Investigating the determinants of Team leader occupational injuries in a South African underground platinum mine

Research Article

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DECLARATION

I, Sthabiso Xaba, declare that this research report entitled 'Investigating the determinants of Team leader occupational injuries in a South African underground platinum mine' is my own unaided work. I have acknowledged, attributed, and referenced all ideas sourced elsewhere. I am hereby submitting it in partial fulfilment of the requirements of the degree of Master of Business Administration at the University of the Witwatersrand, Johannesburg. I have not submitted this report before for any other degree or examination to any other institution.

Sthabiso Xaba
Signed at Johannesburg on 31st March 2021

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ABSTRACT

Author:	Sthabiso Xaba	**Supervisor**	Samukelo Ngubane
Thesis title:	Investigating the determinants of Team leader occupational injuries in a South African underground platinum mine		

Background: Line supervisors in South African underground platinum mines face challenges regarding risks to their health and safety.

Objective: The aim of this study was to investigate the contributing factors to occupational injuries of Team leaders in a South African underground platinum mine.

Method: Mine safety statistics were obtained and analysed for common themes. Qualitative and quantitative data were collected from a focus group interview with Team leaders and 33 questionnaires completed by Team leaders to gather socio-demographic, fatigue, work stress, job satisfaction and risk-taking behaviour information.

Results: Fall of ground, material handling and slip and fall injuries were the common accident-causing agencies. The majority of injuries sustained by Team leaders were serious injuries. No socio-demographic factors were significantly associated with occupational injuries. Fatigue and work stress were significantly associated with injuries. Fatigue was attributed to extended working hours and travelling long distances. Work stress was attributed to the multi-tasking of Team leaders. Job satisfaction was negatively associated with work stress and risk-taking behaviour.

Conclusion: The aim of the study was achieved as fatigue and work stress were found to be contributing factors to occupational injuries. Contributors to fatigue, work stress and job satisfaction ought to be addressed to improve health and safety in the South African platinum mining industry.

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DEFINITION OF KEY TERMS AND CONCEPTS

AIDS	Acquired Immunodeficiency Syndrome
DMRE	Department of Mineral Resources and Energy
GDP	Gross Domestic Product
HIV	Human Immunodeficiency Virus
MHSC	Mine Health and Safety Council
SPSS	Statistical Package for the Social Science
TB	Tuberculosis
USA	United States of America
OFER	Occupational Fatigue Exhaustion Recovery

1 INTRODUCTION TO THE RESEARCH

1.1 Background and context

More generally, this research investigates the determinants of occupational injuries of Team leaders in an underground platinum mine. Prior to introducing the research conceptualisation (Section 1.2), the terms and concepts that were used in conceptualising the current research are briefly introduced in Section 1.1, both generally and broadly. Section 1.1.1 introduces the South African platinum mining industry to capture the overall picture of the industry. Thereafter, Section 1.1.2 introduces occupational safety in South African underground mines. Lastly, Section 1.1.3 introduces Team leaders in the mining industry to capture the role they play. The research conceptualisation section provides for the research problem statement (Section 1.2.1) and consequently the purpose of this research (Section 1.2.2) as well as the research questions (Section 1.2.3). The delimitations and assumptions of the research study are outlined in Section 1.3 while the significance of the research study is discussed in Section 1.4 and a preface to the research report is outlined in Section 1.5. Chapter 2 discusses the research context in a more specific and detailed manner.

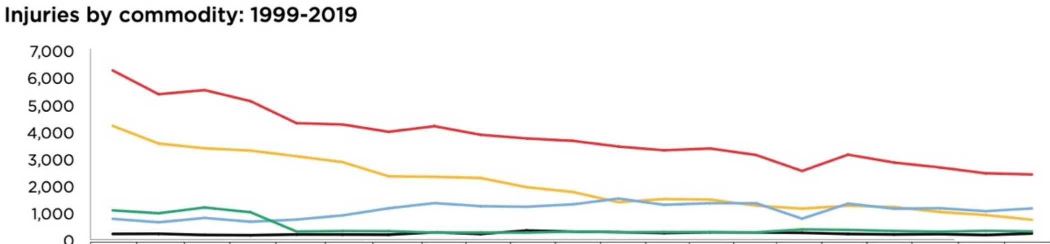
1.1.1 South African platinum mines

The history of the South African platinum industry can be traced to 1923 when Mr Adolf Erasmus discovered the Waterberg platinum deposit near Naboomspruit in the Limpopo province (McDonald & Tredoux, 2005). In 1924 Dr Hans Merensky discovered the world's largest repository of platinum in the Lydenburg district (Hochreiter, Kennedy, Muir & Wood, 1985). Platinum, in South Africa, is located in the Bushveld complex which mainly comprises of the Northern limb, Western and Eastern limb. The mining methods used to extract platinum from underground mines are conventional, mechanised and hybrid mining (Musingwini, & Minnitt, 2008). The South African platinum mining industry forms an important part of the economy that employed 164 000 people in 2019 (Statista, 2020). Further, the mining industry contributed 8.1% of the South African GDP in 2019 (Statista, 2020).

1.1.2 Occupational safety in South African underground mines

One of the major threats to the existence of the South African mining industry is mining accidents which typically result in occupational injuries or deaths. According to the

Minerals Council (2019), the overall safety performance of the mining industry has seen a progressive improvement in the reduction of occupational injuries and deaths as illustrated in Figure 1. The Minerals Council (2018) highlighted a major concern in 2017 as the industry experienced an increase in the annual number of fatal injuries for the first time in a decade. Underground mines are the most significant contributors to mining accidents where falls of ground and transportation are the major agencies. The South African government implemented the Mine Health and Safety Act, 1996 (Act 29 of 1996) as well as the Mine Health and Safety Regulations as measures to safeguard the health and safety of mine employees (Kleyn & du Plessis, 2016).



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Gold	4,202	3,549	3,374	3,288	3,079	2,861	2,338	2,318	2,274	1,937	1,760	1,379	1,498	1,477	1,252	1,142	1,249	1,200	1,018	905	732
Platinum	765	638	797	659	738	892	1,155	1,348	1,233	1,213	1,299	1,515	1,283	1,345	1,344	771	1,328	1,140	1,156	1,049	1,151
Coal	207	213	170	161	188	187	181	266	205	333	295	273	241	269	263	249	206	189	200	169	224
Other	1,079	971	1,184	1,008	296	314	309	257	261	255	296	271	277	276	267	372	355	317	290	324	299
All	6,253	5,371	5,525	5,116	4,301	4,254	3,983	4,189	3,973	3,738	3,650	3,438	3,299	3,367	3,126	2,534	3,138	2,846	2,664	2,447	2,406

Figure 1: South African mining injuries

1.1.3 Team leaders in the platinum mining industry

Team leaders are first-line supervisors of teams in the mining industry. Most teams in the platinum mining industry comprise of a few people who frequently direct themselves with regards to their work. These teams usually have one direct supervisor (a Team leader) who is always present with- and takes charge of the team as it conducts its tasks. The Team leader is normally responsible for planning and scheduling daily tasks and the safe performance of these tasks. Team leaders report to a layer of supervisors responsible for multiple teams. Team leaders are normally employees who have been part of a team, responsible for certain tasks and have been promoted through the ranks to take charge of a team.

1.2 Research conceptualisation

1.2.1 The research problem statement

The mining industry is regarded globally as one of the high-risk occupations where occupational injuries are common and occur often (Nowrouzi-Kia, Gohar, Casole, Chidu, Dumond & Nowrouzi-Kia, 2018). The South African mining industry implemented the Mine Health and Safety Act, 1996 (Act 29 of 1996) and the Mine Health and Safety Regulations as a measure to improve health and safety in mines (Kleyn & du Plessis, 2016). The mine under study made a commitment at the 2014 Mine Health and Safety Council (MHSC) Summit, through its membership with the Minerals Council South Africa, to reduce occupational injuries by 20% year-on-year in pursuit of zero harm by the year 2024 (Minerals Council, 2018; Mine Health and Safety Council, 2014). To that end, the mine under study implemented a number of health and safety initiatives since the establishment of the 2014 MHSC Summit milestones to reduce occupational injuries on a yearly basis. The mine's overall occupational injuries have shown a downward trajectory on a yearly basis since 2015. The overall number of occupational injuries reported to the Department of Mineral Resources and Energy (DMRE) by the platinum mining sector have reduced from the year 2015 to 2019, albeit not at the 2014 MHSC Summit milestone target (Minerals Council, 2019). Despite the overall improvement in the number of occupational injuries, the mine's reports show that the health and safety interventions implemented for the past three years have not been effective in reducing occupational injuries on Team leaders. The mine's reports indicate that whereas all other occupations that are highly susceptible to occupational injuries have shown a reduction in the number of occupational injuries sustained for the past three years, Team leader occupational injuries have increased as shown in In the past three years, the overall number of occupational injuries in the platinum sector has decreased from the year 2017 to 2018 and increased from 2018 to 2019 (Minerals Council, 2019). However, the number of fatalities in the platinum sector increased by 58% in 2019 as compared to 2018 (Mining Journal, 2020). For the mine of study to achieve the 2014 MHSC Summit milestones of a 20% reduction in injuries year-on-year, the mine will need to address and overcome the increasing injuries of Team leaders. To that effect, the aim of the current research is to investigate the factors that influence occupational injuries of Team leaders to understand why there has not been a reduction in occupational injuries comparative to other occupations in the mine of study. Table 1.

In the past three years, the overall number of occupational injuries in the platinum sector has decreased from the year 2017 to 2018 and increased from 2018 to 2019 (Minerals Council, 2019). However, the number of fatalities in the platinum sector increased by 58% in 2019 as compared to 2018 (Mining Journal, 2020). For the mine of study to achieve the 2014 MHSC Summit milestones of a 20% reduction in injuries year-on-year, the mine will need to address and overcome the increasing injuries of Team leaders. To that effect, the aim of the current research is to investigate the factors that influence occupational injuries of Team leaders to understand why there has not been a reduction in occupational injuries comparative to other occupations in the mine of study.

Table 1: Team leader injuries from 2017 to 2019

Year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2017	8	20.0	20.0	20.0
	2018	16	40.0	40.0	60.0
	2019	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

1.2.2 The research purpose (aim and objectives) statement

Most of the previous studies on underground platinum mine occupational injuries focus on the characterisation of the injuries among all workers. However, to realise the industry target of zero harm, it is essential to prevent occupational injuries from the supervisory level down to the lowest employee level. Proper understanding of the factors that influence occupational injuries of front-line supervisors may help improve the personal safety of employees under their care as well as the mining industry in general. As such, the purpose of this research is twofold: 1) To identify the common types of occupational injuries suffered by Team leaders in South African underground platinum mines and 2) To investigate the factors that significantly influence these occupational injuries. First, the literature was reviewed and synthesized to identify and discuss the interpretive framework for the research. Second, a research strategy, research design, research procedure and methods appropriate to investigate the determinants of Team leader occupational injuries in a platinum mine were proposed. Third, data was collected and; 1) descriptive analysis was used to identify the different sources of occupational injuries suffered by Team leaders and 2) inferential analysis was used to determine which factors significantly influence occupational injuries of Team leaders.

This research will assist in identifying key causes of occupational injuries and significant factors to consider when developing safety measures for the reduction of occupational injuries of employees (especially those of Team leaders) in South African platinum mines.

1.2.3 The research questions and research hypotheses or research propositions

1.2.3.1 Question 1: What are the different agencies that cause injuries prevalent among Team leaders in the underground platinum mine of study?

Null hypothesis: There are no causes of occupational injuries prevalent among Team leaders.

Research hypothesis 1 (directional): The most common agencies that cause occupational injuries prevalent among Team leaders are the following:

H1: Falls of ground

H2: Handling of material

Proposition: If there were no falls of ground and handling of material, there would be no prevalent causes of injuries among Team leaders.

1.2.3.2 Question 2: What factors significantly influence Team leader occupational injuries in the underground platinum mine of study?

Null hypothesis: There are no factors that significantly influence occupational injuries of Team leaders.

Research hypothesis 2 (directional): The following qualitative attributes have a significant influence on the occupational injuries of Team leaders:

H1: age

H2: experience

H3: education

Proposition: If Team leaders were older, well experienced and well-educated, they would not suffer from occupational injuries.

Research hypothesis 3: The following quantitative variables have a significant influence on the occupational injuries of Team leaders:

H1: Fatigue

H2: Work stress

H3: Job satisfaction

H4: Risk-taking

Proposition: If Team leaders did not take risks, suffer from fatigue, work stress and job dissatisfaction, then they would not experience occupational injuries.

1.3 Delimitations and assumptions of the research study

There are many factors that contribute to occupational injuries in the mining industry these include: personal, systemic, and environmental factors. Systemic and environmental factors typically affect most of the categories of employees in a mine, whereas personal factors are individually based. This study is limited to fatigue, work stress, job satisfaction and risk-taking as quantitative variables that could be associated with occupational injuries as these factors are believed to be the major factors that affect supervisors in safety.

There are many agencies that cause injuries in underground platinum mines which include, but not limited to: falls of ground, transportation, slip and fall, material handling, lock out and underground fires. This study focuses on the main agencies that only affect Team leaders in the specific mine of study.

There are different mines and commodities that make use of Team leaders in South Africa which include, but not limited to: gold, platinum, coal, manganese and diamonds. This study focuses on the Team leaders of one of the platinum mines in South Africa and includes other commodities or other mines within the platinum mining industry.

1.4 Significance of the research study

The South African mining industry is under pressure to significantly reduce occupational injuries by 20% annually, as well as to achieve a target of zero by the year 2024 (Minerals Council, 2018; Mine Health and Safety Council, 2014). The DMRE is also pressurising the mining industry to reduce occupational injuries through the mine safety stoppages that result from its audits. Consequently, a reduction in occupational injuries should translate to a reduction in occupational deaths.

