Fatigue, substance use and sick leave of employees in a mining environment

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Dissertation submitted in fulfilment of the requirements for the degree *Masters of Commerce in Labour Relations Management* at the Vaal Triangle Campus North-West University

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Graduation May 2018

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DECLARATION

I, Rochelle Fourie declares that **FATIGUE, SUBSTANCE USE AND SICK LEAVE OF EMPLOYEES IN A MINING ENVIRONMENT** is my own work and that all the sources use or quoted by me have been indicated and acknowledge by means of complete references.

26/10/2017

Signature **Date**

REMARKS

The reader is reminded of the following:

This dissertation followed the practice that is in line with the policy of the programme in Labour Relations Management at the North-West University. The prescribed publication Manual (6th edition) of the American Psychological Association (APA) was used for references and editorial style.

This dissertation is submitted in the format of two research articles.

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This certificate serves to confirm that the MA dissertation with the title, ***Fatigue, substance use and sick leave of employees in a mining environment***, has undergone a professional language, stylistic, structural and reference edit. It is important to note that all content in the dissertation, including argumentation, remains the responsibility of the client and the supervisor. The onus rests on the client to work through the proposed changes after the edit has been completed, and either accept or reject the proposed changes.

Natasha Ravyse

PREFACE

I would first like to thank my supervisor, Dr Elsabè Keyser of the Faculty of Humanities (School of Economic Sciences) at the North-West University, Vaal Triangle Campus. Her leadership, patience, support and encouragement made this dissertation possible.

I want to express thanks the diamond mine located in the Free State Province where this study was endorsed, and employees were permitted to take part in the survey as part of the data collection process. Without their passionate participation and input, the survey could not have been successfully conducted.

I must express my very profound gratitude to my parents and to my spouse for continuously supporting and encouraging me throughout my studies. This achievement would not have been possible without you.

Last but not least, I must thank my very good friend, confidant and co-student Diana van Jaarsveld for all her moral and intellectual support.

ABSTRACT

Title: Fatigue, substance use and sick leave of employees in a mining environment

Key words: employee fatigue, fatigue measurements, substance use, sick leave abuse, white-collar employees, blue-collar employees, alcohol, drugs, human fatigue.

A major concern for and challenge to the mining industry are the increasing perceptions of employee fatigue at all levels of the organisational structure. It is compulsory, by legislation that mines in South Africa report yearly on employee fatigue. The emergence of fatigue in South African mines has become inevitable with the current legislation for the mining industry. Furthermore, employees with high levels of alcohol consumption is problematic, and these employees might use short-term absenteeism as a coping mechanism to escape their issues with alcohol.

Chapter 2 (Article 1) investigate the current state of the conceptualisation fatigue by looking at international and national research conducted on employee fatigue in addition to investigating the use of the concept in South African mines/organisations. The article has five major contributions. Firstly, it conceptualises fatigue from a historical and current point of view by investigating the current state of research of employee fatigue in the mining industry by analysing national and international research conducted in this field. Secondly, it focuses on approaches to fatigue. The third and fourth contributions are the investigation of fatigue models and the measurement of the concept fatigue, respectively. Furthermore, focus is given to the history and legislation relevant to the mining industry regarding fatigue. The final contribution relates to the outline and discussion of the characteristics of work fatigue in the mining industry.

Chapter 3 (Article 2) main objective is to determine the relationship between employee fatigue, level of substance use, absenteeism and the demographical information of employees. In order to prevent employee fatigue, it is important that the relationship between employee fatigue and accompanying demographical information of these employees, is understood. The study also focuses on which group of employees, white- or blue-collar employees, have a higher level of substance use, and which group of employees have a higher level of human fatigue in the mining industry.

There is no debating the fact that the South African economy is dependent on the mining industry. This study identified a gap in the current literature with regards to both fatigue studies

in South Africa and fatigue in the South African mining industry. International studies have done vast amounts of research on the phenomenon of employee fatigue and an extensive amount of literature focuses on the mining industry. Thus, further research is required to fill the void in the current literature relating to the topic of employee fatigue, substance use and sick leave of employees in a mining environment. This research will allow the much-needed information to reach both the organisation and the employees that need assistance.

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CHAPTER 1

INTRODUCTION AND PROBLEM STATEMENT

1.1 Introduction and Background

The increase in the literature and research both internationally and nationally on the topic of employee fatigue in the past few years emphasises the rapid growth in concern about this phenomenon. Firstly, a major concern for, and challenge to the mining industry are the increase in perceptions of employee fatigue at all levels of the organisational structure. It is compulsory, by legislation that mines in South Africa report yearly on employee fatigue. As stated in the Code of Good Practice: Government Gazette of Mine Health and Safety Act 1996 (No. R 1025, p.4) "Fatigue can significantly affect an individual's capacity to function. Its side-effects include decreased performance and productivity and increased the potential for injuries to occur". The expectation of this act is that employers have a duty to provide a workplace that is safe and free from risk and this duty and obligation, furthermore, expects that the employer implements relevant control measures to identify and address the risks associated with fatigue. Under the myriad of this Code of Good Practice, a positive obligation is to establish and implement a risk plan for management if risk factors for fatigue are identified. The question is no longer about the existence of employee fatigue in the mining industry nationally and internationally, but the emphasis has shifted to the measurement of its impact on individuals and the mining industry.

Schutte (2010) and Lerman et al. (2012) mention that fatigue is one of the growing problems in modern society. The South African mining industries are affected by employee fatigue resulting in a critical safety issue. Fatigue has an opposing effect on every aspect of human performance. High fatigue levels cause reduced performance and productivity in the workplace and increase the risk of accidents and injuries occurring. Employees' ability to think clearly is affected by fatigue, and this ability is critical when making safety-related decisions and judgements. Employees who suffer from fatigue are unable to measure their level of deficiency and are not as effective or do not work as safely as they would if they did not experience high fatigue levels (Schutte, 2010). Productivity and safety in the workplace are related to employee health. Healthier employees demonstrate less health claims, better safety records and higher productivity. Alert and well-rested employees are critical to productive and safe operations (Lerman et al., 2012).

As mentioned by the New Zealand Government Report (2015) fatigue, drug use and alcohol use are three serious issues in the workplace today. To manage these three risks, like any other significant hazard in the workplace, employers need to take active steps in monitoring and reducing tiredness in the workplace. Furthermore, employers need to identify areas of work that could lead to tiredness or increased alcohol or drug use in order to identify and determine the risks for both the organisation and the employees (New Zealand at Work, 2015).

The diamond mining site that is central to this study's investigation, lost more than 7135 shifts for the financial year (FY) 2017 (July 2016 to June 2017) due to absent employees. This figure has decreased from 8326 in the previous financial year (July 2015 to June 2016) due to limitations placed on unpaid leave, which decreased from 2583 shifts in FY2016 to just 774 shifts in FY2017 (Nkojwa, 2017). As mentioned by Netshidzati (2012, p. 1), "Authorised or scheduled absences occur when an employee is absent from work for any reason, other than illness, which is acceptable to management. Unauthorised or unscheduled absence is considered to be unacceptable and should not be tolerated". This high level of absenteeism has an impact on production at the diamond mine as it calculates to approximately 74 938 production hours lost for FY2016 and approximately 64 219 production hours lost for FY2017. Using current cash cost of production of approximately R476 525 per shift, this calculates to R3 967 792 240 loss in production shifts for FY2016 and R3 400 249 988 for FY2017 (Viljoen, 2017).

Furthermore, in the past seven years (January, 2010 until January, 2017), the diamond mine has charged an abundant amount of employees with substance use offences, which resulted in final written warnings issued. In the same period, the mine has dismissed 54 employees due to further disciplinary action because of substance use (Nkojwa, 2017). Therefore, this may lead to additional challenges such as loss of valuable skills, shortage of employees, recruitment challenges due to the geographical nature of the mine, ongoing training and development, production losses, as well as financial losses due to production losses.

According to Maiden (2014), counsellors in the mines report that miners often smoke cannabis before going down the mine shaft as it takes the edge off fatigue and fear. The National Institute on Drug Abuse (NIH) explains that many adult, illicit drug users are employed. Furthermore, they identify that when comparing non-substance users with substance-using employees, the substance-using employees are expected to be absent and/or late for work more, be less productive, be involved in a workplace accident, change jobs frequently, and file employees' compensation claims (NIH, 2017).

South African labour legislation guides all employers with regards to alcohol and substance use. The South African Labour Relations Act (66 of 1995) states, "[i]n the case of certain kinds of incapacity, for example, alcoholism or drug use, counselling and rehabilitation may be appropriate steps for an employee to consider". The Occupational Health and Safety Act (Act No. 85 of 1993) requires employers to handle the health, safety and well-being of all employees; this includes having strategic interventions in the case of alcohol and substance use.

The Mine Health and Safety Act and Regulations 29 of 1996 states that it is the employers' responsibility to ensure a safe working environment, however, the employee must also look after his or her own safety. Chapter 2, Section 5 of this act explains the employer's responsibility in two parts. First, "[a]s far as reasonably practicable, every employer must provide and maintain a working environment that is safe and without risk to the health of employees" (Mine Health and Safety Act and Regulations 29 of 1996, p. 5). Secondly, "as far as reasonably practicable, every employer must identify the relevant hazards and assess the related risks to which persons who are not employees may be exposed; and ensure that persons who are not employees, but who may be directly affected by the activities of the mine, are not exposed to any hazards to their health and safety" (Mine Health and Safety Act and Regulations 29 of 1996, p. 5).

When focusing on legislation regarding intoxication in the workplace, the Minerals Act (50 of 1991), Chapter 4, Regulation 4.7.1 and 4.7.2 can be applied. These regulations explain that no person in an intoxicated state shall be allowed to enter a mine or be in proximity of any workplace or near any machinery. Anyone who may have entered a mine in a state of intoxication may be arrested immediately by the manager and handed over to police and will be deemed guilty of an offence under the regulation of the act (Mine Health and Safety Act and Regulations 29 of 1996, p. 301).

A study conducted by Ajani (2010) on alcohol and cannabis use in 2003 in the mining industry found that employees with a low level of education and low job categories are positively associated with cannabis and alcohol misuse. The reasons given by employees for the use of alcohol and cannabis was said to be for relaxation, socialising, boredom and coping with stress. Participants felt that mine employees could control the use of alcohol and cannabis through awareness programmes, substance use testing, rehabilitation programmes, disciplinary measures and recreational facilities to relieve boredom.

The second concern identified is high levels of sick leave absenteeism. Absenteeism is defined by Robbins, Odendaal and Roodt (2016, p. 15) as "the failure of an employee to report for work as scheduled, regardless of the reason." Absenteeism is one of the most difficult areas of employee discipline to control. Proper attendance is not the responsibility of the employer but rather the responsibility of the employees themselves; employees should remember that if they are absent from work without good reason, they are in breach of their employment contract and could be dismissed after the correct procedures are followed (Claassen, 2015).

Wilkinson (2015) found that substance use is increasing in the workplace and three out of four alcohol users and 70 percent of drug users are employed. It is projected that in South Africa, the use of alcohol and drugs costs the economy at least R9 billion a year. He further mentioned, employees that use alcohol were found to have lost 86 working days a year due to non-attendance. More than 50 percent of accidents in the workplace are drug-related, and undetected drug use costs an employer a further 25 percent of the employee's salary.

1.2 Literature Review

1.2.1 A fatigued workforce

Occupational fatigue is defined as a multidimensional construct (De Vries, Michielsen, & Van Heck, 2003). Existing literature indicates that fatigue is a multicausal, multidimensional, non-specific and subjective phenomenon, which results from prolonged activity and psychological, socioeconomic and environmental factors that affect both the mind and the body (Soh & Crumpton, 1996; Tiesinga, Dassen, & Halfens, 1996). Current research by Frone and Tidwell (2015, p. 284) emphasises that "despite the importance of this construct, relatively little attention had been paid to its conceptualisation and measurement". Frone and Tidwell, (2015) explain that definitions and measures have been insufficient as they fail to focus on the desirable characteristics of a work fatigue measure. Existing research related to fatigue in the workplace has focused on sleep patterns of employees, emotional exhaustion and burnout components as well as their impact on safety and performance (AbuAlRub, 2004; Aiken, Clarke, Sloane, & Sochalski, 2001; Chen & McMurray, 2001; Gold, Roth, Wright, Michael, & Chin-Yi 1992; Kandolin, 1993; Lindborg & Davidhizar, 1993; Suzuki, Kanoya, Katsuki, & Sato, 2006; Taylor, Weaver, Flannelly, & Zucker, 2006).

