workplace and provides an opportunity to influence positive outcomes for workers, managers and the organization. Haas and Yorio (2016), also stressed once companies understand that safety is not the enemy of efficiency, they can begin to build organizational safety capabilities. The continuous improvement of safety capabilities through safety and health management systems strategically position the organization to establish and achieve occupational safety and health best practice standards (Haas & Yorio, 2016). Safety and health management systems are essential in organization development. According to Pitzer (2015), many organizations have comprehensive safety and health management systems in place, either based on a commercially available package, or internally developed and audited systems. It is therefore important for mine leaders to deploy safety strategies at workplace because it is critical for mine safety (Cheng & Zhou, 2015). Workplace health programs and activities should also incorporate mechanisms that encourage the participation of workers from all levels underpinned by social policies that benefit workers (Bazzani & Sánchez, 2016) and avoid occupational accidents.

## Occupational Accidents in Mining and Quarrying

Occupational accidents are prevalent in mining and quarrying industry and therefore need stringent OSH management controls. Sanmiquel, Rossell, and Vintró (2015), defined occupational accidents as unexpected and unplanned happenings arising out of or in connection with work which results in one or more workers being injured, or die. Kyerematen-Amoah and Clarke (2015), claimed achieving zero incident operations in mining and quarrying is an attainable goal; however, it requires the buy-in of the entire organization. As stated by Beus et al. (2015), team work, transparency in safety policy regulations, and management commitment to safety and health policy implementation attracts a healthy safety climate.

The nature of mining hazards makes the potential for failure unacceptable and requires commitment from both management and workers. Pagell et al. (2016), posited safety is everyone's business in an organization and everybody should own safety. In order to guarantee safety in mining and quarrying operations, a variety of measures need to be implemented to carry out comprehensive management reform including the construction of laws and regulations about mine safety, enhancing internal supervision of mine enterprises, strengthening local government regulation and establishing an institution for mine safety supervision (Chen, Xu, & Fan, 2015). Chen et al. (2015), argued such measures strengthen resources utilization. From the evidence reported by Reyes and Novak (2016), the effective utilization of resources in seeking to reduce

accidents in mines requires that the accident experiences of different mines be first placed on a comparative footing.

**Accidents Prevention and Control**

Avoidance of hazard at workplace and mitigation activities where the risk cannot be avoided should take priority at workplace to achieve a zero accident vision. The aim is to avoid accidents from happening, to lessen their occurrence and severity, and to mitigate their effects. It is necessary for an organization to install a set of safety management practices and to be capable of foreseeing the potential risks (Zwetsloot et al, 2017). As opined by Anger et al. (2015), in an effort to uphold safety management practices, the World Health Organization (WHO) established a program of cooperation with member states to control the accident and injury epidemic, emphasizing the need for prevention and research into the human aspects of safety. To date, many organizations also employ international and national safety standards as guidance to develop their own SMSs (Haas & Yorio, 2016). As a result, occupational safety and health risks are minimized.

Participation of workers in safety issues is key to accidents control. According to Mrugalska, Nazir, Tytyk, and Øvergård (2016), worker participation in occupational safety and health generally achieves better outcomes than unilateral management initiatives. It is therefore important for management and workers to engage in safety issues at all times (Bird, 2014) and trust each other because occupational safety is interwoven with trust (Smit, de Beer, & Pienaar, 2016). In the context of worker and management relations around safety, trust is best understood as an individual's

willingness to rely on another person, based on expectations that he or she will act safely or intends to act safely; for example, management might trust workers not to break safety rules or take unreasonable risks. It is believed that mining and quarrying risk sources consists of inherent hazards, technology equipment defects and safety management misconducts and therefore requires adequate safety controls (Yunfeng et al., 2016). Team work is therefore key to accident control.

Mining and quarrying leaders should enforce compliance of safety and health rules and regulations to minimise workplace accidents and improve at-risk behaviors. As stated by Muir (2016), enforcement of safety rules and standards need to be done consistently. Consistency in the application and enforcement of standards remains a key concern to the mining and quarrying industry (Muir, 2016). The integral management system known as Environmental, Health and Safety Management System may provide good working conditions for mining and quarrying workers environment, minimizing any negative impacts from mining activity and favorable contributions to improve local community life (Phiri, 2016). According to Virchow (2015), managers need to craft systematic, team-based techniques, identify, assess and control unacceptable risks to people, assets, the environment and production thereby making working places safe. Such development and application of risk assessment methods can bring positive change to safety management (Chu, Jain, Muradian, & Zhang, 2016; Cui et al., 2015). Bagherpour, Yarahmadi, and Khademian (2015a), posited in the past safety professionals used behavioral psychology to reduce risk in the workplace; this attention has been justified on the basis that at-risk behaviors are the last measurable and observable events preceding

workplace injuries. However, with the continuous improvement in SMS, safety professionals are able to view mining and quarrying safety through improved lens.

**Underground Safety in Mines**

Underground accidents pose a threat to people's life especially workers in the risky industries such as the mining and quarrying. As claimed by Pillay (2015), although work provides many economic and other benefits, a wide array of workplace hazards also present risks to the safety and health of people at work especially underground workers. According to Akgün (2015), underground mining has the first place in terms of fatal and injury accidents among all businesses due to spontaneous combustion in activities such as coal mining and the presence of methane gas which cause explosions in sub-surfaces. From the evidence reported by Fu-bao, Bo-bo, Jian-wei, and Ling-jun (2015), underground fires are a common threat for the mining and quarrying industry, since spontaneous coal combustion can easily result in gas combustion and explosion. Yunfeng et al. (2016), also reported among many underground accidents worldwide, five of the world's most fatal work safety accidents in the past decade (2001-2010) occurred in China, making China the most risk underground employer. Accidents in underground mining and quarrying industry does not affect the economic benefit of the mine alone, but also threaten workers' lives, safety, and social stability (Lee, Christopoulos, Lu, Heo, & Soh, 2016). Therefore, mine leaders need to come up with strategies to control mine accidents.

**Some Causes of Mine Accidents**

Human error and technical faults are considered as the major causes of accidents in mining and quarrying operations among other common causes. According to Mrugalska et al. (2016), human error and technical failures are still perceived as contributing factors to approximately 90% of occupational accidents in mining and quarrying industry. The accidents are classified under human error and technical failure because they occur when the rules for safety and usage are violated regarding the machines and devices that operate on electricity, accumulator, and diesel (Virchow, 2015). Papic and Kovacevic (2016), summed up occurrence of human errors as being caused by the actions as failure (omission, unsuccessful attempt) to execute a required function, wrong decision in a response on certain problem, performing of function that shouldn't be executed, unsuccessful in recognition (observation, revealing) of a dangerous condition that requires corrective measures, bad timing and bad response on unpredicted circumstances. Contrary, Bonsu, van Dyk, Franzidis, Petersen, and Isafiade (2017), claimed systemic factors, rather than human errors and non-compliance, are the major causes of accidents in the mining sector. According to Bonsu et al. (2017), despite insights highlighted in previous studies, the context in which the studies were conducted determined the outcome. The most common causes of accidents in mining and quarrying are landslips, firedamp and dust explosions, human error, technical failures, and mine fires (Long, Sun, & Neitzel, 2015; Schosker, 2015; Virchow, 2015). Leaders in mining and quarrying industry need to deploy strategies to prevent causes of occupational accidents.

Landslides are mining hazard to human life emanating from a variety of factors. Landslides can occur gradually or more suddenly and are a greater hazard to life, while slow landslides pose a risk to property (Cloutier et al., 2015). It is more likely to be the result of a variety of contributing factors; it might be related to the existence of the rocks that initiate the landslide, or possibly date back to the geological age when the main physical features of the rocks started to evolve (Can, 2014). A landslide event is often a cause of death and economic damages; risk evaluation, hazard assessment or prediction of landslides represent an interesting field of research (Morello, De Capua, Lugarà, Lamonaca, & Fabbiano, 2014).

Apart from landslides, firedamp is a more volatile cause of mine accidents. Virchow (2015), described firedamp as a mixture of methane gas and oxygen in the air at a specific concentration and that explodes due to a source of fire. As claimed by Virchow (2015), if oxygen is at the rate of 12-20% in the air and methane is at the rate of 7-15%, explosion occurs. Gao, Fu, and Nieto (2016), concurred if oxygen is less and methane is more, explosion does not occur. Oxygen concentration in the air should be maintained at safe levels to avoid explosions accidents.

Mine fires is also a common cause of workplace hazards especially in coal mining. As previously eluded by Araos and Onederra (2015), underground fires was one of the major causes of accidents in mines. Coal mine fires represent a threat to human safety and health (Melody & Johnston, 2015). Coal mines are mainly endangered by coal seam spontaneous combustion that threaten the safety of mining (Evyapan, 2015). According to Ahamed, Monir, Biswas, and Khan (2016), the actual control of

spontaneous combustion of coal is important to save coal mine from mine fires and also provides a real opportunity to improve the financial performance of the overall organization. As posited by Akgün (2015), underground mining fires can be ignited by natural causes or by human error. Mine fires can also be started by people burning trash in pits where the coal seam is close to the surface (W. Wang, Cheng, Wang, Li, & Wang, 2015). Mine fire preparedness requires consideration of all possible fires that could occur and establishing a mitigation plan (Pillay, 2015). For example, isolated remnant pillars are critical factors in evaluation of the coal outburst risk of multi-seam mining (Chikande & Zvarivadza, 2016).

Assessment of risks enable managers to make informed safety plans to prevent accidents. As claimed by Årstad and Aven (2017), failure to evaluate accident risk can also cause mine accidents. Risk assessments are used to establish priorities so that the most dangerous situations are addressed first and those least likely to occur and least likely to cause major problems can be considered later (Ivensky, 2016a). According to P. Zhang et al. (2016), risk identification, risk assessment, geologic influence mapping, geotechnical evaluation, risk analysis, risk mitigation, and monitoring are important elements of risk management process that need to be integrated into organizational safety plans. Business managers therefore need to take corrective action to avoid recurrence of accidents.

Mine leaders must avoid replication of accidents by improving safety policies and strict adherence to safety procedures. According to Dash, Bhattacharjee, and Paul (2016), management's inability to learn lesson from previous accidents and take corrective action

results in repetition of accidents. The increased interest in improving the safety at workplace has been driven mainly by a series of recent mining disasters that have occurred worldwide, unfortunately, little was learnt from these past disasters (Dash et al., 2016). The repeated occurrence of gas explosions, often in a similar manner and triggered by unsafe behavior, indicates that mine leaders failed to learn from the past and make inadequate changes in response (Gao et al., 2016). Despite the fact that gas and coal dust explosion are known causes of mine disasters, accidents keep recurring showing weaknesses in learning from previous accidents. In May 2014, the most casualties (301 people) of recent years occurred in the Soma Eynez mining quarry in Turkey that accounted for half of the death of the last thirty years (Akgün, 2015). In October 2014, another disaster occurred at Karaman in Turkey out of similar causes. The accident that happened in Karaman proved that no lessons had been learned from the previous disasters; the chain of neglect has continued, and there is still a long way to go (Akgün, 2015).

Underground mine disasters are mostly caused by gas and dust explosion leading to health problems, injuries and deaths. Cheng, Luo, and Zhou (2015), highlighted during 1900-2006, a total of 11,606 mine workers died in 513 USA underground coal mining disasters; most of the disasters resulted from mine gas and coal dust explosions. H. Wu et al. (2016), also claimed that inhalation of mine dust also causes cadmium (a toxic metal) that lead to adverse health effects. According to Liu, Meng, Hassall, and Li (2016), underground miners are exposed to hazards well in excess of those who work in most

other occupations. The hazards have the potential to cause accidents that can lead to injuries and fatalities unless risk control systems are employed.

Another common worldwide problem that mine leaders experienced was the underground hot hazard caused by the underground hot environment. The hot environment promoted a need of reliable mitigation measures to assist mine leaders controlling the heat stress for miners as well as maintaining the normal operation of the mine (Zhu, Wu, Cheng, Li, & Li, 2015). As claimed by Krishnamurthy et al. (2016), preliminary evidence shows that high-heat exposures and heavy workload adversely affect the workers' health and reduce their work capacities. Leaders in the mining and quarrying industry need to develop strategies that make workplace safe and health (Blair, 2014).

Leaders in the mining and quarrying industry need to deploy strategies that enhance accident prevention systems and near-miss management systems. Accident precursors and near-miss management systems are important safety tools that leaders can use in industries with major accidents hazards, such as the mining and quarrying industry (Gnoni & Saleh, 2017). According to Gnoni and Saleh (2017), near-misses are less costly than learning from accidents; the main value of a near-miss is in the learning loop provided within and across the organization, in focusing safety resources on addressing unsafe acts, reducing unsafe conditions and improving design and operational safety issues. Managers learn and put corrective safety action through near-miss incidents. In such cases, the managers use both the Study and Act components of the Deming's theory (Moen, 2009), a part of this study's conceptual framework.

## Mining and Quarrying Safety Systems

In order to monitor and reduce accidents at workplace, safety systems are an important component in mining and quarrying operations because of the high risk nature of the industry. Safety concerns continue to be worrisome in most underground activities; targeted strategies and full risk assessment are needed to improve the safety and health condition in mining and quarrying (Brogli, 2016). According to Ivensky (2016a), major safety barriers come from the organization itself, its safety system, human behavior, and technical systems. Shea et al. (2016), opined that the organization's management style, principles, standards, motivation, and rewarding system determine the organization's safety levels. As observed by Line and Albrechtsen (2016), safety systems include training, audits, instructions and other safety measures that promote occupational safety and health. Ivensky (2016a), also stressed human behavior plays a vital role in safety systems by incorporating proficiency, education, experience, culture and individual perceptions. However, technical barriers deter safety improvement systems (Trudel, Nadeau, Zaras, & Deschamps, 2015). According to Trudel et al. (2015), technical barriers include faults and failures, disturbances, poor design, and aging.

Mining and quarrying leaders need to formulate strategies to prevent underground disasters by developing safety systems such as wireless sensors. Wireless sensor networks stand out with ease of use and low cost (Dener, Özkök, & Bostancıoğlu, 2015; Garcia et al., 2016). Khan et al. (2015), opined wireless sensor networks BBSs can play a key role in ensuring the safety of people working in mines. However, business leaders

should not be reluctant and dependable on sensors alone as accidents can still happen in the presence of sensors. For example the Russia mine blast that killed thirty six people on 25 February, 2016 was a sudden spike in methane in the mine, rather than a gradual increase, that could not have been picked up by sensors in time (Suopajärvi et al., 2016). Managers should therefore ensure that workers comply with company policy and operational guidelines. Low adherence to safety standards can result in high exposure to safety and health risks (Dener et al., 2015).

Furthermore, safety measures such as training on safe operational practices and technological developments are essential. Managing safety continue to be a challenge for business leaders, practitioners and academics involved in accident prevention and safety management (Pillay, 2015). Pillay (2015), argued a possible reason for this dire state of affairs is that development in safety management have been outpaced by technological advancements, and more innovations are needed. Leaders need to develop common priorities for informing collaborative surveillance, research, interventions, and policies (Brinker et al., 2016). As opined by Martin and Black (2015), managers need to strengthen safety management measures to reduce the number of accidents and fatalities. Martin and Black (2015), argued new paradigms are required to influence step changes in improving mine injury and fatality rates.

## Safety and Health Risks in Mining and Quarrying Industry

Successful mining and quarrying leaders deploy risk interventions to mitigate risk exposure to airborne silica dust, noise from mining equipment, heavy metals and mercury

contamination. Mining and quarrying has been historically considered as a naturally high-risk industry worldwide (Bagherpour et al., 2015b; Long et al., 2015; Nawrocki & Jonek-Kowalska, 2016; Qian & Lin, 2016; Utembe, Faustman, Matatiele, & Gulumian, 2015) Miners and communities are potentially exposed to heavy metals, airborne silica dust, and noise from mining equipment and leaders should pay more attention to organizational safety and health needs (Long et al., 2015). As opined by Castilhos et al. (2015), mercury (Hg) contamination is also an issue of concern in the mining and quarrying industry due to potential health effects associated with Hg exposure in artisanal gold mining areas. According to (NSSA, 2014), in 2014, occupational deaths increased 49% to 106 and occupational injuries increased 36% to 5390 from the previous year in Zimbabwe. Mining and quarrying industry attributed 20% of the deaths in year 2014 compared to 10% the previous year (NSSA, 2014). However, year 2014 had a 300% increase in mining fatalities compared to previous year (NSSA, 2014). Mining captains need to Plan, Do, Study, and Act strategically according to the PDSA theory to mitigate mining risks. Vinnikov (2016) concurred with Castilhos et al. (2015), mining activities are linked to a number of respiratory conditions, such as chronic obstructive pulmonary disease. Leaders need to formulate strategies to develop effective preventive measures associated with the risk factors. These include individual-related factors, job-related factors, and equipment-related factors (Cui et al., 2015).

Mining and quarrying activities expose workers to chronic diseases. Exposure to dust, vapors and gases put workers at risk for chronic diseases (Famiyeh, Adaku, Kissi-Mensah, & Amoatey, 2015). Exposure to dust from mining can lead to many pathological

effects depending on mineralogical composition, size, shape and levels and duration of exposure (Utembe et al., 2015). According to Akgün (2015) and Fritschi et al. (2016), long-term cumulative exposure in workers is likely to develop into silicosis, silico-tuberculosis, pulmonary tuberculosis, obstructive airways disease and occupational asthma. Unhygienic working and living conditions, infused with coal dust has also resulted in a high prevalence of many diseases in mining and quarrying industry (Basu et al., 2015). Workers in heavy industry and in collieries represent an at-risk group of people as their immunity is often weakened by long-term employment in dust environments, frequent smoking and an increased occurrence of pulmonary diseases (Ulmann, Kracalikova, & Dziedzinska, 2015). Analysis and management of safety risk are therefore prerequisites toward control and increment in mines' safety.

Managers need to harmonize both statistics of the occurred incidents and the economic effects to come up with strong safety strategies in decision making processes. According to Bagherpour et al. (2015a), common safety risk analyses in mines are based on the statistical data of the occurred incidents and economical aspects are usually neglected. As observed by Qian and Lin (2016), great effort have been devoted to establish the safety risk management system for mining and quarrying companies in five aspects, that is, (a) the organization structure system, (b) the safety culture system, (c) the technical management system, (d) the disaster prevention and early-warning system, and (e) the project insurance system. This has been a big stride in the Plan, and Study processes of the PDSA cycle theory, the conceptual framework theory for this study.

Metal pollution in soils and rock burst are also high risks in mining and quarrying. Heavy metal pollution in soils caused by mining and smelting has attracted worldwide attention for its health risks to residents (Zeng, Zhou, Ren, & Chen, 2015). Soils are weakened and the eco-system is adversely affected. It is therefore important that mining companies come up with new strategies to minimize pollution in soils. Rock burst also pause high risk to human life and remain one of the most dangerous natural hazards and therefore, are a fundamental problem and have the greatest impact on safety in mining and quarrying industry (Martin & Black, 2015). Leaders need to design methodology of assessing rock bursting hazard to improve work organization methods and mine safety management system (Manowska, 2015).

Gas explosion is another high risk area in mine accidents, it is critical for leaders to study the occurrence of gas explosion accidents and craft strategies to improve safety and health. Many fatalities and economic losses have been recorded worldwide because of gas explosion accidents (Cheng et al., 2015; Gao et al., 2016; L. Wang, Que, Tien, & Aouad, 2015). Studying the occurrence is a recommended component of the PDSA cycle theory that managers should uphold when making safety improvement decisions. Risk assessment falls under Plan in the PDSA cycle theory and is the first stage in risk management cycle. Other management instruments and risk control measures can follow after the planning stage. Therefore, the PDSA holistic identification of risk sources under the planning phase is an extremely important element in the risk assessment, relating to all areas of the enterprise's business and the environment in which it operates (Nawrocki

& Jonek-Kowalska, 2016). As observed by Qian and Lin (2016), safety risk management should be transformed from “rectification after accidents” to “prevention in advance”.