While the mine of study has shown a reduction in occupational injuries on an annual basis, it has not met the 20% requirements of the MHSC. In part, this is due to the increase in occupational injuries of Team leaders from 2017 to 2019. Therefore, this study investigated the factors associated with Team leader occupational injuries to identify focus areas for the continual improvement in health and safety.

This research will be beneficial for the following reasons:

1. It will identify some of the factors that currently hinder the achievement of the 2024 safety milestones.
2. It will assist the South African mining industry improve its human resource management focus to have a positive effect on safety performance.
3. It will add to the body of knowledge with regards to mine health and safety improvement.

1.5 Preface to the research report

To that end, the report has six chapters. Following this introductory chapter, Chapter 2 provides a literature review covering the research problem, past studies, the explanatory framework and the conceptual framework. Chapter 3 discusses the research strategy, design, procedures, reliability and validity measures as well as limitations. Chapter 4 and Chapter 5 present and discuss the findings, respectively to interrogate the research questions, while Chapter 6 summarises and concludes the research.

2 LITERATURE REVIEW

This chapter has three broad objectives namely; to understand the research problem, to identify the knowledge gap, and to develop a framework for interpreting the research findings. Specifically, in Section 2.1, the research problem is detailed by reviewing the literature on the determinants of Team leader occupational injuries in South African underground platinum mines. Section 2.2 reviews literature on methods, data, findings and conclusions on studies that have attempted a similar study or research. With information arising from Section 2.2, qualitative attributes or quantitative variables that are key to this research are identified and detailed in Section 2.3 and the framework that was used to interpret the research findings in Section 2.4.

2.1 Research problem analysis

In section 1.2.1, a research problem statement that this paper intends to resolve was posed. This section uses literature to show that the research problem stated in section 1.2.1 is valid. The literature in this section points out key factors of the problem stated in section 1.2.1 and categorises the factors into root-causes, symptoms and consequences. This section uses a trend analysis of the symptoms to establish how the problem appears over time.

2.1.1 Symptoms

There are some similarities in literature for the measure of mine related accidents that frequently result in injuries or fatalities presented as the total number of accidents during that measured period. Bonsu, van Dyk, Petersen and Isafiade (2017) discuss mining accidents from a South African platinum mine where they analysed 91 accidents and measured these accidents by the total number of accidents. The authors categorised these injuries into fatalities, serious injuries, lost time injuries and minor injuries and analysed the total number in each category.

The Minerals Council, a body that represents about 90% of the South African mining industry by mineral production, also discusses total number of accidents and fatalities during a calendar year (Minerals Council, 2019). Msiza (2019), a Chief Inspector of Mines with the DMRE, also measures occupational fatalities, injuries and diseases by their total number.

Jansen and Brent (2005) describe a different measure for mine related accidents which is the rate of accidents. They discuss fatal accidents in the platinum mining industry within a three-year period and measure the fatality rate as total deaths per 1000 employees. Franz, Ashworth and Mthombeni (1998) also discuss accident rates as a measure in their investigation of underground accidents.

2.1.2 Root-causes

Most of the literature concurs that the major cause of underground mine accidents is unsafe acts performed as a result of non-compliance to safe standards and procedures. In the investigation of causal factors in underground accidents by Franz et al. (1998), the authors find that the major cause of accidents during injury investigations was as a result of deviation from standards and procedures. They discuss how accident investigations found human error as the fundamental cause of the accidents. Analysis of accident results that occurred in a platinum mine in South Africa also concluded that unsafe acts by employees were identified as the major cause of the accidents (Bonsu et al., 2017).

An analysis of the fatal accidents that resulted from the South African platinum mining industry in 2003 found that non-compliance to standards and procedures represented 70% of the accidents (Jansen & Brent, 2005). Factors such as lack of education and inappropriate training of employees have been found to increase the occurrence of non-compliance to standards and procedures (Kleyn & Du Plessis, 2016). The practice of unsafe acts has been found to originate from the individual habits and behaviour of employees in South African gold mines (Kleyn & Du Plessis, 2016).

Similarities in literature also identify falls of ground as the major contributing agency that results in injuries and fatalities in South African underground mines. Jansen and Brent (2005) found falls of ground to be the highest cause of platinum mine fatalities in a study of 2003 fatal mine accidents. The South African mining industry identified falls of ground as the most significant contributor to the overall industry occupational fatalities in 2018 (Minerals Council, 2019). The DMRE regards falls of ground as pertinent causes of injuries and fatalities and ought to be addressed (Msiza, 2019). Seismic factors, that result in falls of ground, are also regarded as significant causes of underground mine accidents

(Bonsu et al., 2017). Systemic factors have also been found to contribute to the causes of some mine accidents (Bonsu et al., 2017).

Jansen and Brent (2005) discuss in the results of their analysis of 2003 fatalities that system failures contributed to as much as 24% of the accidents. Other studies have found socio-demographic factors which include: age, race, education, income, length of service and quality of life, to be associated with the prevalence of mine accidents (Pelders & Nelson, 2019b). Jansen and Brent (2005) found that the majority of South African platinum mine accidents occurred during morning shift whilst the employees were conducting early entry examination - a process of making the working place safe.

2.1.3 Consequences

The consequences of occupational accidents in the mining industry have huge implications in society, the economy and individual companies. Occupational accidents that result in injuries and fatalities and occupational diseases have a negative impact in the mining industry and the communities that surround the mines in the form of direct and indirect costs. The direct costs include workmen's compensation costs, cost of interruption in production and the costs related to the damages of the actual workplace. Indirect costs include the loss of income to the injured person's dependents, the costs related to the loss of livelihoods, company reputational loss and withdrawal of capital investment (Hermanus, 2007).

Historically, mining accidents have led to the constant threat of mine closures and massive job losses (Mail and Guardian, 2011; Mine Safety, n.d.). The South African economy stands to lose significantly if the mining industry were to continue to experience closures. In 2019, the mining industry contributed R360.9 billion directly to GDP, which equates to 8.1% as a percentage of GDP (Minerals Council, 2019). The mining industry also employed 454 861 people in 2019 and the platinum mining industry continued to increase employment numbers year-on-year as from 2012 (Minerals Council, 2019).

The Mine Health and Safety Act, 1996 (Act 29 of 1996) and the Mine Health and Safety Regulations require mining companies to report accidents and incidents to the Regional Principal Inspector of Mines through the employers (Kleyn & Du Plessis, 2016). The reporting of these accidents and incidents could lead to safety inspections and audits from the DMRE in an effort to monitor and enforce compliance (Msiza, 2019). The results of these inspections and audits could lead to companies suffering production losses from stoppages and shutdowns ordered by the DMRE (Mine Safety, n.d.). These companies could also suffer from work stoppages imposed by union members, after suffering from fatal accidents, for a day to mark the death of colleagues (Mine Safety, n.d.).

2.2 Research knowledge gap analysis

In this section of the research, literature was used to undertake a research knowledge gap analysis. This section shows the difference between the empirical research others have pursued and the research problem stated in Section 1.2.1 to justify why this research is worth pursuing. Thereafter, this section shows which direction the research should follow (from the literature discussed in Section 2.1) to effectively advance the body of knowledge.

There are studies (locally and globally) that investigate different factors that contribute to occupational injuries sustained by employees in the mining industry. These studies have found it necessary to investigate these factors due to the negative impact and consequences mining accidents have on the mining industry. The studies describe multi-causal factors that contribute to occupational injuries in different mining environments. They found that factors associated with health and safety of mine workers vary from socio-demographic, systemic, personal and work-related. (Nowrouzi-Kia et al., 2018; Pelders & Nelson, 2019; Maiti, Chatterjee & Bangdiwala, 2004)

Pelders and Nelson (2019b) conducted a study that assessed the contributing factors to the fatigue of mine workers in platinum and gold mines in South Africa. From one platinum mine and four gold mines, qualitative data were gathered and analysed through 21 semi-structured focus groups and quantitative data were gathered and analysed through 564 questionnaires to gather information about fatigue contributors. Thematic analysis was used to analyse the qualitative data, and descriptive and inferential statistical analyses were used to analyse the quantitative data. The study population was sampled through convenience methods and comprised of participants from management, union representatives and mine workers. Results from the study showed that fatigue was a contributing factor to injuries, accidents and long-term health problems in the mining industry. These results are comparable to previous studies done by Schutte (2010). Extended working hours were found to be the main contributor of fatigue among the participants. These results are consistent with findings from another study done by Dawson and Fletcher (2001). The study found that fatigue was a result of working conditions and pressures, socioeconomic factors, living conditions and poor health. The findings of the study supported the conceptual framework described in the literature on the topic. The study concluded that addressing the variables that were found to contribute fatigue, would improve the health and safety of mine workers in South Africa.

Pelders and Nelson (2019a) conducted a study that assessed the relationship of socio-demographic factors to wellness, health and safety in the South African mining sector. From three platinum, two gold, one manganese, one coal and one diamond South African mine, qualitative data were collected from 64 interviews and 14 focus groups and quantitative data were collected from 875 questionnaires. The participants were selected using convenience sampling and included management, union representatives and mine workers. Thematic analysis was used on the qualitative data, Chi-squared analyses were used to determine associations of socio-demographic factors with wellness, health and safety. The results of the study showed that the health challenges experienced by mine workers included HIV/AIDS, respiratory diseases, tuberculosis (TB) and non-communicable diseases while safety challenges included fatigue, stress and worker behaviour. The socio-demographic factors that were found to be associated with accidents, diseases and job satisfaction included education, income, race, length of service, age, nationality, alcohol usage and work status. These finding are comparable to previous studies done by Ghosh, Bhattacherjee and Chau (2004), Yokoyama, Iijima, Hiroto and Mari (2013) and Molarius, Berglund, Eriksson, Lambe, Nordström, Eriksson and Feldman (2007). The study concluded that socio-demographic factors should be considered in programmes for workplace health and safety.

Bonsu, Van Dyk, Franzidis, Peterson and Isafiade (2017) conducted a study to demonstrate how a systemic analysis could be used to determine the causes of mine accidents in a South African platinum mine. The study applied the accident analysis framework on 91 previous mine accidents reported from 2010 to 2012 which were obtained from the mine's accident report. The results obtained from the study showed that workers operate in close proximity to workplace hazards. The results also showed that routine violations to standards and procedures were the most common personal factor that caused accidents. These results are similar to those obtained in a study conducted by Lenné, Salmon, Liu and Trotter (2012). The authors showed that problems in the physical working environment were the most common workplace factor that caused accidents. These results are consistent with those of another study conducted by Patterson and Shappell (2010). The results also showed that inadequate leadership was the most common systemic factor that contributed to accidents in the mine. Even though the causes of mining accidents are complicated and include several factors, the study found that systemic factors were the major causes of accidents in the mining industry. The study concluded that the framework needed to be applied to a wide range of reported accidents from the different mines.

Masia and Pienaar (2011) conducted a study to investigate the relationship of job satisfaction, job security, work stress and commitment to safety compliance in South African mines. The researchers used data collected through a cross-sectional design from a convenience sample of 158 participants. The participants ranged from production manager to miner with an average of 8.47 years of experience. Qualitative and quantitative data were combined to measure the variables. Statistical analysis was used to analyse the data through the correlation coefficients between the variables and logistic regression predicting the likelihood of safety compliance. The results of the study showed that job security and work stress had an inverse relationship with safety compliance. The results were consistent with a study conducted by Ashworth and Peake (1994). The study found that job satisfaction was the most significant predictor of safety compliance. The study recommended that promoting and improving job satisfaction could improve safety compliance within the mining industry.

Studies conducted to investigate the factors that contribute to occupational injuries of mine workers in South African mines have presented a wide range of contributors which include fatigue, work stress, job dissatisfaction, job security and safety compliance. The existence of varying findings in this theme offers an opportunity for further studies that might determine other contributors. Most studies in this topic only target workers outside the accident group through convenience sampling. This is evident in the studies conducted by Pelders and Nelson (2019a), Masia and Pienaar (2011), and Pelders and Nelson (2019b). This offers an opportunity to investigate this topic by targeting both the accident group and the non-accident group through random sampling in order to obtain more representative results of the mining industry. A study conducted by Bonsu et al.

(2017) recommended a further study into the contributing factors that affect leadership in safety performance. This offers an opportunity to investigate the front-line leadership in the South African mining industry *viz.* Team Leaders. This highlights gaps in literature which needs further exploration and this knowledge gap is what guided the current research.

From previous studies conducted on this topic, there are conceptual and theoretical frameworks that were used as a guide for this research. Pelders and Nelson (2019a) developed a conceptual framework on the association between socio-demographic factors, fatigue and safety which was explored in relation to front-line leadership in the mining industry. Bonsu et al. (2017) used the accident analysis framework which was explored in the current research. Masia and Pienaar (2011) studied safety compliance within a work stress framework which was looked at in this study.

2.3 Qualitative attributes or quantitative variables key to the research

In this section of the research, literature was used to understand and detail the qualitative attributes or quantitative variables within the field of study driving the research problem stated in Section 1.2.1. This section reviews similar past and current research studies to understand key attributes or variables that are useful for this research. The key qualitative attributes or quantitative variables are necessary for constructing a theoretical or interpretive framework for this research in Section 2.4.

<u>Attributes</u>

Kumar (2019) describes attributes as variables that show the characteristics of a population of study and they cannot be changed. The author explains that this refers to characteristics such as age, gender, education etc. They are mostly associated with qualitative data which measures categorical variables (nominal or ordinal scales.

<u>Variables</u>

Kumar (2019) describes variables as active variables that can be changed. They are mostly associated with quantitative data which measures continuous variables (interval or ratio scales).

Fatigue

Shen, Barbera and Shapiro (2006) describe fatigue as, "an overwhelming sense of tiredness, lack of energy and a feeling of exhaustion, associated with impaired physical and/or cognitive functioning" (p 70). Chalder, Berelowitz, Pawlikowska, Watts, Wessely, Wright and Wallace (1993) explain that fatigue develops during muscular activity and is experienced when one loses the capacity to generate maximal force. It has been widely accepted that fatigue is a significant factor that contributes to occupational injuries, especially transport related accidents (Ji, Lan & Looney, 2006).