A study by Janssen, Kant, Van Amelsvoort, Nijhuis, and Van den Brandt (2003), focusing on fatigue as a predictor of sick leave, found that the occurrence of sick leave is influenced by four

factors, namely social factors (such as health care, social security system and culture), work-related factors (such as working conditions and work content), organisational factors (such as absence policies, company size, and the existence of health promotion programmes) and lastly, individual factors (such as health and personality). The study by Janssen et al., (2003) points out four reasons why fatigue may be a significant predictive factor for sick leave. First, it was found that there was an existence of high occurrence of fatigue cases in the working population. Secondly, it was determined that fatigue was robust. Thirdly, fatigue was found to be a disabling condition, and lastly, it found that fatigue was an important symptom of mental stress-related health complaints. Fatigue are seen as a predictor of sickness absence of employees (Janssen et al., 2003).

1.2.2 Substance use

Substance use in the workplace is a tremendous problem in companies today. In many cases, it is viewed as an individual problem, although it also affects the organisation as the employee's work performance is affected, resulting in additional costs to the company. These costs are generated by absenteeism, accidents, illness and mortality. Substance use has been associated with negative occurrences in the workplace; these occurrences include stress, boring work, shift work, work requiring relocation and frequent changes in co-employees and supervisors (Modise, 2016).

Studies done by the International Labour Organisation (ILO, 1999) on drug and alcohol use in the workplace have shown:

- Employees with drug and alcohol problems tend to have absenteeism rates that are two to three times higher than those of other employees.
- Employees with chemical dependency problems file five times more employees' compensation claims and three times as many sick benefits claims than those employees without chemical dependency problems.
- That 20-25 percent of accidents at work, where people injured themselves and innocent victims, involved intoxicated people.
- That drugs and alcohol supplied at work attribute to 15-30 percent of all accidents at work.

Robbins et al. (2016: p. 15) estimate that "absenteeism has cost South African organisations millions of rand a year in decreased efficiency and increased benefit payments such as sick leave and payroll costs".

1.3 Research Objectives

This study aims firstly, to investigate the current state of research on the phenomenon of employee fatigue in the mining industry in South Africa by analysing national and international research conducted in this field. Secondly, to determine whether a relationship between human fatigue, substance use and high levels of sick leave/absenteeism can be established. In determining such relationships, it will furthermore be determined, whether or not there are higher levels of substance use with blue-collar employees or with white-collar employees, and which factors contribute and influence the use of substances.

The specific objectives are to:

- investigate the current state of research on the phenomenon and measurement of employee fatigue in the mining industry in South Africa by analysing national and international research conducted in this field (Article 1);
- to determine the relationship between employee fatigue, level of substance use, absenteeism and the demographical information of employees (Article 2);
- determine which group of employees, white- or blue-collar employees, has a higher level of substance use (Article 2); and
- determine which group of employees, white- or blue-collar employees, has a higher level of human fatigue (Article 2).

1.4 Research Method

The research will consist of two phases, namely a literature study and an empirical study.

1.4.1 Literature study

In this first phase, a complete literature review using content analysis will be done focusing on fatigue. The literature review (Chapter2: Article 1) will focus on the current state of international and national research, as well as the measurement of employee fatigue in the South African mining industry. Articles, mine statistics and presentations relevant to the study will be obtained by means of online searches via databases, and books relevant to the study will be obtained by making use of libraries.

1.4.2 Empirical study

The second phase of this study will consist of an empirical study.

1.4.3 Research approach and design

In this study (Chapter3: Article 2), the researcher follows a quantitative approach. A quantitative approach uses measurement instruments where numerical data is analysed and compared for different variables (De Vos, Strydom, Fouché, & Delport, 2011). A cross-sectional design is followed that entails the collection of data at a specific moment in time and is used by researchers to explain and describe differences in a population.

Since this study aims to explain the relationship between employee fatigue, substance use and employee absenteeism of blue- and white-collar employees, primary data (mining) is part of the data collection procedure.

1.4.4 Participants

One-thousand and twenty (1020) employees at a diamond mine in the Free State Province were used as participants. These employees consist of 516 permanent and 504 contracted employees and are divided into two groups. The group consisted of skilled (Patterson Band C upwards) and semi-skilled (Patterson Band A and B) employees.

1.4.5 Measuring instruments

- Fatigue measurement instrument (Ergomax, 2013): The fatigue measurement instrument (2013) was specifically designed for the diamond mine by Ergomax and is used in all mining operations, within the group. This questionnaire consists of 44 items. Typical questions in the Ergomax (2013) range from non-work factors (such as average hours of sleep, travelling time and travelling distance), environmental conditions (such as exposure to noise, temperature and chemicals), work-related factors (such as overtime, work pressure, last leave cycle), work schedule and planning (such as average weekly working hours, number of breaks within a shift, length of shift hours), night shift work (such as number of night shifts worked in succession, period of rest following night shift cycle, breaks during night work). A Likert scale, was used where, for example, average hours of sleep were recorded by participants selecting one of three options: 1 = more than 8 hours, 2 = between 6 hours and 8 hours, 3 = 6 hours or less.

- Substance use measurement (Surujlal & Keyser, 2014): The measurement used to determine employee substance use was developed by Surujlal, Nolen, and Ubane (2012). This questionnaire was later validated and shortened by Surujlal and Keyser (2014) in order to align it with the industrial sector. The questionnaire consists of four sections. Section A consists of eight items that concentrate on substance use patterns, which result from the amount and regularity of alcohol consumption and substance use. Each item is rated on a Likert-type scale of one (every day) to five (once a year or less). Section B consists of 18 items with the emphasis on drinking consequences; each item is rated from one (at least once in the past two months and at least one additional time during the past year) to five (has not happened to me).
- Absenteeism (Psycones, 2006): The behaviour of employees' absenteeism was measured by using the Psychological Contract Across Employment Situation (Psycones) questionnaire (2003). The behaviour questionnaire on absenteeism consists of four items. Typical questions in this questionnaire range from "*How often have you been absent form work due to your state of health over the last 12 months?*" to "*How often have you gone to work despite feeling that you really should have stayed away due to your state of health over the last 12 months?*"

1.4.6 Procedure

This research complies with compulsory legislation (Code of Good Practice: Government Gazette of Mine Health and Safety Act 1996 No. R 1025) that mines in South Africa need to report yearly on employee fatigue. Permission was obtained from the mine manager and relevant stakeholders (trade unions) to conduct the study at the mine. The questionnaires were administered to skilled and semi-skilled employees on the different shifts with the assistance of the Health Safety and Environmental Department (HSE). The mine management first had sessions with the employees, explaining what the research was about and then handed out the consent forms; these forms explained that participation is voluntary, what the purpose of the study is and that all information obtained via the research would be used for research purposes only. Secondly, the responsible person at the mine waited two weeks before they started the questionnaire sessions where large groups of consenting employees completed the questionnaire. An employee from the HSE department was present to explain each question to the employees and answer any questions from the employees.

The questionnaires were then completed in groups and were submitted to the facilitator from the HSE department at the venue, after which the HSE department prepared them for analysis. The

data from the questionnaires were then made available to the researcher to analyse further with the most appropriate software program.

1.4.7 Statistical analysis

The statistical analysis was carried out by utilising Statistical Package for the Social Sciences (SPSS) version 24 (SPSS, 2017). Descriptive statistics were offered by means of analysing the means, standard deviation, skewness and kurtosis of the data. To test for the reliability of the construct, Cronbach's Alpha was computed for the relevant items and a cut-off point of 0.70, as set by Clark and Watson (1995), was used.

The significance of differences between different demographic groups was determined by using Multivariate Analysis of Variance (MANOVA) (Field, 2013). Statistically, significance was set at $p < 0,05$. To test for the relationships between the different variables, Pearson product-moment correlations were used, and statistical significance was set at $p \leq 0.01$, where the practical significance of correlation coefficients were set at $r \geq 0.30$ (medium effect) and a large effect reflected $r \geq 0.50$ (Cohen, 1988). Furthermore, effect sizes were used to measure the practical significance and impact of the various relationships between the different variables. Analyses of regressions were performed to determine whether or not the identified variables have an influence on substance use and the sick leave of employees and whether or not the effect of employee fatigue is supported.

Flynn (2003) explains that T-tests are used to compare the means of two groups, as T-tests focus on two distributions and determine whether or not their means are significantly different. No significant difference between the two means indicates a null hypothesis. To determine differences between the sub-groups in the sample, T-tests and one-way analysis of variance (ANOVA) were used. For difference of medium effect, the practical significance cut-off point was set at 0.05 and 0.80 for a difference of large effect (Cohen, 1988).

1.5 Ethical Considerations

Ethical approval (Annexure B – Ethical Clearance) was obtained prior to the data collection in the mining organisation, and ethical permission for the use of the primary data (mining) was obtained from the North-West University. In the consent letter handed out to all employees at the mine two weeks prior to the questionnaire sessions, the researcher explained to the participants that the study is voluntary, the roles and responsibilities for each of the different parties that will

be involved in the study, as well as the purpose and objectives of the study. Written consent was obtained from each participant prior to their participation in the study. This consent stated that the information obtained via the research would be utilised for research purposes only, any concerns or questions that the participants may have had could be raised with the researcher before considering participation in the study. Feedback on the results of the study will be given to management and if requested by the participants, they will receive feedback as well. Confidentiality and anonymity (where applicable) was assured by making use of company numbers and not names and surnames (De Vos et al., 2011; Struwig & Stead, 2003). The primary investigator took care not to cause harm to participants and also ensured that the dignity and rights of all participants were protected.

1.6 Chapter Division

The chapters in this dissertation will be presented in the following manner:

Chapter 1: Introduction

Chapter 2: Article 1. The phenomenon of employee fatigue in the mining industry.

Chapter 3: Article 2. The relationship between employee fatigue, level of substance use, absenteeism and the demographical information of employees.

Chapter 4: Conclusions, limitations and recommendations.

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CHAPTER 2

RESEARCH ARTICLE 1

THE PHENOMENON OF EMPLOYEE FATIGUE IN THE MINING INDUSTRY

A part of this research article is in press:

Fourie, R., & Keyser, E. (in press). The phenomenon of employee fatigue in the mining industry

CHAPTER 2

ARTICLE 1: THE PHENOMENON OF EMPLOYEE FATIGUE IN THE MINING INDUSTRY

Prior conceptualisation and measures of the concept fatigue from the 16th Century is still inadequate in a number of ways. The emergence of fatigue in South African mines has become accepted as a real phenomenon. The general objective of this article is to investigate the current state of international and national research on employee fatigue and the measurement thereof in the mining industry, by way of content analysis. Articles, mine statistics and presentations relevant to the study will be obtained by doing computer searches via databases and books relevant to the study will be obtained by making use of libraries. Additionally, the article also concentrates on fatigue approaches, models, and characteristics of fatigue.

There is no debating the fact that the South African economy is dependent on the mining industry. This study identified a gap in the current literature with regards to both fatigue studies in South Africa and fatigue in the mining industry. International studies have done vast amounts of research on the phenomenon of employee fatigue and an extensive amount of literature focuses on the mining industry. Thus, further research is required to fill the void in the current literature relating to the topic of employee fatigue, substance use and sick leave of employees in the South African mining environment. This research will allow the much-needed information to reach both the organisation and the employees that need assistance.

Key words: employee fatigue, measurements, individual human factors, non-work factors, environmental conditions, work-related factors, shift work, work schedule and planning.

INTRODUCTION AND BACKGROUND

Fatigue emerged as a concept in the literature for the first time in the 16th Century, as "a description of tedious duty, a sense that has persisted in military terms" as "fatigue-dress" (Barnett, 2005, p. 21), but the definition of *work fatigue* emerged as a concept almost 95 years ago (Pillsbury, 1922). The increase in literature and research, both nationally and internationally on the topic of work fatigue over the past years, emphasises the rapid interest in the phenomenon.

Even after many years of studying fatigue as a concept, a lack of certainty still exists for scientists as the concept fatigue cannot be defined in simple terms (Gomberg, 1947). Even in the 1970s, researchers such as Cameron (1973) emphasise that a lack of clear definition with regard to fatigue led to inconsistency, which has hampered research in this field. He further mentions that one needs to establish if the term is a phenomenon (something that you can observe) or a theoretical entity (hypothetical construct or an intervening variable). Even today, a lack of clear definitions and clear understanding of fatigue in the workplace is apparent (Ahmed, Babski-Reeves, DuBien, Webb, & Strawderman, 2016).

The concept and measurement of fatigue of employees is best understood when it is explained from a historical point of view. Researchers and investigators who studied the field of fatigue in late 1940 state that "…during the past twenty-five years fatigue is still a source of bewilderment to the scientist; it cannot be defined in simple terms and nobody knows how to measure it" (Sappington, 1940, p. 10).

Questionnaire surveys are the most commonly used method to examine fatigue of employees. Many different types of measurement exist to measure fatigue (Sagherian & Brown, 2016). Whitehead (2009) states that a huge quantity of instruments (questionnaires) have been established to measure fatigue. Workplace fatigue cannot be easily measured, as most employees are unwilling to communicate their feelings concerning fatigue. Based on the definitions and discussion above, it is clear that there are difficulties in agreeing to a definition of the concept of fatigue and the multiple causes of fatigue which hinders the singling out of a measuring instrument for employee fatigue. Though, the identification and measuring of fatigue and the causes of fatigue in the workplace must be seen as the initial step to managing fatigue in the workplace (Sadeghniiat-Haghighi & Yazdi, 2015).