Noise exposure is another risk associated with mining and quarrying operations despite the continuous technological improvements. According to Lutz, Reed, Turner, et al. (2015), noise exposures and hearing loss in the mining industry continue to be a major challenge, despite advances in noise control technologies. As claimed by Chadambuka, Mususa, and Muteti (2013), worldwide, 22% of disabling hearing loss in men is caused by occupational noise. Chadambuka et al. (2013), stated that noise induced hearing loss is within the top five occupational illness in Zimbabwe. Leaders need to put safety controls to prevent noise illness, including engineering controls in areas exceeding permissible noise levels (Mapuva & Chimbangu, 2016). Excessive noise beyond tolerated levels is hazardous and could cause hearing impairment; other associated health effects include elevated blood pressure, sleeping difficulty, annoyance and stress (Gyamfi, Amankwaa, Owusu Sekyere, & Boateng, 2016). Lutz, Reed, Lee, and Burgess (2015), opined occupational exposure to noise not only damages hearing, but also negatively affect acute and chronic measures of cardiovascular health. Unlike many injuries or illnesses, hearing loss may be permanent and irreversible, mine leaders should therefore, craft strategies to mitigate the noise risk in mining industries by instituting a hearing conservation program to protect workers against hazardous noise (Beyan, Demiral, Cimrin, & Ergor, 2016). As posited by Mohammadi et al. (2016), exposure to noise can also increase stress, tissue dysfunction, and cause changes in the normal process of secretion of the body’s hormones, thus resulting in significant effects on blood parameters and health.

Mohammadi et al. (2016), further recommended that industrialists perform preventive measures on administrative/engineering controls of noise to reduce workplace noise risk.

## Mine Transport and Equipment

Diesel fuel and hydraulic oil may have transformed the mining and quarrying technology, but their combustibility remains a risk to the mining industry. Diesel fuel is commonly used for underground mining equipment, yet diesel engine exhaust is a known human carcinogen (Lutz, Reed, Turner, et al., 2015). Exposures to diesel fuel emissions are known to cause adverse health outcomes and diesel engine exhaust has been classified by the international agency for research on cancer (IARC) as a Group 1 carcinogen in humans (Lutz, Reed, Lee, et al., 2015). According to Möhner (2016), the diesel exhaust in miners study provides the most suitable epidemiological data on the association between diesel motor exhaust and lung cancer risk. Mine transport therefore remain the major source of equipment-related accidents in mining with the highest fatal accidents rate compared to all other mining equipment (Dindarloo, Pollard, & Siami-Irdemoosa, 2016; Zhang, Kecojevic, & Komljenovic, 2014). The emission of gases such as carbon monoxide, carbon dioxide, or nitrogen oxide pause safety and health risks to mine workers (Bascompta, Castañón, Sanmiquel, & Oliva, 2016) despite the technological benefits obtained from the use of such equipment.

## Technological Advancement in OSH Equipment

Innovation and continuous improvement in technology has improved OSH equipment capabilities enabling a safe and health workplace. The world dynamic changes

in technology is becoming advanced enabling improved safe mining practice (de Wet & Koekemoer, 2016a; Jørgensen, 2016; Murray & Silvestre, 2015; ur Rahman, Rahman, Mansoor, Deep, & Aashkaar, 2016). Technological innovations in mining equipment have led to increased productivity and OSH performance, but their introduction also brings new risks for workers (Trudel et al., 2015). As observed by Fourie (2016), poor equipment efficiency can endanger the success of mining operations. Technological innovations in mining equipment have led to increased productivity and occupational safety and health performance (Kouame, Jiang, Feng, & Zhu, 2017; Trudel et al., 2015). For example, Canada-based CAE mining company was the first simulator supplier in the mining industry with technology that was certified to the global type 7 standards for simulator sophistication and quality that integrated movement, graphics and realistic machine response with millisecond accuracy (Hallowell, Hardison, Desvignes, Wardleworth, & Haas, 2016). However, designers of mining equipment face challenges in that the environments in which such equipment is used are variable (Horberry, Burgess-Limerick, Cooke, & Steiner, 2016). For example, weather, workforce, mining methods, demographics, and operational procedures vary from mine to mine.

Mine ventilation is another technical means for ensuring safety production. The establishment of a scientific and reasonable ventilation system is a basic guarantee for mine safety production, and is an economic way to improve the safety production level of a mine (Fang, Li, Yu, & Yao, 2016; Zhu et al., 2015). Gas explosion, fire, and other mine accidents have a significant influence on the ventilation system, therefore, managers should ensure that effective strategies are crafted to avoid mine disasters (Cheng et al.,

2015) caused by technological defects. According to Bissert, Carr, and DuCarme (2016), some leaders in the mining industry developed proximity detection systems operating on the electromagnetic principle as a substitute for other sensing technologies such as the global positioning system (GPS) to enhance safety and health measures. However, Yorio et al. (2015) argued successful leaders need to focus on the prevention of accidents and diseases in mine operations, developing a multilevel intervention that utilizes mine assessment technology to bridge health communication between workers and management to reduce mine worker overexposure to respirable silica dust. As a result, diseases associated with unsafe mine operations might be reduced.

## Diseases Associated with Unsafe Mine Operations

The mining and quarrying industry is one of the industries that has been associated with negative health risks such as cardiovascular, pulmonary, neurological, renal, haematological and musculoskeletal disorders as a result of hazardous working conditions. According to Halldin, Wolfe, and Laney (2015), miners' exposure to ecological pollutants enhances risks for heart, respiratory and kidney ailment. Such exposures need to be limited to control mine diseases. The production of nitric oxide under oxidative stress conditions also generates strong oxidizing agents (reactive nitric species) that may influence the development and the course of chronic inflammatory airway diseases such as asthma, cystic fibrosis, bronchopulmonary dysplasia, lymphangioleiomyomatosis, and pulmonary hypertension (Skoczyńska et al., 2016). As posited by Skoczynska et al. (2016), exposure to mine dust is also hazardous to mine workers. Skoczynska et al. (2016), argues that mine dust is a primary contributor to

underground mining disasters and is also a major factor in adversely affecting the occupational health of mine workers causing diseases like pneumoconiosis, fibrosis, cancer , silicosis and tuberculosis.

**Pneumoconiosis.** Pneumoconiosis is a lethal lung diseases which is caused by coal dust that can lead to progressive massive fibrosis and is also a serious occupational disease worldwide especially in developing countries (Cohen et al., 2016; Grové, Van Dyk, Franken, & Du Plessis, 2014; Han et al., 2016; Torres Rey et al., 2015). Recent recognition of rapidly progressive pneumoconiosis in younger miners has increased the sense of urgency and the need for vigilance in medical research, clinical diagnosis, and exposure prevention (Petsonk, Rose, & Cohen, 2013). In China, 89.66% of the reported occupational cases were attributed to pneumoconiosis in 2014, of which coal workers' pneumoconiosis (CWP) was 51.52% and silicosis was 42.69%, accounting for the majority cases (Q. Wu et al., 2016). Jungraithmayr et al. (2016), claimed silicoanthracosis is also a pneumoconiosis derived from accumulation of carbon and silica in the lungs from inhaled coal dust; the silica content can produce harmful fibrous nodules throughout the body.

**Fibrosis and cancer.** Coal miners are at risk for dust-related diffuse fibrosis and chronic airway diseases, including emphysema and chronic bronchitis (Petsonk et al., 2013). According to White et al. (2016), pulmonary fibrosis encompasses a group of lung-scarring disorders that occur owing to known or unknown insults and accounts for significant morbidity and mortality. High exposure to *radon* causes lung disease as well. High radon exposure is a risk factor for squamous cell carcinoma, a major lung cancer

observed in former miners (Leng et al., 2016). Working in mines and quarries has been associated with an elevated lung cancer risk but with inconsistent results for coal miners (Taeger et al., 2015). The high prevalence of multi-morbidity, predominance of non-communicable diseases, and widespread interweaving of non-communicable and transmittable disease comorbidities reflect the double disease trouble in mine workers in developing countries. Leaders need to craft integrated, person-centered treatment and control strategies to mitigate the risk. In United States of America (USA), coal miners are offered a health surveillance program administered by the National Institute for Occupational Safety and Health (NIOSH), including chest radiography at first employment and approximately every 5 years thereafter (Petsonk et al., 2013). The key to prevention must come from recognition of work activities likely to lead to over-exposure to silica and devising effective control strategies (Blanc & Seaton, 2016).

**Silicosis and tuberculosis.** In 2012, the ministers of health of the Southern African Development Community (SADC), of which Zimbabwe is a member, signed a declaration committing their countries to reducing the burden of mining related lung disease. Included among the mechanisms for achieving the reduction was improved surveillance of silicosis and tuberculosis (Knight et al., 2015). Silicosis and tuberculosis are linked to silica dust exposure in mines. Measurement of trends in silicosis prevalence is relevant in South African gold mining industry, the main source of silicosis in SADC and an amplifier of tuberculosis risk (Knight et al., 2015). South Africa's gold mines were the first to compensate silicosis and tuberculosis as occupational diseases (McCulloch, 2016). Fortunately, over-exposure to respirable silica dust is preventable

through the development and implementation of engineering control technologies (Yorio et al., 2015). Mine leaders need to intensify dust control measures and incorporate anti-smoking interventions into tuberculosis prevention and control programs (Ngosa & Naidoo, 2016). According to Vynnycky et al. (2015), tuberculosis control requires a combination prevention approach, including health systems strengthening to minimize treatment delay, improving diagnostics, increased antiretroviral treatment coverage, and effective preventive treatment regimens.

**Sporotrichosis.** Sporotrichosis is a common tropical fungal disease that miners are vulnerable to (Ferreira, de Almeida, & Corte-Real, 2015). Ferreira et al. (2015), stated skin infection is the most common form of sporotrichosis infection. As claimed by Govender et al. (2015), between 1938 and 1947, the Witwatersrand gold mines in South Africa were the site of the largest outbreak of sporotrichosis worldwide.

## OSH Legislative Laws Governing Mining and Quarrying Industry

National laws governing specific industry activities form the basis of safety and health rules and regulations in a country. Safety and health rules are unavoidable in hazardous work such as in mining and quarrying activities and are often codified insights from accidents and fatalities (Jahn, 2016). According to Geng and Saleh (2015), effective government policy and safety regulations enhances occupational safety and health in mining and quarrying and is necessary for accidents prevention. However, Sanmiquel et al. (2015), argued despite new laws being introduced to enhance occupational safety, accidents of different nature still occur, including fatal accidents. In common-law jurisdiction, companies have a common law duty to take care of the safety of workers

(Walters, Johnstone, Quinlan, & Wadsworth, 2016a). As posited by Long et al. (2015), the lack of safety regulations and enforcement, education and training, and functional infrastructure and equipment may lead to increased injury rates. Continuous pressure for safely increasing productivity coupled with growing awareness about the safety standards has boosted industries to highlight safety and risk issues (Kumar et al., 2016).

Statute law may in addition enforce additional duties, initiate specific duties, and form government bodies with authority to regulate workplace safety and health issues. As posited by Spada and Burgherr (2016), strengthening the safety regulator is needed, backed by the legislative policies. Such initiatives can save the lives of many mine workers and contribute to mine accident reduction in both developed and developing countries (Spada & Burgherr, 2016).

**Developed countries.** UK is one of the developed countries with a successful record of safety and health practices. According to Uyanusta Kucuk and Ilgaz (2015), health and safety law in UK has been in existence for over 200 years. Uyanusta Kucuk and Ilgaz (2015), stated that the laws came as a result of political responses to social problems arising from the disturbances of the industrial revolution and the insufficiency of earlier Elizabethan poor laws. As posited by Baum et al. (2016), among other legislation, the mines and quarries act 1954 was the most extensive safety legislation in UK. The act laid down statutory duties on mine managers and gave power to inspectors of mines (Baum et al., 2016). Uyanusta Kucuk and Ilgaz (2015), stated the act extended

regulation in relation to equipment, places, access, processes, specific hazards and ways of working.

Subsequent legislation strengthened the mines and quarries act. The Health and Safety at Work Act 1974 and the Management of Health and Safety at Work Regulations 1999 govern the mining sector in UK (Mallick & Mukherjee, 1996). According to Mallick and Mukherjee (1996), with effect from 6 April 2015, the Mines Regulations 2014 also applied (which replaced previous legislation relating specifically to health and safety in mines). The Mines Regulations 2014 and Quarries Regulations 1999 impose a wide range of duties on managers, operators and employees (and others) in relation to health and safety in mines and quarries (Perchard & Gildart, 2015). The regulations are successfully monitored through state inspections.

In USA, the Mine Safety and Health Administration (MSHA) is an agency of the United States Department of Labor which administers the provisions of the Federal Mine Safety and Health Act of 1977. The Safety and Health Act of 1977 was passed, (a) to enforce compliance with mandatory safety and health standards, (b) to eliminate fatal accidents, (c) to reduce the frequency and severity of nonfatal accidents, (d) to minimize health hazards, and (e) to promote improved safety and health conditions in the nation's mines (Muir, 2016). USA is one of the biggest coal producers in the world (Dzonzi-Undi & Li, 2015). Dzonzi-Undi and Li (2015), reported despite improvements, USA as one of the biggest coal producers in the world had at certain point experienced worst safety situation and ‘‘severe casualty accidents.’’ According to Dzonzi-Undi and Li (2015), USA had four largest coal mining accidents in history which happened in 1905, 1907,

1948 and 1968. However, with the careful development of legislation, regulations, effective enforcement and use of modern SMSs, the industry is now one of the best of the country (Dzonzi-Undi & Li, 2015). Success lessons can be learned from MSHA. In most advanced market economies, the representation of workers' interests in OSH is addressed through regulatory measures, most from the 1970s onwards (Walters, Johnstone, Quinlan, & Wadsworth, 2016b). OSH regulation formation, regulation challenges, inspector organization, and worker representation in OSH assist developed countries to successfully manage OSH issues (MA, 2016).

Australia is another developed country with legislative laws and statutes successfully regulating the mining and quarrying industry. According to Joy (2004), in Australia, legislation regulating OSH dates back to 1854 for the mining sector, when the colony of New South Wales enacted a statute to regulate the inspection of coal mines. The early safety and health statutes in Australia drew heavily on the UK safety and health regulatory models of the day, included sanctions for breaching of some of the provisions in the statute, in the form of prosecution, resulting in a pecuniary fine (Baum et al., 2016). Since late 2011, the Australian Commonwealth, states and territories have gradually been adopting a model Work Health and Safety Act (WHSA) endorsed by Australia's Workplace Relations Ministers' Council in 2009 (Tynan et al., 2016). Tynan et al. (2016), posited the harmonization of work health and safety law is the latest in 170 years of policy discussions over the structure and content of work health and safety regulation in Australia. From 2012, the jurisdictions adopting the model WHSA have enacted a positive and proactive duty requiring officers to exercise due diligence to

ensure that companies conducting mining business or undertaking act in accordance with its duties and obligations under the Act (Tynan et al., 2016). Tynan et al. (2016), stated where an officer is reckless and engages in conduct that exposes an individual to whom a duty is owed to a risk of death or serious injury or illness, the officer can be imprisoned for up to five years. Punitive penalties to offenders, inspections, investigations, prosecutions, training to mine employees, use of technology and innovations has added success to developed countries' mining firms (Baum et al., 2016; Joy, 2004; Tynan et al., 2016).

**Developing countries.** Some countries in the developing world have legislative bodies governing the mining and quarrying industry to monitor safety and health. There are about 2.4 billion working people in developing countries and China is the largest employer in mining and quarrying (Dzonzi-Undi & Li, 2015). Dzonzi-Undi and Li (2015), claimed Chinese industry's fatality rate as compared to other developing countries (i.e., India, Russia) and USA was estimated at 10 times and 100 times higher, respectively, despite USA being only the second largest coal producer and consumer from China. The Chinese government established a surveillance system for monitoring work safety accident since 2001 under State Administration of Work Safety System (SAWS), which is the only authority system for work safety accidents inquiry in China (Yunfeng et al., 2016). Developing countries need to adopt auditing regulations to monitor OSH. Suresh Cuganesan, Sun, Alles, and Vasarhelyi (2015), found excessive government intervention in business, the lack of competition, independence of auditors,

the support from management and the continuous auditing-specific regulations, as well as the technology gap between developed and developing countries, are the main barriers for the implementation of continuous auditing in developing countries.

In South Africa's (SA) mining sector, health and safety is governed by the Mine Health and Safety Act (MHSA) (Hermanus et al., 2015), which provides for extensive dialogue and consultation between the Mine Health and Safety Inspectorate (MHSI). van den Honert and Vlok (2015), concurred MHSI represents mining stakeholders on matters of safety policy, regulation, research, and the state of health and safety in the mining and quarrying industry. In Zimbabwe, the basic legislation regulating mining and quarrying activities is the Mines and Minerals Act and Regulations (Spiegel, 2015). According to Spiegel (2015), the Act is a 1961 piece of legislation which has seen minor amendments over the years. The workers' lack of compliance with safety regulations represents an enduring problem that often involves first-level managers, who are willing to turn a blind eye toward divergent practices (Ripamonti & Scaratti, 2015). Therefore, leaders in the mining and quarrying industry need to enforce compliance of the regulations at all levels in the organization.

Balancing maximization of benefits and minimization of workplace hazards should remain a leadership priority. According to Perchard and Gildart (2015), the challenge for governments, the mining industry and the general population is how to balance the socio-economic and environmental issues in a way that maximizes benefits and minimizes or eliminate harm and degradation. Hallowell et al. (2016), opined mature organisations require objective knowledge of the location and timing of safety risks that

are not necessarily intuitive. However, Murombo (2016), argued in the absence of adequate legislation there can be no significant improvement in OSH initiatives. Leaders in the developing world need to develop OSH strategies that promote and enhance legislation as is the case with developed nations. Regulations must be observed and carefully implemented. Failure to abide by standing regulations should result in stiffer penalties. For example, Don Blankenship, Chief Executive Officer (CEO) of Massey Energy, was indicted on November 12, 2014, on four counts, including conspiracy to impede mine safety officials and conspiracy to violate mine safety standards and was sentenced to a year in prison and ordered to pay a US$250,000 fine (Binder, 2016). Authorities should enforce the complete implementation of laws and regulations governing the supervision of workers' safety and health (Müezzinoğlu, 2015). According to Qian and Lin (2016), an organization's legal strategy should aim to provide a strong basis for regulating the safety risk management to maximize on workers' morale and the organization's productivity through safety culture.

## Occupational Safety Culture

In an investigation of the impact of organizational culture and leadership within the context of occupational safety and health (Cooper, 2015) noted transformational culture and transformational leadership as major strengths for safety culture excellence. Cooper (2015), opined a company's safety culture is driven by the executive leadership team that creates, cultivates and sustains a company's journey to safety excellence. As posited by Lu and Chen (2015), the construction of a people-oriented safety culture is the key method to strengthen miners' rule-following behavior and decrease the probability of

accidents in mines. Kim et al. (2016), also argued though the introduction of safety and health management systems has decreased the incidence of occupational injuries and diseases, the systems are not effective unless accompanied by a positive safety culture in the workplace. Some of the factors that contribute to the establishment of a workplace safety and health culture are management commitment, leadership responsibility for safety, and everyone's accountability for the others' safety. Safety becomes everyone's responsibility within the organization. According to Chu et al. (2016), a culture of safety is a fundamental building block in safety management. However, despite the fact that safety culture measurement systems have been implemented and maintained in numerous enterprises all over the world for more than three decades, there has been no agreement on what factors make up safety culture (Ali & Shariff, 2016b). Some organizations aspire to become world class safety champions by continuously improving systems and strategies, and by the confidence in the efficacy of preventive measures (Zivkovic & Ivanova, 2016). Learning and continuous improvement is key to SMS that is also envisaged in the PDSA cycle theory (Moen, 2009). Safety experts continue to promote better working environments by improving safety and health cultures. As stated by Saujani (2016), when OSH professionals talk about world class, they generally mean best of best, best in the class, and best in the world. Visible senior management leadership and commitment to safety are critical factors in setting a goal to attain world-class performance and developing the culture needed to achieve the goal (Jahn, 2016; Johnson, Haegeli, Hendrikx, & Savage, 2016).

Safe workplace should be the priority of organizational leaders. Safe organizations are reported by employees to have better communication, clear goals and policy statements, better accident prevention, better reporting and safety practices (Johnson et al., 2016). As claimed by Saujani (2016), safety culture is based on five key pillars, namely, (a) management commitment, (b) employee ownership, (c) system data, (d) system integration, and (e) organizational engagement. An organization can achieve a world-class safety culture through innovation, hard work, and persistence within the five pillars (Kumar et al., 2016; Saujani, 2016). Leaders need to construct a safety culture that will not collapse under the pressure of quick fixes but a culture of excellence (Saujani, 2016). A strong safety culture allows managers to make practical regulations that emphasize a harmonious relationship between humans and nature, and strengthen miners' awareness of mine safety (Chu et al., 2016).