Ji et al. (2006) assert that fatigue is a mechanism that is difficult to understand. Fatigue and sleepiness are terms that are regularly used interchangeably (Shen et al., 2006). Shen et al. (2006) mention that within the working population, fatigue has been identified as a major life-threatening factor. There have been several scales produced to measure the severity and perception of fatigue and there has not been a general acceptance (Chalder et al., 1993).

Ji et al. (2006) state two physiological factors that are fundamental to determine fatigue namely; sleep and circadian. The authors assert that the common causes of fatigue are illness, early morning departure, heavy workload and late arrival.

Job satisfaction

Locke (1969) describes job satisfaction as a "pleasurable emotional state resulting from the appraisal of one's job as achieving or facilitating the achievement of one's job values" (p 316). Kalleberg (1977) notes the importance of studying issues related to job satisfaction to try and improve individuals' experience at work and to improve productivity and the functioning of the organisation. Brayfield and Rothe (1951) assert that it is difficult to obtain indices of job satisfaction.

Kalleberg (1977) explains that the variation in the job satisfaction of employees has been explained in terms of individual workers' personalities and as a function of the variances in the jobs that people perform. The author describes several factors that affect job satisfaction which include; pay, fringe benefits, job security, good working hours, no excessive amounts of work, enough time to do the work, good chances of promotion, friendly co-workers who provide adequate information, equipment and authority to do the work.

Work stress

Cox (1993) (as cited in Jeremy, 2005) describes work stress as "a psychological state which can cause an individual to behave dysfunctionally at work and results from people's response to an imbalance between job demands and their abilities to cope" (p 2). Jeremy (2005) explains that work stress arises from people confronting difficulty, worry and anxiety whilst trying to cope with pressure connected to their work. The author describes stress as a rate of deterioration of the human body's systems as a result of life.

Nakata, Ikeda, Takahashi, Haratani, Hojou, Fujioka, Swanson and Araki (2006) suggest that studies have found psychological work stress to be an important contributing factor to occupational injuries. The authors suggest that work stress arises as a result of people experiencing a high variation in their workload, high cognitive demands of the job, low job control, high future ambiguity of the job and high conflict with colleagues. Jeremy (2005) asserts that the most common sources of work stress are information overload, work beyond the person's mental capacity, role ambiguity, role conflict, fear of being dismissed and redundant, threat to a person's safety and no recognition.

Risk taking

Surry (1969) (as cited by Salminen, Klen, & Ojanen, 1999) defines risk-taking as "the willing performance of an action which has been judged to have a nonzero degree of risk" (p 144). The authors explain that this is exposure to a dangerous situation that is made consciously and voluntarily. The concept of risk is largely centred on a choice which is affected by the expected return of an alternative outcome (March & Shapira, 1987).

Salminen et al. (1999) suggest that literature has made it common belief for risk-taking to be highly associated with occupational injuries. They assert that drivers involved in accidents are more likely to take risks than drivers who have never been involved in accidents. The authors reviewed literature to find that most of the reviewed literature found a positive correlation between risk-taking behaviour and being involved in accidents. The authors suggest that the personality traits that have been found to be associated with risk-taking are impulsiveness and extroversion. In their study, the authors measured sociability, neuroticism, impulsive and fatalistic attitudes to determine the risk-taking tendencies of respondents.

2.4 Framework(s) for interpreting research findings

In this section of the research, literature was used to identify theoretical frameworks or other frameworks, theories or models to explain and interpret research findings. This section interrogates literature in the field of study and the interpretive frameworks to establish a plan for interpreting the empirical research findings. In this section, most of the theoretical or interpretive frameworks were reviewed to identify the most appropriate frameworks, theories, models or constructs for interpreting research findings.

Interpretive framework

A theoretical framework is "a selection of concepts and relations among them, grouped so as to enable its users to easily see their structure" (Rowlands, 2005, p 86). The author explains that this framework has four elements to it. Firstly, the elements which include variables, constructs etc. Secondly, the "how" and "why" the elements relate. Thirdly, the assumptions and fourthly, the limitations on the proposition.

Job Stress

Kerr (1957) pioneered a stress theory in which he explains that negative and unusual stress increases the chance of an accident or poor behaviour of a person. The author explains that the stresses upon the individual could be imposed by the internal or external environment. He describes the external environment to include physical work strain, excessive noise level, excessive temperature and others. Studies done by Murphy, DuBois and Hurrell (1986) and Leung, Liang and Olomolaiye (2016) support this theory.

Leung et al. (2016) observed that construction workers were exposed to work-related hazards on construction sites when they were forced to work faster or when they were working without equipment. The authors deduced that these working conditions induced serious stress that led to dangerous conditions at work. The authors collected data through questionnaires and carried out correlation and regression analyses to determine that stress predicts safety behaviour. The findings of this study are useful for reducing accidents in construction sites through the implementation of stress-reduction initiatives.

Murphy et al. (1986) observed that there was not much literature on the association of work stress and injury occurrences and that literature suggested that stress has some contribution in accidents. The authors reviewed stress data linked to unsafe behaviour to propose a model. They suggested that stress may have an influence in accidents. These findings are useful for the current research which examined the factors associated with occupational injuries of Team leaders.

Fatigue

Bogardus (1912) was one of the early pioneers to have associated fatigue to work accident in the industrial world. The author's study was developed through the theory that fatigue was brought about by the end of the domestic industry by the factory system. The author's study was supported by Lilley, Feyer, Kirk and Gander (2002) who studied the change in forestry workers in New Zealand with regards to fatigue and safety. This study was further supported by Smith (2016) who used a multivariate approach to investigate the association of fatigue and road traffic accidents.

Lilley et al. (2002) conducted a survey whereby 367 forestry workers answered a questionnaire to determine the prevalence of fatigue among the forest workers. All three studies found that fatigue is associated with work accidents and compromised safety. This fatigue theory is useful for the current research as it can be used to predict work injuries. The research examined factors associated with Team leader occupation injuries and due to the nature of work in platinum mines, the fatigue theory could be a significant predictor of these injuries.

Job satisfaction

Pestonjee, Singh and Ahmad (1977) conducted a study to identify if job satisfaction was linked with the high industrial accidents reported in India. The authors surveyed a sample of 100 workers (with 50 from the accident group) to collect data for analysis. Their results showed that there is an intimate relationship between job satisfaction and accidents.

Holcom, Lehman, and Simpson (1993) conducted a study that supported this relationship between job satisfaction and accidents. In their study, the authors intended to investigate the relationship between substance use and accidents from a sample of municipal workers in the United States of America. The authors used variables from job characteristics, personal characteristics and substance use as discriminators. Their findings suggest that workers who are likely to have accidents are the ones dissatisfied and tense at work.

Barling, Kelloway and Iverson (2003) conducted a study to investigate whether job satisfaction affected occupational injuries, by randomly sampling 2001 employees for data collection. The authors analysed the data to find that employees who worked safely were those that experienced high levels of job satisfaction. These findings are beneficial to the current research as job satisfaction could be a factor that contributes to high occupational injuries among Team leaders in the mine of study.

Risk-taking

Some of the early pioneers of risk-taking and its association with work-related accidents include Cohen, Dearnaley and Hansel (1956) who considered a variety of questions pertaining to "subjective probability and risk-taking" (p 67). They describe risk as a person's attempt at performing a task when they are uncertain if they will succeed. The authors studied the different risk-taking levels of bus drivers who had to make decisions on whether a gap was large enough to drive through. This theory was later supported by Smith (2016) who used a multivariate approach to investigate the association of risk-taking and road traffic accidents.

The results of both studies found that the drivers who took less risks, were involved and reported less road traffic accidents. This theory was challenged by Trimpop and Kirkcaldy (1997) who studied the personality traits of drivers who got involved in accidents. In their study, the association of risk-taking and driving accidents was not clearly related. This theory is useful and could be applicable to the current research for examining factors associated with Team leader work-related injuries in a South African platinum mine.

2.5 Summary and conclusion

2.5.1 Summary of literature reviewed

To analyse the research problem, this study reviewed literature on symptoms, causes and consequences of occupational injuries. The South African mining industry mostly measures the symptoms of occupational accidents as total numbers of occupational fatalities or injuries. The occupational injuries are further divided into serious injuries, lost time injuries and minor injuries.

The major root-causes of accidents in the mining industry were found to be personal and systemic factors. These include unsafe behaviour, non-compliance to procedures, lack of education and inadequate training. The consequences of occupational accidents include direct and indirect costs. The direct costs include loss of production and cost of damages whereas the indirect costs include reputational loss and the loss of livelihoods.

In analysing the knowledge gap, most studies on occupational injuries sample respondents who might not have been involved in occupational injuries. This study will contribute to filling that gap by including respondents who have been previously involved in injuries. Previous studies have recommended a study that involves leadership within the industry. This research investigates first-line supervisors as a form of leadership.

Variables that were considered significant to first-line supervisors were fatigue, work stress, job satisfaction and risk-taking.

2.5.2 Proposed research strategy, design, procedure and methods arising from the literature reviewed

This study has two main objectives which emanate from the research questions, these are: 1) to identify the common types of accidents that are prevalent among Team leaders in the mine of study and 2) to investigate the socio-demographic, systemic and personal factors that are associated with occupational injuries of Team leaders.

The proposed study utilised a mixed method research strategy for a comprehensive understanding of the research topic. The study utilised a cross-sectional research method which analyses data collected at a specific point in time.

The target population of the research was Team leaders in the specific mine of study. Team leaders were sampled using a convenience sampling method due to access to the target population. The data collection instruments that were used are a semi-structured focus group discussion and fully structured questionnaire.

Content analysis was utilised for the study to identify recurring themes. Descriptive and inferential statistics were performed to provide descriptions of the population and to make predictions about the population. Bivariate analysis and Regression were performed to assess associations between variables.

3 RESEARCH STRATEGY, DESIGN, PROCEDURE AND METHODS

In Section 1.2.3, two questions that this research report intends to answer were posed that is, 'What are the different agencies that cause injuries prevalent among Team leaders in the underground platinum mine of study?' and 'What factors significantly influence Team leader occupational injuries in the underground platinum mine of study?' An interpretative as well as conceptual framework were developed upon reviewing literature to help guide the choices of techniques to be used in the study. This chapter identifies and describes the research approach, design as well as procedure and methods that were employed in this research to collect, process, and analyse empirical evidence. Broadly, it has three objectives namely; to identify and describe the research strategy (Section 3.1), the research design (Section 3.2), as well as the procedure and methods (Section 3.3). The chapter also describes the reliability and validity measures (Section 3.4) that this research applied to make it credible, as well as the technical and administrative limitations of the choices made (Section 3.5).

3.1 Research strategy

A research strategy (also referred to as the research approach) refers to the general orientation to conduct social research (Bryman, 2016). This is a plan and procedure for conducting research which includes general assumptions, comprehensive methods of how data will be collected, data analysis and interpretation (Creswell & Creswell, 2017). A research study can take the form of three strategies: qualitative, quantitative and mixed methods – a strategy that combines qualitative and quantitative research (Bryman, 2016).

A mixed methods research strategy was utilised for this study. This research method combines both qualitative and quantitative methods.

Leavy (2017) notes that this method involves the collection, analysis and integration of both qualitative and quantitative data within a single research project. The author asserts that the use of a mixed methods research strategy could result in a comprehensive understanding of the topic being investigated due to this integration of both qualitative and quantitative data. Bryman (2016) concludes that the use of a mixed methods strategy may enhance a researcher's confidence in their own findings especially when triangulation was conducted. The author explains that the process of triangulation involves cross-checking the results obtained with one research strategy against the results of another research strategy.

Bryman (2016) describes qualitative research as a research strategy that normally stresses on words in the collection and analysis of data. The author also describes quantitative research as a research strategy that normally focuses on measured data in the collection and analysis of data. A mixed methods strategy integrates words and measured data collection and analysis in its approach. Due to its ability to draw on the strength of both qualitative and quantitative research, and the minimization of limitations of both methods (Creswell & Creswell, 2017), the mixed methods strategy was chosen for the current study. This method also allows for a complete understanding of the research problem.

In a similar study, Pelders and Nelson (2019b) examined the socio-demographic contributors to the health and safety of mine workers. The main aim of their study was to examine for associations between socio-demographic factors and the health, safety and wellbeing of workers in South African mines. A mixed method strategy was applied in their study to allow for a comprehensive understanding of the research topic. One of the key advantages of using a mixed method research strategy for the current study was the link between participant characteristics and the associations of socio-demographic characteristics with health and safety variables. The comprehensive outcome of this study could be used to recommend improvements to health and safety in the South African mining industry.

3.2 Research design

A research design is described as a framework used for the collection and exploration of data (Bryman, 2016). Creswell and Creswell (2017) refer to research design as types of inquiries used within the different research strategies that provide direction for procedures in research. Bryman (2016) identifies and examines five different types of research designs including; experimental, cross-sectional, longitudinal, case study and comparative research deign. This study made use of a cross-sectional research design.

Bryman (2016) explains that a cross-sectional design involves gathering data from more than one case at a single point in time. The author further explains that the aim of cross-sectional design is to gather data that can be quantified in association to two or more variables to determine patterns that show relationships. Edmonds and Kennedy (2016) assert that this research design is commonly used to collect opinions or attitudes from a specific group of people. Kumar (2019) states that this research design is aimed at investigating the prevalence of a problem and is useful in understanding the overall picture at a particular point in time and for this reason, the currentstudy committed to this design.

Masia and Pienaar (2011) conducted research to unravel safety compliance in the South African mining industry. The objective of that study was to investigate the relationship between job satisfaction, job insecurity, work stress, organisational commitment and safety compliance in a mine. The aim was to also determine whether work-related variables could be used to predict safety compliance of mine employees. The rationale for applying this design was to assess inter-relationships between variables and obtain an overall picture at a point in time. The benefit for applying this design was that the authors were able to examine patterns that showed a relationship between the aforementioned variables.