Current research by Frone and Tidwell (2015, p. 284) emphasise that "despite the importance of this construct, relatively little attention had been paid to its conceptualisation and measurement". Frone and Tidwell, (2015) explain that definitions and measures have been insufficient as they fail to focus on the desirable characteristics of a work fatigue measure.

As mention by Dall (2015), the government of South Africa issued implementation guidelines with regards to the measurement of fatigue (Annexure B). Under the myriad of this Code of Good Practice, a positive obligation is to establish and implement a risk management plan should risk factors for fatigue be identified. The question is no longer about the existence of employee fatigue in the mining industry both nationally and internationally, but the emphasis has shifted to the measurement of its impact on individuals and the mining industry. Therefore, it is important to investigate current measurement methods of work fatigue.

The present article has five major contributions. Firstly, it conceptualises fatigue from a historical and current point of view by investigating the current state of research of employee fatigue in the mining industry by analysing national and international research conducted in this field. Secondly, it focuses on approaches to fatigue. The third and fourth contributions are the investigation of fatigue models and the measurement of the concept fatigue, respectively. Furthermore, focus is given to the history, and legislation relevant to the mining industry regarding fatigue. The final contribution relates to the outline and discussion of the characteristics of work fatigue in the mining industry.

OBJECTIVE OF THE ARTICLE

The focus of this article was to investigate the current state of the conceptualisation *fatigue* by looking at international and national research conducted on employee fatigue in addition to investigating the use of the concept in South African mines/organisations. The various methods and instruments used to measure fatigue/work fatigue are, therefore, significant and using standards to assess the value of these measures are of further importance. The results of the application of the instruments were evaluated by focusing on whether or not reliability and validity tests were performed on the instruments.

It is essential that existing managers and researchers have reliable tools and guidelines available to direct effective fatigue management as well as the accurate measurement of fatigue in mines. This study will serve as an agenda for research in the future and will, therefore, provide clear

guidance and structure for the mining industry in South Africa. It will furthermore provide a fresh view on the methodology of investigating fatigue in the mining industry in South Africa.

METHOD OF RESEARCH

In this article, a literature review was conducted by means of content analysis. Bryman (2015, p. 285) define content analysis as "an approach to the analysis of documents and texts that seek to quantify contents regarding predetermined categories and a systematic, replicable manner".

The first step was to facilitate a descriptive investigation of the literature with regards to fatigue. Various electronic databases were used, including but not limited to, Google Scholar, NWU online library, Ebsco, Google Books, Elsevier and Science Direct. Various key words were searched, such as employee fatigue (111 000 results), fatigue measurements (2,100,00 results), fatigue (1 784 611 results), fatigue, mining and South Africa (532 000 results), individual human factors and fatigue (1 300 000 results), fatigue and non-work factors (11 000 results), environmental conditions and fatigue (1 680 000 results), fatigue and work-related factors (66 800 results), shift work (5 280 000 results), shift work and fatigue (1 070 000 results), work schedule planning and fatigue (150 000 results). This process was followed to identify relevant research articles, books and other sources pertaining to fatigue.

Relevant international and national publications were identified after which data was structured in order to accommodate the content analysis. Upon analysis, it became apparent that sub-categories could be developed, such as the historical development of fatigue, the conceptualisation and features of fatigue, measurement of fatigue, approaches and models to fatigue, legislation applicable to fatigue and the characteristics of employee fatigue.

HISTORICAL DEVELOPMENT OF FATIGUE

Fatigue has passed through different time periods. In the 16th Century, fatigue was described as a tedious duty (Beaulieu, 2005) and in the 19th Century, the use of the concept started to change (Barnett, 2005). Cameron (1973) and Hutchins (1987) explains that research into fatigue has undergone numerous periods of interest over the years and can be divided into three periods.

Firstly, the period before and after World War One, the focus of research into fatigue was primarily on productivity in industry, more specifically, the munitions industry. Secondly, during the 1940s and the 1950s, the focus shifted to fatigue and the aviation industry. The third period

of interest began in the 1940s and is still relevant today. This time period will be discussed in more detail below.

In the 17th Century, the word energy was used to describe fatigue. Fatigue reports often make use of ontological metaphors and modern metaphors link fatigue to the "loss of energy" (Hockey, 2013). Fatigue only received a negative connotation in the last two centuries when it was linked to tiredness.

Hockey (2013) states that the agricultural employee of the 17th Century certainly got tired after working all day, but there is limited evidence on this topic. From 1750 to 1880, major work changes were experienced by employees. Furthermore, the middle of the 18th Century is associated with the greatest changes to working life due to the industrial revolution, leading to the changing understanding of work and fatigue. During 1879, Wilhelm Wundt founded the first laboratory dedicated to psychology at the University of Leipzig, in Germany, where experiments were conducted to determine a relationship between work pace, boredom and fatigue (Kaufman, 2006). Although Wundt contributed significantly to psychology with his studies of external conditions on reaction time, his main contribution comes from the influence he had on those working in his laboratory.

As mention by Fletcher, Hooper, Dunican, and Kogi (2015) the concept of employee fatigue was researched and documented since the 19th Century. Expressions of the feelings associated with fatigue stem from 19th-century "energy" ideas (Fletcher et al., 2015, p. 7) and fatigue. However, expressed feelings of fatigue date further back when considering the root metaphor of man and machine from a grounded theory perspective.

By the 1900s, fatigue started to be perceived as a major problem for society and employees. In the early 1900s the metaphorical phrase, *mental energy* (about human behaviour) emerged (Rabinbach, 1990). Rabinbach (1990, p. 12) refers to the new way of conceptualising human activity as "the human motor". This concept refers to physical work, however, was quickly extended to account for fatigue from mental work. The concern with fatigue in the early 1900s was about employees' health and their well-being. Derickson (1994) argues that the work reform was ultimately effective not because it was able to demonstrate impaired productivity, but rather because the new work-energy perspective explained that effort could overcome work demands but only up to a limit, until energy becomes exhausted.

In the early 19th Century, modern life was fast and exhilarating, equivalent feelings of exhilaration were triggered by technologies, consequently leading to a shift in the use of the term fatigue (Barnett, 2005). The common reports of fatigue problems associated with the conditions of work in factories during the second half of the 19th century led to the work-fatigue problem being recognised, furthermore, during the late nineteenth century the emerging of a Europe-wide "science of work" (Hockey, 2013).

One of the Europe-wide "science of work" was the Mather trial consisted of experiments and observations with shorter working hours and played an important part in the formulation and elaboration of the concept of industrial fatigue. The further investigation (both prevalence and empirical) of the concept in Britain was limited for over two decades by two factors namely, the stalling of employers' organisations, and the frequency of customary and traditional practice. Experimentations abroad, especially at Zeiss Optics in Germany (1901) and at the Engis Chemical Works in Belgium (1905), however, established Marther's hypothesis that productivity significantly increased as excessive working hours were reduced. This period also saw the beginning of laboratory research into the physiological and nutritional aspects of human fatigue. As mention by McIvor (1987) the founding fathers, Ranke and Mosso, developed instruments to measure muscular energy expenditure as well as the ergo graph.

The term industrial fatigue becomes the dominant concept in the field of physiology of work and the principal area of functional physiology in the 1910s and 1920. Triggered by the deficits in production during the First World War, numerous governments set up committees of inquiry and research programs designed to lessen fatigue and increase productive efficiency. With the start of World War One, American employers received the assistance of biomedical scientists for the first time, as the employees in the defence industries became a matter of national interest when it was decided that the amount of effort that these employees should disburse each working day must be determined. Although the partnership between physiology and business was short-lived, it contributed directly to one continuing change in employment conditions, as it introduced one of the first modern employee benefits (paid rest during the work day) (Gillespie, 1987).

The First World War led to the establishment of dedicated national bodies to examine the impact of fatigue on production. 1914 saw Britain entering in the First World War; the American economic mobilisation drew from the desperate drive to produce military equipment and supplies that were propelled by Britain. As the work day sometimes lengthened to twelve hours, productivity fell, accidents, spoiled work, absenteeism and other manifestations of fatigue

multiplied and the British government introduced the Health of Munition Workers Committee (HMWC) (Hockey, 2013). This committee was tasked with investigating these phenomena and report more bearable measures to Winston S. Churchill. HMWC found that "although employees' rate of output fell after eight hours on the job, their total output after ten or more hours' work still exceeded that accomplished on the shorter shift: the war effort demanded inefficiency" (Derickson, 1994, p. 487).

Although the committee recommended only modest limitation on working hours, they suggested that adult males work no more than sixty-seven hours per week. Females of all ages and boys under sixteen years, work no more than sixty hours; they also gave an extensive list of other recommendations such as preventing Sunday labour, providing nutritious meals, holidays, short rest periods during shifts and health care as incentives. The HMWC also gave the first functional definition of industrial fatigue: "the sum of the results of activity which show themselves in a diminished capacity for doing work" (Health of Munition Workers Committee, 1916, p. 4). In other words, no fatigue existed as long as threats, stimulants, financial incentive, nationalistic appeals, or machine pacing could motivate employees to maintain output throughout their work shifts.

Americans accepted that the operational definition of fatigue was reduced output, and so, the Committee of Industrial Fatigue (CIF) was founded by the Council of National Defence (CND) in April of 1917 (Geison, 1987). The CIF had two mandates, firstly to conduct innovative research that would produce new scientific knowledge on the phenomenon of fatigue and, secondly, to filter through the available information to determine findings that could be enforced to expedite the production of war material. Unfortunately, the CIF had tremendous limitations right from the start, the first being that it lacked strong leadership, secondly, the committee lacked its funding for research and education, and much of the research became collaborations with the US Public Health Services that were funding the committee (Derickson, 1994).

Nevertheless, Wood and Wood (2002) state that amidst all the aforementioned challenges, the committee had a primary asset, Frederic S. Lee who presented the CIF (Committee of Industrial Fatigue) with a document titled "How Industrial Fatigue May Be Reduced" that was published in Public Health Reports, the journal of the US Public Health Service, a year later. Some of the recommendations in this document included; beginning with the rest periods, provision of adjustable seats, fresh air, and other improvements in working conditions. Although the report did not mention an eight-hour work day, it did state that the relationship between the length of

shift and the quality of production was not fully studied for all conditions, however, a shorter working day was mainly indicated to be in the best interests of the organisations themselves (Vernon,1921; Hockey, 2013).

Wood and Wood (2002, p. 234) in their work reported that according to Lee in July of 1917 the "Ford Motor company was Anxious to have us come out there". Ford had already started with the eight-hour work days and introduced other advanced measures, which allowed the CIF to focus on rest breaks. In October of 1917, Lee and Schereschewsky of the Public Health Service experimented with selected groups of auto employees giving them two ten-minute breaks during their shift. They were testing if the basic physiological principle that the human body could restore its productive capacity if given a proper period of recuperation from exertion and the results were as expected. On the 3rd of November 1917, it was reported that daily output had increased regardless of the twenty-minute reduction in working time and that the rest period was welcomed by both the employees and the foreman alike. This symbolised that a moderate adjustment in working conditions had benefited both the employee and the employer (Derickson, 1994; Widrich, 2014).

The Scovill Manufacturing Company provided Lee with the setting for a more ambitious attempt to inducing rest periods. This project mainly intended to find the "conditions under which the operatives, the human machines of the factory, can perform their work with the highest degree of efficiency" (Wood & Wood, 2002, p. 235). They concentrated on gathering data relating to hourly rates of output, power usage, and accidents on the job. In 1917, shorter night shifts in some departments (from twelve to ten hours) and rest periods were implemented by The Public Health Service (PHS). This study by the PHS came at a time when there was a strong drive to shorten hours as recurrent union agitation in Bridgeport, and other factories, raised the pressure on Scovill to end its ten-hour workday. The federal government introduced overtime at superior pay for any work going beyond the "basic" eight-hour day (Edsall, 1918).

Not only did Scovill change its approach to labour management, it also sponsored a girls club for female employees and introduced a ten-minute recess during mid-morning and mid-afternoon for all employees at one factory. Although management was afraid that these recesses would negatively impact production, they insisted that the experiment proceed and it was found to be a valuable way for management to promote a perception of company loyalty towards the female employees (Strom, 1992). Goldmark (1912) conducted the observations and found that the total daily output of rested employees increased by about three percent, which led to the experiment

being implemented in other facilities. The researchers encountered a problem at Scovill and elsewhere, that being the gendered nature of fatigue. There was a preconceived notion that these measures being implemented were to protect weak females, new to the wage-earning workforce. Although little resistance was encountered from men initially, it later appeared that men resented these breaks and shortened work days as an affront to their manhood and suggested that they lacked the stamina to perform a long day's work. Despite the resistance, the system of rests extended to include diverse operations (Fasce, 2002).