Organizations with positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by the confidence in the efficacy of preventive measures (Ali & Shariff, 2016b). Ali and Shariff (2016a), argued leaders of such organizations are accountable for organizational safety and health. Successful leaders in the mining and quarrying industry show that they genuinely care about people by involving everyone in safety; showing appreciation; trusting people to do the right thing; listening to followers; and acting on relevant information (Cooper, 2015). The managers are responsible for the formulation, implementation, evaluation and control of safety and health strategies; thus aligning the organization's safety activities with the Deming's PDSA theory. The strength of a

company's safety performance lies within the strength of its safety culture (Ali & Shariff, 2016b). Ivensky (2016b) concurred with Ali and Shariff (2016a) and added if culture is to yield sustainable results, it must be integrated wholly and firmly within core line management instruments and the fundamental tasks of human resources management.

Successful leaders in OSH management strive for safety excellence through the zero accident vision approach to workplace accidents. According to Cooper (2015), effective safety leadership results in safety culture excellence globally. While global-class safety may only be attainable for the most ardent and committed, most mining companies can still realize improvements toward highest levels of safety culture and performance by implementing strategies needed to move forward (Pater, 2015). Commitment from senior managers, with a show of leadership by example, can be instrumental in creating a safe and health workplace culture and lasting program success (Pagell et al., 2016). Organizations that nurture positive safety culture understand the importance of health and safety and believe in prevention rather than dealing with consequences (Grabovac & Mustajbegović, 2015).

A safety culture facilitates safety compliance and safety involvement behavior through empowerment and belongingness. According to (Pater, 2015), a safety culture benefited organizations by influencing safety behaviors, empowering workers through safe work practices, and encouraging shared responsibility. A safety culture was a result of team values, norms, attitudes, behaviors and competencies (Hee, 2014). As posited by Kim et al. (2016), a safety culture formation was the starting point in achieving a zero accident vision and corporate sustainability.

## Occupational Safety Climate

Safety climate is one of the factors related to effective hazard management, including management of noise (Gardner et al., 2014). As defined by Gardner et al. (2014), safety climate is the workers' perception of safety in an organization at a certain point in time. The perceptions and customs can be influenced by the attitudes, values, opinions and actions of other workers in an organization. It is widely accepted among practitioners and researchers that a good safety climate results in improved safety (Leitão & Greiner, 2016). As claimed by von Thiele Schwarz, Hasson, and Tafvelin (2016), the safety climate in an organization is determined by how managers balance the relative importance of safety and productivity. Barbaranelli, Petitta, and Probst (2015), also found safety climate in mining organizations was predictive of employee safety knowledge and safety motivation. Daniels, Beesley, Cheyne, and Wimalasiri (2016), concluded safety climate is thought to influence safety because the extent to which workers value certain actions, especially from supervisors and senior managers, exerts a strong influence on intentions and motivations to perform those actions. A safety climate make workers feel comfortable with the workplace environment and induces a sense of belongingness. According to Amponsah-Tawiah and Mensah (2016), leaders within the mining sector should recognize that workers who feel safe and healthy in the performance of duties, develop emotional attachment and have a sense of obligation to their organization and are committed to the organization. Employees expect management to first think about the workers' safety and health needs by instituting good and sound policy measures (Boye Kuranchie-Mensah & Amponsah-Tawiah, 2016). Hicks, Buttigieg, and De Cieri (2016),

claimed mine leaders need to manage safety climate through management attitudes to safety, maintaining high safety standards and communication to reduce ambiguity on safety norms. Leadership style therefore is key to safety climate.

## Mine Leadership Style

Leaders use various leadership styles to change the attitudes, beliefs, values, behaviors and norms of workers to shape the safety culture of an organisation. Leadership style improves OSH activities (Herrmann & Felfe, 2014). Leaders who are concerned about their workers' safety and health influence positive safety behaviors (Collinson & Tourish, 2015). According to Collinson and Tourish (2015), leadership involves stimulating support and teamwork from a network of people and keeping people in the network motivated. Almost every organization has a strategic framework, and successful mining companies have well-defined strategies (Dobni et al., 2016). As claimed by Ferdowsian and van der Wiele (2016), leaders in the mining and quarrying industry have enhanced many of their internal programs dealing with better training, good leadership, and effective collaboration and communication through ethics and excellence. Leaders need to protect workers who point to the internal contradictions of safety procedures of the organization as answers to adaptive challenges do not reside in the executive only, but in the shared intelligence of all employees (Lawton & Páez, 2015). Lawton and Páez (2014), argued successful leaders consider training and development, communication satisfaction, performance appraisal, employee empowerment, employee motivation, team work, trust between employee and manager, employee wellness and image of the organization to be the important factors in organization development. Workers who feel

valued for their safety proactivity develop a personal bond with the organization and the leaders for continuing to make safety related enhancements (Balderson, 2016).

Successful leaders advocate for the promotion of organizational OSH initiatives anchored on workplace safety and health. Winning managers thrive for the zero harm philosophy, that suggests zero occupational injuries and illnesses for all workers and for anyone affected by a company's business (Ivensky, 2016b). Hurst and Jones (2016), concurred with Ivensky (2016b) and added leaders should speak to the importance of conceptually analysing the key concepts of a safety measurement system, such as injury or near-miss accidents to build organizational excellence. According to von Thiele Schwarz et al. (2016), managers who focus on general leadership skills show greater improvement in safety climate expectations. Therefore, management is responsible from (a) planning healthy and safely working systems, (b) examining the systems, (c) developing the education programmes, (d) creating health and safety committees, and (e) following the safety policies and arranging the action plans and the control lists (Avci & Yayli, 2014). Pitzer (2015), claimed leaders must develop capacities to take safety risk competently, rather than avoid risk effectively. Successful mine managers considered a multitude of factors in order to identify possibly risky actions and strive to reduce the risk (Jizu, Yuejiao, & Xiaoguang, 2015). As observed by Gunarathne et al. (2016), safety supervisors need to formulate, implement, control and evaluate strategies to facilitate continuous improvement.

Leaders in the mining and quarrying industry should deploy OSH strategies in line with the supporting resources at disposal and critical evaluation of the programs.

According to Spiegel (2015), in the 1990s, government authorities in Zimbabwe introduced internationally praised safety and health policies to formalize the artisanal and small-scale mining sector, using a combination of district administered and nationally administered licensing and capacity building strategies. However, implementation of the policies hit a snag because of inadequate resources and political pressure (Spiegel, 2015). Årstad and Aven (2017), posited managers need to maintain prudent policies to improve safety. OSH plans, hazard assessment, and an outline of the responsibilities of both management and employees should be defined to enhance OSH integration (Murombo, 2016). The lack of integration of OSH activities into organisations' general management is one of the main constraints on the quality of workplace prevention (García & Benavides, 2014). Successful leaders take time to reflect on what has been done, lessons learned and how to make future adjustments to get even better (G. I. Zwetsloot et al., 2017). Safety management by policy, directive and regulation is also necessary to motivate people to do the right things for injury prevention. Geller (2016), concluded the approach will not achieve an injury-free workplace on its own, other safety and health strategies are necessary.

## Strategies to Improve OSH Practice

One of the important pillars of a universal OSH strategy includes the adoption and implementation of a national preventative OSH protocol. New technologies, globalization and continuous demographic shifts have produced far-reaching changes in the world of work and new challenges for the safety and health of workers (Iavicoli, 2016). According

to Zwetsloot et al, (2017), the zero accident vision is a promising approach developed in industry, but not so much addressed by the safety science research community. Hilgert (2015), argues policy makers in the mining and quarrying industry should establish policies that are easy to adopt and take account of the occupational safety and health strategies. The policies should incorporate local miners' associations and cooperatives to build capacity to make mining regulation effective, seeking to achieve such goals as the protection of natural resources, good health and safety standards (Fuisz-Kehrbach, 2015; Hilgert, 2015; Mutemeri, Walker, Coulson, & Watson, 2016). As reported by Blair (2014), safety controls and corrective action makes effective safety strategies. A corrective action is an action taken to avoid or reduce workplace risk (Blair, 2014).

Mining and quarrying leaders should also work out policy frameworks on occupational exposure limits (OEL) for some hazards based on mines toxicity studies, not simply adopting OELs from other nations. The limits should take into account the issue of mixtures to which workers could be exposed as well as the health status of the workers (Utembe et al., 2015). Managers should develop effective interventions for accident prevention to improve occupational safety and health (Liu, Wen, Xu, & Wang, 2015). The conditions that give rise to injuries must be clearly reflected in regulatory standards, which must be communicated to workplace parties, and enforcement strategies must be implemented to identify and address non-compliance (MA, 2016).

Understanding the accident causality was a major step in pursuit to reduce workplace accidents and build an effective remedies design. Mining leaders should identify deficiencies in the safety and health standards and work to prevent common causes of

mining accidents through training programs (Zwetsloot et al, 2017). Every mine should have an effective emergency management system; everyone in the organization should know what to do in any given situation (Altınöz & Özmen, 2015). Ultimately, safety should be approached with the same mind-set as productivity, with a goal of constant improvement (Brogli, 2016; Moen, 2009). As opined by Jung and Makowsky (2014), mines corporate boards need to be focused on helping the CEO build relevant safety and health strategy, so as the OSH professionals to enhance shareholder wealth. Also, as claimed by Mohammadfam, Ghasemi, Kalatpour, and Moghimbeigi (2017), instantaneous improvement of supporting environment and employee involvement is the best strategy to reach a high proportion of safety behavior at the workplace. Mining companies should strengthen their risk reduction role by properly assessing the health consequences of their projects through an integrated Environmental Impact Assessment (Viliani, Edelstein, Buckley, Llamas, & Dar, 2017). Leaders in the mining industry need to ensure that training is developed and disseminated with consideration of various levels; individual, interpersonal, organizational, and community to promote skills (Haas & Yorio, 2016).

## Safety and Health Training

Improving workplace safety and health is key to organizational development and sustainability. Training may offer some potential in helping support learning, behaviour change and is consistent with feedback and development approaches used in BBS (Passmore et al., 2015). Safety and health training is essential for workplace safety and to be effective requires that the learned knowledge and skills are transferred to the job

(Freitas & Silva, 2017; Y. Zhang et al., 2016). As claimed by Rupprecht (2015), training is an integral part of risk management for risk identification and communication between all the stakeholders including management, technical and safety personnel, and miners.

Across the world, improving worker safety in mining is a key target. Walker (2014), argued that lack of knowledge and training is a major cause of occupational accidents especially in the mining sector. Educational safety programs are therefore required to increase peoples' knowledge by giving them a background on theories, principles and techniques for improving their future problem-solving abilities (Line & Albrechtsen, 2016). As opined by Carter (2016), training helps employees see and avoid hazards. Carter (2016), argued that a successful training program can positively impact workers' safety by giving them the tools and knowledge to use when faced with emergency. Mine leaders, therefore, need to have training systems in place to keep conscietizing employees on accident prevention (Anger et al., 2015; Walters et al., 2016b).

Although training includes content to develop skills in a variety of mineworker competencies, research and recommendations continue to specify that specific limitations in the self-escape portion of training still exist and that mineworkers need to be better prepared to respond to emergencies that could occur in the mine. According to Ivensky (2016a), the safe operation of a mine is dependent on the competence of the employees. Mine leaders need to have training systems in place to measure the competence of its managers, supervisors and miners (Ivensky, 2016a; Walker, 2014). Moyo et al. (2014), observed in Zimbabwe, training and education in OHS, enhances the development and

maturation of occupational health. Employee training, employee participation and periodic maintenance in the workplace are more important accident prevention factors than risk assessment and preventive OSH services (Yilmaz & Alp, 2016).

Globally, organizations strive for a zero accident vision through workers' education and compliance to safety and health laws and regulations. Training, risk assessment, definite responsibility, communication and dissemination of occupational health and safety results and activities remain the major influential factors towards organizational safety excellence (Mohammadfam et al., 2016). Based on results from safety and health training studies, both workers and managers benefit from quality training and the results have been observed as improved safety (Kim et al., 2016). OSH training must be understood as one of the means required to develop a safety culture that contributes to the reliability of work system and employee loyalty (Vidal-Gomel, 2017).

Leaders give workplace safety priority as it is a pillar to human life and organizational productivity. When it comes to cultivating employee loyalty and promoting workplace productivity, safety weighs even more than a generous pay-cheque or an attractive contract (Line & Albrechtsen, 2016). As claimed by Vidal-Gomel (2017), employees must understand the importance of keeping them and their colleagues safe, as work-related injuries can lead to lasting (and even life altering) physical, mental, and emotional consequences. For this reason, those in the leadership position should always offer continual safety training to employees on a regular basis to remind them of their duties and roles in advancing workplace safety (Freitas & Silva, 2017; Spies, Delport, & le Roux, 2015; Vidal-Gomel, 2017; Walker, 2014).

## Transition and Summary

In Section 1, I presented the background of the study prior to focusing on the problem and purpose statements. I then expressed the central research question and interview questions before providing an in-depth narrative of the nature of the study. The conceptual framework followed after the nature of study, through which lens I will explore the findings of this study. Subsequent was an analysis of the significance of the study focusing on both the contribution to the business practice and social change. A review of academic and professional literature then followed. The review integrated a full analysis of the existing literature on OSH and aligned it with the PDSA cycle conceptual framework highlighting the need for continuous improvement in OSH programs. The history of the PDSA cycle theory was discussed in depth with figurative expressions to support the academic literature and the scope of the study. Other relevant theories that can help answer the research question such as the Hazard Theory (HT), the Domino Safety Theory (DST), the Normal Accident Theory (NAT), the Reason Model of Human Error (RMHE) and the High Reliability Organization (HRO) Theory were considered and the PDSA cycle theory was the most suitable framework among them. An in-depth analysis of occupational hazards and strategies successful leaders employ to improve occupational safety and health was deliberated in detail, focusing on SMS, BBS, safety culture change programs, occupational safety systems in mines, technological advancement, legislative laws governing mining industries, safety culture and climate, safety and health strategies among others. The review highlighted both the positives and

negatives of the models and why OSH requires a unique approach in the mining industry. Section 2 addresses the purpose statement, the role of the researcher, participants, the research method and design, population and sampling, ethical research, data collection instruments and techniques, data organization techniques, data analysis, reliability and validity and provides an overview of Section 3.

## Section 2: The Project

In Section 2, I present the purpose statement, my role as the researcher, participants, research method and design, population sampling, ethical research data collection instruments, data collection technique, data organization technique, data analysis, the reliability and validity of the study, and transition and summary into Section 3. In this section, I present a comprehensive explanation of research methodology and research design adopted. I start this section by confirming the purpose of the study through the purpose statement. Next, I explain my role as the researcher. I also explain the way I will relate with the research participants, and justification of the selection criteria of the research population. The research method and design decisions is followed by a discussion of the population and sampling. Next, I present the ethical respects applied to the study, followed by the selections made regarding data collection instruments, data collection techniques, data organization, and data analysis methods .As opined by Cronin (2014), data collection in a multiple case study is rigorous, drawing on multiple sources of data, such as observations, documents, interviews and audiovisual materials. Furthermore, the research reliability and validity is presented. According to Catherine  Marshall and Rossman (2016), reliability and validity implement measures that ensure credibility and transferability to safeguard the integrity of the study. The PDSA cycle is the conceptual theory used in this study to explore strategies leaders in the mining and quarrying industry use to improve OSH. The PDSA cycle is the scientific method used to evaluate how leaders implement safety improvement strategies in their

organizations (Leis & Shojania, 2016). The summary and transition concludes Section 2 and transit into Section 3, where I will present the empirical evidence of the study.

## Purpose Statement

The purpose of this qualitative multiple case study was to explore the successful strategies leaders in the mining and quarrying industry deployed for improving employee occupational safety and health. The population group target consist of six mine executives at three mining and quarrying companies in Zimbabwe who successfully implemented strategies to improve employee occupational safety and health. Mining and quarrying companies may be influenced to adopt leadership strategies that reduce occupational accidents. The potential positive influence on social change includes promotion of a safety culture through knowledge sharing and training, thereby reducing accidents affecting workers' families and communities.

## Role of the Researcher

The role of the researcher for a qualitative study involves data collection, data organization, and analysis of the results (Grossoehme, 2014). The researcher performing qualitative research assumes the role of a data collection instrument (Leedy & Ormrod, 2014). Birchall (2014), posited that a researcher must be able, through interviews, documents review, audio materials and observations, to collect data that are both reliable and valid. My role as a researcher was to ensure that participants are respected and voluntarily consent to participate in the study, and avoiding bias. To preserve the purpose of the study, a researcher must always maintain ethical standards (Lewis, 2015). I also kept to the protocols of the Belmont Report (1979), to maintain ethical standards

throughout the study (Miles, Huberman, & Saldana, 2014). According to Finlay (2014), some of the strategies that help to mitigate bias in the qualitative study include reflexivity, reporting disconfirming evidence and associating oneself from the participants views. I will use an exploratory multiple case study design to relate and cooperate with participants through interviews and collect secondary data from company documents. According to Lewis (2015) and Leedy and Ormrod (2014), the researcher is part of the research instrument because the researcher decides the participants, interview questions and the manner of asking, and also has interests and ideas about the study. As a senior executive officer for the past 20 years in Zimbabwean companies, I am familiar with strategy formulation, implementation, evaluation and control. My experience was valuable to the research study because work experience and skills related to the research topic enhanced the content of the study.

According to Bailey (2014), the role of the researcher involves listening, taking notes, recording the interview and observing without asking leading questions. The researcher engages participants in a way that allows participants to express and interpret reality (Yin, 2013). I allowed participants to validate my interpretations and to confirm if the formulated interpretations reflects the participants viewpoints (Finlay, 2014). The researcher must engage interviews in a calm manner, allowing a smooth flow of proceedings (Grossoehme, 2014). I avoided being judgmental and remained unbiased. According to Catherine  Marshall and Rossman (2016), a researcher who recognizes personal views is better placed to understand and appreciate interpretations from other people. Through member checking (Harvey, 2015), I ensured participants' responses to

interview questions, observations and documentary evidence formed the source for the interpretation of the research findings.

## Participants

The purposive sample for this study was composed of six mine executives from three mining organizations in Zimbabwe that had successfully adopted and implemented OSH strategies. Sampling in qualitative research usually focuses on a small number of interviewees and relies on in-depth, detailed responses (Birchall, 2014; Catherine Marshall & Rossman, 2016). Pagell et al. (2016), argued that managers and supervisors in an organization have direct influence on occupational safety and health strategies. The participation of mine executives in the study helped answer the research question. Only employees from mining organizations that had successfully implemented OSH strategies in Zimbabwe were eligible to participate in this study. The participants had some experience in OSH strategies formulation, implementation, evaluation, and control. Among the participants were chief executive officers, mine directors, and OSH managers. I sought approval to conduct the study from the organizations before engaging the research participants. I sent letters of introduction to the targeted organizations explaining the purpose of the research, selection criteria, and benefits accrued by the organization taking part in the study. I sought IRB approval. The IRB approval number is 03-06-18-0645752. After obtaining IRB and corporate approval, I chose possible participants for interviews based on the participants' experience and skills on occupational safety and health leadership (Leedy & Ormrod, 2014; von Thiele Schwarz et al., 2016). I approached individual participants to obtain voluntary participation approval from them

(Lewis, 2015). The selection of participants was based on the assumption they practiced occupational safety and health leadership and therefore experienced to share on how to improve occupational safety and health strategies (Finlay, 2014; G. I. Zwetsloot et al., 2017).

Recruitment of participants was through an invitation letter, which I delivered in person or electronically. The invitation letter clearly spelt out the purpose of the study, individual and organizational benefits from the study as well as the voluntary nature of participation and the freedom to withdraw any time. Individual appointments with the participants were prearranged at the participants' convenience in terms of place and time for conducting the interviews (Leedy & Ormrod, 2014). I established a working relationship with participants to enable success of the study. According to Grossoehme (2014), the researcher should establish a working relationship with participants for qualitative research to be successful. Grossoehme (2014), recommended consistent communication between researcher and participants and that the researcher should as well maintain principles of the investigator's responsibility to the participants. Jamshed (2014), concurred by Grossoehme (2014), adding ethical investigation and honest responses as an important component of a qualitative multiple case study. Once a prospective participant agreed to participate in the study, I used phone calls and electronic communication as means of establishing a working relationship, allowing participants' honest responses.