The current study aims to investigate patterns of association among age, experience, education, fatigue, work stress, job satisfaction, risk-taking and Team leader safety at a single point in time as per previous studies (Masia & Pienaar, 2011). Data for this study was collected from a specific group (Team leaders) in a South African underground platinum mine. The data was gathered from several cases to establish a mixed level of the variables. The cross-sectional research design was utilised to provide the required outcomes of this study.

3.3 Research procedure and methods

This section documents the actual procedure and the methods employed in this research to collect, collate, process, and analyse empirical evidence. Broadly, we detail the data and information collection instruments were detailed (Section 3.3.1), the target population and sampling of respondents (Section 3.3.2), the ethical considerations during the research process (Section 3.3.3), data and information collection process and storage (Section 3.3.4), data and information processing and analysis (Section 3.3.5) as well as the background description of the respondents who provided empirical evidence for this research study (Section 3.3.6).

3.3.1 Research data and information collection instrument(s)

Kumar (2019) explains that a research data collection instrument is anything that is a means of gathering information for a study. Bryman (2016) describes data collection instruments to include self-completion questionnaires, interview schedules and participant observations. Interviews include face-to-face interviews, computer-assisted interviews, telephone interviews, and other interviews through electronic media (Sekaran & Bougie, 2016). Sekaran and Bougie (2016) mention that questionnaires could be personally administered, sent through the mail or electronically administered. They believe that questionnaires have an advantage of gathering data more efficiently in terms of energy, costs and time. Based on the aforementioned advantage, the current study utilised personally administered questionnaires to collect data from respondents.

Sekaran and Bougie (2016, p. 174) describe a questionnaire as "a preformulated written set of questions to which respondents record their answer, usually within rather closely defined alternatives". The authors explain that questionnaires are very efficient instruments to collect data if the researcher knows how to measure the required variables. They assert that a good way to collect data when the survey is in a local area, and the organisation can assemble groups of employees to respond to the questionnaires, is through personally administered questionnaires. They mention that the main advantage of this is that all the completed responses can be collected in a short space of time. Sekaran and Bougie (2016) explain that administering questionnaires to groups is less time consuming, less expensive and does not require skills as with conducting interviews. These are the reasons the current study utilised this collection instrument.

Leavy (2017) describes three levels of research data collection instrument structure that ranges from unstructured to semi-structured to highly structured. The author explains that in-depth interviews range from unstructured to semi-structured which means they do not have a determined set of acceptable responses. The author explains that this means that participants can respond in any direction they wish to respond to the question, and they could provide long and detailed responses if they so wish. Bryman (2016) describes a fully structured approach where a researcher knows in advance the broad outlines of what they need to find out about and they design research instruments, such as questionnaires, to implement what they need to know. The author describes the three structures of data collection instruments to include unstructured, semi-structured and structured.

A structured and a semi-structured research data collection instrument was utilised in the current study.

Bryman (2016) describes a structured interview, which is sometimes referred to as a standardised interview, as a method that requires an interview schedule to be administered by the interviewer and contains mainly questions that are fixed choice. The author explains that a structured interview is one of the two main ways a survey research instrument is administered. The author asserts that the questions on a structured interview are normally very specific and frequently offer respondents a fixed range of responses. The author also asserts that the structured interview promotes standardisation in the asking of questions and the recording of responses. Leavy (2017) explains that highly structured interviews use the same interview guide with every respondent.

Bryman (2016) lists the advantages of structured interviews as; (i) having less potential for interviewer variability, (ii) good facilitation of data processing, (iii) enhancing the comparability of responses, (iv) clarifying the meaning of questions, and (v) ease of completion by the interviewer and respondents. Based on the characteristics explained, a structured data collection instrument was utilised for this study.

Bryman (2016) explains semi-structured interviews to include questions that act as an interview guide with the respondent having leeway on how to answer the question. The author explains that the questions may not follow the schedule and other questions that are not included in the guide may be asked as the interviewer picks up on other things mentioned by the respondents. The author also explains that by the end of the interview, all the questions set out in the guide will be asked.

Bryman (2016) lists that advantages of semi-structured interviews which include: (i) respondents answer in their own terms, (ii) tapping into the knowledge of respondents, (iii) using answers to generate fixed-choice type of answers, and (iv) allowing unusual responses. Based on the characteristics explained, a semi-structured data collection instrument was also utilised in this research study.

In a similar study, Pelders and Nelson (2019a) investigated factors that contributed to the fatigue of mine workers in the South African gold and platinum mining industry. Semi-structured focus group discussions were held to gather quantitative data, and fully structured questionnaires were used to gather quantitative data and to investigate variables associated with fatigue. The qualitative data was used to explain the quantitative associations. The advantages of that study in terms of using qualitative data to explain quantitative associations, administering of a large number of questionnaires and the tested variables associated with fatigue were of benefit to the current research.

The questionnaire utilised in the current research to collect quantitative data consisted of five parts. The first section dealt with some of the socio-demographic particulars of the respondent. The second section dealt with fatigue measured with a 15-item scaled questionnaire adopted from the Occupational Fatigue Exhaustion Recovery (OFER) scale, developed by Winwood, Winefield, Dawson, and Lushington (2005). Each item on the questionnaire was measured on a five-point Likert Scale which ranges from strongly agree at 1 (one) to strongly disagree at 5 (five). The third section dealt with work stress measured with a 14-item scaled questionnaire adopted from the scale used by Ghosh et al. (2004). Each item on the questionnaire was also measured on a five-point Likert Scale which ranges from strongly agree at 1 (one) to strongly disagree at 5 (five). The fourth section dealt with job satisfaction measured with a 15-item scaled questionnaire adopted from the scale used by Ghosh et al. (2004). Each item on the questionnaire is also measured on a five-point Likert Scale which ranged from strongly agree at 1 (one) to strongly disagree at 5 (five). The fifth section dealt
with risk-taking behaviour measured with an 11-item scaled questionnaire adopted from the scale used by Ghosh et al. (2004). Each item on the questionnaire is also measured on a five-point Likert Scale which ranges from strongly agree at 1 to strongly disagree at 5.

The mine accident data was collected from the mine accident reports where a total of 40 injuries that were sustained by Team leaders were recorded between 2017 and 2019.

3.3.2 Research target population and selection of respondents

3.3.2.1 Research target population

Bryman (2016) describes a target population to consist of a universe of cases in which a sample is drawn from. Walliman (2017) describes the target population as the total cases which are the subject of a research.

The target population for the study consisted of adults that work in a South African platinum mine located in the bushveld complex in Limpopo. The respondents consist of employees of the mine employed in the first line of supervision as Team leaders. All the Team leaders working underground, who were at the training centre during the data collection, were invited to participate in this study.

Prior studies that have investigated similar topics have not effectively utilised the specific target population that was identified for the current study. Most studies utilised a target population that consisted of different job categories of mine employees within specific mines. For example, Pelders and Nelson (2019b) conducted a study to examine the socio-demographic contributors to the health and safety of mine workers. The target population for their study consisted of mine workers, managers and union representatives thus representing a wide range of job categories. The target population was selected to enhance the representativity of the participants. The advantage of utilising this target population was that the researchers were able to use a large sample size and were able to infer their findings on eight South African mines.

A study conducted by Bonsu et al. (2017) recommended a further study into the contributing factors that affect leadership in safety performance. For this reason, the current study utilised the front-line leadership as a target population which other similar studies have not utilised before. The current research can benefit from previous studies in that the proposed target population was incorporated in the association of variables found in those studies. The target population in the current study falls within the target population of previous studies similar to the current one.

3.3.2.2 Sampling or selecting respondents from the target population

Sample refers to the portion of the population that is nominated for investigation (Bryman, 2016). Leavy (2017) refers to a sample as a number of cases that a researcher draws and from which data is generated. This therefore means that sampling is the process of selecting a few cases from a bigger group (Kumar, 2019). The current study utilised non-probability sampling.

Walliman (2017) explains that non-probability sampling involves selection using means that are not random. This technique is useful where it is challenging to access the target population. Bryman (2016) explains that there are three main types of non-probability sampling techniques which include convenience sampling, snowball sampling and quota sampling. The author describes a convenience sample to be one that is obtainable to the researcher because of its accessibility. The author further explains that the data obtained through this sampling technique does not allow definitive findings to be generalised but provides a platform for further research to be pursued.

Bryman (2016) describes Snowball sampling as a technique whereby the researcher makes initial contact with people relevant to the topic and uses the contacts to make contacts with others. For the purpose of the current study, convenience sampling was utilised since there was convenient access to a number of Team leaders at the mine of study within the training centre of the mine.

Earlier studies that have investigated similar phenomena in the mining industry have successfully utilised non-probability sampling techniques in the form of convenience sampling. Pelders and Nelson (2019a) conducted a study to investigate factors that contributed to the fatigue of mine workers in the South African gold and platinum mining industry. Non-probability sampling, specifically convenience sampling, was utilised in that study as probabilistic sampling was not possible. The target population was sampled from the mine training centre as to not interrupt production. This sampling technique provided an exploratory understanding of the topic under investigation.

The current study benefited from utilising non-probability, specifically convenience sampling, as specified by the authors above. The study firstly, had access to a limited population of Team leaders within the training centre. Secondly, the study provided an exploratory understanding of the research topic. Due to time constraint and resources to conduct the research, a convenience sampling technique was suitable for the current study.

3.3.3 Ethical considerations when collecting research data

Kumar (2019) described ethics in research as the professional practice in accordance with the principles of conduct that are acceptable when conducting research.

As a researcher involved in the investigation of determinants of Team leader occupational injuries in a South African platinum mine, the researcher conducted this research in accordance to accepted research ethics. The researcher did not cause any real or potential harm or stress or loss of self-esteem to the respondents in the collection of research data. The researcher did not cause any of the respondents to perform reprehensible acts. The researcher obtained informed consent by giving participants enough information for them to make an informed decision on whether they would like to participate or not before they participated in the collection of data. The researcher assured the research community that their identities would be protected and the research data would be securely stored in a password protected computer until it is destroyed.

Permission to conduct this research at the mine was obtained from the General Manager. Also, ethical approval to conduct this study was received from the School of Graduate School of Business Administration Ethics Committee of the University of the Witwatersrand (Certificate number: WBS/BA0500570V/981).

3.3.4 Research data and information collection process

Creswell and Creswell (2017) describe research data collection as gathering information from a sample through a research data collection instrument and establishing how this information will be recorded. Walliman (2017) explains that data collection needs a plan that identifies what data is needed, where the data can be found and the appropriate methods to collect that data. Leavy (2017) mentions different methods of data collection which include questionnaires (administered in numerous ways), interviews (face-to-face, telephone, or internet based), focus groups, participant observation or ethnography and document analysis. This study made use of a focus group discussion to collect qualitative data and a questionnaire for quantitative data collection administered by the researcher for consistency.

Walliman (2017) describes a focus group as a type of group interview that focuses on a particular theme. The author explains that the group is normally made up of people who have in-depth knowledge and experience on the topic of research. The author mentions that questionnaires are more suitable for gathering quantitative data even though they can be used for qualitative data. The author believes that a questionnaire enables a researcher to organise questions and receive responses without having to talk to all the respondents. Furthermore, the questionnaire has a structured format, is convenient for respondents and is affordable and quick to administer. Leavy (2017) explains that the questionnaire technique allows the researcher to collect a wide range of data from a large sample. The authore also explains that the advantage of focus group discussions is in the collection of rich data. The aforementioned reasons serve as justification for utilising the focus group and a questionnaire for the current research.

Pelders and Nelson (2019b) conducted a study to examine the socio-demographic contributors to the health and safety of mine workers. The researchers used focus group discussion fore gathering qualitative data and a questionnaire for the gathering of quantitative data. The benefit to the study was that the researchers were able to do methodological triangulation to analyse the results. The researchers were also able to collect a range of data from a large sample (875 participants). The two techniques of collecting data were of benefit to the current study as it allowed methodological triangulation to be used to analyse the results and collection of a range of data from a reasonable sample of Team leaders.

To devise storage that is safe and only accessible to the researcher, the data was transcribed electronically and stored in an encrypted file with password protection in order to secure the data.

3.3.5 Research data and information processing and analysis

3.3.5.1 Research data and information processing

Kumar (2019) describes the processing of data to entail all the actions undertaken from when the data is gathered until it is ready to be analysed. The author explains that the first step in data processing is editing the data. This is followed by data coding which requires developing a code book.

Kumar (2019) explains that data coding involves transforming the gathered information into numerical values to ensure that the information can be analysed easily. Data coding in the current study entailed manually capturing and coding on Microsoft Excel responses from participants' answers recorded on a pen and paper-based questionnaire.

Sekaran and Bougie (2016) discuss data entry as the entering of data into a database after coding the responses. They explain that raw data can be entered onto a software programme. In this study, data was entered onto a computer programme (the SPSS Data Editor, version 27).

Sekaran and Bougie (2016) explain that data cleaning/editing entails detecting and fixing inconsistent, illogical and illegal data and omissions from the data obtained from the participants. All the cases in this study were checked for errors and missing information. Invalid codes were checked through frequency tables in SPSS.

3.3.5.2 Research data and information analysis

Bryman (2016) explains that research data analysis is about the reduction of data and involves reducing a large amount of information gathered to make sense of it. The author further explains that this data reduction could be producing averages or tables for quantitative data and grouping text into themes for qualitative data. Kumar (2019) discusses data analysis of purely descriptive data through content analysis and quantitative data through frequency distribution, cross-tabulation, regression analysis, analysis of variance and factor analysis.

Content analysis was utilised for the purposes of this study so as to identify recurring themes. Descriptive and inferential statistics were performed to provide descriptions of the population and to make predictions about the population. Bivariate correlation and linear regression analyses were performed on SPSS to assess associations between variables.

Bryman (2016) describes content analysis as an approach to analyse documents and texts in order to quantify the categories of content in a replicable manner. The author explains that content analysis is applicable to unstructured information. This analysis of qualitative data is to make inferences from the gathered data (Sekaran & Bougie, 2016). Descriptive statistics are important as they provide an account of the context in which people's behaviour takes place (Bryman, 2016).