It is important to note that as the contemporary *Safety First* movement, in which Scovill also took part, structured rests highlighted the fact that management, not a labour union, held power to improve working conditions. Frank and Lillian Gilbreth, management consultants, claimed in 1919 that in all parts of the country and all categories of professions, breaks during working hours were being tested with male and female employees identically. The National Industrial Conference Board reported that 89 of 233 organisations that were surveyed were found to give short breaks to their employees. The US Bureau of Labour Statistics found that breaks were provided by almost one-quarter of large organisations and the Conference Board considered that any employee can benefit from breaks as it is significant to health and efficiency and it would be a mistake to only give these breaks to female employees (Derickson, 1994).

Frank Gilbreth's paper on motion study found that Frederick W. Taylor had calculated that the amount of fatigue caused, equalled the percentage of rest required with great precision (Moray, 2005). However, Bertrand Thompson recognised, in 1917, that, "the statement sometimes made that the founders of scientific management had formulated the laws of fatigue is altogether too broad" and he concluded that the school of Taylorism had not yet studied fatigue (Wood & Wood, 2002, p. 241).

In Goldmark's (1912) book "Fatigue and efficiency: a study in the industry" explains that the difference between the normal approaches of speeding up and the speed accomplished by efficiency engineering is clear to see by all. Historians such as Daniel Nelson have added to the criticism of scientific management as unscientific. Taylor's selfish modifications of facts in the succeeding recounting of the pig-iron experiment were exposed by Wrege and Perroni after which Taylorism was described as a superficial scheme for exploiting employees and extracting consulting fees. The limitations of Taylorism were noticed by Frederic Lee, who on the specific issue of fatigue, disapproved, and stated that, "while talking much of fatigue, do not appear to have an adequate knowledge of the physiology of the phenomenon" (Wood & Wood, 2002, p.

243). Spaeth (1919) excluded the efficiency engineers' claim to have found a law of energetic labour, challenging that a positive physiological basis, through carefully administered laboratory trials must still be established (Derickson, 1994).

According to McIvor (1987), almost all the nineteenth-century industrialists in Britain openly accepted several significant myths regarding labour management. Any serious investigation into human efficiency, health and more productive working methods were delayed and discouraged by these myths that were circulated by certain classical economists. The 19th Century did see growth in the awareness and concern for employee health. After Parliament had reacted to the callous working conditions in the early factories and mines, working hours were reduced, and conditions improved. In 1833, the Factory and Mines Acts was implemented, and an extensive Factory and Mines Inspectorate was progressively formed (McIvor, 1987).

Hockey (2013) states that the interest into human work and fatigue reached a peak during 1930 as the period between 1900 and 1940 was filled with comprehensive empirical studies, extensive theoretical concentration, and interested in knowledge applications of both educational and industrial practice. Myers (1937) found that in 1930, a strong link between boredom and fatigue was established leading to a distinction between mental fatigue and boredom. However, since the 1940s, fatigue has gradually withdrawn from the scientific landscape. During the World War 2 in 1943, the Royal Air Force raised concerns with regards to decrements in detecting targets during two-hour sessions by experienced employees. This lead to the examination of the decline of attentiveness that influenced research into human performance for the next 30 years. Mackworth (1948) wrote a landmark paper on the deterioration of attentiveness in which he found that a decline in performance could be noticed within 30 minutes or so after the start of a task.

This period of research into fatigue focused on driver fatigue and the effects thereof on safety. Additionally, the separation of reactive inhibition and accumulative fatigue through the increased length of fatigue studies was also very important for this period. Reactive inhibition was defined as short-term fatigue that could be recovered from in a single rest cycle, whereas cumulative fatigue was defined as ongoing fatigue that was sustained by the continuation of external and internal stimulus (Cameron, 1973; Hutchins, 1987). Limited research exists with regard to the division of time periods after 1940. In the following paragraph, it is clear from the literature, that the periods following the three above-mentioned ones, can be added; namely the 1990s and currently, where the focus of fatigue studies include ergonomics and employee diseases such as private, work-related, occupational and accidental fatigue (Sirois, 2009).

The awareness of the risk to safety posed by human fatigue has become more apparent over the past 20 years due to industrial disasters (Fourie, Holmes, & Bourgeois-Bougrine, 2010). Before 1956, an annual death toll related to accidents in South African mines varied around 800. Due to the Coalbrook disaster of 21 January, 1960, the figure rose to 1400. The penetration to greater depths was seen as a contributing factor as at such depths (9000 feet and deeper) the ventilation systems is the least adequate, and the pressures, temperatures and humidity are at their greatest. In these conditions, miners tend to get exhausted quickly, and fatigue-related accidents and deaths from heat stroke tend to increase (Simons, 1961). Uranium'Ezulwini mine suffered a fatal accident after a rock fall, resulting in the death of one employee, and at Harmony Gold's Kusasalehu, an employee disappeared after a seismic event. Mr David Msiza, the chief inspector of mines in South Africa's Department of Mineral Resources at the time, found that inadequate living conditions, fatigue and poor nutrition were causes for the fatalities (Matomela, 2011).

In 2015, 77 people lost their lives in South African mine accidents, compared to 84 the previous year, however, a warning by observers indicated that this does not mean the mining industry in South Africa is safe. Although Mr Msiza stated that these figures are the lowest ever recorded in the mining sector and are encouraging, he failed to mention that mine employees are still being injured, as accidents for the same period rose by 500. Over the past five years, 15 000 employees have been injured; this calculates to at least eight accidents a day in South African mines (Saba, 2016). It should be noted that the DMR recognised fatigue as a key contributing factor to injuries and since 19 December, 2014, it is compulsory, by legislation that mines in South Africa report yearly on employee fatigue (Mine Health and Safety Act, 1996).

Based on the above, the researcher argues that research into fatigue is currently moving into the sixth period of interest. The focus of this period has shifted from productivity, aviation, driver fatigue and safety, ergonomics and employee diseases as stand-alone entities to a holistic approach. Current fatigue research incorporates environmental, individual and organisational factors and the impact these factors have on human fatigue. Furthermore, it focuses on the impact that fatigue has on safety, productivity, health and the contributing factors that work schedules and shift work have on fatigue. This is important for the field of industrial relations as it not only provides a much need guideline for further research but also guides organisations with regards to preventative measures and training that can be implemented to limit the impact of fatigue on employees' health and safety.

CONCEPTUALISATION AND FEATURES OF FATIGUE

When using fatigue as a phenomenon, the concept needs to be defined. The definition of fatigue has changed in accordance to work environment changes in the past century. During the 20th Century, the duties of employees were of a more physical nature, and fatigue was thus described from a physical point of view. During industrialisation, process work was more repetitive, and therefore, fatigue was described more in psychological terms (Fletcher et al., 2015).

Bills (1934), from a phenomenon perspective, distinguishes between three types of fatigue; subjective fatigue, objective fatigue and psychological fatigue but as explain by Völker, Kirchner, and Bock (2016) it can be a mixture of both subjective and objective fatigue. Fatigue as a subjective phenomenon, as explained by Bartley and Chute (1947), is the feeling of tiredness, bodily discomfort and aversion to effort, while psychological effects should be termed as impairment. Subjective ways to assess fatigue include diary studies, interviews, and questionnaires (De Vries, Michielsen, & Van Heck, 2003).

Measurements of objective fatigue mainly concentrate on physiological processes or performance including reaction time or quantity of errors (De Vries, et al., 2003). In England, before World War One, fatigue research primarily addressed objective fatigue by looking at ways of reducing fatigue of employees to increase industrial production (Haworth, Triggs, & Grey, 1988).

Psychological fatigue is the sum of the psychological changes that accompany extended performance (De Vries, et al., 2003). It was argued by Tsanva and Markov (1971, p.11) that, "fatigue is determined by the production of a metabolite that raises the synaptic threshold between a nerve and the organ it controls". A problem with physiological definitions of fatigue is that they do not apply as easily to fatigue, which occurs as a result of mental activity.

Fatigue as a multifaceted concept, and one which has, thus far, not been defined independent of the setting (Ahsberg, 2000; Akerstedt, Kecklund, Alfredsson, & Selen, 2004; Friedberg & Jason, 1998; Hockey, 1983; Soh & Crumpton, 1996). Different authors such as Ahsberg (2000), De Vries et al. (2003), and Tiesinga, Dassen & Halfens. (1996) all agree that even though occupational fatigue is repeatedly defined as a multidimensional concept, most of the current research still only focuses on sleep, burnout, emotional exhaustion and the implications of these factors on performance and safety.

Definitions with regards to fatigue can be linked to the three feature of fatigue. Firstly, both extreme tiredness (lack of energy) and reduced functional capacity indicate a decrease in the capacity and motivation to react to certain spurs or participate in certain categories of activities or behaviours. Secondly, extreme tiredness and reduced functional capacity (physical, mental and emotional) are experienced by employees. As indicated in Table 1 below, recurrent distinctions are made between fatigue as a result of muscular exhaustion (physical), and fatigue as a result of cognitive energy exhaustion (mental) as well as fatigue as a result of emotional energy (emotional). Lastly, temporally tied to an employee's workday as a result of various job demand, resources and non-work factors; although the consequence of numerous job demands and resources is expected to lead to fatigue, it can also result from non-work factors such as personality; chronic disease and demands outside the workplace (Frone & Tidwell, 2015).

It is evident from literature that the concept of fatigue has been conceptualised and defined in different ways by different authors and researchers. Reflecting on the different definitions with regards to fatigue is important in order to understand the focus of each conceptualisation. Table 1 focuses on different definitions of fatigue.

Table 1

Definitions and features of fatigue

Term	Source / Author(s), Year	Definition	Features of fatigue according to the classification of Frone and Tidwell (2015)
Fatigue	Pillsbury (1922, p. 541)	"By fatigue, we mean a reduction in the capacity for doing work which comes as a result of work."	The experience of extreme tiredness (lack of energy) and reduce functional capacity (decrease in the capacity and motivation)
	The Occupational Safety and Health Services (1998, p. 7)	"Temporary inability or a decrease in ability or a strong disinclination to respond to a situation, because of inadequate recuperation from the previous over-activity, either mental, emotional or physical."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
	Saito (1999, p. 134)	"A state of being tired which is brought about by an excess of mental and physical work."	The experience of extreme tiredness (lack of energy) and reduce functional capacity (decrease in the capacity and motivation)
	De Vries, Michielsen, & Van Heck, . (2003, p. 10)	"An experience of tiredness, dislike of present activity and unwillingness to continue" OR "Disinclination to continue to performing the task at hand and a progressive withdrawal of attention."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
	Stasi, Abriani, Beccaglia, Terzoli, and Amadori (2003, p. 1787	"Fatigue is the state of weariness after a period of exertion, mental or physical, characterised by a decreased capacity for work and reduced efficiency to respond to stimuli."	The experience of extreme tiredness (lack of energy) and reduce functional capacity (decrease in the capacity and motivation)
	Leung, Chan, and He (2004, p. 233)	"The manifestation of a decrement of performance; that is, deterioration in performance as a result of having worked for a considerable length of time."	The experience of fatigue due to the employee's workday as a result of various job demand, resources and non-work factors
	Yang and Wu (2004, p.	"A subjective state of an imbalance in the	The experience of extreme