## Research Method and Design

I explained and justified the choice of the research method and research design for the study in this section. The object of this study was to explore what successful strategies mine leaders in the mining and quarrying industry lack for improving employee occupational safety and health. The qualitative method and multiple case study design more adequately addressed the research question and were therefore most appropriate for the research. Qualitative researchers use an emerging qualitative approach to inquiry, collecting data from multiple sources, and analyzing the data inductively and deductively (Bailey, 2014). According to Lewis (2015), a multiple case study is more appropriate when the research question seek to explain how or why some phenomenon works and requires an in-depth analysis of the phenomenon. Addressing research method and research design in detail enhances validity of the study (Leedy & Ormrod, 2014).

### Research Method

I used a qualitative method to explore strategies mine leaders in the mining and quarrying industry use to improve safety and health. Qualitative research is an important method of enquiry researchers use to explore issues related to management and build an understanding of the phenomena from the participants' viewpoint (Gergen et al., 2015). I conducted in-depth analysis from the participants' perspective relating to OSH, and used interviews, observations, documents, and audio materials as the methodology tools. Quantitative researchers use statistical data to test a theory or examine causal interactions (Onen, 2016). Quantitative research methods answer the how much, how many type of questions (Leedy & Ormrod, 2014), and were not appropriate for this study. Mixed-

methods research involves the collection of both quantitative and qualitative data to study a phenomenon (Halcomb & Hickman, 2015). The mixed method is most useful when one method does not provide a complete understanding of the study (Abro et al., 2015). A mixed methods approach was not appropriate because only the qualitative phase of the study would be relevant and the quantitative phase would not assist in answering the research question (Lewis, 2015). In this study, the qualitative method more adequately addressed the research question and was therefore most appropriate. Accordingly, I did not pick a quantitative or mixed methods research design for the study as the multiple case study research design is appropriate because it enables the in-depth study of the organizations' occupational safety and health leadership strategies at different locations (Cronin, 2014; Sarma, 2015).

**Research Design**

The research design most appropriate for the study was a multiple case study. I used a multiple case study research design for this study because this design is suitable for the exploration of a particular phenomenon and enables the investigation and description of the phenomenon within a particular contemporary context (Sarma, 2015). Although single case studies can yield invaluable insights, most multiple case study designs are likely to be stronger than single case study designs (Lewis, 2015). I examined the phenomenon under exploration through a selection of lenses that allowed for discovering and understanding multiple facets of the phenomenon (Bailey, 2014; Birchall, 2014). Accordingly, I studied the issue under investigation through a selection of lenses that allowed for discovering and understanding multiple aspects (Grossoehme,

2014). Because multiple-case studies are rich in information gathered from multiple data sources, they can give insight into phenomena that a researcher cannot get in any other way of the phenomenon (Cronin, 2014; Gergen et al., 2015). A multiple-case study design was an exceptional fit for the study because the exploration of safety and health strategies requires information derived from multiple data sources. Other qualitative designs include phenomenology, ethnography, and grounded theory (Bailey, 2014; Sarma, 2015). In phenomenology, researchers collect data primarily through interviews (Grossoehme, 2014), likely weakening the ideal depth and scope of exploration for the study. In this research, observations and document reviews were critical to achieve the research purpose; thus phenomenological design was a less suitable alternative. Ethnography centers on extended cultural theory test (Green et al., 2015), which was not the focus of this study. Grounded theory design centers on theory derivation from field data collection (Corbin & Strauss, 2014). Since the purpose of this study was to explore the rich case data and not to build theory, grounded theory was not suitable.

## Population and Sampling

The population for the study was made up of mine leaders of three mining organizations in Zimbabwe. Six mine executives made up the research sample because organizational strategies are crafted, implemented, and controlled by managers (Fusch & Ness, 2015). Among the participants were Chief Executive Officers, mine directors, and OSH managers. I employed purposive sampling to recruit participants with appropriate knowledge and skills. Purposive sampling allows identification of participants who are most likely to provide information required for meaningful understanding of phenomena

(Finlay, 2014; Catherine Marshall & Rossman, 2016). The Matabeleland and Mashonaland Central regions of Zimbabwe were the geographic location for the study I chose these two regions because the regions comprise of some of the most successful mining activities in Zimbabwe in terms of occupational safety and health as documented by NSSA, (2014).

I used homogeneous sampling technique to find and recruit study participants. In homogeneous sampling, a researcher purposively picks participants from various groups, who have alike characteristics to ensure the exploration of a multiplicity of perspectives regarding the phenomenon (Catherine Marshall & Rossman, 2016). The homogeneous sampling technique was most appropriate for the study as only leaders who were involved in promoting occupational safety and health strategies had the knowledge and experience under study (Yin, 2013). I determined a suitable sample size for the study in line with the number of participant organizations (i.e., mining organizations that had successfully implemented OSH strategies in Zimbabwe mining industry) and the required number of participants per organization. According to Bailey (2014), a large sample is not necessary to attain balance and attention to detail during the conduct of a qualitative case study. At least two participants per company were enough to ensure the achievement of a suitable depth and diversity of perspectives in qualitative research (Bailey, 2014; B. Marshall, Cardon, Poddar, & Fontenot, 2013; Yin, 2013). The selection of prospective participants was based on the trust they were involved in formulation and implementation of occupational safety and health strategies (von Thiele Schwarz et al., 2016).

The selection of participants was based on the participants' knowledge and experience in managing occupational safety and health initiatives (Finlay, 2014). I allowed participants to establish location of choice. The approach allowed for open and honest communication and responses to the interview questions (Grossoehme, 2014). I interviewed 6 participants from three mining sites in Zimbabwe, each site contributing two participants. Only participants deemed to possess distinctive insights were interviewed to reduce excessive homogeneity of the sample, which weakens transferability of research findings (Lewis, 2015; Rossetto, 2014). The selection of the research sample of 6 participants was centered on the advice of qualitative research methodologists such as Morse (as cited in Marshall, Cardon, Paddar, and Fontenot, 2013), who recommended four to 10 participants. Data saturation was reached when all evidence was gathered and no new evidence could be collected from further interviews (Leedy & Ormrod, 2014). I achieved saturation after interviewing fifth participant. No material insights were revealed from further interviews. I followed the method adopted by B. Marshall et al. (2013), who continued adding new interviewees to the sample during the study to achieve data saturation. Each face-to-face interview, consisted of seven open-ended questions, and lasted between 30 and 60 minutes.

## Ethical Research

Researchers have an ethical duty to protect study participants from harm, protecting participants' confidentiality, gain the trust of participants, guarantee the research integrity, and obtain participants' voluntary consent before they participate in the study (Knepp, 2014; Leedy & Ormrod, 2014; Rowley, 2012). I explained the

voluntary nature and purpose of the study to prospective participants as well as the risks and benefits and asked participants to voluntarily consent to take part in the study (Rossetto, 2014). There were no incentives or rewards for participating in the study (B. Marshall et al., 2013). Participants were free to withdraw from the study at any time without any costs or penalties (Rowley, 2012). Participants only needed to inform the researcher of their intention to withdraw from the study and the researcher would accept without any explanations. Prospective study participants signed a consent form confirming their preparedness to participate in the study and were free to ask any questions pertaining to the study. I provided the participants with the consent form and collected it from the participants after consent signature. In the consent form, I explained the: (a) purpose and nature of the study, (b) sponsoring organization, (c) associated risks, (d) voluntary nature of the study, (e) freedom to withdraw from the study at any time, and (f) contact details. I also advised participants that no individual or company names would be mentioned during and after the study (Rowley, 2012).

During data analysis, block quotation were not used and the thematic approach was preferred (Leedy & Ormrod, 2014). Each participant was assigned a code for easy of referring and identification while at the same time concealing participants identities. Participants were coded Participant 01, Participant 02, and so forth in the transcripts and interview papers. The identification inscriptions in the interview data were removed before safe keeping to ensure participants' confidentiality was protected (Leedy & Ormrod, 2014; Rowley, 2012). The data collected during the interviews were secured on a password-protected electronic device and hard copies. The electronic device and the

hard copies of the transcription forms will be kept in a locked cabinet at the researcher's home for no less than five years (Rossetto, 2014). Thereafter, the researcher will destroy the data by re-formatting the storage device and shredding the hard copies. I completed the National Institutes of Health Office of Extramural Research training program and received the certification required to engage in research concerning human research participants. The certification number is 2072742. I also sought approval from Walden University Institutional Review Board (IRB) for academic standards and ethics in research before conducting the study. The approval number is 03-06-18-0645752.

## Data Collection Instruments

In this section, the choices made regarding, data collection techniques, the research instruments and data organization are presented before the data collection exercise. The researcher was the primary data collection instrument (Yin, 2013). As the principal data collection instrument, I collected data using semi-structured interviews and company documents as research instruments. Interviews allowed the speech, moods, feelings and expression to be captured and offered a deeper understanding of the problem under investigation (Knepp, 2014; Rossetto, 2014; Rowley, 2012). Interviews and company documents also enable the researchers make an interpretation of what they see, hear, and understand in a holistic manner (Rossetto, 2014). Following IRB approval, I contacted prospective participants using emails with details of the proposed study and the consent form. The prospective participants who agreed to participate signed the informed consent form and I collected the form from each willing participant. I planned interviews for a time, date, and location jointly agreed upon with each agreeable participant. A semi-

structured interview procedure comprising of seven open-ended questions formed the source of the interview process and each interview lasted 30-60 minutes.

The use of the interview procedure ensured that study participants offer answers to the same issues in a similar way (Leedy & Ormrod, 2014). Participants in the research pronounced their knowledge and experiences with OSH implementation strategies. I conducted the interviews using seven open-ended questions covering research participants' experiences and views of OSH implementation strategies. Information from company documents and observations supplemented the interviews in line with Rowley (2012)'s recommendation of data triangulating from various sources to ensure research reliability. Semi-structured interviews were more appropriate because they enabled the researcher to discuss main issues and follow-up questions to clarify facts and emerging themes (Leedy & Ormrod, 2014; B. Marshall et al., 2013). Company documents included policy documents, company reports, as well as OSH application guidelines. I used an observational procedure to note participants' mannerisms as the participants responded to the interview questions, workplace environments, as well as workplace activities. The main reason of using this approach was to understand the strategies mining organizations use to implement OSH.

I also employed the multiple interactive interview approach. The multiple interactive interview approach encompasses calling the same study participant many times during the study to try to find explanation on matters raised in the interview transcripts or in documents made available to the researcher to supplement the interview evidence (Rowley, 2012). Participants' feedback during the research process was critical

because feedback assisted refining validity by asking the participants to validate the researcher's interview transcription and interpretation of the participants' responses (Finlay, 2014). According to Harvey (2015), member checking or feedback from participants bring validity and reliability to qualitative data and reduces the possibility of participants claiming the researcher misunderstood the information provided by the interviewees. Additionally, participant feedback provided chances for the researcher to pursue explanation on what certain information means, allowing for further information collection, providing participants with the chance to confirm the correctness of data, and finally, enabled participants to assist form research conclusions (Harvey, 2015).Despite the benefits of participants feedback presented, there are also possible weaknesses of the member checking approach. The possible weakness of member checking is some interviewees might try to please the researcher by approving the researcher's defective analyses (Leedy & Ormrod, 2014). Rowley (2012), concluded that cross-case validation of findings with the enquiry group mitigates against participants who try to make happy the researcher by approving defective summary and conclusions of the researcher. Data and methods triangulation was done to produce new information that was included into research findings. Evidence from various participants was contrasted in the data triangulation process to enhance validity and reliability of the study (Leedy & Ormrod, 2014). Research validity and reliability was improved by contrasting the research evidence against similar findings and conclusions from the literature (Lewis, 2015).

## Data Collection Technique

I collected data using the semi-structured interview tool, company documents and audio recording material. Interviews was the core base for data collection because it captures the voice, experiences, and body expressions (Finlay, 2014). Interviews are a kindlier tool compared to most other data collection techniques because in interviews the researcher and participant engages in mutually beneficial discussion (Finlay, 2014). I used open-ended questions allowing participants to describe with nuance and detail how they perceive the concept under study (Tran, Porcher, Tran, & Ravaud, 2016). I scheduled interviews for a date, time, and place jointly agreed upon with the participant (Rowley, 2012). Each interview lasted 30 to 60 minutes. The interview format was in the form of semi-structured questions and audio recording following an interview procedure (Rossetto, 2014; Rowley, 2012; Yin, 2013). Semi-structured interviews let participants provide in-depth responses. The use of the interview procedure guaranteed that I ask similar questions in the same order to all participants (Leedy & Ormrod, 2014).

Data were extracted from company documents and interview observations using an observational procedure. The data extracted from company records enhanced the interview data. Company documents included annual reports, policy documents, and OSH procedure manuals. According to Leedy and Ormrod (2014), the use of multiple data sources in a qualitative research enhances the study reliability and validity. I sought the participants' permission to audio-record the interviews. After obtaining permission from the participants, I audio-recorded the interviews in addition to taking notes on observations during each interview. I recorded the interviews verbatim before

transcribing the interviews at the end of each interview. Audio recording the interviews enabled the researcher to listen to participants' confirmation repeatedly to enrich the researcher's comprehension and to simplify the data transcription process.(B. Marshall et al., 2013; Rossetto, 2014). According to Rowley (2012), audio recording the interviews allowed detailed analysis of the participants' responses and the ability to quote statements verbatim. I used an interview protocol and made sure that all participants provide answers in the same order to one question at a time. Despite following the interview protocol, participants were allowed to express their viewpoints freely (Rowley, 2012).

I maintained a neutral position during and after the interviews. Maintaining an impartial position and expression when asking questions or taking notes is an important and critical part of the interview protocol (Leedy & Ormrod, 2014). I remained in control of the interview process, keeping track of time. Remaining in control of the interview progression assisted avoid idleness and enhanced effectiveness (Rossetto, 2014). Cross-case validation and member checking were used simultaneously by looking for clarification of participants' perspective from within the same company and also from other participating companies to ascertain the reality of evidence captured during the data gathering process (Leedy & Ormrod, 2014). I used the member checking technique to enrich the reliability and credibility of data (Elo et al., 2014; Rossetto, 2014; Rowley, 2012) and the correctness of interpreted meanings through participant review and feedback (Finlay, 2014; Harvey, 2015).

## Data Organization Technique

Data obtained from interview participants was kept confidential. According to Crittenden and Hill (1971), a researcher can maintain participants confidentiality by using a coding system. For this study, I used alphanumeric codes to hide the names and identities of the participants. I audio recorded all interviews and saved the data in a password-protected computer file and also kept a copy saved in an electronic external drive as a back-up copy as advised by Rowley (2012). After the interviews, I also transcribed the recorded interviews verbatim into written form, which I kept in singular files for each participant on a password-protected computer file for safety and confidentiality reasons. In addition, I used the NVivo software to analyze and store the transcribed data. NVivo is a data analysis software package designed for qualitative researchers working with rich data, where in-depth analysis of data is essential (Salmona & Kaczynski, 2016). Data recordings and transcripts were kept in a locked safe at the researcher's place of residence for not less than five years. After the expiry of five years, the manual transcripts and other material used during the study will be destroyed by shredding and re-formatting.

## Data Analysis

In qualitative research, the purpose of data analysis is to reveal themes that answer a central research question (Yin, 2013). In this study, data analysis followed the method described by Leedy and Ormrod (2014), which involves (a) editing, (b) cross-member checking (c) classification, (d) coding, (e) interpretations, and (f) conclusions. Transcript editing and cross-member checking involved examining the collected data to

identify errors and exclusions and, where necessary, consulting the participants for clarification (Leedy & Ormrod, 2014). Classification involved assembling data into categories based on themes (Lewis, 2015). Coding involved allocating numbers, and color codes to participants' responses to limit the number of groups (Finlay, 2014). Data interpretation then followed. According to Leedy and Ormrod (2014), interpretation of the data involved the researcher giving meaning to the data and verifying the interpretation with some of the participants to guarantee accuracy. The final step in data analysis was the conclusion. Conclusions refer to developing a sequence of statements that organize the data analysis around the study's central research question (Yin, 2013).

Interview transcripts had margins for the researcher to take notes of emerging themes. Transcripts were analyzed item-by-item including the emerging themes to avoid omission of evidence. The thematic data analysis approach was used because it involves the identification of concepts in the text contrary to content analysis which depend on specific words identification in the scripts (Miles & Huberman, 2015). The thematic analysis approach allowed me to search for sets of words as they relate to a particular concept as opposed to content analysis where the meaning of a concept can be stated in different words (Fusch & Ness, 2015). As stressed by Leedy and Ormrod (2014), thematic analysis allowed the researcher to check and organize data in terms of frequent themes, then the researcher was able to draw meaning from the analysis.

After analyzing all interview transcripts, I assembled themes and where necessary, combine the themes to give complete data analysis. I used NVivo software in performing data analysis functions. NVivo is a software package that aids with

qualitative data analysis. NVivo reduces strenuous tasks such as making codebooks and sorting and arranging of data and assist in aligning the composed data with previous literature; additionally, the program easily links documents, so a theme can be traced through different participants replies (Paulus, Woods, Atkins, & Macklin, 2017). I used color coding to classify recurring themes. I modified the transcripts themes in line with the audio-recorded material to get a holistic analysis of the data (Leedy & Ormrod, 2014). I grouped the themes and meanings according to identity and interpreted the data using the thematic analysis approach (Miles & Huberman, 2015). The themes and meanings obtained from initial cross-member checking and cross-case validation were used to form a complete interpretation of the data (Harvey, 2015). Both the researcher and the participants were involved in the data analysis and interpretation process in a participatory way. An interactive form of feedback between the researcher and the participants solidified the validity of data. According to Harvey (2015), participatory analysis and interpretation was based on the researcher's appreciation and the reality of participants. Both the deductive and inductive reasoning processes were used to interpret data.

Finally, I developed a conclusion based on the analysis and interpretation of the data. The conclusion involved developing a series of statements that organize the data analysis around the study's research question (Yin, 2013). Concluding themes and patterns derived from the central research question were fundamental to understanding the findings of a qualitative research study (Elo et al., 2014). I analyzed data through the lens of Moen's (2009) plan, do, study, act (PDSA) framework to accept richly detailed

evidence in priority to evidence which was not adequately described. The use of this model, together with data coding aided data transcription and analysis which helped in interpreting the meaning of data assembled to research conclusion. By examining OSH improvement strategies through the lens of Moen's (2009) PDSA cycle, I compared the data collected with a well-known model relevant to the phenomenon

## Reliability and Validity

According to Lewis (2015), researchers must assess the rigor of qualitative research using reliability and validity as the assessment criterion. To validate academic rigor, this research clearly explained the research design and research methods pronouncing processes in a step-by-step approach for the benefit of the readers and other scholars (Leedy & Ormrod, 2014). The reliability and validity of the research will help other researchers to examine the research process to establish if the same results could be found if the study was to be repeated (Grossoehme, 2014).

### Reliability

Reliability refers to the level of truth of a study obtained by assessing the completeness of data collection methods, sources of data, data analysis and interpretation anchored on literature sources (Lewis, 2015). I clarified the research methods step-by-step to allow other scholars and readers to trail the same steps and confirm similar interpretation (Grossoehme, 2014).

Confirmability refers to the criteria for assessing the correctness and rationality of the findings obtained from the data and observation of the participants (Catherine

Marshall & Rossman, 2014). As stated by Grossoehme (2014), the confirmability of a research depended on the detailed nature of the sample and research methods employed and the inspection track of the research process. I kept a record of the interview process containing decisions made in the field of inquiry relating to real experiences, and choices. (Lincoln & Guba, 1985). Lewis (2015), stressed confirmability is enhanced by using block quotations in reporting evidence as the evidence can be confirmed through repeated or similar research. The intention was to confirm that data collected answers the research question and research findings are supported by the evidence (Leedy & Ormrod, 2014).