Bryman (2016) notes that the chi-squared analyses allow the researcher to determine how confident they can be that a relationship exists between variables in the population. The author explains that the chi-squared value needs to be interpreted in relation to the statistical significance level associated with the value. These analyses helped to determine the prevalent causes of injuries and to identify factors associated with injuries (safety) of Team leaders in the study.

Pelders and Nelson (2019b) conducted a study to examine the socio-demographic contributors to the health and safety of mine workers. Thematic analysis was utilised to identify the main topics from the discussion. Chi-squared analyses were performed to determine relationships between socio-demographic factors and health, safety and wellness. The authors were able to determine the participant characteristics and the associations of socio-demographic characteristics with safety, health and wellness. The authors were also able to use the qualitative data to explain the quantitative results. These analysis tools were beneficial to the current research in determining the prevalence of common injuries, determining the characteristics of the research participants, determining the relationships of independent variables with injuries (safety) and using qualitative data to explain the quantitative data.

3.3.6 Description of the research respondents

A total of 33 respondents participated in completing the questionnaire. Table 2 presents some of the respondents" characteristics.. All the respondents were Team leaders and male with a mean age of 47.12 years and standard deviation (SD) of 7.3 years. Their ages ranged between 33 – 58 years. Their education level ranged from standard 3 (grade 5) to tertiary, with the mean education at standard 8.7 and standard deviation (SD) of 2.2. The respondents work experience varied from 7 - 34 years in the mining industry with a mean of 21.9 years and standard deviation (SD) of 7.5 years. Their experience as Team leaders varied from 1 – 26 years with a mean of 13.6 years and standard deviation (SD) of 6.0. The majority of the respondents were married (90.9%) and more than a quarter (36.4%) had previously suffered from a work-related injury sustained at the mine of study. All the respondents worked in the underground workings at the mine of study.

Table 2: Respondents' characteristics

Statistics

		Age	Edu	Exp. TL	Exp. Min	Married	Injury
N	Valid	33	32	33	33	33	33
	Missing	0	1	0	0	0	0
Mean		47.12	8.69	13.55	21.88	.91	.36
Median		48.00	9.50	15.00	24.00	1.00	.00
Mode		49	10	18	13[a]	1	0
Std. Deviation		7.275	2.221	6.021	7.516	.292	.489
Minimum		33	3	1	7	0	0
Maximum		58	11	26	34	1	1
Sum		1555	278	447	722	30	12

a. Multiple modes exist. The smallest value is shown

A total of eight respondents participated in the focus group discussion. These respondents were all Team leaders and all male, working in different parts and sections of the mine of study. All the participants worked in the underground workings at the mine of study.

3.4 Research strengths—reliability and validity measures applied

Bryman (2016) notes the three criteria for evaluating social research in terms of quality namely; reliability, replication and validity. The author describes reliability as a measure of whether the results of a research study are repeatable. Kumar (2019) explains that reliability is a quality that provides accuracy and repeatability of a measurement procedure. Bryman (2016) explains that validity has to do with the truthfulness of the conclusions derived from research. The author further explains that it has to do with whether indicators used to measure a concept actually measure that concept.

Reliability

Bryman (2016) asserts that the three prominent factors of reliability are stability, internal reliability and inter-observer consistency. The author explains that internal reliability measures the reliability of multiple-indicator measures. They further mention that a result of 0.80 and above means that the internal reliability is acceptable. The author also mentions that researchers use Cronbach's alpha to test for internal reliability. At the same time, Nunnally (1978) suggests that a result of 0.60 and above is acceptable for early stage of research.

Masia and Pienaar (2011) conducted research to investigate the relationship between job satisfaction, job insecurity, work stress, organisational commitment and safety compliance in a South African mine. This study had acceptable levels of internal consistency in the measuring instruments. All the Cronbach alpha coefficients were 0.70 or more.

Validity

Kumar (2019) explains that validity is the level to which a researcher measures what they intended to measure. Bryman (2016) suggests that there are four main types of validity namely; measurement validity, internal validity, external validity and ecological validity. The author lists the aspects of four main types of trustworthiness in qualitative research as credibility, transferability, dependability and confirmability.

Measurement validity

Bryman (2016) explains that this is also referred to as construct validity. The author explains that this has to do with whether a measure really reveals what the concept it is denoting. The author suggests that this measure is related to reliability.

Internal validity

Bryman (2016) explains that internal validity is concerned with whether the findings of a causal relationship between variables is true or not. The author further explains that this has to do with the confidence level of an independent variable being responsible for the change in the dependent variable. The current research utilised a survey instrument for gathering data meaning that the dependent variable could not be controlled by the researcher and could only be inferred

External validity

Bryman (2016) describes external validity as a measure that deals with whether the results of a study can be generalized to a population beyond the study. The current study made use of convenience sampling which limits external validity as comparable to a study conducted by Pelders and Nelson (2019b).

Ecological validity

Bryman (2016) describes ecological validity as a measure that deals with whether the findings of a research can be applicable to people's natural environment.

3.5 Research weaknesses—technical and administrative limitations

Technical limitations

The dependent variable was not under the control of the researcher and therefore the causal effect between variables could only be inferred.

Sampling constraints were applicable to this study with non-probability sampling (convenience sampling) being used. This meant that the results of this study could not be generalised to Team leaders in South African mines i.e. there was constraint on external validity.

Through the use of a survey, there could be other variables that could have had an effect on the dependent variable that were not recorded in the questionnaire.

Administrative limitations

Given that the surveys were conducted during working hours, there was a significant risk of a low response rate and respondents fearing to be honest when answering the survey.

4 PRESENTATION OF RESEARCH RESULTS

This chapter presents the research results obtained using the research strategy, design, procedure and method proposed earlier in Chapter 3. Thereafter, this chapter compares the research results with those found by other researchers of similar studies. Each section in this chapter attends to each of the two questions, hypotheses and propositions presented in Chapter 1.

4.1 Research question/hypothesis/proposition 1

This section presents the research results of the question: 'What are the different sources of injuries that are prevalent among Team leaders in the underground platinum mine of study?' This section also presents research results to test the null hypothesis, research hypothesis and proposition in section 1.2.3.1. Thereafter, the research results are compared with those found by others in similar studies.

The accidents that were analysed in this study consisted of 40 injuries suffered by Team leaders in the mine of study from the year 2017 to 2019. These were all the injuries suffered by Team leaders in that three-year period. These injuries consisted of 70% serious and reportable injuries, 22.5% lost time injuries, and 7.5% dressing cases or minor injuries as illustrated in Figure 2. A reportable injury is defined as an injury that results in one of the following: the death of an employee, incapacitation of an employee from performing their normal duties in 14 days or more, or the loss of limb (Department of Mineral Resources, 2007). A lost time injury is an injury that results in the incapacitation of an employee from performing their normal duties from 1 to 13 days, and a dressing case is an injury where the employee can continue with their normal duties the next calendar day (Department of Mineral Resources, 2007).

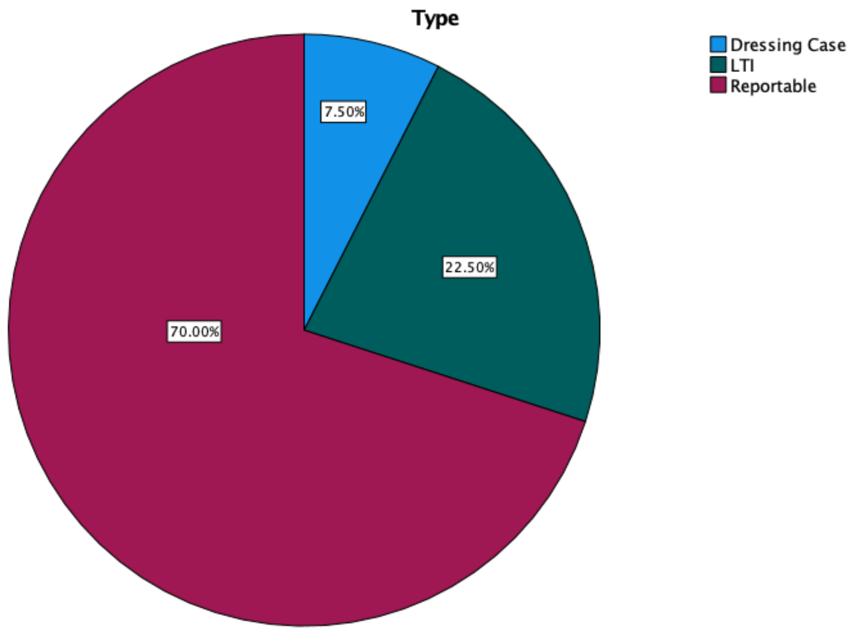


Figure 2: Injury classification

The focus group discussion with Team leaders revealed the safety challenges faced by Team leaders on a daily basis in the pursuit to complete their work. They reported that fall of ground, tracks and tramming, material handling and slip and fall injuries were the highest injury agencies that were prevalent among themselves in the mine of study. They reported that shortage of material, the high absenteeism of people and the safety reports that are not taken seriously were the major contributors to the specific high injury agencies. The Team leader focus group also reported that traveling back and forth to reclaim old material to use also contributed to the slip and fall injuries they suffered.

Analysis of the three-year injury report showed that the causes of occupational injuries prevalent among Team leaders were falls of ground (45%), material handling (27.5%) and slips and falls (17.5%). These results reject the null hypothesis that there no injury causes prevalent among Team leaders in the mine of study. The results support the hypothesis that states that falls of ground and material handling were the agencies prevalent among Team leaders causing a total of 72.5% of the injuries. The proposition stating that if there were no falls of ground and material handling injuries then there would be no injuries prevalent among Team leaders is also rejected. The study revealed that slipping and falling is also another common cause of injuries among Team leaders, contributing 17.5% of the total injuries.

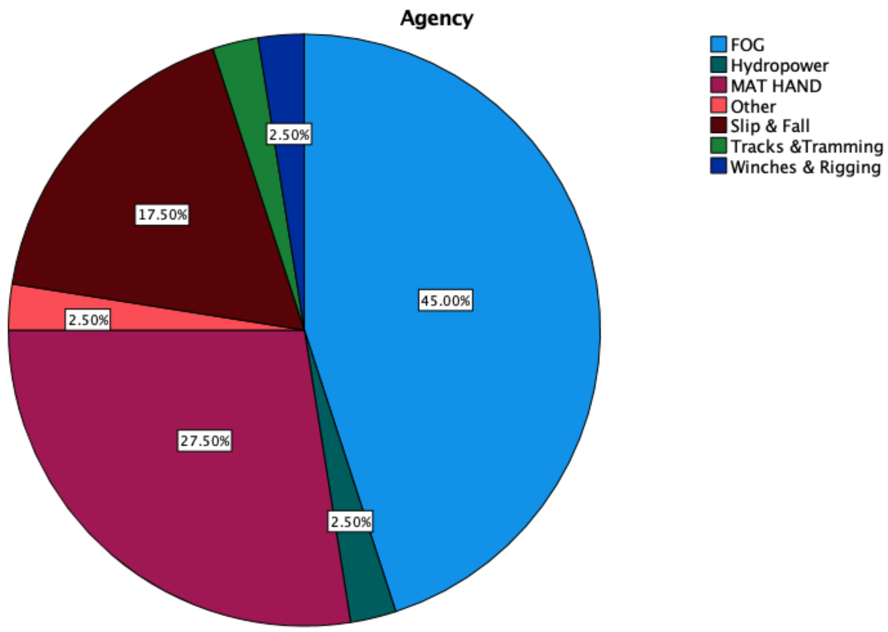


Figure 3: Injury agencies

The results also show that the tasks performed on the mine require manual handling of tools and machinery. Consequently, the second highest injury agency was material handling contributing 27.5% of the injuries among Team leaders.

Bonsu et al. (2017) conducted a similar study in a platinum mine whereby they found common agencies to include hand tools (20%), falls of ground (15%), falling/rolling rock (14%), material handling (11%), and slipping and falling (13%). The percentage contribution of these injury agencies varies with the current study, however, the agencies themselves are similar.

4.2 Research question/hypothesis/proposition 2

This section presents the research findings of the question posed in Section 1.2.3.2, that is: 'What factors significantly influence Team leader occupational injuries in the underground platinum mine of study?' The research findings to test the null hypothesis, research hypothesis and proposition in Section 1.2.3.2 are also presented in this section. The section ends with a comparison of the research results with results of other similar studies.

The Cronbach alpha coefficients of the measuring instruments used in the current study were found to be; 0.708 for fatigue, 0.824 for job satisfaction, 0.632 for risk-taking, and

0.808 for work stress as shown in Appendix A. The Cronbach alpha coefficients were all higher that 0.6 and therefore deemed to have adequate reliability.

The Team leaders focus group discussion reported fatigue arising from working long hours, lack of sleep, working different job categories due to absenteeism, and traveling long distances as one of the major factors that significantly influenced Team leader occupational injuries. The Team leaders reported work stress arising from production pressures, intimidation from supervisors, risk-taking for production and not getting time off to see family across provincial and national borders as the second major factor that significantly influenced Team leader occupational injuries.

A total of 33 respondents participated in completing the questionnaire with a response rate of 99.6% and only one respondent not completing the questionnaire. The results presented on the correlation Table 3 show that the correlations between injury and all the other variables (age, education and experience) were not statistically significant. These results indicate that the probability of the null hypothesis being true is high and therefore cannot conclude that a significant relationship exists between injury and any of the variables. These results mean that the null hypothesis of age, education and experience having no significant influence in the injuries of Team leaders in the mine of study is retained. As a result, the alternative hypothesis is rejected.