	1357)	availability of inner resources needed to perform physical or mental activities."	tiredness and reduced functional capacity (physical, mental and emotional)
	Australian Safety and Compensation Council (2006, p. 4)	"Feeling of wariness from bodily or mental exertion; and feeling tired, drained and exhausted. Fatigue influences an individual's physical, mental and emotional state, which may result in less alertness, accompanied by poor judgment, slower reactions to events and decreased motor skill."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
	Ricci, Chee, Lorandeau, and Berger (2007, p. 1)	"A feeling of weariness, tiredness, or lack of energy."	The experience of extreme tiredness (lack of energy) and reduce functional capacity (decrease in the capacity and motivation)
	Schutte (2010, p. 53)	"A state of impaired mental and physical performance and lowered alertness arising as a result of or a combination of hard physical and mental work, health and psychosocial factors or inadequate restorative sleep." "Increasing difficulty in performing physical or mental activities."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
	Lerman, Eskin, Flower, George, Gerson, Hartenbaum, Hurst, and Moore-Ede (2012, p. 231)	"The body's response to sleep loss or prolonged physical or mental exertion."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
	Sadeghniiat-Haghighi and Yazdi (2015, p 12-13.)	"A state of feeling tired, weary, or sleepy that results from prolonged mental and physical work, extended periods of anxiety, exposure to the harsh environment, or loss of sleep." "Fatigue is a result of prolonged mental or physical exertion; it can affect people's performance and impair their mental alertness, which leads to dangerous errors."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
Human Fatigue	Moore (2009, p. 1)	"An impairment of mental and physical function manifested by a cluster of debilitating symptoms, usually including excessive sleepiness, reduced physical and mental performance ability, depressed mood and loss of motivation, which may result from a variety of causes including sleep deprivation , sleep disorders, illness or distress, therapeutic side-effect, heavy stressful physical or mental exertion and/or stimulant drug usage."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
Occupational Fatigue	Leung et al. (2004, p 233)	"Fatigue is related to the work task being performed and is exaggerated with a specific task demand being imposed on a person. It is a gradual and accumulative process and can be briefly divided into mental and physical aspects."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
Mental Work Fatigue	Leung et al. (2004, p. 234)	"Accompanied by a sense of weariness, reduced alertness, and reduced mental performance."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
	Boksem and Tops (2008, p. 126)	Mental fatigue is "experienced "after or during prolonged periods of cognitive activity" and involves "tiredness or even exhaustion, an aversion to continue with the present activity, and a decrease in the level of commitment to the task at hand."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
	Frone and Tidwell (2015, p. 274)	"Represents extreme mental tiredness and reduced capacity to engage in cognitive activity that is experienced during and at the end of the workday".	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
Physical Fatigue	Leung et al. (2004, p. 234)	"Accompanied by the reduction of performance in the muscular system."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
	Frone and Tidwell (2015, p. 274)	"Represents extreme physical tiredness and reduced capacity to engage in physical activity that is experienced during and at the end of the workday".	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
Compassion Fatigue	Figley (1995, p. 1)	"A natural response or reaction to working	The experience of fatigue due to

		with individuals or groups of people who are in crisis."	the employee's workday as a result of various job demand, resources and non-work factors
	Koenig (2014, p. 9)	"The natural emotional and behavioural reactions that occur from the knowledge of someone close experiencing a traumatic event, combined with the stress caused by the desire to help the traumatised individual."	The experience of fatigue due to the employee's workday as a result of various job demand, resources and non-work factors
Work fatigue	Frone and Tidwell (2015, p. 274)	"Represents extreme tiredness and reduced functional capacity that is experienced during and at the end of the workday."	The experience of fatigue due to the employee's workday as a result of various job demand, resources and non-work factors
	Van Jaarsveld (2016, p.1)	"A state of impaired mental and/or physical performance and lowered alertness which affect employees at every level of the organisation."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)
Emotional fatigue	Frone and Tidwell (2015, p. 274)	"Represents extreme emotional tiredness and reduced capacity to engage in emotional activity that is experienced during and at the end of the workday."	The experience of extreme tiredness and reduced functional capacity (physical, mental and emotional)

Recent research by Frone and Tidwell (2015, p. 274) mention that inadequate definitions still exist with regards to work fatigue. They explain that work fatigue is, firstly, characterised by extreme exhaustion and reduced functional ability. Secondly, physical work fatigue is characterised by extreme physical exhaustion and a decreased ability to participate in physical activity. Thirdly, mental work fatigue is characterised by extreme mental exhaustion and a decrease in the ability to engage in the cognitive activity. Lastly, emotional work fatigue is characterised by extreme emotional exhaustion and a decreased ability to engage in the emotional activity. All three types of fatigue mentioned above are encountered during the workday and at the end of the shift.

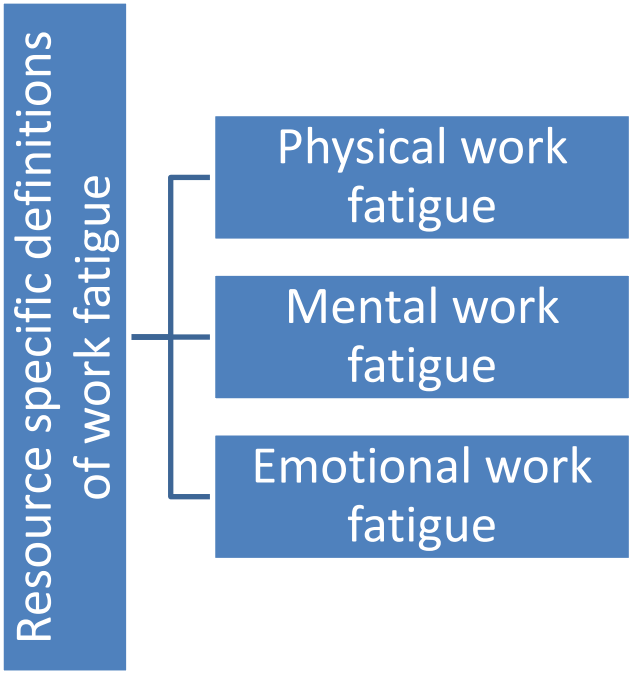

Figure 1 Different types of work fatigue (Compiled by Keyser, (current).

Considering the various definitions as set in Table 1, there is one theme that remains continuous throughout, that fatigue is a result of prolonged mental and physical exertion. Using this as a baseline, one can argue that employee fatigue can be defined as a state of prolonged mental and physical exertion caused by responsibilities being performed by an employee in a work environment.

Frone and Tidwell (2015) explain that for a measure of work fatigue to be multidimensional, it must incorporate three general types of assessments. Firstly, it must be able to compare the levels of the same type or several types of work fatigue within the same group of employees. Secondly, it must compare the strength of the relationship concerning a definite predictor to mental, physical and emotional fatigue (the three types of work fatigue). Lastly, it must compare the strength of the relationship between the three types of work fatigue and some outcomes. Considering the above definitions and the features of fatigue, it is clear that it is difficult to describe the content of fatigue. This is further problematized by fatigue potentially containing hundreds of items, which can be different depending on the organisation or person. Because of the conceptual problem related to the features of fatigue, it is clear that feature-oriented measures are not the preferred way to measure fatigue. It is, therefore, important to look at the content of each measuring instrument that measures fatigue. Furthermore, in order to fully compare the aforementioned three types of work fatigue, a measure would be required to be fully consistent. Edwards and Shipp (2007) and Hussong, Curran, and Bauer, (2013) explain that for a measure to be fully consistent, it must possess two characteristics. Firstly, it must be conceptually equivalent, meaning that the three types of work fatigue must be characterised in similar terms, the number of items and conceptual meaning must be the same. Secondly, the measures of physical, mental, and emotional work fatigue must have metric equivalence, meaning that the response scale used must be the same.

MEASUREMENT OF CONCEPT

In 1921 and 1979, Muscio and Broadbent, respectively, attempted to measure fatigue and found it not possible to test. As mention by De Vries et al. (2003) until about 24 years ago, fatigue questionnaires for particular studies were primarily developed on an *ad-hoc* basis and was usually developed for a specific group of people. De Vries et al. (2003) further confirm that some criteria need to be applied when measuring fatigue.

In this study, the general principles used to assess the content and construct validity of a scale development for fatigue are applied. Cronbach and Meehl (1955) explain that the first principle is that the measurement of the construct needs to be placed in a theory bases nomological net. Murphy and Davidshofer (1988) explain that the measurement instrument must have content validity that provides "an adequate sample of a particular content domain" (p. 95) and it must also have construct validity where the "scores of the measurement provide a good measure of the concept fatigue" (p. 95). Furthermore, the general criteria for any measurement are that it should be theory-based and that it should reflect both content and construct validity. Freese and Schalk (2008) have identified specific criteria for a fatigue measuring instrument:

The ***first criterion*** is that the fatigue instrument must be theory-based or be inductively developed. Different measurements for fatigue were developed on both theoretical and empirical foundations, and lack agreement on the content of fatigue (Grant, 1971; Yoshitake, 1971).

The organisation must decide on what type of measurement instrument is used to measure fatigue (Sadeghniiat-Haghighi, & Yazdi, 2015). Fatigue measurement instruments can be separated into unidimensional instruments and multidimensional instruments (Beurskens, Bültmann, Kant, Vercoulen, Bleijenberg, & Swaen, 2000). This is support by Sadeghniiat-Haghighi and Yazdi, (2015) who explain that fatigue measurement instruments can dictate one or multiple dimensions of fatigue. Additionally, other measurements can be utilised to obtain further information with regards to the type of fatigue, impact of fatigue or theories relating to fatigue.

Before the start of the 1990s, fatigue was predominantly seen as an unidimensional construct (De Vries et al., 2003). Smets, Garssen, Bonke, and De Haes, (1995) state that using unidimensional instruments eliminates the opportunity for a more comprehensive explanation of fatigue as only one dimension of fatigue can be introduced and significantly highlighted with the phrasing of a single question. These scales are fairly brief; and are repeatedly characterised by respectable levels of internal consistency and test-retest reliability (Percy, 2012).

The dimension most frequently focused on is severity. Also, four or five-point verbal rating scales, numeric scales, and visual analogue scales (VAS) are the most frequently used (Whitehead, 2009; Sadeghniiat-Haghighi & Yazdi, 2015). Some of these unidimensional fatigue measures include *Fatigue Assessment Scale (FAS)* that is comprised of 10 items; five items focusing on physical fatigue, and five items focusing on mental fatigue. This measure was developed for the working and the general population in Germany (De Vries et al., 2003). A 5

point Likert scale (1 = never to 5 = always) is used, and only a total score, ranging from 10 to 50, is calculated. The FAS has a 0.90 reliability value (De Vries et al., 2004). Another instrument is *the Need for Recovery Scale (NRS).* This scale is short but sufficient for measuring initial indications of workplace fatigue at various levels such as individual, departmental organisation and national (Van Veldhoven & Broersen, 2003). This 11 item scale was derived from the questionnaire of perception and judgement at work and measures the short-term effects of one day in the workplace. The NRS is a dichotomous scale with yes or no answers, and proves to be reliable and valid (De Vries et al., 2004). Pace, Cascio, Civilleri, Guzzo, Foddai, and Van Veldhoven, (2013) confirms that the NRS is preferred in measuring workplace fatigue and the recovery time quality of employees and is seen as a forerunner of ongoing fatigue of an employee.

Multidimensional scales offer a thorough qualitative and quantitative assessment of fatigue and provide adjustable psychometric data (Percy, 2012). These types of scales focus on collecting data on numerous dimensions, in other words, they allow for broader knowledge concerning fatigue. Such scales most frequently incorporate two to seven factors, thus not merely focusing on the intensity but also including duration, daily pattern, and effect of daily activities. Other dimensions include the effect of fatigue on mental, behavioural, and social functioning. The greater part of multidimensional measures use a Likert scale and are evaluative in the determination (Whitehead, 2009).

One example of a multidimensional fatigue scale is the *Symptom Distress Scale (SDS).* This 13 item, 5 point Likert scale questionnaire measures distress and depression as associates of fatigue, reporting the results as various degrees of distress with lack of symptoms at the beginning of the scale and being at its worst condition at the far end of the scale (Sadeghniiat-Haghighi & Yazdi, 2015).

The *Fatigue Scale (FS)* is another multi-dimensional scale. The FS is a 5 point Likert scale, which functions as a self-rating scale measuring the severity of fatigue consisting of 11 items (De Vries et al., 2003). It consists of four items focusing on mental fatigue and seven items focusing on physical fatigue. The scale was found to have good reliability and validity (Chalder, Berelowitz, Pawlikowska, Watta, Wessely, Wright, Wallace & Chandler, 1993).

The *Multidimensional Assessment of Fatigue (MAF)* is a self-administered questionnaire, which measures self-reported fatigue, experienced one week before taking the test. The MAF focuses

on the following four dimensions: degree and severity, the amount of distress fatigue causes, the timing of fatigue, and the degree to which fatigue interferes with activities of daily living. These four key areas as part of the questionnaire's design are a strength as the results provide data for a fuller account of fatigue in the population of interest (Neuberger, 2003; Sadeghniiat-Haghighi & Yazdi, 2015).

The *Energy and Fatigue Subscale* consists of only four items, two items focusing on energy and two on fatigue. A 5 point Likert scale is used to answer two positively phrased questions regarding energy, and two negatively phrased questions regarding fatigue. The reliability and validity of this scale are deemed acceptable (De Vries et al., 2003).

The *Piper Fatigue Scale* is a more inclusive scale as supplementary items are included, which measure the intrusion of fatigue on day-to-day activities as well as the timing of fatigue (Sadeghniiat-Haghighi & Yazdi, 2015).

The *Myasthenia Gravis Fatigue Scale* consists of 26 items, using a 5 point Likert scale, perceptions of fatigue, task avoidance behaviours resulting from fatigue, and the observable motor signs or symptoms resulting from fatigue are measured. The internal consistency was measured at 0.89113 - 0.934, and the test-retest reliability was found to be equal to 0.85 and 0.872 (Whitehead, 2009).

The *Horne – Ostberg Questionnaire (HOQ)* consists of 19 items focusing on determining if an individual is a morning person (Lark type), evening person (Owl type) or has no preference (indifferent type) by focusing on when participants prefer to wake up or go to sleep, compared to when they essentially do. This scale can be used to determine what type of shift design will suit the individual best (Sadeghniiat-Haghighi & Yazdi, 2015).