As stated by Elo et al. (2014), dependability refers to how reliable the data were and was often compared to the concept of reliability. The dependability of a study centers on comprehensive explanations and validations of the study sample. I used techniques such as member-checking and cross-case validation to ensure the findings stated were a true reflection of the meaning of the studied phenomena (Finlay, 2014; Harvey, 2015). I used data triangulation using the various data sources to gain a deeper understanding of how to improve occupational safety and health in the mining and quarrying industry. Data triangulation, member checking and audio recordings of the interviews captured people's experiences and beliefs thereby authenticating participants' views (Harvey, 2015). In addition, confidence in the accuracy of the results was established by using participants' feedback to validate and approve facts and interpretations (Elo et al., 2014).

**Validity**

I evaluated the methodology of the study to establish the appropriateness of the data collection tools that I used for the level of authenticity required for the study (Miles

& Huberman, 2015). I also assessed the interview questions to establish if the questions exploited the chances of ascertaining the full details of the phenomenon under study (Finlay, 2014). In addition, I assessed the level to which the interview questions make the detail required for answering the central research question (Rowley, 2012)

According to Miles and Huberman (2015), transferability refers to assumptions on the possible applicability of findings to other circumstances under similar, but not identical, circumstances. Bailey (2014), stressed that transferability is enhanced by systematic sampling, triangulation and process audit among other criterion. In this study, a purposive sample was selected to explore the strategies that mine leaders lack to improve occupational safety and health. The rigorous explanations of processes were noted and the step-by-step explanation of the research methods enabled the replication of the research by other scholars (Finfgeld-Connett, 2010).

Creditability refers to whether the findings are correct and reliable from the viewpoints of the researcher, the participants, and the reader (Lincoln & Guba, 1985). According to Cope (2014), creditability is the truth in-built in the data and enriched by the accuracy of the researcher's established interpretation. To maintain creditability, I used the data triangulation methods to assure readers the results are backed by the data (Leedy & Ormrod, 2014) and to ensure the certainty of the evidence provided in interviews by validating evidence provided by executives in the same company and in other companies under study (Cope, 2014). Finally, I separated biases and presumptions which should not interfere with research evidence by relying only on audio-recorded evidence and interview transcripts as research evidence in expressing the results of the

study outcomes (Finlay, 2014). Also, I engaged procedures to report disconfirming evidence so as to support the validity of the study (Leedy & Ormrod, 2014). As posited by Grossoehme (2014), disconfirming evidence is a qualitative validation technique whereby data that presents a perspective opposing to the one shown by the established evidence is also reported.

I continued conducting interviews until no new information or themes were observed in the data, in which case saturation was reached. The aim was to gather enough data to adequately saturate the model (Fusch & Ness, 2015). I achieved saturation by interviewing additional participants, until no material insights were revealed from further interviews. I followed the method adopted by (B. Marshall et al., 2013), who continued adding new interviewees to the sample during the study to achieve data saturation. Tran et al. (2016), stressed data saturation in qualitative research is an important tool to ensure adequate and quality data are collected to support the study.

## Transition and Summary

In section 2, I prepared for the data collection, data analysis and data interpretation. I clarified the role of the researcher, and the research instruments. Semi-structured interviews formed the basis of the study. I selected the research sample and explained the data collection tools and data collection procedures. I obtained the Institutional Review Board approval before the data collection began. The data collection method was followed by data analysis, data interpretation, and secure storage of the data. In this section, a qualitative multiple case study approach based on a case study research design that answered the research question was adopted. Semi-structured interviews were

conducted at three mining sites in two provinces in Zimbabwe. Six participants were interviewed to gather evidence on what successful strategies mine leaders employ to improve occupational safety and health. The participants consisted of mine executives. In section 3, I presented and deliberated the outcomes of the empirical study.

Section 3: Application to Professional Practice and Implications for Change

## Introduction

My purpose in this qualitative multiple case study was to explore the successful strategies that leaders in the mining and quarrying industry deployed for improving employee occupational safety and health. The findings and recommendations from this study provide a compilation of strategies leaders in mining and quarrying industry could use for successful OSH implementation. Furthermore, the research results inform professional practice by exceeding legal compliance, by advocating for voluntary awareness, and having adequate information about each task before, during, and after task-execution.

The following themes emerged from the analysis of data: organizational culture, strategic leadership, compliance to rules and regulations, hazards and risk management, planning, accident prevention, and documentation of safety procedures. Research findings indicate that business leaders are in control of workplace safety and health. Business leaders therefore, should craft and implement strategies to improve workplace safety and health.

The findings from this study, examined in light of PDSA cycle theory, confirm that workplace safety and health initiatives need to be continuously improved to avoid occupational accidents. The research findings support the PDSA framework by underscoring (a) planning jobs or tasks following the laid down OSH procedures, (b) executing the job plan, (c) studying the executed plan, and (d) taking remedial action on

what is learned. Safety and health leaders were introduced to a PDSA framework to guide business leaders in creating a safe and health workplace.

## Presentation of the Findings

The overarching research question was: What successful strategies do leaders in the mining and quarrying industry use to improve employee occupational safety and health in Zimbabwe? I conducted this study to assist safety and health leaders develop more sustainable accident prevention strategies to successfully implement OSH interventions, thereby benefitting from the accident reduction and increased productivity and workers' welfare. Based on in-depth interviews and organizations' documents, the study consisted of identifying strategies mining and quarrying leaders use to successfully implement OSH interventions. I used a purposive sample of six mining and quarrying leaders from three mining and quarrying companies in Zimbabwe that have successfully implemented OSH strategies.

Data saturation was reached when themes began to recur and this happened from the fourth interview until the sixth interview. As opined by Fusch and Ness (2015), data saturation is reached when themes begin to recur and there are no new insights or coding from additional interviews. The research sites were assigned anonymous codes A, B, and C. Two participants were interviewed from each site. Participants from company A were assigned anonymous codes A01 and A02, and participants from company B were assigned anonymous codes from B03 and B04, and participants from company C were assigned anonymous codes C5 and C6. In this study, interviews with participants from the three companies helped bring out some of the strategies used by mining and quarrying

leaders to successfully implement OSH interventions. The interviews were semi-structured to allow coverage of the main issues of concern with each participant while allowing the flexibility to probe for more details and enable the participants to contribute any other significant information. I asked questions aimed at determining the strategies mining and quarrying leaders use to implement OSH. I planned to interview six participants from three participating mining and quarrying companies, with two participants from each company. The questions proved to be straightforward and easy to comprehend by the participants; therefore, I was assured of the alignment of the study and research instrument with experiences of the mining and quarrying leaders.

After completion of the data collection, I transcribed the recorded interviews and imported the transcriptions into NVivo 11 for coding. I used the main topics from the interview protocol to come up with the coding schema (NVivo nodes). Using NVivo 11, I coded pertinent information from all six transcribed interviews to a suitable node. As the coding advanced, it was necessary to put together, modify or increase nodes in line with the findings. The resulting dataset comprised all extracted data from the interviews, organized by main themes and subthemes relevant to the research question of the study. Table 1 provides the resulting key themes and subthemes. In the following sections, I will describe the research findings derived from the themes verbatim with direct quotations from the interviews where necessary to demonstrate the themes from the participants' point of view. The order of reporting the themes is not ranked by importance, but simply an analytical approach to presenting the results of the study.

Table 1

*Major Themes and Subthemes*

| Major themes | Subthemes |
|---|---|
| Organizational culture | Values, beliefs, and behaviors. |
| Strategic leadership | Corporate social responsibility. |
| | Implementation strategies used. |
| | Communication. |
| | Organizational preparedness. |
| Compliance to rules and regulations | OSH code of practice. |
| Hazards and risk management | Health risks. |
| Planning, organizing, and control | |
| Accident prevention | Strategies to improve OSH practice. |
| | Zero accident vision. |
| | Training and development. |
| Documentation of safety procedures | |

**Emergent Theme 1: Organizational Culture**

The major contributing factors to the establishment of a workplace safety culture were: stakeholder support, leadership commitment, team work, and implementation of a recognized safety management system (Hee, 2014). Participants A01 and A02 both from company A emphasized the need for international standardization of processes as

enshrined in the International Standards Organization (ISO) procedures. ISO standards were recommended as the best standards. Participant A01 encouraged leaders in the mining and quarrying industry to adopt ISO standards because they help simplify OSH processes through standardized documentation, and continuous improvement (A01, Personal Communication, March 9, 2018).

Participant B02 from company B concurred by saying:

> We obtained ISO certification on two ISO standards in OSH and this was a great achievement to support our OSH improvement strategies (B02, Personal Communication, March 12, 2018).

All participants from companies A, B, and C highlighted their companies' culture was anchored on standardized processes, procedures, supervision and continuous improvement. As posited by Grabovac and Mustajbegović (2015), organizations that nurture positive safety culture understand the importance of health and safety and believe in prevention rather than dealing with consequences.

A safe organizational culture is centered on leadership commitment and workers' team work. Cooper (2015), opined a company's safety culture is driven by the executive leadership team that creates, cultivates and sustains a company's journey to safety excellence. As posited by Lu and Chen (2015), the construction of a people-oriented safety culture is the key method to strengthen miners' rule-following behavior and decrease the probability of accidents in mines. Participants A02, B01, C01, and C02 consented on team work, and implementation of a recognized safety management system being influential in creating safety values, beliefs, and behaviors. Participant A01

described safety culture as: the way we do things here (A01, Personal Communication, March 9, 2018).

Participant B02 highlighted:

> Our company culture is vested in our shared values beliefs and behaviours (B02, personal communication, March 12, 2018). The concept of safety culture relies on shared values, norms, behaviours, and shared knowledge (Zivkovic & Ivanova, 2016). Furthermore, Participant A01 argued, safety culture change programs were the base for OSH culture.

Participant C02 concurred with Participant A01 and added:

> Organizational safety climate also stands as a pillar for OSH excellence (C02, Personal Communication, March 13, 2018). It is widely accepted among practitioners and researchers that a good safety climate results in improved safety and health (Leitão & Greiner, 2016).

Commitment from organizational leaders, with a show of leadership by example, can be instrumental in creating a safe and health workplace culture and lasting program success (Pagell et al., 2016). Participant B02 posited, leadership commitment is key to achieving workplace safety and health excellence. Senior management leadership and commitment to safety are critical factors in setting a goal to attain world-class performance and developing the culture needed to achieve the goal (Jahn, 2016; Johnson et al., 2016). Cooper (2015), opined a company's safety culture is driven by the executive leadership team that creates, cultivates and sustains a company's journey to safety excellence. Participant A02 reiterated:

> Safety and health is everyone's responsibility within our organization (A02, Personal Communication, March 9, 2018). A culture of safety is a fundamental building block in safety management (Chu et al., 2016). Leaders need to construct a safety culture that will not collapse under the pressure of quick fixes but a culture of excellence (Saujani, 2016).

**Subtheme: Shared values, beliefs, and behaviors.** All Participants from companies A, B, and C described their OSH culture as a product of shared norms, beliefs, values, traditions, operating style and internal workplace environment. **S**hared values, norms, beliefs and behaviors emerged as a dominant subtheme with all participants indicating that this was a critical success factor for OSH implementation and control. Participants noted shared values, beliefs, and behaviors as important during the construction of an effective OSH management system.

Participant B02 stated:

> Our company culture is vested in our shared values beliefs and behaviours (B02, Personal Communication, March 9, 2018). Participants A01, A02, B01, C01, and C02 indicated that shared values, norms, beliefs, and behaviours interweaves their company OSH culture and distinguishes their companies in the way they perceive safety and health at workplace.

Participant A01 defined safety culture as: the way we do things here (A01, Personal Communication, March 9, 2018).

Participant C02 opined: it is the pillar of OSH strategic planning (C02, Personal Communication, March 13, 2018). The strength of a company's safety performance lies

within the strength of its safety culture (Ali & Shariff, 2016b). Ivensky (2016b) concurred with Ali and Shariff (2016a) and added if culture is to yield sustainable results, it must be integrated wholly and firmly within core line management instruments and the fundamental tasks of human resources management.

**Emergent Theme 2: Strategic Leadership**

The way leaders lead and the type of leadership they adopt was an overriding theme in my study. Transformational leadership emerged to be the commonly adopted style in all the three companies.

Participant A01 stated:

Transformational culture and transformational leadership are the major strengths for our success in safety excellence. We are committed to our safety policies and procedures and ensure every worker's safety and health is our priority. Despite having OSH procedure manuals, we lead by example by walking the talk (A01, Personal Communication, March 9, 2018).

Participant A02 concurred and added:

> Communication at all levels instils confidence and trust within our ranks. Our safety and health guidelines are dynamic and properly fit into the prevailing situations. Our continuous risk identification, assessment and accident prevention measures allow us to have an accident free workplace. As you could have noticed, we had no occupational accidents occurring in our company for the past seven

> years. We are really proud of this as we owe it to team work, loyalty, and continuous process improvement. Our transformational leadership style has risen our safety and health flag high. (A02, Personal Communication, March 9, 2018)

Participants B01 and B02 both from company B had this to say:

> The strong relationship between leaders and followers binds together our safety and health transformation process. Our safety processes are dynamic and encourages workers comply beyond expectation. Our strength relies on intrinsic motivation and development of our workers' safety as we strive to improve the performance of workers and develop employees to their fullest potential. As leaders, we need to be safety champions; simply being quiet leads to negative consequences. (B01, Personal Communication, March 12, 2018).
>
> Our senior executives personally lead effort to align safety, health, and environment with the overall business strategy. Our leadership style transforms people. It enables a safe and healthy working environment based on trust. Our safety policy is not only about compliance but also assessing employees' motives and satisfying their needs. Our main objective is to ensure that workers perform their duties under strict health and safety standards. Everyone owns safety in our company. Continuous process improvement is key to our safety and health success (B02, Personal Communication, March 12, 2018).

Leadership style remained a key issue among all research participants.

Participant C01 had this to say:

> Our leaders empower employees and nurture them in safety awareness changes. We attempt to educate individuals and to get them to transcend self-interest for the sake of other employees. We had no accidents in recent years. We contribute this to our culture of collectiveness in which employees are empowered and encouraged to freely discuss safety and health issues that affect their workplace (C01, Personal Communication, March 13, 2018).

Participant C02 concurred and added:

> Our leaders are strong role models. We respect our moral values and a self-determined sense of identity. We listen to opposing views and encourage a spirit of cooperation at all levels. Our workers want to emulate their superiors because the superiors are committed to workers' safety and health issues. (C02, Personal Communication, March 13, 2018)

All participants' assertions were in line with Herrmann and Felfe's (2014) observation. Herrmann and Felfe (2014), observed that leadership styles shape the safety culture of an organisation and improves OSH activities. Also, Collinson and Tourish (2015), observed leaders who are concerned about their workers' safety and health influence positive safety behaviors.

Based on the results of the study, safety leaders make decisions on the jobs to be done, how the jobs should be done, the time jobs should be undertaken, the person to perform the job, and the safety procedures to be followed. In addition, the research findings indicate safety leaders decide people who should work at work stations, their qualification, experience, and skills. In addition the research findings indicate safety

leaders train workers on OSH issues including workplace hazards identification and risk assessment. Furthermore, the research findings extend the literature by demonstrating safety leaders control job activities and the workplace environment thereby enabling a strong safety culture. A strong safety culture allows managers to make practical regulations that emphasize a harmonious relationship between humans and nature, and strengthen miners' awareness of mine safety (Chu et al., 2016). Research participants confirmed, safety culture, safety climate, and leadership style determined the safety leaders' ability to make decisions. The empirical evidence from this study further shows; leadership was the pivot of workplace safety and health supported by other company stakeholders. As observed by Zwetsloot et al. (2017), leaders control workplace safety initiatives, and this was confirmed by the results of this study.

**Subtheme 1: Corporate social responsibility (CSR).** Five out of six participants agreed that CSR was influential in their safety and health programs. Participant A01 stated:

> Our company is accountable for the social and environmental consequences of our operations. Our CSR initiatives are interlinked with safety and health policies. We live in harmony with our communities because we plough back to them dividends of our profits through CSR programs (A01, Personal Communication, March 9, 2018).

Participant A02 concurred and had this to say:

> CSR influences development of OSH management and particularly contribute to developing strategies that improve OSH but also foster innovation. Despite the fact that we had no accidents happening in recent times, CSR initiatives put together our company relationship with the communities in which we operate. As a result of the bond between us and the communities, the hazardous nature of our mining activities is welcome by the communities. Communities are now willing to take part in our safety and health initiatives (A02, Personal Communication, March 9, 2018).

Participants B01 and B02 agreed with A01 and A02's assertions. Participant C02 concurred and stated:

> Implementing CSR related programs positively influence job satisfaction and quality of working life. For example, our community safety awareness program that we held two years ago yielded immense results in preventing domestic accidents in the communities (C02, Personal Communication, March 13, 2018)

Participant C01 did not see CSR as an important initiative and had this to say:

> The journey to CSR is not clear-cut. CSR programs are intended to suit company objectives and align with the business, but this causes a scenario of dependency rather than assisting the communities to help themselves (C01, Personal Communication, March 13, 2018).

Literature support that apart from looking after the safety and health of employees, mining leaders need to maintain positive relations with mining communities though CSR initiatives (Suopajärvi et al., 2016). As observed byGunarathne et al. (2016), safety and

health strategies are interwoven with the company's CSR sustainability drive. The current world trend is the use of sustainable development theory to propose a new dimensioning of CSR composed of economic, social and environmental aspects including safety and health at workplace (Sharma & Bhatnagar, 2015).

**Subtheme 2: Implementation of safety and health strategies.** Questions two, three, four, five and six were directly related to the overarching research question, and it was from responses to these questions that subtheme 2 under theme 2 emerged as a dominant subtheme. All Participants concurred business leaders can craft good safety and health strategies but needs an effective implementation plan to drive the whole process. The success of a strategy is in its implementation (Qian & Lin, 2016). However, some participants observed the future of workplace safety and health goes beyond implementing more rules and regulations, and compliance standards. Some Participants felt safety culture and performance benchmarking should be given priority.

All Participants agreed implementation closes the gap between theory and practice, and enables management goal focus. The driving force behind every strategy is the manner in which it was executed (Zwetsloot et al., 2017). While participants were from three different companies, it was evident that implementation strategies cut across the organizational divide as evidenced in table 2.

Table 2

*Implementation Strategies Adopted*

| Response | Respondents | |
|---|---|---|
| | Number | % |
| User involvement in choice of OSH system | 6 | 100 |
| Adequate financial resources | 6 | 100 |
| OSH training and development | 6 | 100 |
| Continuous stakeholder involvement | 6 | 100 |
| Leadership and worker empowerment | 6 | 100 |
| Ease of system and procedures | 6 | 100 |
| Planning for implementation | 6 | 100 |
| Compliance to rules and regulation | 6 | 100 |
| Link OSH system to protective processes | 6 | 100 |
| OSH system integration | 6 | 100 |
| Hazard identification and risk analysis | 6 | 100 |
| Workflow re-engineering | 5 | 83 |
| Use of personal protective equipment | 5 | 83 |
| OSH performance benchmarking | 4 | 67 |
| Use of consultants | 3 | 50 |
| OSH communication | 3 | 50 |
| OSH standards and policies | 2 | 33 |
| OSH best practice and safety culture | 1 | 33 |

All participants were eager to articulate the strategies used to implement OSH strategies in mining and quarrying companies. Table 2 shows the range of the strategies

that participants noted as having been used to improve OSH initiatives in their companies. All the participants (*n*=6) mentioned user involvement, adequate financial resources , training and development, continuous stakeholder involvement, ease of system and procedures, compliance to rules and regulations, linking OSH systems to production processes, OSH systems integration, hazards identification and risk analysis user-friendly system, as necessary strategies for implementing OSH. Eighty three percent of the participants indicated that they used a standardized approach on OSH project management. A standardized approach to project management is effective and increase focus on workers' participation (Famiyeh et al., 2015) Four out of six of the participants (67%) mentioned the importance of OSH benchmarking. According to Qian and Lin (2016), benchmarking is important in project management because it helps an organization become more competitive. Other notable strategies included communication platforms, use of consultants, continuous review of standards and policies, and focus on best practice and safety culture.

Participant B02 stated:

> One of the strategies that we did was first to involve all employees in coming up with the OSH system. One of the things was that we went through a session of hazard identification where we identified the different hazards in all workstations. We then carried out a risk assessment and established appropriate remedial strategies. That input was put together to come with an OSH system that incorporated all the different workstations. So one of them [strategies] was to involve all employees (B02, Personal Communication, March 12, 2018).