The results show that there is: a statistically significant ($0.00 < 0.05$) negative correlation that is strong (-0.621) between age and education level; a statistically significant (0.017) positive correlation that is noteworthy (0.412) between age and experience as a Team leader; and a statistically significant (0.00) positive correlation that is strong (0.653) between age and experience in the mining industry. The results also show that there is: a statistically significant (0.018) negative correlation that is noteworthy (-0.412) between education level and years of experience as a Team leader; and a statistically significant (0.00) negative correlation that is very strong (-0.702) between education level and years of experience in the mining industry. Lastly, Table 3 shows that there is a statistically significant (0.00) positive correlation that is strong (0.638) between years of experience as a Team leader and years of experience in the mining industry.

Table 3: Injury, age, education and experience correlations

Correlations

		Injury	Age	Edu	Exp. TL	Exp. Min
Injury	Pearson Correlation	1	.040	.140	.334	.038
	Sig. (2-tailed)		.825	.444	.057	.834
	N	33	33	32	33	33
Age	Pearson Correlation	.040	1	-.621**	.412*	.653**
	Sig. (2-tailed)	.825		.000	.017	.000
	N	33	33	32	33	33
Edu	Pearson Correlation	.140	-.621**	1	-.416*	-.702**
	Sig. (2-tailed)	.444	.000		.018	.000
	N	32	32	32	32	32
Exp. TL	Pearson Correlation	.334	.412*	-.416*	1	.638**
	Sig. (2-tailed)	.057	.017	.018		.000
	N	33	33	32	33	33
Exp. Min	Pearson Correlation	.038	.653**	-.702**	.638**	1
	Sig. (2-tailed)	.834	.000	.000	.000	
	N	33	33	32	33	33

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Pelders and Nelson (2019b) conducted a similar study where the results revealed a possible association between increased length of service and accidents due to the increased cumulative exposure to work hazards. Their study also revealed that employees with higher levels of education had a lower accident rate.

The results on the correlation in Table 4 shows a statistically significant correlation between injury and two other variables (fatigue and work stress).. The correlation between injury and the other two variables (job satisfaction and risky behaviour) were not statistically significant. The results show a statistically significant (0.003) positive correlation that is strong (0.504) between the dependent variable (injury) and the independent variable (fatigue). The results also show a statistically significant (0.007) positive correlation that is also strong (0.46) between the dependent variable (injury) and the independent variable (work stress). These results show that the probability of the null hypothesis being true is extremely small therefore the null hypothesis is rejected. The results support the alternative hypothesis that states that only two of the four variables (fatigue and work stress) have a significant influence on the occupational injuries of Team leaders.

The results also show that there is a statistically significant (0.00) positive correlation that is strong (0.655) between fatigue and work stress. There is a statistically significant (0.003) negative correlation that is strong (-0.503) between job satisfaction and work stress as well as a statistically significant (0.001) negative correlation that is strong (-0.542) between job satisfaction and risky behaviour. There is no other significant correlation between any of the independent variables.

Table 4: Injury, fatigue, work stress, job satisfaction and risky behaviour correlations

Correlations

		Injury	Fatigue*	Work Stress*	Job Satisfaction*	Risky Behaviour*
Injury	Pearson Correlation	1	.504**	.460**	-.281	.171
	Sig. (2-tailed)		.003	.007	.113	.340
	N	33	33	33	33	33
Fatigue*	Pearson Correlation	.504**	1	.655**	-.213	.211
	Sig. (2-tailed)	.003		.000	.234	.239
	N	33	33	33	33	33
Work Stress*	Pearson Correlation	.460**	.655**	1	-.503**	.290
	Sig. (2-tailed)	.007	.000		.003	.102
	N	33	33	33	33	33
Job Satisfaction*	Pearson Correlation	-.281	-.213	-.503**	1	-.542**
	Sig. (2-tailed)	.113	.234	.003		.001
	N	33	33	33	33	33
Risky Behaviour*	Pearson Correlation	.171	.211	.290	-.542**	1
	Sig. (2-tailed)	.340	.239	.102	.001	
	N	33	33	33	33	33

**. Correlation is significant at the 0.01 level (2-tailed).

The model summary table (Table 5) shows the results of the correlation between the independent variable (injury) and the combination of the two significant independent variables (fatigue and work stress) to be large (0.532). The results also show an R Square of 0.283 which means the combination of the two variables can only explain 28.3% of the variation in the dependent variable (injury) which is low. The Adjusted R Square (0.236) is close enough to the R Square (0.283) which represents an adequate sample size.

Table 5: Regression model summary (injury, fatigue and work stress)

Model Summary[b]

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.532[a]	.283	.236	.427	.283	5.933	2	30	.007	2.201

a. Predictors: (Constant), Work Stress*, Fatigue*

b. Dependent Variable: Injury

The results from the ANOVA (Table 6) show that there is a statistically significant (0.007 < 0.05) relationship between the independent variable (injury) and the combination of the two dependent variables (fatigue and work stress). This also confirms that the probability of the null hypothesis being correct is very small and therefore the null hypothesis is rejected.

Table 6: ANOVA (injury, fatigue and work stress)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.164	2	1.082	5.933	.007[b]
	Residual	5.472	30	.182		
	Total	7.636	32			

a. Dependent Variable: Injury

b. Predictors: (Constant), Work Stress*, Fatigue*

The Coefficients (Table 7) show the linear relationship between each independent (fatigue or work stress) and the dependent variable (injury) after adjusting for the other independent variable. The results show the significance values of both the predictors to be statistically insignificant, as a result, the model drops both the predictors. This shows that the proposition of Team leaders not suffering from occupational injuries if they did not take risks, suffer from fatigue, work stress and job dissatisfaction is rejected.

Table 7: Coefficients (fatigue and work stress)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-1.069	.490		-2.185	.037					
	Fatigue*	.341	.197	.355	1.733	.093	.504	.302	.268	.571	1.753
	Work Stress*	.323	.290	.228	1.113	.274	.460	.199	.172	.571	1.753

a. Dependent Variable: Injury

Pelders and Nelson (2019b) conducted a similar study where they also found fatigue and stress to be safety risks that contributed to workplace accidents. Their results showed that stress led to a lack of focus and concentration which eventually led to accidents. Similarly, their results did not show a direct relation of job satisfaction to injuries but rather a negative correlation of job satisfaction to stress which in turn related to injuries. Their results found some form of relationship between fatigue and job satisfaction which was not significant in the current study.

Paul and Maiti (2007) conducted a similar study where the authors also found that risk-taking behaviour was negatively correlated to job satisfaction. Their study found, however, a positive and significant correlation between risk-taking and work injuries.

5 DISCUSSION OF RESEARCH FINDINGS

5.1 Introduction

The research set out to investigate the determinants of Team leader occupational injuries in a South African underground platinum mine. To undertake this investigation, the research posed two questions: Firstly, what are the different sources of injuries that are prevalent among Team leaders in the underground platinum mine? Secondly, what factors significantly influence occupational injuries of Team leaders in the underground platinum mine? This chapter presents the interpretation and the analysis of the findings presented in Chapter 4 using the interpretive frameworks proposed in Chapter 2. This chapter ends with a summary of the analysis.

5.2 The different sources of injuries

Fall of ground injuries were found to be the highest injuries (45%) suffered by Team leaders at the mine. The results obtained show that the mine of study is one of the deepest in its commodity with high numbers of fall of ground incidents recorded among Team leaders. Fall of ground injuries on the mine could be contributed to the lack of support material available for the crews to install and make their work areas safe as mentioned in the focus group discussion. The shortage of material was highlighted, during the focus group discussion, as the major cause of accidents in the mine as people were forced to make their own "plans" to complete their tasks. This was supported by 78.8% of participants who were dissatisfied with their jobs due to having inadequate material as shown in Table 13 in Appendix A. Most of the participants (54.5%) reported to have previously worked in an unsupported area to complete their work as presented in Table 12 of Appendix A. Fall of ground injuries also tend to be more serious injuries and this is confirmed by the injury classification shown in Figure 2 where 70% of the injuries were serious and reportable.

Results from the current study show that material handling was the second highest (27.5%) injury agency among Team leaders. The multi-skilling of Team leaders (in supervisory positions) to perform tasks of other members in their crew when there is shortage of labour, was one of the contributing factors to material handling injuries which was highlighted in the focus group. This was supported by 93.9% of participants who were stressed at work as a result of having to perform tasks over and above their scope of work as required by their supervisor (Table 14 of Appendix A). These results show that Team leaders are trained to manually perform tasks they would not normally perform on a daily basis to compensate for labour shortages. This could be the contributing factor to Team leaders being injured by material handling. In their normal role as Team leaders, they would not be required to handle material or machinery.

The high number of slip and fall injuries (17.5%) could be attributed to the labour intensity of the mine of study. Slip and fall injuries were found to be the third highest injuries among Team leaders in the mine of study. It could also be attributed to the shortage of material which results in Team leaders having to travel to old working areas to reclaim old material for the completion of their tasks as asserted in the focus group discussion.

The results show that the mine of study was labour intensive and most of its labour had to work in close proximity to health and safety hazards. These hazards posed a serious risk to employees' health and safety since they were not addressed adequately through the supply of appropriate health and safety material. The multi-tasking of Team leaders was a risk to their safety as they oftentimes found themselves performing tasks that they may have been trained for, they did not conduct frequently enough to perfect their performance. These odd tasks were performed in the absence of persons who would specialise in them. The results also show that there was an alarmingly high number of serious injuries as compared to less severe injuries which could be a business risk for the mine in future.

Bonsu et al. (2017) similarly noted that fall of ground, material handling and slip and fall injuries were frequent causes of injuries in a platinum mine. This implies that the profile of the injuries used in this study could be a fair representation of the injury profile of most platinum mines in South Africa.

The injury profile from 2017 to 2019 showed that the injuries among Team leaders consisted of 70% serious and reportable injuries, 22.5% lost time injuries, and 7.5% dressing cases or minor injuries. These results show reason for concern as the injuries with the highest severity were the ones mostly suffered by Team leaders.

5.3 Factors that influence occupational injuries

As indicated previously, Jansen and Brent (2005) asserted that non-compliance to standards and procedures was the highest contributor to mine accidents in the South African mining industry. Pelders and Nelson (2019b) concluded that socio-demographic factors which include age, education, length of service and quality of life, contributed to a person's non-compliance to rules and procedures which eventually led to mine accidents. Research findings from the current study seem to present a different point of view. Research findings show no correlation between socio-demographic factors (age, education, years of service and years appointed) of a Team leader and occupational injuries among Team leaders. The results of this study are in agreement with Hakamies-Blomqvist, Raitanen and O'Neill (2002) who concluded that there was very little convincing scientific evidence to associate occupational accidents and age. Aderaw, Engdaw and Tadesse (2011) also concluded in their study that there was no statistically significant association between the level of education and the occurrence of occupational injuries.

The apparent difference in the results of the current study with literature could be attributed to the fact that the study population from Pelders and Nelson's (2019b) study included all types of mine employees and the study setting was different. The current study only investigated one job category. The difference could also be due to that education, when investigated individually, would not reduce occupational injuries with the associated high hazard levels in the platinum mining industry.

Result did, however, show a significant negative correlation between age and education level. This result shows that the younger Team leaders are more educated than their older counterparts. The results of this study also show a significant positive correlation between age and Team leader experience. These research findings are aligned with Statistics South Africa (2016) findings that there is a year-on-year increase of individuals completing grade 12 from 1996 to 2016.

Kleyn and Du Plessis (2016) asserted that the practice of non-compliance to standards and procedures originates from the individual habits and behaviour of employees in South African mines. Bogardus (1912), an early pioneer of fatigue and work accidents, found that fatigue influences behaviour which is associated with work incidents. The results of this study are in agreement with Smith (2016) who found a significant positive correlation between fatigue and accidents. This study has found a strong (0.504) positive association of fatigue with Team leader injury. This result is also in agreement with most mining studies that found fatigue to be a common influence in employee accident rates. The fatigue experienced by the Team leaders was mostly due to working long hours, which in turn was a result of having to walk long distances to and from the working areas. When Team leaders work longer hours, they arrive home late and suffer from lack of sleep. This finding is in agreement with Schutte (2010) who found that the biggest contributor to worker fatigue was extended working hours.

Kerr (1957), a pioneer of the stress theory, explained that negative and unusual stress increases the chance of an accident or to poor behaviour of a person. This poor behaviour influences a person's decision making process with regards to not complying to company standards and procedures. Results from this study fully supports this stress theory as the findings were a strong (0.46) positive association of work stress with Team leader injury. A large number (93.9%) of the respondents were stressed due to performing multiple tasks at work. The Team leaders were trained in different job categories because they were expected to perform tasks of missing persons in their crew as well as perform their normal tasks of a supervisor. Crew members were frequently missing from duty due to absenteeism and labour shortages. The expectation of Team leaders to perform multiple tasks could be the major influence on their unusual stress which potentially leads to their poor decision making and ultimately, accidents. This finding could be the major contributor to Team leaders being the third highest job category to experience occupational injuries in the mine of study.

The Team leaders reported that work stress was the second major factor that significantly influenced occupational injuries among them. Work stress was also influenced by supervisors who apply pressure to reach daily production targets without addressing challenges experienced by Team leaders. These supervisors also intimidated Team leaders for not producing and for requesting days off work to visit their family members across provincial and national borders. These findings show that Team leaders were confronted with difficulty, anxiety and worry at work – consistent to the work stress explanation by Jeremy (2005). Work stress was also found to have a significantly strong positive (0.655) association with fatigue.

A study conducted by Pestonjee et al. (1977) concluded that there is an intimate relationship between job satisfaction and accidents. The findings of the curren study present an alternative view in that the results do not show a direct association of job satisfaction with injuries. The results show a significantly strong negative association of job satisfaction with work stress. Work stress was earlier found to be strongly associated with occupational injuries. These results show that job satisfaction has an indirect negative association with occupational injuries through work stress. A study by Pelders and Nelson (2019b) found results that consistent to those of the current study. Their results did not show a direct relation of job satisfaction to injuries, but a negative correlation of job satisfaction to stress which in turn related to injuries. This result is also consistent with Ahsan, Abdullah, Fie and Alam (2009) who found a significant negative relationship between job stress and job satisfaction. The majority of the respondents (78.8%) were not satisfied in their job as a consequence of working with inadequate material. The Team leaders reported that they were sometimes instructed to fetch and use old material from abandoned workplaces which lead to their dissatisfaction. This is consistent with Leung et al. (2016) who observed that the dissatisfaction of construction workers working without material induced serious stress that led to dangerous conditions at work.