The *Checklist Individual Strength (CIS)* is a 20-item, 7 point self-report instrument that can be used to measure chronic fatigue consisting of four dimensions (Beurskens et al., 2000). De Vries et al. (2003) explain the number of items and four dimensions as: eight items for the subjective experience of fatigue, five items for reduced concentration, four items for reduced motivation and three items for reduced physical activity levels. These dimensions (severity, motivation, concentration, and physical activity level) are comparable to the concept of continued fatigue. This measure is used to relate the occurrence of fatigue across demographic and occupational subgroups (Bültmann, 2000).

The *Epworth Sleepiness Scale (ESS)* is an 8-item, self-reporting scale uses sleep and depression as instruments to rank the sleepiness of a person. In other words, it detects if an employee is suffering from the effects of fatigue. This measure can thus be used to indicate how prone an employee is to falling asleep throughout normal, daytime working hours (Sadeghniiat-Haghighi & Yazdi, 2015).

The *Subjective Symptom Survey Of Fatigue* was designed by the Industrial Fatigue Research Committee in Japan, the survey consists of 30 items focusing on five dimensions namely, dull, drowsy, exhausted, a mental decline of working motivation, the specific feeling of incongruity in the body and, lastly, dysfunction of autonomic nervous systems (Saito, 1999).

The *Fatigue Questionnaire* reflects a four-dimensional symptom questionnaire, which measures the severity of physical and mental fatigue, with seven items focusing on physical symptoms of fatigue and four items focusing on the mental symptoms of fatigue. A strength of this measure, which is worth mentioning, is that separate scores can be determined for physical and mental fatigue in addition to a collective score (Neuberger, 2003).

Researchers have also focused on various, more objective strategies, which can be used to measure fatigue. Firstly, laboratory testing focuses on aspects of performance including short-term memory, reaction time and attentiveness. These results can be used as indications of the capability of employees to perform their duties. The Psychomotor Vigilance Task assessment has been used extensively for this purpose. Secondly, sleep problems are an important indicator for fatigue. Sleep diaries, questionnaires, actigraphy and polysomnography are used in the workplace and laboratories to determine sleep quality and quantity. Thirdly, depression must be considered when studying fatigue as fatigue is recognised as a symptom of depression. The Profile of Mood States is a measure comprising of six subscales namely, vigour, confusion, depression, fatigue, anger and tension. Lastly, biological parameters can be used to assess fatigue. Although no strong biological markers exist for detecting fatigue, and it is problematic to monitor them during working hours, the daily rhythms of body temperature and hormone levels have been used to investigate fatigue by focusing on circadian cycles. All the instruments discussed above can be used in the workplace (Sadeghniiat-Haghighi & Yazdi, 2015).

The ***second criterion*** is that a measurement instrument should reflect the core and most important aspects of the definition of fatigue. Currently, a lack of clear definitions and clear understanding of fatigue in the workplace is discernible (Ahmed, et al., 2016). In line with

current definitions, the following need to be included when measuring fatigue, namely physical work fatigue, mental work fatigue and emotional work fatigue questions. Questionnaires that focus physical work fatigue usually ask question such as: "*What are the typical symptoms you feel when you are fatigued?*, I get tired very quickly; I have enough energy for everyday life". Mental work fatigue scales include questions such as "*How is your memory?*; Become forgetful, and unaware of objects off the road, Mentally, I feel exhausted; when I do something I can concentrate quite well". Emotional work fatigue instruments focus on questions such as: "I feel burned out from my work" and "I have become more callous toward people since I took this job".

Several scales do not meet this criterion, such as the Vitality Subscale of the Short Form Health Survey, Rhoten Fatigue Scale (RFS), Brief Fatigue Inventory (BFI), Pearson and Byars Fatigue Feeling Checklist, Fatigue Severity Scale (FSS), Schedule Of Fatigue and Anergia (SOFA), Fatigue Impact Scale, Fatigue Symptom Inventory (FSI), Multidimensional Fatigue Inventory (MFI-20), Parkinson's Fatigue Scale, Checklist Individual Strength (CIS), and Fatigue Questionnaire. These scales focus on fatigue in the medical industry as the focus of attention is on cancer patients, post-partum depression, Parkinson's disease, Chronic Fatigue Syndrome (CFS), and Multiple Sclerosis (MS).

C*riterion three* focuses on the measurement and sampling issues of the population. As the content of fatigue can differ between groups of employees and work environments, the suitability of items' content for the sample substudy needs to be evaluated. If a questionnaire was not previously used, it must first be tested using a pilot study. It is important that researchers do not just add and/or delete items of an existing questionnaire when measuring fatigue at a specific workplace. Researchers also need to provide details of subscales used when reporting results.

A number of criteria may be applied in the selection of a fatigue measurement technique. These include several factors, which determine whether or not employee fatigue research is carried out at the workplace or in a simulator. Regardless of the testing environment, Grant (1971) emphasises that detail and synchrony of behavioural and physiological measurements should be given. Research by Yoshitake (1971) emphasises that the best method for measuring fatigue may depend on the nature and demands (mental and physical) of the supposedly fatiguing task of the employee.

Within the mining industry, clear criteria are available (See Annexure B) on what needs to be measured within the mining environment. This legislation specifically stipulate that these measurements should be done frequently (daily, weekly, monthly) and every year, a report should be submitted to the Department of Mineral Resources (DMR).

However, the fundamental questions of which items should be included in a work fatigue questionnaire cannot only be answered by providing a standard list of items. It is more important to ensure that the list has been constructed in a methodological, sound way and if the list of items suit the sample that is being assessed.

Criterion four notes that the evaluation of fatigue has to assess using separate items.

As seen from Table 2, variations exist pertaining to the different scales that have been used to evaluate fatigue.

Table 2

Fatigue related measurements

Author	Instrument	Number of items	Subscale	Response scale and examples of questions asks	Cronbach alpha
Yoshitake (1971)	Subjective Feeling of Fatigue	7	Dull Drowsy (Physical symptoms)	Dichotomous Scale Yes and No	No Cronbach alpha could be found in existing literature for each individual subscale, however, a Cronbach alpha of 0.91 was documented for the entire 30 item fatigue symptom checklist
		3	Exhausted (Physical symptoms)	Dichotomous Scale Yes and No	
		10	Mental decline of working motivation	Dichotomous Scale Yes and No	
		6	Specific feeding of incongruity in the body (Physical symptoms)	Dichotomous Scale Yes and No	
		4	Dysfunction of autonomic nervous system (Physical symptoms)	Dichotomous Scale Yes and No	
Krupp, LaRocca, Muir-Nach and Steinberg (1989)	Fatigue Severity Scale	9		Seven points Likert Scale 1, strongly disagreed to 7, Strongly Agreed	0.89
Ware and Sherbourne (1992)	SF-35-Version 1 Vitality (Energy/Fatigue) Subscale	4	-	Six points Likert Scale 1, all of the time to 6, none of the time	0.87
Vercoulen, Alberts and Biejenberg (1999)	Checklist Individual Strength – 20 CIS20 (Multidimensional Scale)	8	Subjective experience of fatigue (SEF)	Seven point rating scale 1, yes, that is true to 7, no, that is not true	0.96
		5	Reduced concentration (CON)	Seven point rating scale 1, yes, that is true to 7, no, that is not true	0.92
		4	Reduced motivation (MOT)	Seven point rating scale 1, yes, that is true to 7, no, that is not true	0.87
		3	Reduced physical activity level (PA)	Seven point rating scale 1, yes, that is true to 7, no, that is not true	0.88
Maslach,	Emotional Exhaustion	5		Seven point rating scale	0.88

Jackson and Leiter (1986)	Subscale (EE scale)			1, never, to 7 Always.	
WHOQOL Group (1998)	The Energy and Fatigue Subscale from the World Health Organisation Quality of Life Assessment Instrument (EF-WHOQOL-100) Dutch version	4		Five-point Likert scale 1, never, to 5, always	0.88
Chalder et al., (1993)	Fatigue Scale	4	Mental Fatigue	Five point scale 1, never to 5, always	0.72
		7	Cognitive difficulties and physical fatigue		0.84
Von Veldhoven and Meijman (1994)	Need for Recovery Scale (NRS)	11	Work-related fatigue	Dichotomous Scale Yes and No	0.91
Michielsen, De Vries and Van Heck (2002)	Fatigue Assessment Scale (Unidimensional Scale)	5	Physical fatigue	Five-point rating scale 1, never to 5, always	0.90
		5	Mental Fatigue		
Kim, Lovera, Schaben, Melara, Bourdette and Whitman (2010)	Subjective Fatigue			Eleven point rating scale 0, no fatigue, 5, moderate fatigue, 10, maximally possible fatigue	
Ergomax (2015)		6	Individual Human Factors Non-Work Factors Environmental Conditions Work-related Factors Work Schedule and planning Night Shift	Dichotomous Scale Yes and No	

Another important issue is if the question of if the measurement instrument is tested globally assessment or and assessment for each item of the fatigue, or both? A clear distinction should be made between a multifaceted concept to measure fatigue such as fatigue, human fatigue, occupational fatigue, mental work fatigue, physical fatigue, work fatigue and emotional fatigue. Furthermore, it is important to look if the fatigue items focus on work and non-work related fatigue questions.

Criterion 5 in the evaluation of fatigue it should be assessed whether an item is important and relevant. Furthermore, the researcher needs to be clear regarding how these multifaceted concepts differ from one another when measuring fatigue. Therefore, a complete employee fatigue measurement needs to be manifold according to Frone and Tidwell (2015) by including mental, physical and emotional work fatigue questions.

FATIGUE MODELS

Fatigue has been found to significantly affect the capacity of individuals to function. A decrease in performance and productivity and an increase in the potential for injuries to occur are all side-

effects of fatigue (Mine Health and Safety Act 29 of 1996). Several models that currently exist with regards to occupational fatigue do not distinguish between sleep, burnout, emotional exhaustion, and the implications of these factors on performance and safety is severe. This is further confirmed by the definitions of occupational fatigue currently available (Winwood, Winefield, Dawson & Lushington, 2005). The existing fatigue models currently used in the industry are discussed below:

Conceptual model focusing on the relationship between occupational injuries and illnesses and demanding work schedules.

Dembe, Erickson, Delbos, and Banks, (2005) investigated overtime work prompting fatigue and consequently increasing the inclination for accidents. In the above model, overtime and long working hours are assumed to affect workplace accidents risks by causing numerous transitional conditions in affected employees; these include fatigue, stress, and drowsiness. The approach linking a challenging work schedule to the intermediary requirement and ultimately, to a workplace accident can be facilitated by a variety of individual and environmental factors (age, gender, health status, job experience), job factors (job intensity, hazard, exposure), and organisational factors (overtime policy, supervision). The study found that in any particular continuous work span, an increase in accidents is observable as the number of overtime days escalates. Additionally, fatigue is experienced to a greater extent by older employees and female employees, who consequently are more likely to have accidents. A stronger relationship among overtime, fatigue and accidents exists in organisations where overtime is mandatory.

Furthermore, Theron (2014) adapted the model to show the association between overtime and accidents, through which overtime influences accidents through its effect on a dominant variable, namely fatigue was used, confirming that insufficient decision-making resulting from fatigue leads to incidents/injuries. Employees working more than 60 hours a week or working 12 hours or more in a day, have a higher risk of work-related incidents/injuries and illnesses compared to those working an 8-hour shift. The rate of incidents/injuries doubles after 12 hours at work. After the fourth day shift, the incidents/injuries rate increased by 17 percent and a 30 percent increase are noted on the fourth night shift compared with the first, unless preventative measures such as frequent rest breaks are implemented.

Fatigue-Risk Trajectory Model

Fletcher, (2011), Moore-Ede, (2009) and Dawson and McCulloch, (2005) have all designed more comprehensive descriptive approaches to fatigue. Dawson and McCulloch, (2005) designed the Fatigue-risk trajectory model based on the Fatigue-Related Incident (FRI) model. The FRI is the final point in a longer chain of events or error trajectory and is always led by a collective order of event orderings that lead to the actual incident. Thus, Fatigue-Related Errors (FRE) are continuously followed by an FRI. Each step in the model offers a chance to identify, control, monitor and prevent a potential FRI. This framework can also allow us to recognise causes of FRIs in a logical and reliable method. Furthermore, using a systems-based approach, the organisation and implementation of systematic and effective control measure for fatigue-related risks can occur. Finally, the figure suggests that a reduction of FRIs can occur by making use of more harmonised or united control of the predeceasing events or behaviours (Dawson & McCulloch, 2005).