As observed by Zwetsloot et al. (2017), involvement of workers in OSH initiatives builds a bond of oneness and buy-in workers' project ownership. Similarly, Participant C01 added:

> The spirit of ownership was easily accepted by all employees, creating a bond of compliance. You also notice that once workers doubt the security of their [workers] safety and health system, and fail to buy-in the safety and health system; you will have problems in implementing such as system. So there was leadership commitment and workers' empowerment [as strategies] (C01, Personal Communication, March 13, 2018).

Participant C02 concurred and added:

> The fact that we [leaders] were involved and committed to the OSH strategy, and that workers were empowered, made our implementation strategy successful (C02, Personal Communication, March 13, 2018). In contribution, Participant A02 had this to say:
>
> The most important strategy was to make people comply with the OSH system through training. Also, equipping them with Personal Protective Equipment (PPE) was a prerequisite. The initial involvement of all employees ensured that there was buy-in on the OSH system from the beginning. I think involving all employees was the most important critical success factor because all employees bought-in the strategies and built-in ownership (A02, Personal Communication, March 9, 2018).

Business leaders looking to reduce risk and optimize efficiency, employee safety, and understanding consider training as key to workplace accidents reduction (Dash et al., 2016). With regard to PPE, Govender et al. (2015) observed the ideal way to protect employees from workplace hazards was at source; but when engineering, work practices, and administrative controls are not feasible or do not adequately protect, employers must provide PPE and ensure its use.

There was a particular emphasis by all participants on the need to have adequate funds to ensure OSH implementation success. Participants A02, B01, C01, and C02 observed that implementation delays occurred due to lack of adequate funds or poor preparation.

Participant B01 lamented:

> On some incidents we had to postpone the program simply because we had no enough funds (B01, Personal Communication, March 12, 2018).

Participant A01 noted:

> Finances were the major drawback, though safety and health was given priority. Adequate financing was therefore a necessity on OSH implementation plans. However, despite implementation delays all our OSH projects were successful (A01, Personal Communication, March 9, 2018).

As observed by Rodriguez-Fernandez et al. (2016), formulation and administration of OSH financial budgets enable successful implementation of OSH strategies.

On the use of consultants as an implementation strategy Participant B02 had this to say:

> The initial thing a consultant will do when he or she begins working with you is complete a careful assessment of possible hazards and risks that need to be addressed and gaps that need to be addressed. This initial stage will give you an idea of the work needed to be accomplished to improve your performance (B02, Personal Communication, March 12, 2018).

Participant A01 concurred and added:

> A consultant will take the time to assist you write the essential procedures. This can save you time and resources that you can dedicate on other priorities (A01, Personal Communication, March 9, 2018).

Geller (2016), observed OSH management consulting companies can bring a combination of skills, knowledge and innovative tools that are not readily available in most organizations. By putting together the capabilities with an understanding of best-in-class OSH management practices, it is simple to see how the benefits realized from using an OSH management consulting company can far outweigh in-house effort (Geller, 2016).

**Subtheme 3: Communication.** Communication assists leaders to execute their jobs and tasks efficiently and effectively. Team work and communication within the company's workforce improve workflow and performance (Geller, 2016). Employers who devote time and energy conveying safety and health communication to workers build trust amongst workers, leading to increased productivity, sense of belongingness and morale at workplace (de Wet & Koekemoer, 2016b). All participants' findings indicated that communication forms an integral part in disseminating safety and health

information at workplace particularly information on hazards and risks, and the mitigation processes. Participants A01 and A02 observed e-mails, notice boards, meetings and discussions, and signposts were used to convey safety and health messages in company A. Participants B01 and B02 agreed with participants A01 and A02's observation.

Participant A01 added:

> In our company we use fliers, signposts, notice boards, billboards, meetings, informal discussions, and social media for disseminating safety and health information (A01, Personal Communication, March 9, 2018). Participants C01 and C02 observed the use of multiple languages to disseminate safety and health information.

Participant C02 had this to say:

> All our workers below the level of a supervisor are local nationals, the use of vernacular language enhances our safety communication skills (C02, Personal Communication, March 13, 2018).

As reported by Participant C01, all workers are encouraged to bring any new information on hazards and risks to make everyone aware and mitigating initiatives should be put in place (C01, Personal Communication, March 13, 2018). Furthermore, Participant B01 argued communication of safety messages had no bounds from top leaders of the company to the bottom.

Participant B01 had this to contribute:

> Workplace accidents can happen to anyone irrespective of their position in the organization, so sharing information about hazards and risks is crucial (B01, Personal Communication, March 12, 2018).

Safe organizations are reported by employees to have better communication, clear goals and policy statements, better accident prevention, better reporting and safety practices (Johnson et al., 2016). Participant B02 proposed safety and health competitions at workplace to motivate employees to identify hazards and risks and improve safety skills and knowledge. In corroboration, Participant A01 argued for national trophies (from competitions) and rewards presented to best safety and health compliant companies in honor of their contribution towards workers safety and health. Daniels et al. (2016), opined, the extent to which workers value certain actions, especially from supervisors and senior managers, exerts a strong influence on intentions and motivations to perform those actions.

As echoed by Participant A02:

> The national trophies and rewards were given on the workers' day commemorations. Senior government officials and the local communities attended the annual celebration day (A02, Personal Communication, March 9, 2018).

All Participants from companies A, B, and C concurred national commemorations promoted safety and health information and knowledge sharing while competitions motivated workers to exceed expectations in safety and health matters.

**Subtheme 4: Organizational preparedness**. Participants from the three companies concurred preparedness was key to occupational accidents prevention. Participant A01 had this to say:

> Some companies fail to deal with accidents regardless of the fact that the companies are highly equipped for such happenings. This is simply because they do not have adequate training on emergency preparedness. Here [at the company] we train our people through drills, mocks, and continuous daily safety briefs before starting a job (A01, Personal Communication, March 9, 2018).

The documentary evidence provided by participants confirm drills and safety briefs were internal safety preparedness procedures.

Participant A02 noted:

> The objective of emergency preparedness is to make things easier for decision making during emergencies. To minimize the number of accidents, one has to be prepared for such accidents, make conscious decisions on actions to be carried out at the time of the accident, and effectively implement these decisions. Our emergency preparedness plan incorporates the means to rapidly identify, evaluate and react to a range of emergency situations. Our emergency plans are dynamic and are regularly reviewed to reflect the dynamic nature of the company's activities (A02, Personal Communication, March 9, 2018).

Participants B01 and B02 identified training as another tool for emergency preparedness.

Participant B01 put it this way:

> Emergency preparedness is not a one size fits all process. The proper emergency response to a fire might be quite different to an equipment crush, or a hazardous chemical spill. Not knowing the difference could make a bad situation a lot worse. We don't want to wait until a disaster happens to find out that our emergency training is not effective. So the initial step in an effective training program is to determine what types of emergencies might occur and determine the appropriate measure. Deadly emergencies can happen in any workplace, so it simply makes sense for us to make sure employees know how to respond properly and safely (B01, Personal Communication, March 12, 2018).

According to Pillay (2015), a comprehensive emergency response program can help reduce legal costs, injuries and fatalities, and non-productive costs like absenteeism costs. Participant B02 elaborated:

> Safety and health leaders in our company provided guidelines to the company's emergency response procedures. For example, we provided guidelines on how to handle potential hazards and threats that might create an emergency within the workplace; and use of common emergency response equipment, such as alarms and communication procedures (B02, Personal Communication, March 13, 2018).

Safety leaders need to ensure evacuation and shelter procedures are very clear and easy to follow, and make sure all workers are familiar with reporting and accountability procedures (Geller, 2016).

Participants C01 and C02 noted that safety and health emergency training was supreme in company C.

Participant C02 stated:

> Safety and health training is a continuous process that underpins our company's everyday activity, it is not a one-time effort. We normally conduct emergency training: 1. immediately after developing an emergency preparedness program. 2. after any revisions to the emergency preparedness plan. 3. for all new employees joining the company. 4. for employees with new responsibilities or assignments. 5. when new equipment, materials, or processes are introduced. 6. when exercises and drills show unsatisfactory performance (C02, Personal Communication, March 13, 2018). Participant C01 concurred and added: in any event, safety and health emergency preparedness training should be conducted at least annually to keep workers familiar with procedures (C01, Personal Communication, March 13, 2018).

Every mine should have an effective safety and health emergency management system; everyone in the company should know what to do in any given situation (Altınöz & Özmen, 2015). Ultimately, safety and health should be approached with the same mind-set as productivity, with a goal of constant improvement (Brogli, 2016; Moen, 2009). As opined by Jung and Makowsky (2014), mines corporate boards need to be focused on helping the CEO build relevant safety and health strategy, so as the OSH professionals to enhance shareholder wealth. Also, as claimed by Mohammadfam et al. (2017),

instantaneous improvement of supporting environment and employee involvement is the best strategy to reach a high proportion of safety behavior at the workplace.

**Emergent Theme 3: Compliance to Rules and Regulations**

OSH rules and regulations seek a uniform approach to accidents preventions and management at workplace. Safety and health rules are unavoidable in hazardous work such as in mining and quarrying activities and are often codified insights from accidents and fatalities (Jahn, 2016). According to Geng and Saleh (2015), effective government policy and safety regulations enhances occupational safety and health in mining and quarrying and is necessary for accidents prevention. Participants from all three companies observed mining and quarrying activities as controlled by national laws.

As observed by Participant A01, OSH is over-regulated because of the hazardous nature of mining and quarrying operations. Some OSH laws protect the safety and health of workers and forbid the failure to ensure the protection of employees (Hermanus et al., 2015).

Participant A02 stated:

> Government legislation and our company safety protocol form the basis of our safety and health policy to ensure a safe workplace (A02, Personal Communication, March 9, 2018).

Participant B01 concurred and added:

> Penalties are clearly laid down for offenders in the form of license cancellation or suspension, financial, and imprisonment of leaders found floating the law. The

> enforcement of laws create safer working environments (B01, Personal Communication, March 12, 2018).

Participant B02 observed rules and regulations in the mining and quarrying industry as a necessity for accident prevention and management. Participant C01 stated: the Labor Act of 2005 is the framework of all other national labor laws governing workplace safety and health in Zimbabwe (C01, Personal Communication, March 13, 2018). From the results of documents study, it was clear that legislation is key in OSH compliance and workplace safety.

Participant C02 had this to say:

> The secret of any successful company are its employees, and should therefore be jealously guarded. Workplace accidents should be avoided at all costs. Here [the company] OSH compliance is our hymn while the Labor Act of 2005 is our guiding book (C02, Personal Communication, March 13, 2018).

As posited by Spada and Burgherr (2016), strengthening the safety regulator is desired, supported by the legislative policies. Such initiatives can save the lives of many mine workers and contribute to mine accident reduction in both developed and developing countries (Spada & Burgherr, 2016).

The research findings also indicate that compliance to rules and regulations in mining and quarrying industry lessens the risk of injury and fatalities, and agree with Geng and Saleh's (2015) safety compliance approach. According to Geng and Saleh (2015), effective government policy and safety regulations enhances occupational safety and health in mining and quarrying and is necessary for accidents prevention. As

observed by Jahn (2016), Safety and health rules are unavoidable in hazardous work such as in mining and quarrying activities and are often codified insights from accidents and fatalities. The elements of OSH code of practice were revealed in the themes from this study. The results of the study further extend the body of knowledge by making available empirical evidence of how compliance to rules and regulations is enforced to improve workplace safety and health.

**Subtheme: OSH code of practice.** The results of documents study reveal that the Labor Act of 2005 is the supreme legislation codifying OSH activities in the mining and quarrying industry in Zimbabwe. Participant B02 had this to say: our operations are guided by policies and procedures emanating from the Labor Act of 2005. For example, Statutory Instrument 154 of 2003 provides for the inspection of mining and quarrying activities carried out by Ministry of Labor agencies. Ministry of labor agencies deploy inspectors to carry out physical inspections to ensure compliance and if mining and quarrying operations were safe to employees. It is a requirement of law that a certificate of inspection should be displayed at the reception area to confirm compliance with the labor laws (B02, Personal Communication, March 12, 2018). Documentary evidence also indicate Statutory Instrument 109 of 1990 as a key legislation on safety and health in mining and quarrying industry. Statutory Instrument 109 of 1990 outlines the minimum safety standards for mining and quarrying operations and also includes punishments and fines for breach of law.

Participant C01 stated:

> As you might have observed in our safety manual, our mining management and safety regulations are enshrined in Statutory Instrument 109 of 1990 while Factories and Works Regulations are bound by instrument 263 of 1976. Statutory Instrument 109 of 1990 provides the minimum safety standards for a mining and quarrying company while Statutory Instrument 263 of 1976 impose fines for breach of law. Our codes of operation promote a safe and healthy workplace (C01, Personal Communication, March 13, 2018).

From the documentary evidence made available by participants, Statutory Instrument 185 of 1995 sets minimum health and sanitation standards for mining and quarrying activities in Zimbabwe. Documentary evidence also provided by participants confirm Statutory Instrument 304 of 1976 provides guidelines for electrical installations. The guidelines include standard color-coding for electrical wiring and protection of electrical fittings.

Statutory Instrument 264 of 1976 sets out the safety guidelines for buildings in Zimbabwe. Participant A01 had this to say: all our buildings were built according to Statutory Instrument 264 of 1976. They [the buildings] are among the best safe buildings in Zimbabwe. The Building Inspectorate pay attention to detail and even the tiniest regarding safety is scrutinized. During construction, one of our three-tower buildings could not proceed because we had used less ventilated air-vents. We had to import the required air-vents from Germany in order to proceed. Today we shine as role models for safety and health and we are an employer of choice (A01, Personal Communication, March 9, 2018).

Participant A02 concurred and added:

> Apart from Statutory Instrument 264 of 1976, Statutory 263 of 1976 also supports workplace safety and health. The Statutory Instrument [263 of 1976] provides guidelines for the safe installation, use, and maintenance of elevators. Our world class story-building is clear testimony of our seriousness towards world-class safety (A02, Personal Communication, March 9, 2018).

As reported by Participants B01 and C02, the legislation imposes compulsory yearly inspections for elevator installations to guarantee safe use. Participant B01 added: yearly inspection certificates are issued to elevator installations. The yearly inspection certificate must be displayed on each elevator to reveal compliance (B01, Personal Communication, March 12, 2018). As observed by Murombo (2016), in the absence of adequate legislation there can be no significant improvement in OSH initiatives. Leaders in the developing world need to develop OSH strategies that promote and enhance legislation as is the case with developed nations. Regulations must be complied and stiff penalties imposed on offenders (Binder, 2016). Failure to abide by standing regulations should result in stiffer penalties. For example, Don Blankenship, CEO of Massey Energy, was indicted on November 12, 2014, on four counts, including conspiracy to impede mine safety officials and conspiracy to violate mine safety standards and was sentenced to a year in prison and ordered to pay a US$250,000 fine (Binder, 2016). Authorities should enforce the complete implementation of laws and regulations governing the supervision of workers' safety and health (Müezzinoğlu, 2015).

**Emergent Theme 4: Hazards and Risk Management**

Mining and quarrying has been historically considered as a naturally high-risk industry worldwide (Bagherpour et al., 2015b; Long et al., 2015; Nawrocki & Jonek-Kowalska, 2016; Qian & Lin, 2016; Utembe et al., 2015). As observed by all participants, Mine workers and communities are potentially exposed to chronic diseases.

Participant A01 had this to say:

> Understanding and knowing your workplace surroundings is the first step to preventing illness or injury in the workplace. With the introduction of strict safety statutory instruments and our in-house operational procedures, as well as technological advances in safety equipment, our company has not experienced any workplace accidents for the past seven years. Our risk management is a continuous process to ensure any emerging risks are taken care of (A01, Personal Communication, March 9, 2018).

Participant A02 concurred and added:

> Mining and quarrying risks change significantly with what you mining, where you mining and how you mining. Here [mining site] we mine coal and our major hazard is coal dust, and the major risks are diseases associated with coal dust like silicosis. The situation could be totally different to miners of other minerals. Coal mining is more risky than metal mining, and underground mining is more dangerous than opencast mining (A02, Personal Communication, March 9, 2018).

Fortunately, over-exposure to respirable silica dust is preventable through the development and implementation of engineering control technologies (Yorio et al., 2015). Mine leaders need to intensify dust control measures and incorporate anti-smoking interventions into tuberculosis prevention and control programs (Ngosa & Naidoo, 2016).

The mining and quarrying industry has a reputation for being a risky industry, with various serious health risks. Participant B01 and B02 concurred, mining activities are among the most risk operations, therefore, hazards identification and risk assessment should be priority for a safe working environment.

Participant B02 added:

> The hazards covered in our industry [mining and quarrying] include: accidents, dust, high temperature and humidity, noise, and toxic gases. These hazards pause serious health risk and body harm (B02, Personal Communication, March 12, 2018).

As posited by Skoczynska et al. (2016), exposure to mine dust is also hazardous to mine workers. Skoczynska et al. (2016), argues that mine dust is a primary contributor to underground mining disasters and is also a major factor in adversely affecting the occupational health of mine workers causing diseases like pneumoconiosis, fibrosis, cancer , silicosis and tuberculosis.

Participant C01 had this to say:

> The biggest risk in mining and quarrying in my opinion is working near operational equipment. The workers' health risks are important too, but getting run over or crushed by heavy moving equipment is more important than the rest. I

> think covering your employees in high Personal Protective Equipment is worth nothing if you don't train them [employees] safe practice and how to work safely near equipment (C01, Personal Communication, March 13, 2018).

Safety and health training is essential for workplace safety and to be effective requires that the learned knowledge and skills are transferred to the job (Freitas & Silva, 2017; Y. Zhang et al., 2016). As claimed by Rupprecht (2015), training is an integral part of risk management for risk identification and communication between all the stakeholders including management, technical and safety personnel, and miners.

Participant C02 was keen in elaborating hazard assessment at workplace and highlighted: in addition to compliance with legislative site requirements, we always carry out hazards assessments. We use our site hazard checklist, our own experience, or our observations of the job as it is being done. During the observation time we mainly look at two major areas: Hazards that were recognized before starting the job, and the controls that were put in place to manage the hazards, and Hazards that seem not to have been recognized or identified and why or how these were not identified. This [the hazard assessment] makes it easier when it comes to risk assessment. For example, hammer is a hazard, but using it and getting injured is a risk. The continuous identification of new hazards and risks in our workplace makes us proactive in accident prevention (C02, Personal Communication, March 13, 2018).

Participants from company B emphasized the need for a risk management plan for the provision of sustainable safety and risk management systems and gave a detailed account.

Participant B01 had this to say:

> Here [the company] we are guided by our risk management plans. The national OSH legislation requires that all predictable hazards are identified and the risks are controlled. We review our control measures quarterly every year to check effectiveness. Hazards are identified through workplace inspections, incident reports, injuries register, feedback from workers, and discussions with workers. After hazards identification, we proceed to risk assessment. This is the process that determines the likelihood and seriousness of the effects of the risk to the workers exposed to the hazard. At risk assessment level we categorize risks by their level of severity and deal with the most severe first. In assessing the risk, we consider the consequence, likelihood, frequency and duration of exposure, workers effect, and layout and workplace condition. After assessing the risk, we decide on what needs to be done to eliminate or control the risks. Where possible, we always try to eliminate the problem from the work environment, for example by changing the way a job is performed (B01, Personal Communication, March 12, 2018).

Participant B02 concurred and added:

> Our risk control measures are designed in hierarchy order: a) Design to eliminate the hazard from the workplace: b) eliminate or substitute the hazard: c) Enclose or isolate the hazard: d) Reduce the risk through engineering and administrative controls, and e) Provide appropriate Personal Protective Equipment and ensure all workers are trained in its proper use. The last stage is reviewing the effectiveness

> of the whole plan. We achieved this through periodic safety audits, workplace inspections, discussions with workers and review of incident inquiries. Our risk management system is built into all workplace activities that can give rise to safety and health concerns (B02, Personal Communication, March 12, 2018).

The research results further agree with Bagherpour et al. (2015a) and Nawrocki and Jonek-Kowalska (2016) who observed mining and quarrying activities were a high- risk industry. The research results also confirm the importance of safety and health management at workplace and agree with Zwetsloot et al. (2017), who argued successful safety leaders prioritize safety at workplace and strive for a zero accident vision. From the research findings, safety leaders need to have in-depth understanding of their workplace and the hazards and risks associated with the environment. The research findings agree with von Thiele Schwarz et al. (2016) who encouraged total compliance approach to risk management. Furthermore, the research findings extend the literature by indicating the need for careful assessment of hazards and risks at workplace. All research participants confirmed the importance for hazard and risk assessment at workplace.