Cohen et al. (1956) were some of the early pioneers of risk-taking behaviour and they asserted that risk-taking is associated with work-related accidents. The results of this study did not find a significant relationship between risk-taking and occupational injuries. A possible reason for that is that data collected from the respondents may have had information bias. This is consistent with Trimpop and Kirkcaldy (1997) who did not find a significant relationship between risk-taking and accidents. Most of the Team leaders did present some risk-taking behaviour as 54.5% agreed to have previously worked in unsupported areas knowingly. The Team leaders also reported that they were sometimes forced to work in substandard areas. They would take the risk of working in these hazardous areas in fear of losing their jobs or being replaced by a subordinate, acting in a Team leader's capacity who would be seeking a promotion.

Results of this study did however find a significantly strong (-0.542) negative association of risk-taking and job satisfaction. This finding means that Team leaders who were less likely to take risks were those that exhibited high job satisfaction. This finding is consistent with Barling et al. (2003) who found that employees that work without taking risks are those that experience high levels of job satisfaction.

The results of this study suggest that fatigue is the most influential (0.504) contributor to occupational injuries of Team leaders at the mine of study. This result is in agreement with Shen et al. (2006) who note that within the working population, fatigue has been identified as a major life-threatening factor. The results of this study further suggest that work stress is the second significant major contributor (0.46) to occupational injuries of Team leaders.

6 SUMMARY, CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

The purpose of this chapter is to present a summary of the research report, present conclusions based on the findings and the discussion thereof, present limitations of the study, and make recommendations and suggest future research. A summary of what was proposed in Chapter 1 is first presented, followed by an overview of what was carried out to address the proposal. Conclusions on each of the research questions, hypotheses and propositions and an overall conclusion addressing the research problem follow. Limitations of the study follow, and the chapter ends with recommendations for future studies.

6.1 Summary

Mining accidents are one of the major threats to the existence of the South African mining industry as they normally result in occupational injuries or deaths. Within the South African mining industry, underground mines are the most significant contributors to mining accidents where fall of ground is the major agency. The South African mining industry implemented the Mine Health and Safety Act as a measure to improve health and safety in mines. The overall number of occupational injuries in the platinum mining sector have reduced from the year 2015 to 2019, however, the improvements are below the 2014 MHSC Summit milestone target. In the mine of study, the overall number of occupational injuries from the year 2017 to 2019 also decreased, however injuries sustained by Team leaders increased.

It was decided to conduct a research study of Team leader safety with the aim to investigate the factors that influence occupational injuries of Team leaders. The study would give an understanding as to why there has not been a reduction in occupational injuries of Team leaders comparable to other occupations in the mine of study. Team leaders are direct line supervisors that take charge of the team as they conduct their tasks, and they are normally responsible for planning and scheduling of daily tasks and the safe performance of these tasks.

The first chapter contains the background and context of this research by providing the research problem statement, the research questions, and explaining the purpose and

significance of the study. To investigate the factors that influence the occupational injuries of Team leaders at the mine of study, the following research questions guided the study:
1) What are the different agencies that cause injuries prevalent among Team leaders in the underground platinum mine of study?
2) What factors significantly influence Team leader occupational injuries in the underground platinum mine of study?

In the second chapter, we validated the research problem by categorising its factors into symptoms, root-causes, and consequences. The symptoms of occupational injuries in the South African mining industry were measured as total number of fatalities, serious injuries, lost time injuries and minor injuries. Major root-causes of the injuries were found to be personal and systemic factors which included unsafe behaviour, non-compliance to procedures and inadequate training. The consequences of these injuries included direct loss of production and indirect loss of livelihoods. The following factors surfaced as being significant contributors to occupational injuries: fatigue, work stress, job satisfaction and risk-taking.

In the third chapter, an effort was taken to identify and describe the research approach, the research design and the methods employed to collect, process, and analyse empirical evidence. A mixed method research strategy was utilised for this study. A cross-sectional research was conducted where data were collected through a semi-structured group discussion and a structured questionnaire administered by the researcher. Bivariate correlation and linear regression analyses were performed on SPSS to assess associations between variables. A total of 33 respondents were conveniently sampled from the mine training centre to complete the questionnaire.

In the fourth chapter, the research results were compared to those found in similar studies. With regards to the first question, the hypothesis was that the most common agencies that cause occupational injuries prevalent among Team leaders were falls of ground and manual handling of material. The proposition was that if there were no falls of ground and handling of material, there would be no prevalent causes of injuries among Team leaders. The literature noted that fall of ground, material handling and slip and fall injuries were frequent causes of injuries in platinum mines (Bonsu et al., 2017). In support of this, findings from the current study indicated that fall of ground was the highest agency contributing 45% of all the injuries sustained by Team leaders. The second highest agency was manual handling of material contributing 27.5% of all injuries. The proposition was rejected as slip and fall injuries were also a major contributing injury agency contributing 17.5% of all injuries. Fall of ground, as the highest agency, led to serious injuries and this was confirmed by the injury classification where 70% of all the injuries among Team leaders were serious and reportable.

With regards to the second question, the hypotheses were:
1) The demographic qualitative attributes of age, education and experience have a significant influence on occupational injuries of Team leaders.
2) The quantitative variables (fatigue, work stress, job satisfaction and risky behaviour) have a significant influence on occupational injuries of Team leaders.

Literature indicates that socio-demographic factors which include age, education and length of service, contributed to mine accidents (Pelders & Nelson, 2019b). Contrary to this, the findings of the current research did not show any significant association between occupational injuries with age, education and experience.

The literature also indicated that the variables: fatigue, work stress, job satisfaction and risky behaviour contributed to occupational injuries (Bogardus, 1912; Kerr, 1957; Pestonjee et al., 1977; Cohen et al., 1956). In support of the first two variables, findings from the study indicated significant positive associations of occupational injuries with fatigue and work stress. Contrary to most of the literature, findings from this study did not show any significant associations of occupational injuries with job satisfaction and risky behaviour. Findings from the current study indicated significant negative associations between job satisfaction with work stress and risky behaviour. These results were consistent with Pelders and Nelson (2019b) as well as Barling et al. (2003). The results also indicated a significant positive association of fatigue with work stress.

In the fifth chapter, the interpretation and the analysis of the finding were presented. The high number of fall of ground injuries on the mine could be contributed by the lack of support material available for the crews to install and make their work areas safe as 78.8% of participants mentioned that they were dissatisfied with the shortage of material. The multi-skilling of Team leaders to perform tasks of other members in their crew when there is shortage of labour was one of the contributing factors to high material handling injuries.

The difference in the results of this study with literature, with regards to socio-demographic factors contributing to occupational injuries, could be attributed to the diverse population that included various occupations of mine employees being studied, as well as the different study setting as opposed to one job category studied in the current study.

Fatigue experienced by Team leaders was mostly due to working long hours and walking long distances to and from working areas. Fatigue was found to be the major contributor to occupation injuries of Team leaders. Work stress was found to be the second major contributor to occupational injuries among Team leaders and multi-tasking was reported to be the major contributor to work stress.

6.2 Conclusions

Through a mixed method research strategy, knowledge relating to the common types of occupational injuries suffered by Team leaders in a South African underground platinum mine and the factors that significantly influence these occupational injuries was adequately contributed. Results from the current research were able to support most of the conceptual frameworks discussed in Chapter 2. This study offered an opportunity to investigate the causal effect of the safety performance of front-line leadership in the South African mining industry which has previously not been investigated.

Fall of ground was found to be the highest agency that contributed to Team leader injuries, followed by the manual handling of material. Slip and fall injuries were found to be the third highest agency causing occupational injuries among Team leaders. The results showed that there is a reason for concern as the injuries with the highest severity were the ones mostly suffered by Team leaders.

There was no significant association of injuries with socio-demographic attributes of Team leaders. Fatigue was the highest variable associated with occupational injuries. Working extended hours and travelling long distances to and from working areas were the main reported causes of fatigue among Team leaders. Work stress was the second highest variable associated with occupational injuries. A large number of the respondents were mostly stressed due to performing multiple tasks at work. Work stress was found to be negatively associated with job satisfaction and positively associated with fatigue. Job satisfaction was found to be negatively associated with risk-taking behaviour. The major cause of job dissatisfaction was reported to be working with inadequate material. This could be the major cause for fall of ground accidents as there could be a shortage of support material. Most of the respondents agreed to have knowingly worked in unsupported areas. Findings from this research are consistent with literature.

Addressing the challenges of fatigue, work stress and job satisfaction, could result in improving the overall health and safety of all employees in the South African platinum mining industry.

6.3 Limitations

This study only focused on Team leaders from one of the platinum mines in South Africa and did not include other mines within the platinum mining industry. Due to this factor, findings from this research cannot be generalized to the South African platinum mining industry.

The study made use of self-reported data and therefore the findings could have been influenced by information bias. There could have been differences in the understanding of the questionnaire by participants due to the vast difference in education levels.

The sampling method used was not probabilistic sampling and did not allow definitive findings. This study, however, still contributes to the body of knowledge as it pertains to factors that influence occupation injuries.

6.4 Recommendations

Addressing the challenges of fatigue through adequate and efficient transport measures would reduce travelling times and improve safety in South African mines. A change in the culture of prioritising production above safety is required to prevent risks associated with the multi-tasking of Team leaders. Addressing the challenges of material shortage would reduce fall of ground accidents and thus reduce the number of serious injuries that place underground mines under health and safety risks. It is recommended that a similar study is conducted with a more representative sample size across different underground South African mines. It is also recommended that other variables that could influence occupational injuries of Team leaders in underground mines be investigated.

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APPENDICES

Appendix A: Additional Figures and Tables

Table 8: Fatigue Cronbach's Alpha

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.708	.709	15

Table 9: Job Satisfaction Cronbach's Alpha

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.824	.837	15

Table 10: Risk-taking Cronbach's Alpha

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.632	.608	11

Table 11: Work Stress Cronbach's Alpha

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.808	.805	14

Table 12: Working in unsupported area

Unsupported

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	18	54.5	62.1	62.1
	5.00	11	33.3	37.9	100.0
	Total	29	87.9	100.0	
Missing	System	4	12.1		
Total		33	100.0		

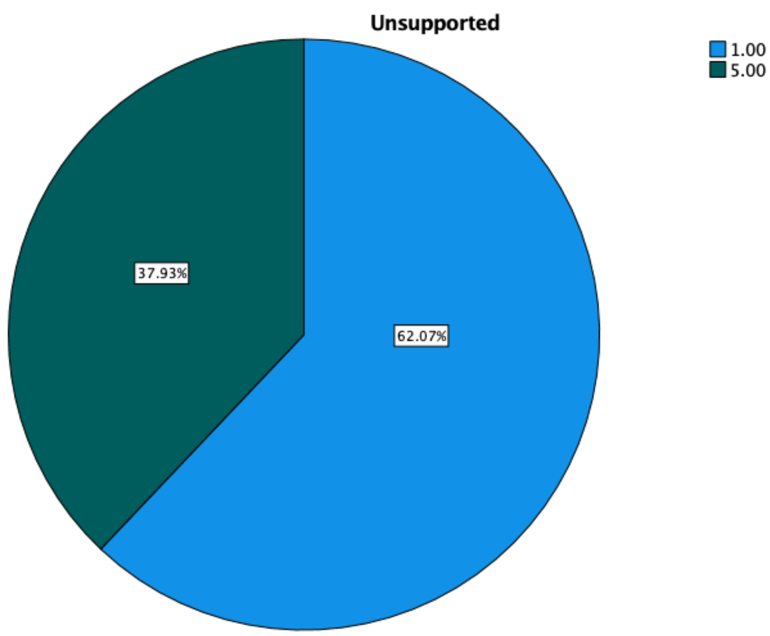

Figure 4: Working in unsupported area

Table 13: Working with adequate material

Adequatematerial

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	3	9.1	10.3	10.3
	5.00	26	78.8	89.7	100.0
	Total	29	87.9	100.0	
Missing	System	4	12.1		
Total		33	100.0		

Table 14: Team leaders with multiple jobs

Multitasking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	31	93.9	93.9	93.9
	5.00	2	6.1	6.1	100.0
	Total	33	100.0	100.0	

Appendix 1.1: Data collection instrument(s)

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Interview Guide

I would like to thank you for your participation in this focus group discussion. I am an MBA student at the University of the Witwatersrand an I am investigating the determinants of Team leader occupational injuries in a South African underground platinum mine.

As Team leaders in an underground platinum mine, you views will be of assistance in the understanding of the common agencies that cause injuries and factors that are associated with occupational injuries of Team leaders.

I can assure you that the information you provide will be kept confidential at all times. This study may be published in a journal but the data collected will be stored in a secure place until it is destroyed. Your participation in the group discussion is voluntary and you are free to refrain from answering any question or to withdraw from the discussion at any point in time.

This group discussion will be recorded in order to analyse the responses at a later stage. The discussion will take approximately 45 minutes to complete. If you have any concerns you can contact me or my supervisor on the following contact details:

Researcher
Name: Sthabiso Xaba
Email: sthabiso43@yahoo.com
Phone: 0632545925

Supervisor
Name: Samukelo Ngubane
Email: mbovusam@gmail.com
Phone: 0827267830

We will now begin with the focus group discussion.