The Fatigue Management Maturity Model (FM3)

In 2011, the Fatigue Management Maturity Model (FM3) was publicly presented for the first time at three international fatigue conference meetings; these conferences took place in South Africa, Sweden and Australia. The model intentionally sets out to further advance managing the impairment caused by workplace fatigue. Furthermore, it uses approaches such as Maturity Models, Integral Theory and Triple-loop Learning and is thus conversant by practice and theory. When a maturity model is applied, it defines what stage of growth a system is in. By using the stage of growth, it defines and resonates the components specific to the organisation in question. Additionally, it recognises that sustainable growth occurs from competency accomplished and it cannot be forced as it grows with each previous stage (Fatigue Management Workshop, 2012). The stages, as mentioned by Fletcher (2011), are as follows: Stage 1: Not aware: At this stage, the employer does not contemplate that human fatigue is a concern that needs to be managed; Stage 2: Reactive: During this stage, the employer is not aware of the genuine complexity of fatigue-related risks or appropriate solutions; Stage 3: Experimental: During this stage, the employer is implementing a variety of risk treatments in a way that is uncoordinated and poorly measured; Stage 4: Systematic: This stage comprises of rule-based restrictions and all basics of the risk management cycle in a justifiable system; Stage 5: Global leader: During this stage, the employer has internal data that demonstrates that fatigue management is essential for business in numerous measurements (Higher safety and moral, equals lower costs and fatigue risks).

The Fatigue Management Maturity Model (FM3) is more inclusive and requires the collection of evidence at each stage, leading to more creditable, justifiable, all-inclusive results, and any measured benefits (Fatigue Management Workshop, 2012).

Bio-Mathematical Models of Fatigue (BMMF)

Bio-mathematical Models of Fatigue (BMMF) aim to calculate the effects of various working patterns on consequent job performance by contemplating the relationship between work hours, sleep and performance, through scientific data. A significant advantage of the BMMF approach is that, at least in theory, it is plausible to produce quantitative models that calculate the level of fatigue related to a specific work design and examine the fatigue-related with different shift patterns. Furthermore, these models can then be used to make better, informed decisions in terms of possible fatigue related to different work patterns, at the organisation or socially, thereby managing the risk of fatigue (Dawson, Noy, Härmä, Åkerstedt, & Belenky, 2011).

The models in current use are a two-process model, a three-process model of alertness, a system for aircrew fatigue evaluation, inactive neurobehavioural mode, fatigue audit inter dyne, circadian alertness simulator, prior sleep-wake model and sleep, activity, fatigue and task effectiveness. These models are explained in the table below.

Models in current use in the industry

Table 3 Models in current use in the industry (Complied by the researcher, 2017)

Model	Source	Description	Inputs	Validation	Implementation
Two-process model	Achermann, 2004; Borbély, 1982; Borbély and Achermann, 1992; Mallis et al. 2004; Fourie et al.2010	Modelling the physiology fundamental to sleep and sleep tendency to predicting alertness was used in the development of the two process model and other models that predict neurobehavioral performance.	Sleep-wake history and circadian phase are the most common implementations used as inputs.	Validated against alertness and EEG during sleep.	Implementations of the two-process model typically do not take into account workload.
Three-process model of alertness	Åkerstedt et al., 2004; Mallis et al. 2004; Fourie et al. 2010	An extension of the two-process model through the addition of a third process representing sleep inertia.	Work–rest history or sleep-wake history. Estimations are then made with regards to sleep and predictions are made with regards to subjective alertness, neurobehavioral performance and fatigue risk.	Validated in workplace and shift work settings.	Used to manage shift work and accident risk indication.
System for Aircrew Fatigue Evaluation (SAFE)	Belyavin and Spencer, 2004; Mallis et al. 2004; Fourie et al. 2010	A version of the two-process model, (without a sleep inertia component).	Self-reported sleep-wake history.	Validated against experimental data to predict subjective alertness and neurobehavioral performance.	Instigated as a self-supporting tool for civil aviation as well as an element of a more extensive, integrated system to assess human system performance under environmental stress.
Interactive neurobehavioral model	Forger, Jewett and Kronauer, 1999; Mallis et al. 2004; Kronauer et al. 1982); Fourie et al. 2010	A three-process model involving a linear combination of homeostatic drive, circadian rhythm, and sleep inertia. It models the circadian rhythms.	Sleep-wake history and light exposure.		
Sleep, Activity, Fatigue, and Task Effectiveness (SAFTE)	Hursh, Redmond, Johnson, Thorne, Belenky, Balkin, Storm, Miller, and Eddy, 2004; Mallis et al. 2004; Fourie et al. 2010	A three-process model with an additive combination of homeostatic drive, circadian rhythm, and sleep inertia.	It takes as input sleep-wake history measured directly by actigraph, self-report or estimated from shift timing and duration and time of day.	Validated against laboratory and field studies.	

Fatigue Audit Inter Dyne (FAID)	Mallis et al. 2004; Roach, Fletcher and Dawson,. 2004; Fourie et al. 2010	Based on the two-process model. It was developed to predict employee fatigue directly from shift schedules. Importantly, FAID does not predict fatigue per se but rather, predicts a 'sleep opportunity' or work-related fatigue score.	Sole inputs - the start of work shift and end of work shift.	Validated against laboratory studies and field studies in industry.	Applied to estimating work-related fatigue during shift work, extended work hours, and as a decision-support tool for managing fatigue-related risk and as one element of an integrated defences-in-depth approach.
Circadian Alertness Simulator CAS	Mallis et al., 2004; Moore-Ede et al. 2004; Fourie et al. 2010	Based on the two-process model. It was developed as a tool to assess the risk of diminished alertness in the workplace.	Like FAID, CAS takes employee work schedules as its primary input; from this, it estimates patterns of sleep and subsequent alertness, then calculates a cumulative fatigue score.	Validated against work/rest and accident data from the trucking industry.	CAS has been applied to the evaluation of operational fatigue risk, work schedule optimisation, and fatigue-related accident investigation.
Prior sleep-wake model	Dawson and Holland, 2006; Fourie et al. 2010	A relatively simple 'mental heuristic' that individuals can use to assess an employee's fitness for work vis-à-vis fatigue. Using this approach, fatigue can be managed in real-time at the individual level without the need for any additional technology. The fatigue-related risk is estimated via a simple set of rules based on the amount of sleep in the 24 and 48 h before commencing work and the duration of wakefulness since the last sleep greater than two h in duration. These prior sleep and wake times are used to determine whether an employee has obtained a 'minimum duration' of sleep or exceeded a maximum period of wakefulness in order to be considered 'fit-for-work'.			

Even though the use of fatigue models in the workplace is limited, researchers are already mindful of the concerns that can affect their successful application. While the predictive and reliability of these models still have to be demonstrated, the existence of a recognised process of measuring sleep opportunity through the use of Bio-mathematical models of fatigue could lead to positive outcomes in workplace safety (Dawson et al., 2011).

One of the most dangerous work environments worldwide has historically been the mining industry (Eiter, Steiner, & Kelhart, 2014). The South African mining industry is also affected by employee fatigue, and it is a critical safety issue (Schutte & Maldonado, 2003). The issue of fatigue has become universal because many employees work non-standard schedules, and are often unsuccessful in gaining sufficient sleep. Employee fatigue is a substantial threat from a health and safety standpoint. As the realisation that drowsiness and fatigue are becoming widespread in the mining population, leading to human error, and therefore too many (sometimes severe) accidents have become apparent in the last couple of years. These aforementioned reasons have led to increased consideration pertaining fatigue management in the industry. The quality of life and work performance are severely undermined by the threat of fatigue, especially when it becomes long-lasting or disproportionate (Piper, 1989; Okogbaa, Shell, & Filipusic, 1994). Due to the complex and dynamic nature of fatigue, it is problematic to define, observe and measure.

Notices in the Government Gazette relating to a guideline for the execution of a mandatory code of practice (COP) intended for risk-based fatigue management at South African mines referenced as DMR16/3/2/4-B2 was issued on Friday, 19 December 2014, by the Chief Inspector of Mines, Mr David Msiza. In this guideline, employers are well directed to draft and implement a COP to combat employee fatigue.

Fatigue introduces several complications and challenges to both the individual (employee) and the organisation as a whole. When focusing on work performance, fatigue can cause an immense reduction in safe work practices, productivity, teamwork and morale (Goldenhar, Hecker, Moir, & Rosecrance, 2003). Thus the risk of accidents in the workplace increases. Goldenhar et al. (2003) further detected that during prolonged periods of work, the occurrence and severity of injuries increased. Higher levels of sick leave and higher accident rates are some of the various ways that employees are negatively impacted by fatigue (The Occupational Safety and Health Services, 1998).

The South African legislation leaves a lot to desire with regards to fatigue. Some progress has been made with the Department of Mineral Resources (DMR) issuing an instruction in the Government Gazette on the 19th of December, 2014. This publication gives South African Mines guidelines for a mandatory code of practice for risk-based fatigue management (Mine Health and Safety Act 1996).

The Mine Health and Safety Act and Regulations 29 of 1996 states that it is employers' responsibility to ensure a safe working environment, however, the employee must also look after his or her safety. Chapter 2, Section 5 of this act explains the employer's responsibility in two parts. First, "[a]s far as reasonably practicable, every employer must provide and maintain a working environment that is safe and without risk to the health of employees" (Mine Health and Safety Act and Regulations 29 of 1996, p. 5). Secondly, "as far as reasonably practicable, every employer must identify the relevant hazards and assess the related risks to which persons who are not employees may be exposed; and ensure that persons who are not employees, but who may be directly affected by the activities of the mine, are not exposed to any hazards to their health and safety" (Mine Health and Safety Act and Regulations 29 of 1996, p. 5).

The Mine Health and Safety Act also comes into consideration when looking at reasons for absence from work in the mining industry. As previously mentioned, this act prevents an employee from entering the mine intoxicated, whether that might be due to alcohol, drugs or any other type of intoxication. Thus employees failing to pass a mandatory alcohol test upon entering the mine will be prevented from entering and, at the same time, if an employee fails to pass a random drug test he or she will also be prevented from returning to work until he or she passes a drug test.

FATIGUE LEGISLATION APPLICABLE IN OTHER COUNTRIES' MINING INDUSTRIES

In December, 2013, The Government of Western Australia Department of Mines and Petroleum issued an information sheet stating that Section 9 of the Mines Safety and Inspection Act 1994 "requires employers and employees to consult and cooperate in the workplace to identify hazards, carry out risk assessments and take steps to eliminate or effectively control the risks to within that which is reasonably practicable. Fatigue needs to be managed and controlled, like other hazards, as part of the duty of care responsibilities of the employer and workforce" (Government of Western Australia Department of Mines and Petroleum, 2013, p. 1).

The National Heavy Vehicle Regulator (NHVR) was implemented in Australia in February 2014; this legislation is valid on all vehicles with a mass of 12 tons and busses over 4.5 tons carrying more than 12 adults (Swart & Sinclair, 2015). Some of the aspects that this regulation outlines is the maximum work requirements and minimum rest requirements, work diary requirements, and other provisions (Heavy Vehicle National Law Act 2012). The Australian Government has various websites, such as www.nhvr.gov.au and www.safeworkaustralia.com, and organisations that assist both mines and other organisations with managing the risk of fatigue.

According to the Office of Rail Regulation, (2012), all employers in the United Kingdom have a responsibility under the Health and Safety at Work Act of 1974, the Management of Health and Safety at Work Regulations 1999, and the Working Time Regulations 1998 to control risks from fatigue. In accumulation to these acts and regulations, Regulation 28 of the Railways and Other Guided Transport Systems Regulations 2006, focuses explicitly on fatigue management duties on controllers of safety-critical work in the railway industry. Reference must also make to the Health and Safety Executive (HSE) which is a managerial, non-departmental public entity, supported by the Department for Work and Pensions, which acts as the independent national regulator for work-related health, safety and illness. By acting in the public's best interest, the HSE aims to decrease work-related death and serious injury across Great Britain's workplaces.

The National Conference of State Legislatures in the United States of America stated that in recent years there had been legislative efforts to reduce the number of drowsy drivers on the road, this, however, does not necessarily cover fatigue in the workplace. The USA currently has a total of nine laws addressing drowsy driving and 26 Bills that were introduced from 1997 to 2015 (Summaries of Current Drowsy Driving Laws, 2016).

DISCUSSION AND CONCLUSION

The general objective of this article was to investigate the current state of research on the phenomenon and measurement of employee fatigue in the mining industry by analysing national and international research conducted in this field. Fatigue is fundamental to the behaviour of the human being. Fatigue has not been fully defined after over nine decades of research. When researching fatigue in an organisation, it is much like choosing a point of view toward a topic or problem.

Many different ways exist to conceptualise fatigue. It is clear from the literature that the concept fatigue is a multi-dimensional construct that focuses on a psychological, physiological and social component that is used to represent an individual experience (Hauck, 2010; Hossain, Reinish, Kayumov, Bhuiya, & Shapiro, 2003). This concept has been researched extensively as a complex phenomenon that leads to numerous problems for both the organisation and the individual, such as sick leave, poor judgement and sleep loss (Dall, 2015).