**Subtheme: Health risks.** The likelihood of dying or being injured from explosions, cave-ins and equipment accidents are always present in mining activities, and many chronic and deadly conditions are associated to their toxic nature. All participants highlighted that mining was a health-risk business that need adequate surveillance. As observed by Participant B02, it is obvious mining and quarrying is an unsafe industry with regard to health issues, but it doesn't have to be unsafe. We should always keep alert

of the health risks associated with our operations (B02, Personal Communication, March 12, 2018).

Participant B01 concurred and added:

> Health risks are abundant in mining and quarrying but we need to be cautious and avoid health-risk loopholes in our operations. We face lung diseases, tuberculosis, fibrosis, silicosis, asthma, pneumoconiosis, cancer, and many more other diseases (B01, Personal Communication, March 12, 2018).

Mining and quarrying operations expose workers to chronic diseases. Exposure to dust, vapors and gases put workers at risk for chronic diseases (Famiyeh et al., 2015). Exposure to dust from mining can lead to many pathological effects depending on mineralogical composition, size, shape and levels and duration of exposure (Utembe et al., 2015). According to Akgün (2015) and Fritschi et al. (2016), long-term cumulative exposure in workers is likely to develop into silicosis, silico-tuberculosis, pulmonary tuberculosis, obstructive airways disease and occupational asthma.

Participant C01 put it this way:

> The nature of our business subject us to fatal and chronic diseases caused by dust, radon, welding fumes, mercury, and other hazards. However, we have a strong preventative and mitigating OSH policy that we are proud of. The most important thing to do is to comply. If you just do things the way you're supposed to do, there's a good chance of finishing out your career here [at the company], and look forward to a good pension package (C01, Personal Communication, March 13, 2018).

As observed by Ulmann et al. (2015), workers in heavy industry and in collieries represent an at-risk group of people as their immunity is often weakened by long-term employment in dust environments, frequent smoking and an increased occurrence of pulmonary diseases. Also, high exposure to radon pause a risk to lung cancer. High radon exposure is a risk factor for squamous cell carcinoma, a major lung cancer observed in former miners (Leng et al., 2016). Exposure to mercury is also a health risk that can cause muscle weakness, poor coordination, numbness in the hands and feet, skin rashes, anxiety, and memory problems. As opined by Castilhos et al. (2015), mercury (Hg) contamination is also an issue of concern in the mining and quarrying industry due to potential health effects associated with Hg exposure in artisanal gold mining areas.

**Emerging Theme 5: Planning, Organizing, and Control**

All research participants concurred that planning, performing, studying, and acting was a fundamental theme in making a safe workplace. As posited by Cooper (2015),organizational leaders should plan, organize, and monitor safety and health activities at workplace. Participants A01, B01, and B02 concurred, leaders decide work to be done and allocate resources accordingly. In support, Participants A02, C01, and C02 confirmed: leaders use financial resources in crafting safety and health budgets and subsequently monitor and evaluate performance. As observed by Participant A01, leaders are the drivers of the company's long-term safety and health vision. In addition, Participant A02 defined a safety vision statement as: providing a risk free working environment by promoting a positive safety culture and continuously improving the health, safety and wellbeing of workers (A02, Personal Communication, March 9, 2018).

As observed by Participant C02, the safety vision statement is a broader expression of the leaders' perspective. The safety vision statement should always be accompanied by a safety mission statement which states how the company will achieve its desired future expectations (C02, Personal Communication, March 13, 2018). Furthermore, Participant A01 posited, safety vision and mission statement guide workers and managers in executing their day to day activities. All Participants concurred: the safety vision, mission, values, and goals of a company anchors the leadership style towards a zero accident vision. As observed by Zwetsloot et al. (2017), it is necessary for an organization to install a set of safety management practices and to be capable of foreseeing the potential risks.

Participant B02 reported, planning involves the creation and maintenance of a strategy to achieve improved workplace safety (B02, Personal Communication, March 12, 2018). As posited by Pagell et al. (2016), planning and coordinating workplace activities lessons the likelihood of accidents. Participant B01 observed planning as inseparable from business processes. Participant C01 described planning as key to business operations.

According to Zwetsloot et al. (2017), organizational safety excellence requires commitment from all stakeholders and attainable action plans. As observed by Participants A02, and C02, crafting action plans requires teamwork and consultation within the company hierarchy. Additionally, Participant B02 had this to say: all our tasks here [at the company] are well planned with safety in mind. Everyone is expected to follow safety rules, and procedures including contractors, subcontractors, suppliers, and

vendors (B02, Personal Communication, March 12, 2018). Participant A01, B01, and C02 agreed that planning, organizing, and controlling should happen successively with planning taking place first, followed by organizing, then evaluation and control. As stated by Participant B01, planning is the initial step involving resource allocation to specific jobs (B01, Personal Communication, March 12, 2018). All Participants from three companies concurred, planning, implementation, evaluation, and control constituted key strategies in a workplace that promotes safety and health practice. As observed by Qian and Lin (2016), safety leaders should craft, implement , and evaluate business strategies in line with safety rules and regulations.

The research findings confirm need for planning, organizing, and control in safety and health strategies as envisaged in the literature by providing empirical evidence of the practical use of some safety and health strategies on how to improve workplace safety and health. Cooper (2015), observed organizational leaders should plan, organize, and monitor safety and health activities at workplace. The research findings further extended Cooper's observations by revealing the importance of planning, organizing, and control at workplace. Following the results of the study, safety leaders initiate the roles of planning, organizing, and control to enable a safe and healthy workplace. Furthermore, the research findings indicate planning as an integral part of decision making at workplace.

**Emerging Theme 6: Accident Prevention**

All participants indicated that OSH strategies should be improved to eliminate occupational accidents at workplace. As observed byJørgensen (2016), accident prevention and control is key to a safe and healthy workplace.

Participant A01 stated:

> Workplace safety is guaranteed by a strong OSH code of practice that promote total elimination of occupational accidents through prevention initiatives (A01, Personal Communication, March 9, 2018).

Participant A02 concurred and added:

> The aim is to eliminate workplace accidents, to lessen their occurrence and severity, and to mitigate their effects. We achieved this through improving our work procedures, and concerted effort to achieve a zero accident vision (A02, Personal Communication, March 9, 2018).

As postulated by Participants B01, B02, and C02, participation of workers in safety and health issues is important to accidents control. Additionally, participant C01 argued, timeous identification of hazards and assessment of risks aids prevention of workplace accidents (C01, Personal Communication, March 13, 2018). Furthermore, as opined by Participant A02, risk assessment should be measured to assess the likelihood of accident happening and the severity if it happened (A02, Personal Communication, March 9, 2018).

Research Participants agreed water-tight OSH strategies helped prevent and control workplace accidents by enforcing safety compliance through rules and

regulations. Safety leaders should set safe risk tolerance limits for different tasks. Asked what they did to prevent workplace accidents, Participant B01 had this to say:

> Here [at the company] we reward employees who abide by complying with OSH standards or staying injury free for at least one year. We also ensure our workplace receives maximum housekeeping. The layout of our workplace have enough foot path markings, free of debris, and areas for cleaning up spills (B01, Personal Communication, March 12, 2018).

As observed by Utembe, Faustman, Matatiele, and Gulumian (2015), poor housekeeping can cause safety and health hazards in mining and quarrying operations. It is important for an organization to keep safety management practices and to be capable of predicting potential risks (Geng & Saleh, 2015). In addition, Virchow (2015) observed managers need to craft systematic, team-based techniques, identify, assess and control unacceptable risks to people, assets, the environment and production thereby making working places safe.

Participant C01 explained need for communication, teamwork, and commitment at all levels to make people aware of accident prevention initiatives. Participant B02 went further and stated: accident prevention is not an event, but is a process. It is continuous since workplace hazards emerge regularly and risk assessment is needed every time a new hazard is identified. Compliance to OSH procedures is a prerequisite for zero harm visionaries (B02, Personal Communication, March 12, 2018). In support, Participant A01 posited, workers are expected to measure the risk level before performing a task. If the risk is low the workers can proceed with the task, if it is medium they should consult the

safety supervisor, and if it is high they should not perform the task but alert the safety supervisor for further action (A01, Personal Communication, March 9, 2018).

The results of the study reveal the importance of OSH compliance in an organization and the need for safety leaders to stick to safety procedures. As observed by Qian and Lin (2016), safety leaders need to improve accident preventative strategies by improving safety policies and strict adherence to safety procedures. Furthermore, as reported by research participants, housekeeping, compliance to OSH procedures, and risk measurement were success factors to accident prevention, which aligns with Zwetsloot et al. (2017) recommendations. All research participants agreed, safety leaders should set safe risk tolerance limits for different tasks. Qian and Lin (2016) and Pillay (2015) concurred, establishing risk tolerance limits guide safety leaders' decision making process. As revealed by the research results, safety leaders should always be on alert for new hazards and risks associated with the hazards and take preventative measures where signs of medium or high risk appear. Furthermore, the study revealed safety leaders should develop effective interventions for accident prevention to improve occupational safety and health. The conditions that give rise to injuries must be clearly reflected in regulatory standards, which must be communicated to workplace parties, and enforcement strategies must be implemented to identify and address non-compliance.

**Subtheme 1: Strategies to improve OSH practice.** One of the important pillars of a universal OSH strategy includes the adoption and implementation of a national preventative OSH protocol. Strategies to improve OSH practice emerged as a major subtheme especially as it concerns decision making at workplace. Participants from

Companies A, B, and C agreed, continuous examination and improvement in OSH strategies reduces the likelihood of accidents at workplace. As opined by Brogli (2016), safety and health at workplace should be approached with the same mind-set as productivity, with a goal of constant improvement.

Participant A01 lamented:

> Safety and health leaders should craft strategies that are easy to follow and invest in safety technology (A01, Personal Communication, March 9, 2018).

Participant A02 concurred and had this to say:

> Safety and health policies should be compatible with the overall company strategy. Identification of hazards and risk assessment should be included in safety and health strategies. Workers should be involved and encouraged to report potential hazards and continuous task improvement should be encouraged to reduce risk rate. Business leaders should be in the forefront in strategy formation as they [leaders] are the decision makers. However, all strategies should be within the OSH framework and compliant with the legislative laws (A02, Personal Communication, March 9, 2018).

Participants A01, and A02's assertions were in agreement with Hilgert (2015) and Fuisz-Kehrbach (2015), who observed policy makers in the mining and quarrying industry should establish policies that are easy to adopt and take account of the occupational safety and health strategies. The policies should incorporate local miners' associations and cooperatives to build capacity to make mining regulation effective, seeking to

achieve such goals as the protection of natural resources, good health and safety standards (Fuisz-Kehrbach, 2015; Hilgert, 2015).

As reported by Blair (2014), safety controls and corrective action makes effective safety strategies. A corrective action is an action taken to avoid or reduce workplace risk (Blair, 2014). Participants B01 and C02 confirmed by stating, OSH controls should be supreme when safety leaders make safety decisions. Controls avoids repetition of errors and encourages workers to execute their tasks in a particular safe way. Participant B01 argued: the overall objective of including safety controls in OSH strategies is to ensure effective long-term control of hazards and risks. Controls help track progress toward risk assessment and should be part of OSH strategies (B01, Personal Communication, March 12, 2018).

Mining and quarrying leaders should also work out policy frameworks on occupational exposure limits (OEL) for some hazards based on mines toxicity studies. Participant C01 reported, OELs should be documented in the OSH policy framework to safeguard workers from excessive exposure. Participant C01's observation was echoed by Utembe et al. (2015) and Zwetsloot et al. (2017) by observing, the limits should take into account the issue of mixtures to which workers could be exposed as well as the health status of the workers. Liu et al. (2015), also stated managers should develop effective interventions for accident prevention to improve occupational safety and health. As revealed by the research results, safety and health leaders in the mining and quarrying industry should continuously craft safety and health strategies to eliminate hazards and reduce risk at workplace.

**Subtheme 2: Zero accident vision (ZAV).** The subtheme of working towards ZAV was universal among the participants. This subtheme merged well with the fact that all the participants noted that safety leaders need strategies to improve workplace safety and health to achieve ZAV. As observed by Kyerematen-Amoah and Clarke (2015), achieving a zero accident vision in mining and quarrying is an attainable goal; however, it requires the buy-in of the entire organization. Participants A01, B02, and C02 noted: the ZAV approach is achievable. It needs commitment at all levels, ownership of OSH initiatives, teamwork, and adequate resources (A01, Personal Communication, March 9, 2018). Documentation of procedures should be prioritized to avoid repetition of incidents (B02, Personal Communication, March 9, 2018). Most important is the identification of hazards and assessment of risks associated with the hazards before a task is performed. This gives workers awareness to accident prevention and control (C02, Personal Communication, March 13, 2018).

Participant A02 concurred and added:

> It needs a collective approach towards OSH to achieve ZAV. In our company [company A] we achieved it [ZAV] through various strategies including, workers' empowerment and buy-in, involvement of all stakeholders, training and development, workflow re-engineering, compliance to rules and regulations, allocation of adequate resources to OSH programs, and performance benchmarking. I would say that the first thing that comes to mind is the empowerment of all employees being able to stop unsafe tasks. Just that in itself makes a difference. It takes the responsibility of having a safe workplace from a

> few safety workers and distributes it to the whole company. For example, let's say that someone is considering to perform an unsafe task as a shortcut. It could be anybody that raises the issue of unsafe work practices and stop it (A02, Personal Communication, March 9, 2018).

In corroboration, Participant B01 had this to say:

> ZAV is based on the premise that all workplace accidents are preventable. It is an essential strategy for avoiding workplace accidents. It is also a pillar to OSH management system. To achieve it [ZAV] you need to have universal commitment towards hazards identification and risk rating. Near-miss incidents are potential accidents and should be investigated and corrective measures taken to avoid workplace accidents. I have seen some employees report unsafe acts, and stop operation when they thought it was unsafe. I see people do things differently to ensure what they do is safe. Our motto is: Do safe things first time and always (B01, Personal Communication, March 12, 2018).

As observed by Gnoni and Saleh (2017), near-misses are less costly than learning from accidents; the main value of a near-miss is in the learning loop provided within and across the organization, in focusing safety resources on addressing unsafe acts, reducing unsafe conditions and improving design and operational safety issues.

Participant C01 added this insight:

> ZAV was an achievable strategy. Getting to an accident free workplace takes determination and commitment. Commitment and determination were the

> essential ingredients that underpinned the rest of our ZAV program (C01, Personal Communication, March 13, 2018).

The research findings confirm the notion that all accidents are preventable. However, it needs dedication, commitment, and determination. Zwetsloot et al. (2017) and Qian and Lin (2016) concurred ZAV was an achievable strategy. The research findings further extended Zwetsloot et al and Qian and Lin's observation by enlightening the importance of ZAV in pursuit of organizational safety and health excellence at workplace. The research participants agreed with Lawton and Páez (2014) who observed that leaders need to protect workers who point to the internal contradictions of safety procedures of the organization as answers to adaptive challenges do not reside in the executive only, but in the shared intelligence of all employees. Furthermore, research participants concurred with Ivensky's observation that winning managers thrive for the zero harm philosophy, that suggests zero occupational injuries and illnesses for all workers and for anyone affected by a company's business (Ivensky, 2016b). Hurst and Jones (2016), concurred with Ivensky (2016b) and added: safety leaders should speak to the importance of conceptually analysing the key concepts of a safety measurement system, such as injury or near-miss accidents to build organizational excellence. Based on the results of the study, safety leaders need to craft strategies in line with ZAV to eliminated workplace accidents.

**Subtheme 3: Training and development.** Research Participants concurred that training was an integral part of OSH strategies' formulation, implementation, evaluation and control. As opined by Lawton and Páez (2014), successful business leaders consider

training and development, communication satisfaction, performance appraisal, employee empowerment, employee motivation, team work, trust between employee and manager, employee wellness and image of the organization to be the important factors in organization development.

Participant A01 had this to say:

> We achieved ZAV for the past seven consecutive years mostly through compliance and training. Despite the fact that every employee knew how to perform his/her tasks, training was essential because we gained more knowledge about new hazards and risks surrounding our tasks. Training promoted team work and knowledge sharing at workplace. It Increased employee job satisfaction and morale, and improved innovation in safety and health strategies adoption (A01, Personal Communication, March 9, 2018).

Participant A02 concurred and added:

> Some workers have weaknesses in workplace skills. Safety and health training programs allowed us to strengthen our skills that needed improvement. Our OSH development program imparted similar skills and knowledge to workers (A02, Personal Communication, March 9, 2018).

Based on results from safety and health training studies, both workers and managers benefit from quality training and the results have been observed as improved safety (Kim et al., 2016). The research participants' observations were echoed by Kim et al. (2016). Kim et al. (2016), observed OSH training must be understood as one of the means

required to develop a safe workplace that contributes to the reliability of work system and employee loyalty.

Participant B01 stated:

> Training and development was key to successful implementation of OSH strategies. Workers got prepared for potential risks. Evaluation of risk and classifying risks into low, medium, and high groups was an effective way of keeping workers alert with workplace hazards (B01, Personal Communication, March 12, 2018).

Participant B02 concurred and added:

> Training workers industry-standard best practices help in building reputation. For example, we [employees at company B] are known in the mining and quarrying industry as one of the best safety and health practitioners, we are proud of it. Other companies come to us for assistance in this regard. Investing in OSH training positively impacts workers' morale and builds a good reputation for the company (B02, Personal Communication, March 12, 2018).

As revealed by the research results, OSH training should be done regularly to strengthen workers' skills and knowledge. Furthermore, as reported by research participants, OSH training let workers gain more knowledge about new hazards and risks surrounding their tasks, which aligns with the recommendations by Zwetsloot et al .(2017). As observed by Beus et al. (2015), OSH training is the road map to achieving ZAV.

**Emerging Theme 7: Documentation of Safety Procedures**

Documenting safety procedures simplifies performance of tasks in an organization (Zwetsloot et al. 2017). All Participants from the three companies agreed; tasks and activities should be documented. Participants A01 and C02 agreed, documentation helps in knowledge sharing and enables continuous improvement of activities.

Participant B01 added:

> Recording workflow activities guide workers in performing their duties (B01, Personal Communication, March 12, 2018). As stated by B02, workers can easily perform each other's tasks in their absence if procedures and activities are documented.

The research findings confirm knowledge in literature on workplace safety management continuous improvement by providing empirical evidence of the practical use of some of the recommended ways of improving safety at workplace. Johnson et al. (2016), claimed safe organizations are reported by employees to have better communication, clear goals and policy statements, better accident prevention, better reporting and safety practices. The research results agree with Brogli (2016) and Blair (2014) on the documentation of safety procedures to improve workplace safety and health. Documenting safety procedures assist streamline tasks and make it more effective (Brogli, 2016). The research findings confirm Brogli (2016) and Blair's (2014) assertion that documentation is key to workplace safety and health improvement. Research participants' evidence confirm Dash et al. (2016) observation that safety and health procedure documentation

help ensure tasks are accomplished in a reliable and repeatable way. As observed by Cooper (2015), procedures do not only help ensure tasks are completed in a reliable and repeatable manner, they also help facilitation of transfer of institutional knowledge. All research participants confirmed, documentation of safety procedures is invaluable to workplace safety.

**Linking to Conceptual Framework**

I used the Plan, Do, Study, Act (PDSA) cycle theory described by (Moen, 2009), as the conceptual framework for the study. The model, designed specifically to learn and improve organizational systems, is an adoption of the Deming cycle theory of 1950 (Moen, 2009), which has been successful in continuously improving organizations' operational standards. The findings from this study, examined in light of PDSA cycle theory, confirm that workplace safety and health initiatives need to be continuously improved to avoid occupational accidents. The research findings support the PDSA framework by underscoring (a) planning jobs or tasks following the laid down OSH procedures, (b) executing the job plan, (c) studying the executed plan, and (d) taking remedial action on what is learned which aligns with Moen (2009) interpretation of the PDSA framework.

As detailed in the results of the study, all the PDSA stages are executed for each action in a systematic approach including safety improvements for jobs with medium to high risks, which agrees with Leis and Shojania (2016) recommendations on the PDSA framework implementation. In addition, the research findings further contribute to the body of knowledge and extend the PDSA framework by offering a stage-by-stage approach to organizational activities to improve safety and health at workplace.