1. Is the training you receive as a Team leader sufficient for you to do you work? Elaborate?

2. Do you normally have enough equipment to conduct your work?

3. Do you normally have enough people in your crew to conduct your work?

4. How often do you have to perform other functions either than the functions of a Team leader when completing at task?

5. What are the major sources of fatigue you have experienced?

6. What are the some of the causes of work stress you have experienced?

7. What are the things that make you dissatisfied in your work?

8. How often do you take risks when you conduct you work?

9. What are the agencies that cause Team leaders injuries at your work?

10. What are the factors that influence Team leader injuries at your work?

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Questionnaire

I would like to thank you for your participation in this questionnaire. I am an MBA student at the University of the Witwatersrand an I am investigating the determinants of Team leader occupational injuries in a South African underground platinum mine.

As Team leaders in an underground platinum mine, you views will be of assistance in the understanding of the common agencies that cause injuries and factors that are associated with occupational injuries of Team leaders.

I can assure you that the information you provide will be kept confidential at all times. This study may be published in a journal but the data collected will be stored in a secure place until it is destroyed. Your participation with this questionnaire is voluntary and you are free to refrain from answering the questions.

The questionnaire will take approximately 45 minutes to complete. If you have any concerns you can contact me or my supervisor on the following contact details:

Researcher
Name: Sthabiso Xaba
Email: sthabiso43@yahoo.com
Phone: 0632545925

Supervisor
Name: Samukelo Ngubane
Email: mbovusam@gmail.com
Phone: 0827267830

This questionnaire consists of questions on a 5 point scale whereby

1 – Strongly agree
2 – Agree
3 – Undecided
4 – Disagree
5 – Strongly disagree

There is no right or wrong answer but mark what appeals to you.

Particulars of participant

In which year were you born? ___________________________

What is your highest qualification? ___________________________

How long are you a Team Leader? ___________________________

Years of experience in the mines? ___________________________

Are you married? _______________

Have you suffered from a mine injury (whether you reported it or not)? ____________

The fatigue scale is an adoption of the Occupational Fatigue Exhaustion Recovery (OFER) scale

***Fatigue* with 15 items:**

I use a lot of my spare time recovering from work
1 2 3 4 5

I often wonder how long I can keep going at my work
1 2 3 4 5

I feel most of the time I'm living to work
1 2 3 4 5

My head feels heavy a lot of the time
1 2 3 4 5

I often feel exhausted at work
1 2 3 4 5

Too much is expected of me at my work
1 2 3 4 5

My working life takes all my energy from me
1 2 3 4 5

I usually have lots of energy to give my family or friends*
1 2 3 4 5

I have energy for my hobbies/relaxing activities in my spare time*
1 2 3 4 5

I have plenty of reserve energy when I need it*
1 2 3 4 5

I can't recover my energy completely between work shifts
1 2 3 4 5

I am fully rested at the start of each work day/shift*
1 2 3 4 5

Worrying about work issues makes it hard to relax at home
1 2 3 4 5

I usually recover my energy within a few hours of getting home from work*
1 2 3 4 5

I usually feel fully relaxed by the time I go to bed*
1 2 3 4 5

***Work stress* with 14 items:**

I have to work hard in the performance of my work
1 2 3 4 5

I think that my job is hard
1 2 3 4 5

I think I have to work in a hurry to complete my work
1 2 3 4 5

I have members of my family that depend on me
1 2 3 4 5

The training I receive is sufficient to conduct my work*
1 2 3 4 5

I have a clear idea of my work and its results*

1	2	3	4	5

I feel that I am recognised for the work I do at the mine

1	2	3	4	5

I receive a salary that is adequate for my labour/work*

1	2	3	4	5

My work is full of danger

1	2	3	4	5

I have to do other jobs either than the job of a supervisor

1	2	3	4	5

I work with the fear of being dismissed at the mine

1	2	3	4	5

My co-workers spontaneously help me to solve any problem my team encounters*

1	2	3	4	5

I feel that my immediate supervisor is incompetent

1	2	3	4	5

I am happy to be responsible for a team at work*

1	2	3	4	5

***Job satisfaction* with 15 items**:

I am satisfied with the conditions in my work place

1	2	3	4	5

My co-workers are friendly and helpful

1	2	3	4	5

I think my work is respected by other persons

1	2	3	4	5

There are chances of a promotion in my work

1	2	3	4	5

The promotions of workers is fair and honest

1	2	3	4	5

I think I am in the right work for myself

1	2	3	4	5

My supervisor appreciates the quality of work I do

1	2	3	4	5

I think that my work is difficult*

1	2	3	4	5

I receive adequate information to complete my work

1	2	3	4	5

I receive adequate equipment to complete my work

1	2	3	4	5

If I had an opportunity I would like to leave this company and join another Company*

1	2	3	4	5

I am getting paid enough for the work I do

1	2	3	4	5

There is enough time to do my work

1	2	3	4	5

I am allowed to make decision with regards to my work

1	2	3	4	5

I think that I work good working hours

1	2	3	4	5

***Risk taking behaviour* with 11 items:**
I am ready to take some risk to complete my work
1 2 3 4 5
I have previously worked in an unsupported area knowingly
1 2 3 4 5
I enjoy working at speed
1 2 3 4 5
I enjoy taking risks
1 2 3 4 5
I work without doing a Hazard Identification Risk Assessment (HIRA)/safe declaration
1 2 3 4 5
I allow a member of my team to take a risk to complete a task
1 2 3 4 5
I enjoy walking fast underground
1 2 3 4 5
I am rather cautious in new and unusual situations*
1 2 3 4 5
I always wear safety equipment when working underground*
1 2 3 4 5
I would do anything possible to complete my work
1 2 3 4 5
I conduct work if I am given an unsafe instruction by my supervisor
1 2 3 4 5

Appendix 2.1: One-page bio of the researcher including declaration of interest in the research and funders, if any

Sthabiso Xaba is an entrepreneur who started NKX Holdings to provide engineering services on conveyor belt installations to the mining and manufacturing industries. After spending more than a decade working as a Maintenance Engineer for two leading South African platinum mining companies, Sthabiso knows how to truly maintain machinery such that they are operating optimally – and that is not making sure the moving part are lubricated. It is how best you listen to all the signals that the machinery is communicating, and how you plan and act to attend to those signals.

Sthabiso has been involved in the design, installation and maintenance of some of the most critical underground mining machinery including conveyor belts, chairlifts, winding plant and a water pumping chamber. He holds a BSc Engineering (Mechanical) from the University of the Witwatersrand, GCC (Mines and Works) from the Department of Mineral Resources and is completing his MBA at the University of the Witwatersrand.

Sthabiso enjoys solving engineering problems and bringing innovative solutions to ensure that the safety of people within the mining and manufacturing industries.

The author has nothing to declare.

Appendix 2.2: Ethic documentation

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

SCHOOL OF GRADUATE SCHOOL OF BUSINESS ADMINISTRATION ETHICS COMMITTEE
CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE **PROTOCOL NUMBER WBS/BA0500570V/981**

PROJECT TITLE Investigating the determinants of team leader occupational injuries in a South African underground platinum mine

INVESTIGATOR Mr Sthabiso Xaba

SCHOOL/DEPARTMENT OF INVESTIGATOR MBA (Research Article)

DATE CONSIDERED 24 November 2020

DECISION OF THE COMMITTEE Approved unconditionally

RISK LEVEL MINIMAL RISK

EXPIRY DATE 30 JUNE 2021

Matshabaphala.

ISSUE DATE OF CERTIFICATE 15 December 2020 **CHAIRPERSON** __ ___________________________
(Dr MDJ Matshabaphala)

cc: Supervisor: Mr Ngubane

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School/Department ethics committee.

I fully understand the conditions under which I am are authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

___________________________ 15 / 12 / 2020
Signature **Date**

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Appendix 3.1: Dully filled in data collection instrument(s)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Questionnaire

I would like to thank you for your participation in this questionnaire. I am an MBA student at the University of the Witwatersrand an I am investigating the determinants of Team leader occupational injuries in a South African underground platinum mine.

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The questionnaire will take approximately 45 minutes to complete. If you have any concerns you can contact me or my supervisor on the following contact details:

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This questionnaire consists of questions on a 5 point scale whereby

1 – Strongly agree
2 – Agree
3 – Undecided
4 – Disagree
5 – Strongly disagree

There is no right or wrong answer but mark what appeals to you.

Particulars of participant

In which year were you born? ________1965________________

What is your highest qualification? ________Matric________________

How long are you a Team Leader? _________17 yrs________________

Years of experience in the mines? __________17 yrs_______________

Are you married? _____yes_________

Have you suffered from a mine injury (whether you reported it or not)? _____No_______

The fatigue scale is an adoption of the Occupational Fatigue Exhaustion Recovery (OFER) scale

***Fatigue* with 15 items:**

I use a lot of my spare time recovering from work
1 2 3 4 5
I often wonder how long I can keep going at my work
1 2 3 4 5
I feel most of the time I'm living to work
1 2 3 4 5
My head feels heavy a lot of the time
1 2 3 4 5
I often feel exhausted at work
1 2 3 4 5
Too much is expected of me at my work
1 2 3 4 5
My working life takes all my energy from me
1 2 3 4 5
I usually have lots of energy to give my family or friends*
1 2 3 4 5
I have energy for my hobbies/relaxing activities in my spare time*
1 2 3 4 5
I have plenty of reserve energy when I need it*
1 2 3 4 5
I can't recover my energy completely between work shifts
1 2 3 4 5
I am fully rested at the start of each work day/shift*
1 2 3 4 5
Worrying about work issues makes it hard to relax at home
1 2 3 4 5
I usually recover my energy within a few hours of getting home from work*
1 2 3 4 5
I usually feel fully relaxed by the time I go to bed*
1 2 3 4 5

***Work stress* with 14 items:**

I have to work hard in the performance of my work
1 2 3 4 5
I think that my job is hard
1 2 3 4 5
I think I have to work in a hurry to complete my work
1 2 3 4 5
I have members of my family that depend on me
1 2 3 4 5
The training I receive is sufficient to conduct my work*
1 2 3 4 5
I have a clear idea of my work and its results*

1	2	3	4	5

I feel that I am recognised for the work I do at the mine

1	2	3	4	5

I receive a salary that is adequate for my labour/work*

1	2	3	4	5

My work is full of danger

1	2	3	4	5

I have to do other jobs either than the job of a supervisor

1	2	3	4	5

I work with the fear of being dismissed at the mine

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My co-workers spontaneously help me to solve any problem my team encounters*

1	2	3	4	5

I feel that my immediate supervisor is incompetent

1	2	3	4	5

I am happy to be responsible for a team at work*

1	2	3	4	5

***Job satisfaction* with 15 items**:

I am satisfied with the conditions in my work place

1	2	3	4	5

My co-workers are friendly and helpful

1	2	3	4	5

I think my work is respected by other persons

1	2	3	4	5

There are chances of a promotion in my work

1	2	3	4	5

The promotions of workers is fair and honest

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I think I am in the right work for myself

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My supervisor appreciates the quality of work I do

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I think that my work is difficult*

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I receive adequate information to complete my work

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I receive adequate equipment to complete my work

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If I had an opportunity I would like to leave this company and join another Company*

1	2	3	4	5

I am getting paid enough for the work I do

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There is enough time to do my work

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I am allowed to make decision with regards to my work

1	2	3	4	5

I think that I work good working hours

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***Risk taking behaviour* with 11 items:**

I am ready to take some risk to complete my work
1 2 3 4 5

I have previously worked in an unsupported area knowingly
1 2 3 4 5

I enjoy working at speed
1 2 3 4 5

I enjoy taking risks
1 2 3 4 5

I work without doing a Hazard Identification Risk Assessment (HIRA)/safe declaration
1 2 3 4 5

I allow a member of my team to take a risk to complete a task
1 2 3 4 5

I enjoy walking fast underground
1 2 3 4 5

I am rather cautious in new and unusual situations*
1 2 3 4 5

I always wear safety equipment when working underground*
1 2 3 4 5

I would do anything possible to complete my work
1 2 3 4 5

I conduct work if I am given an unsafe instruction by my supervisor
1 2 3 4 5

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Questionnaire

I would like to thank you for your participation in this questionnaire. I am an MBA student at the University of the Witwatersrand an I am investigating the determinants of Team leader occupational injuries in a South African underground platinum mine.

As Team leaders in an underground platinum mine, you views will be of assistance in the understanding of the common agencies that cause injuries and factors that are associated with occupational injuries of Team leaders.

I can assure you that the information you provide will be kept confidential at all times. This study may be published in a journal but the data collected will be stored in a secure place until it is destroyed. Your participation with this questionnaire is voluntary and you are free to refrain from answering the questions.

The questionnaire will take approximately 45 minutes to complete. If you have any concerns you can contact me or my supervisor on the following contact details:

Researcher
Name: Sthabiso Xaba
Email: sthabiso43@yahoo.com
Phone: 0632545925

Supervisor
Name: Samukelo Ngubane
Email: mbovusam@gmail.com
Phone: 0827267830

This questionnaire consists of questions on a 5 point scale whereby

1 – Strongly agree
2 – Agree
3 – Undecided
4 – Disagree
5 – Strongly disagree

There is no right or wrong answer but mark what appeals to you.

Particulars of participant

In which year were you born? _________1965________________

What is your highest qualification? __________Std 8_______________

How long are you a Team Leader? __________14_______________

Years of experience in the mines? _________26________________

Are you married? ______yes________

Have you suffered from a mine injury (whether you reported it or not)? _____no_______

The fatigue scale is an adoption of the Occupational Fatigue Exhaustion Recovery (OFER) scale

***Fatigue* with 15 items:**

I use a lot of my spare time recovering from work
1 2 **3** 4 5
I often wonder how long I can keep going at my work
1 2 3 **4** 5
I feel most of the time I'm living to work
1 **2** 3 4 5
My head feels heavy a lot of the time
1 **2** 3 4 5
I often feel exhausted at work
1 **2** 3 4 5
Too much is expected of me at my work
1 2 3 4 **5**
My working life takes all my energy from me
1 2 **3** 4 5
I usually have lots of energy to give my family or friends*
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In which year were you born? _________1964________________

What is your highest qualification? __________Std 7_______________

How long are you a Team Leader? _________18 yrs________________

Years of experience in the mines? __________24yrs_______________

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