Further to the body of knowledge on the PDSA framework, the findings of the study show the PDSA framework could be more efficient in a safety and health improvement program as plan-do-study-act (PDSA) systematic manner.

The results of the study confirm planning (Plan) as the first step safety leaders take to improve workplace safety and health. Panning involves thinking about and organizing the tasks required to achieve organizational objectives. It includes the formulation, and maintenance of a plan. After planning, implementation of the Plan (Do) should take place followed by the evaluation of the plan (Study). Implementation takes place after a risk assessment has been done and the results show low risk for the task. If results show medium risk, the safety supervisor should be consulted. If the result show high risk, the task should not be performed until mitigating interventions are put in place. An evaluation of the plan is instituted during the studying (Study) stage and risk assessments are done. Risk monitoring should be an ongoing exercise in improving safety at workplace. After evaluating risks associated with tasks, action (Act) should be taken to address the emerging risks. The research results confirm; evaluation, monitoring, reporting, and control continue during the execution stage of the task.

From a business point of view, the PDSA is an invaluable framework to improve workplace safety and health as it encourages continuous task improvement and is supported by the results of the study. The PDSA is therefore a more appropriate approach to improve workplace safety and health. The study results agree with Leis and Shojania (2016) who observed various models on task improvement from the plan-do-review-empower-control perspective. Shojania's (2016) plan-do-review-empower-control

process is an improvement on Shewhat's PDCA cycle but as revealed by the results of the study, the PDSA framework is concise and more effective in improving workplace safety and health. From the study findings, hazard identification and risk assessment should be prioritized before performing any task to reduce workplace accidents, and this result contributes to the body of knowledge on workplace safety and health improvement.

## Applications to Professional Practice

The research findings bring to the fore that workplace safety and health improvement requires a dynamic model that accommodates hazard identification and risk control strategies. Risk control strategies include integrating hazard and risk management in all workplace safety and health decisions (Qian & Lin, 2016). OSH adoption needs a multidisciplinary approach with the participation of all stakeholders. The process should not only be about how people comply with law, but also how workers view safety and health at workplace.

As indicated by the research participants, adoption of safety and health strategies requires taking a broad look at potential workplace hazard and risk associated with task. The study provides a stage-by-stage approach to hazard and risk control management in a safety and health program at workplace. In addition, the results of the study inform professional practice by extending further than legislative compliance, by promoting voluntary hazard identification and risk assessment before, during and after task performance at a workplace. Research participants supported stakeholders' commitment, communication at all levels, employee by-in and empowerment, and compliance to rules and regulations to be key to a successful continuous safety and health program.

The findings from this study may assist mining and quarrying leaders in accident prone workplaces adopt safety and health strategies and improve workplace safety and health. Mining and quarrying leaders in developing countries can also benefit from this study by improving focus on safety and health initiatives at workplace to reduce or eliminate accidents as previously observed by G. I. J. M. Zwetsloot et al. (2017). Based on the findings of this study, safety leaders can define better strategies and policies for their workplace.

The research results confirm the path to attaining workplace safety and health as: Planning, Implementing, Evaluating and Control. A PDSA framework is proposed to guide safety and health leaders create a safe workplace. The PDSA is an improvement to the PDCA framework. Risk assessment is important before a task is performed. The research findings show the PDSA framework is more aligned to hazards identification and risk management than the PDCA framework.

## Implications for Social Change

The study results show that improving workplace safety and health promote the reduction of pain and suffering caused by workplace injuries and fatalities. Employees in the mining and quarrying industry are often placed in hazardous situations and need to know how to keep themselves safe. By implementing the recommendations for further action identified below, safety leaders will have added tools to achieve their responsibilities and decrease workplace accidents. Other mining companies will also benefit by sharing the information identified in this study to improve safety and health strategies at their workplaces. The results of this study could affect social change by

providing leaders in the mining and quarrying industry with knowledge and skills to improve workplace safety and health as a key strategy to increase productivity rates while creating employment for communities.

My vision is that injury rates in Zimbabwe will achieve zero levels in the near future if mining companies follow recommended strategies. As opined by Zwetsloot et al. (2017), ZAV is achievable if business leaders comply with safety and health laws and constantly improve accident control strategies. Recommendations leading to improved safety and health strategies will reduce workplace accidents and benefit workers, the industry, and particularly society that still relies upon the output of the mining and quarrying industry for daily existence. Communities supply mining companies with labor force. Therefore, workers practicing safe work behavior take the safe behaviors home, and the communities benefit from shared knowledge and skills of the workers on safety and health (Mohammadfam et al., 2017).

Workers disabled by occupational accidents cannot participate in family functions and cannot support their families in the lifestyle they are used to living, because of accidents that could have been prevented. By adopting the recommendations in this study, business leaders will eliminate workplace accidents and workers can enjoy their life and their families, continue to be productive in their societies, and support their families. Furthermore, mining and quarrying companies would benefit from reduced costs of health care and medical expense could decrease for the worker, mining company, and insurance companies.

## Recommendations for Action

From the results of the study, safety and health at workplace depends on leadership commitment, stakeholders' participation, communication, and empowerment of workers. The level of commitment by safety and health leaders, participation of all business partners, and employees' empowerment create a safety workplace (Pagell et al., 2016). Business leaders can create a safe workplace by taking the following action steps: (a) plan tasks and method of performing the tasks, (b)ensure enough resources are made available, (c) document task performance step –by-step, (d) identify workplace hazards and assess risk before performing a task (e) empower and train workers, (f) lead, (g) evaluate and control, (h) report and communicate any divergences, (i) carry out safety and health compliance audits, (j) correct divergences and continue identifying new hazards and assess risk. Business leaders can implement the steps concurrently in a continuous fashion. Continuous improvement is an important factor in all the steps .Hazard identification, risk assessment and mitigation should be integrated in all tasks. Business leaders should take a proactive approach in dealing with workplace safety and health by forestalling hazards and risks and mitigating them before they happen. A PDSA framework is recommended to business leaders to continuously identify new hazards and risks and carry risk assessment to determine the level of risk before commencement of any task to save workers from occupational accidents.

Business leaders, investors, governments, workers, and communities should pay attention to the study findings. Business leaders can benefit from the study findings by creating a safe workplace through a continuous risk management system. Furthermore,

by following the recommendations, business leaders enhance goodwill for the organization and becomes employers of first choice (Geller, 2016). Investors potentially benefit from the study findings by enforcing compliance thereby reducing workplace injuries and fatalities and enhancing productivity and profitability. Governments could benefit from having safe employees as it cuts the cost of social welfare and government spending. Additionally, governments will benefit from tax contributions from long serving workers. A healthy workforce contribute to national development through their intellectual capital (Ripamonti & Scaratti, 2015).

The research findings should also be beneficial to workers because by following detailed documented procedures and identifying hazards and assessing risk before executing any task will ensure a safe and healthy workplace. This research premises on the safety and health of workers, so the research findings could be of interest to workers. Workers unions may also find the research findings beneficial because the research findings can be used to promote safe work practices. Additionally, workers' unions can lobby governments to increase legislative provisions based on the research findings to improve workplace safety and health.

Lastly, communities should find the study findings beneficial because communities are a key stakeholder in workplace safety and health. Injuries or fatalities at workplace adversely affect communities. Community union groups could learn strategies to improve workplace safety and health from the study findings and lobby employers to improve safety and health at workplace. Additionally, community union groups could

lobby support for implementation of the study recommendations by stakeholders to improve workplace safety.

The results of the study can be disseminated through training lectures, meetings, safety procedures manuals, and workers magazines promoting workplace safety. The researcher and captains of industry can arrange industry events to share the research findings. In Zimbabwe the Confederation of Zimbabwe Industries is the supreme body for all industries and it can involve and propagate the research findings to needy industries. Industries will be encouraged to share the research findings and implement the recommended strategies to improve workplace safety and health. Government agencies can also help disseminate the research findings by giving regulative guidelines to industry leaders on how to improve safety and health at workplace based on the research findings. I have already initiated an occupational safety and health advisory business which have a website hosting the research findings. The company is called Safe Africa Private Limited. As the name implies, inspired by Walden University social change agenda, I intend serving the whole of Africa starting with my country Zimbabwe. I will raise safety and health issues on the website blog page and seek input from business leaders on ways to improve workplace safety and health. The website is www.safeafrica.co.zw.

## Recommendations for Further Research

Examination of the responses from research participants, review of the organizational documents, and analysis of findings led to the emergence of multiple themes concerning OSH implementation strategies used by leaders in the mining and quarrying industry. Recommendations from this study might encourage mining and

quarrying leaders to develop a positive orientation on OSH initiatives, and embrace proven OSH implementation strategies for use in their companies. The following subjects are recommended for further research: (a) investigating the relationship between employee age-group to the accident rate, (b) examining the influence of education and skills to workplace hazards identification, (c) examining the relationship between OSH resource allocation and accident prevalence rate, (d) examining the relationship between risk levels and nature of workplace hazards. The proposed areas of further research will provide empirical evidence on the relationship between workplace variables and equip leaders with better strategies to improve workplace safety and health. Furthermore, the proposed areas for further research may assist business leaders identify safety performance indicators and pay more attention to workplace safety and health. Additionally, business leaders may be assisted in resource allocation planning and decision making.

The limitations to this study were that only three mining and quarrying companies in two provinces out of eight provinces were studied and only the researcher was the single data coder. Also, some confidential OSH information could not be made available because of company policy restrictions. Further research could be based on a broaden base to include more mining and quarrying companies and more provinces. The inclusion of more provinces could be more representative. In addition, more collaboration in the study could improve data collection, coding, and analysis. More collaboration in a study broaden the scope and extend of the study and improve the strength of analysis and research validity (Crittenden & Hill, 1971). Collaboration of more researchers could

improve on the limitation caused by only one data coder conducting the data coding and analysis from three mining and quarrying companies in Zimbabwe. Separation of distinct information could be useful for further research. Companies could be encouraged through regulations and procedure to separate OSH information from workers' private health details enabling researchers access to pertinent OSH material. Involvement of the legislature in this regard could be necessary.

## Reflections

As a successful businessman I chose to do DBA in search for new intellectual challenge. When I started the DBA program, I was fully aware of its practical nature and relevance to my business practice. In conducting this multiple case study, my objective was to enhance my research techniques and experience as I explored a topic that was close to my heart. During in-depth interviews with participants, I managed to obtain insight of strategies successful leaders in mining and quarrying industry in Zimbabwe use to improve OSH. Throughout the conduct of the study, I acknowledged the possibility of personal bias or preconceptions, so it did not affect research findings. To minimize personal biases, I used bracketing during interviews and stayed focused on the research process during data organization and analysis. I relied on the audio recorded material, documentary evidence, and interview transcripts throughout the research process.

I have over 25 years' experience as a business leader but after the research, my knowledge and perception on workplace safety and health changed. I learned new strategies to improve workplace safety and health through the study process. I also have realized the power of research in contributing to the body of knowledge through primary

data gathering. I am confident practical business problems can be solved through conducting research in any business setup. I acknowledge having learned the need of authenticity, credibility, and reliability of research findings, and the rigor and validity of the research process.

## Conclusion

Mining and quarrying operations are considered risky and hazardous, entailing the application of high safety and health standards to build organizational safety capabilities (Gunarathne et al., 2016). The risks in mining and quarrying include accidents which have resulted in loss of life over the years, as well as health hazards that miners face on a day to day basis. Numerous factors influence adoption of OSH strategies in the mining and quarrying industry ranging from lack of resources to lack of skills and knowledge (Qian & Lin, 2016). Safety and health leaders often lack strategies to implement OSH successfully.

This study's purpose was to explore successful strategies used to implement OSH in mining and quarrying industry in Zimbabwe. Various strategies emerged from the findings including user involvement in choice of OSH system, adequate financial resources, OSH training and development, stakeholder involvement, leadership and worker empowerment, ease of system and procedures, planning for implementation, compliance to rules and regulation, systems integration, hazard identification and risk analysis.

In Section 1, I focused on the problem statement and reviewing supporting literature. In Section 2, I concentrated on research methodology, sampling method, and

data analysis techniques. In Section 3, I presented the study findings. Three mining and quarrying sites in Zimbabwe were studied. The sites studied were assigned anonymous codes, A, B, and C. Six research participants from the sites studied were also assigned anonymous codes Participants A01 and A02 were from Company A, Participant B01 and B02 were from Company B, and Participants C01 and C02 were from company C. Anonymous codes were used to maintain confidentiality during and after the study. Data triangulation and cross case validation were part of data analysis methods. Face-to-face audio-recorded interviews and documentary evidence were key to this study findings.

The research findings may impact on social change by improving workplace safety and health thereby promoting the reduction of pain and suffering caused by workplace injuries and fatalities. By implementing the recommendations for further action identified in section 3, safety leaders will have added tools to achieve their responsibilities and decrease workplace accidents. Other mining companies will also benefit by sharing the information identified in this study to improve safety and health strategies at their workplaces. Furthermore, the results of this study could affect social change by providing leaders in the mining and quarrying industry with knowledge and skills to improve workplace safety and health as a key strategy to increase productivity rates while creating employment for communities.

The findings and recommendations from this study provide a compilation of strategies leaders in mining and quarrying industry could use for successful OSH implementation. Additionally, the research results possibly impact professional practice by proposing a stage-by-stage approach to hazard identification and risk assessment

programs in workplace safety improvement. Safety and health leaders were encouraged to be proactive in managing workplace hazards and risk and develop a mitigating framework before occurrence. Furthermore, the research results inform professional practice by exceeding legal compliance, by advocating for voluntary awareness, and having adequate information about each task before, during, and after task-execution.

The following themes emerged from the analysis of data: organizational culture, strategic leadership, compliance to rules and regulations, hazards and risk management, planning, accident prevention, and documentation of safety procedures. Research findings indicate that business leaders are in control of workplace safety and health. Business leaders therefore, should craft and implement strategies to improve workplace safety and health.

The findings from this study, examined in light of PDSA cycle theory, confirm that workplace safety and health initiatives need to be continuously improved to avoid occupational accidents. The research findings support the PDSA framework by underscoring (a) planning jobs or tasks following the laid down OSH procedures, (b) executing the job plan, (c) studying the executed plan, and (d) taking remedial action on what is learned. Safety and health leaders were introduced to a PDSA framework to guide business leaders in creating a safe and health workplace.

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Appendix A: Interview Protocol

| **What you will do** | **What you will say—script** |
|---|---|
| Introduce the interview and set the stage—often over a drink or coffee. | My name is Bernard Mabika and I am doing research under the supervision of Dr. Brandon Simmons towards a Doctor of Business Administration degree at Walden University. I am inviting you to participate in a study entitled "Improving Workers' Safety and Health in the Zimbabwean Mining and Quarrying Industry". |
| Watch for non-verbal queues.<br>· Paraphrase as needed.<br>· Ask follow-up probing questions to get more in-depth information. | 1. What successful strategies are you using to reduce workplace injuries and fatalities in your organization? |
| | 2. What have been the effects of OSH successful strategy and process adoption and implementation in your organization?<br>3. What training, development, or processes influenced the successful implementation of the strategies for OSH? |
| | 4. What were the key OSH challenges you encountered to implementing the strategies for improving OSH? |
| | 5. What did you do to respond to the challenges to implementing the strategies for improving OSH? |
| | 6. What were the critical processes for implementing the successful strategies for improving OSH? |
| | 7. What else do you want to add that I have not asked about OSH in mining and quarrying? |
| Wrap up interview thanking participant. | Thank you for your participation and invaluable input during the interview. Do you think there is anything material that might be helpful in me understanding strategies you used to improve workplace safety and health? For example, OSH literature for me to read. |
| Schedule follow-up member checking interview. | After interviews I will analyze and interpret data. Are you comfortable if I call for clarification of the interview data during or after my interpretation of data? |
| | |

| Follow–up Member Checking Interview | |
|---|---|
| Introduce follow-up interview and set the stage. | I have gathered a lot of information from interviewees and I need to confirm my understanding and interpretation of the data discussed with subject experts like you. |
| Share a copy of the succinct synthesis for each individual question.<br><br>Bring in probing questions related to other information that you may have found—note the information must be related so that you are probing and adhering to the IRB approval.<br>Walk through each question, read the interpretation and ask: Did I miss anything? Or, What would you like to add? | I have recorded the following evidence from research participants and have summarised my understanding as per my transcription and I wish to check with you if my understanding and interpretation is correct. |
| | 1. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed |
| | 2. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed |
| | 3. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed |
| | 4. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed |
| | 5. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed |
| | 6. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed |
| | 7. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed |

Appendix B: Email Invitation

Dear _____

My name is Bernard Mabika, and I am a Doctor of Business Administration (DBA) candidate at Walden University. I am conducting research to complete my DBA degree. You are invited to take part in a research study to determine what successful strategies leaders in the mining and quarrying industry use to improve employee occupational safety and health in Zimbabwe.

Did you know that mining and quarrying companies could achieve up to 10% savings in operational costs, workers' compensation claims, lost labor hours, and absenteeism as a result of successful implementation of occupational safety and health strategies? In this study, I will investigate the strategies used by mining and quarrying leaders in Zimbabwe to successfully implement occupational safety and health (OSH) initiatives. There are some specific criteria for participants to be included in this study. They are:

- A leader with decision-making role in formulation, implementation and evaluation of OSH strategies in a mining and quarrying company in Zimbabwe,
- An individual who works in a mining and quarrying company that has successfully implemented OSH strategies.

If you meet the above criteria and agree to be in this study, please contact me via email at bernard.mabika@waldenu.edu or by phone at 0773465800. I will ask you to sign a consent form (attached to this email). You can decide if you would rather I interview you in person or by phone. I will schedule an appointment convenient for you, respecting

your busy schedule. The interview should last no more than 30 to 60 minutes. Thank you so much for this opportunity for me to involve you in this important study.

Appendix C: Letters of Cooperation

[redacted]

January19, 2018

[redacted]

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

Your request to conduct an academic research entitled **Improving Workers Safety and Health in the Zimbabwean Mining and Quarrying Industry** with [redacted] has been approved. As part of this study, I authorize you to recruit and interview willing participants. Individuals' participation will be voluntary and at their own discretion.

We understand that our company's responsibilities include: assisting the researcher in identifying potential participants for the study, and allowing the researcher access to the company documents pertaining to safety and health at workplace. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I am authorized to approve research in this setting and that this plan complies with the company's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's faculty/staff without permission from the Walden University IRB.

Good luck with your research.

Sincerely

[redacted]

HUMAN RESOURCES DIRECTOR
Cc Safety and Health Manager

[redacted]

January 22, 2018

Dear Bernard

**RE: ACADEMIC RESEARCH REQUEST**

Based on my review of your research proposal, I give permission to you to conduct the study entitled **Improving Workers Safety and Health in the Zimbabwean Mining and Quarrying Industry** with our organization.

As part of this study, I authorize you to recruit and interview willing participants. Individuals' participation will be voluntary and at their own discretion.

We understand that our organization's responsivities include: a) assisting you as the researcher in identifying potential participants for the study. b) Allowing you as the researcher access to [redacted] safety and health documents that you might need during the research. c) Allowing you as the researcher to conduct interviews within or outside our premises. d) Allowing you as the researcher to observe our occupational safety and health systems at the company.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's faculty/staff without permission from the Walden University IRB.

Sincerely

[redacted]

**Chief Executive Officer**

[redacted]

19th January, 2018

RE: **PERMISSION TO CONDUCT RESEARCH: BERNARD MABIKA**

Based on my review of your research proposal, I give permission for you to conduct the study entitled **Improving Workers Safety and Health in the Zimbabwean Mining and Quarrying Industry** with [redacted]. I therefore authorize you to recruit and interview participants from our organization on a voluntary basis.

Our organization's responsibilities will include:

1) Assisting the researcher in identifying suitable participants for the study.
2) Allowing the researcher to carry out interviews within or outside our premises.
3) Assisting the researcher with relevant company documents relating to occupational safety and health.

I confirm that I am authorized to approve research in our organization and that this plan complies with the organization's policies. We reserve the right to withdraw from the study unconditionally at any time should our circumstances dictate.

I understand that the data collected during your research will remain confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from Walden University IRB.

Yours sincerely

[redacted]

**GENERAL MANAGER**

Appendix D: Protecting Human Research Participants

# Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Bernard Mabika** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 05/14/2016.

Certification Number: 2072742.