In this study, the research has contributed by adding a sixth period of interest of fatigue research, as the focus of this period has shifted from productivity, aviation, driver fatigue and safety, ergonomics and employee diseases as stand-alone entities to a holistic approach. Fatigue is very difficult to measure due to its subjective nature. This is due to the tremendous variation or adaptability that human beings possess. The bulk of research has broken into various sub-categories or pluralities of fatigue but has not attempted to explain the experience of the whole person. Moreover, Bartley and Chute (1947) explain that the subcategories of fatigue, as mentioned earlier, have stayed the same since the writing of "Fatigue and Impairment in Man".

Instruments that measure the content and evaluation of fatigue need to be grounded in theory or based on an inductive analysis of data. Since different measurement instruments have different items related to fatigue, it should be clear why different context make use of various instruments. For that reason, a specific measurement instrument should be selected by reviewing valid content items, the theory or theories applicable in the research, and the kind of inductive analysis the compositions of the items are based on. Frone and Tidwell, (2015) explain that work fatigue is characterised by extreme exhaustion and reduced functional ability, physical work fatigue is characterised by extreme physical exhaustion and a decreased ability to participate in physical activity. Whereas mental work fatigue is characterised by extreme mental exhaustion and a decrease in the ability to engage in the cognitive activity of an employee's thinking. Lastly, emotional work fatigue is characterised by extreme emotional exhaustion and a decreased ability to engage in the emotional activity. A multidimensional measure must be used when these three types of fatigue are evaluated. Edwards and Shipp (2007) and Hussong et al. (2013) explain that for a measure to be fully consistent, it must be conceptually equivalent; meaning that the three types of work fatigue must be characterised in similar terms in addition to the point that the number of items and conceptional meaning must be the same. Additionally, the measures of physical, mental, and emotional work fatigue must have metric equivalence, meaning that the response scale used must be the same.

When focusing on legislation regarding intoxication in the workplace, one can review The Minerals Act No.50 of 1991 Chapter 4 Regulation 4.7.1 and 4.7.2. These regulations explain that no person in an intoxicated state shall be allowed to enter a mine, or be in the proximity of any workplace or near any machinery. "Any person who may have entered a mine or works in a state of intoxication may be arrested immediately by the manager and handed over to police and will be deemed guilty of an offence under the regulation of the Act" (Mine Health and Safety Act and Regulations 29 of 1996, p. 301).

Health and safety risks are increased by fatigue, long shift lengths, pressures placed on mental capacity, heavy physical work, repetitive work, vibration and the increasing age of the workforce. It appears that the mining industry does not recognise these causes as potential causes of health problems, and it is likely that stress and morbidity in mine employees will be impacted by at least some of these causes if they are not balanced out by informed decisions from management. However, the evolution of involved approaches to the problem of fatigue in some parts of the mining industry is reassuring (McPhee, 2004).

There is a vast benefit in doing fatigue focused research, not only for organisation and employees, but also for the field of Industrial Relations. Each can benefit in different ways; the organisation will be better equipped to deal with the risk of fatigue, drug use and absenteeism, which will, in turn, allow them to better assist employees with specific targeted Employee Assistance Programs leading to employees who are better equipped to cope and deal with their problem. The organisation will thus benefit by being in a position where they comply with legislation and if the employees are better equipped to deal with their problems, the organisation benefits with more focused employees and less sick leave shifts being booked. A workforce that is more focused and less fatigued will lead to less safety incidents and higher production, which also has a positive impact on the company's bottom line.

Thus lastly, the field of Labour/Industrial Relations can start to fill the void in the current literature relating to the topic of fatigue; this research will allow the much-needed information to reach the appropriate parties involved. This research can also lead to further studies in the field as other researchers and organisations can use the research outcomes to equip themselves better to deal with the same problems that might be costing them unnecessary skills and money. The impact of fatigue can be seen on both the effect it has on job performance and the health of employees, as well as on productivity at the mine. Furthermore, the immediate community's health and well-being can also experience the impact of fatigue (Fourie et al., 2010).

RECOMMENDATIONS

Based on the current literature with regards to both fatigue studies in South Africa and fatigue in the South African mining industry, it is recommended that the organisation develops and implements a fatigue risk management plan in consultation with employees. The aforementioned plan must, firstly, promote a healthy work environment through annual employee fatigue measurements. Secondly, it should ensure the development and implementation of an employee fatigue management training program. Thirdly, information sharing sessions or pamphlets should be initiated. Lastly, an Employee assistance program that promotes the management of fatigue in the workplace should be established. International studies have done vast amounts of research on the phenomenon of employee fatigue, and an extensive amount of literature focuses on the mining industry, although national studies are limited. Thus, further research is essential to fill the void in the current literature relating to the topic of employee fatigue both nationally and in the South African mining industry.

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CHAPTER 3

RESEARCH ARTICLE 2

THE RELATIONSHIP BETWEEN EMPLOYEE FATIGUE, LEVEL OF SUBSTANCE USE, ABSENTEEISM AND THE DEMOGRAPHICAL INFORMATION OF EMPLOYEES

A part of this research article is in press:

Fourie, R., & Keyser, E. (in press). The relationship between employee fatigue, level of substance use, absenteeism and the demographical information of employees

CHAPTER 3

ARTICLE 2: THE RELATIONSHIP BETWEEN EMPLOYEE FATIGUE, LEVEL OF SUBSTANCE USE, ABSENTEEISM AND THE DEMOGRAPHICAL INFORMATION OF EMPLOYEES

The main objective of this research is to determine the relationship between employee fatigue, level of substance use, absenteeism and the demographical information of employees. In order to prevent employee fatigue, it is important that the relationship between employee fatigue and accompanying demographical information of these employees, is understood. The study also focuses on which group of employees, white- or blue-collar employees, have a higher level of substance use, and which group of employees have a higher level of human fatigue in the mining industry.

A cross-sectional survey design was used. The total sample size consists of 386 employees (82.9percent male), comprising of managers, blue-collar and white-collar employees, in a mining company in South Africa. This study found that a relationship between employee fatigue, the level of substance use, absenteeism, and the demographical information of employees, exists. Furthermore, it was found that no significant difference exists between white and blue-collar employees and level of substance use.

There is no debating the fact that the South African economy is dependent on the mining industry. Further studies must be done to start to fill the void in the current literature relating to the relationship between employee fatigue, substance use and absenteeism. This research will allow the much-needed information to reach both the organisation and the employees that need assistance.

Key words: employee fatigue, substance use, absenteeism, blue-collar, white-collar, mining industry

INTRODUCTION AND BACKGROUND

One of the growing problems in our modern society is fatigue (Caldwell, Caldwell, & Schimidt, 2008; Asare, Schmitt, & Bernhagen, 2013). Current research indicates that 19percent of healthy employees describe feeling fatigued and suffer from heavy-headedness, headaches, dizziness, or having difficulty concentrating. These complaints are common in the working population (Magnavita, 2015). Andrea, Kant, Beurskens, Metsemakers and Van Schayck (2003) further confirm that 13.9percent of employees (one in seven) schedule an appointment with a general practitioner, as a result of fatigue-related problems.

Internationally, interest in the causes and outcomes of work fatigue can be seen in the large collection of multidisciplinary literature that links employees' work-related fatigue and personal outcomes to working conditions and work attitudes of an employee (Frone & Tidwell, 2015). However, national research concerning the causes and outcomes of work fatigue is limited. It is emphasised by Ahmed, Babski-Reeves, DuBien, Webb and Strawderman (2016) that the experience of fatigue, and the negative consequences thereof, has increased in recent decades but there is still a lack of clear understanding of fatigue in the workplace.

Recent research by Dall (2015) emphasizes that fatigue is a reality but research, specific to the mining industry concerning the causes of fatigue (such as shift work, long working hours, overexertion and disruption of sleep and mentally or physically demanding work) is sparse. Lee, Moon, Lee, and Kim (2014) mention that work-related fatigue takes place when the work environment (physical) interacts with various other elements, such as work-related psychology and personal life circumstances of an employee.

Useche, Ortiz and Cendales (2017) emphasise that negative behavioural changes such as drinking, smoking, unhealthy diet and counterproductive work behaviour can be linked to the employee's working conditions. The mining industry is characterised by long working hours with employees working and living away from their residence and family for long periods of time (Asare et al., 2013). One of the primary factors that significantly affect an employee's fatigue is the amount of time spent at the workplace and the duration of work-tasks (Ahmed, et al., 2016). Overworked employees are at an increased risk of accidents due to sleep deprivation that results in fatigue and this, in turn, has an impact on their health and performance at work (Asare et al., 2013).

De Vries, Michielsen, and Van Heck, (2003)define fatigue as a multidimensional construct. Soh and Crumpton , (1996) and Tiesinga et al. (1996) further confirm that fatigue is a multicausal, multidimensional, non-specific and subjective phenomenon, which results from prolonged activity and psychological, socioeconomic and environmental factors affecting employees both mentally and physically. Clearly, the aetiology of fatigue is multidimensional and exists outside and inside the workplace (Tang, Li, & Huang, 2016). The Code of Good Practice within the Government Gazette of the Mine Health and Safety Act 1996 No. R 1025 offers six factors that contribute to fatigue, namely, individual human factors, non-work factors, environmental conditions, work-related factors, work scheduling and planning, and night shift work. On a national level, reports are available on employee fatigue as required by the Code of Good Practice, but these reports do not focus on the relationship between employee fatigue and levels of substance use.

The mining industry is known to be very challenging and draining, as employee's responsibilities are diverse and require a substantial amount of physical work; these responsibilities often involve strength, flexibility, and muscular stamina. The intensity of the work performed is ordinarily recurrent. Employees often experience a dramatic increase in heart rate due to the recurrent nature of underground mining, accompanied by peaks of very high-intensity work (Asare et al., 2013). Different research and authors state that existing research related to fatigue in the workplace has focused on the sleep patterns of employees, emotional exhaustion and burnout components related to their impact on safety and performance (AbuAlRub, 2004; Aiken, Clarke, Sloane, & Sochalski, 2001; Chen & McMurray, 2001; Gold, Roth, Wright, Michael, & Chin-Yi, 1992; Kandolin, 1993; Lindborg & Davidhizar, 1993; Suzuki, Kanoya, Katsuki, & Sato, 2006; and Taylor, Weaver, Flannelly, & Zucker, 2006).

In a study focusing on fatigue as a predictor of sick leave, conducted by Janssen, Kant, Van Amelsvoort, Nijhuis, and Van den Brandt (2003), four factors that determine the amount of sick leave are identified. The first factor (social factor) concerns health care, social security system and culture; the second factor (work-related factor) relates to working conditions and work content; the third factor (organisational factor) addresses absence policies, company size, and the existence of health promotion programmes; and the last factor (individual factor) pertains to health and personality. The study conducted by Janssen et al. (2003) indicates four explanations as to why fatigue is a substantial predicting factor for sick leave. First, it is found that a high occurrence of fatigue cases in the working population exists. Secondly, it is determined that

fatigue is robust. Thirdly, fatigue is a disabling condition, and lastly, fatigue is an important symptom of mental stress-related health complaints. Fatigue is seen as a predictor of employee absence, in the form of sick-leave (Janssen et al., 2003).

Sirois (2009) states that organisations with vast fatigue problems have almost double the absenteeism rates compared to organisations where fatigue is not an issue. Many mines in South Africa are being affected by employee fatigue, and it is an increasingly critical issue with regards to safety (Schutte & Maldonado, 2003). A study by Cunradi, Greiner, Ragland, and Fisher (2005) explains that employees with high levels of alcohol consumption and alcohol problems might use short-term absenteeism as a coping mechanism to escape their problems. Few documented cases of substance use by employees in South African during the 1800s exist. However, the use of substances in the workplace by mine employees can be traced back to the 1960s. This period saw many black males migrating to the mining areas as miners. Employee safety and well-being were of little concern and terrible working conditions, and fatalities were common. Living conditions were poor, and these mine employees lived far from their families in overcrowded hostels. This led to the development of informal bars and brothels, in turn, establishing the mining culture of high alcohol use and unsafe sexual behaviour. The time spent away from employees' families led many to use alcohol and other substances (cannabis) as coping methods to fill the void (Allen, 2005).

A study conducted by Ajani (2010) on alcohol and cannabis use in 2003 in the mining industry expounds that employees with a low level of education and low job categories are positively associated with cannabis and alcohol misuse. The reasons given by employees for the use of alcohol and cannabis was said to be for relaxation, socialising, boredom and coping with stress. Participants felt that mine employees could control the use of alcohol and cannabis through awareness programmes, substance use testing, rehabilitation programmes, disciplinary measures and recreational facilities to relieve boredom.

Job dissatisfaction, unhealthy environments, family problems, poor welfare facilities and poor working conditions are all causes of absenteeism in the production industry (Kalita & Nath, 2014). Noweir, (1984) conducted a study concentrating on the average noise exposure (80 to 99 dBA) of employees at three textile mills, he focused on productivity, work rule violations, absenteeism, and accidents. That the findings of the study show that employees who are exposed to high noise levels (greater than 90dBA) have higher disciplinary actions and absenteeism levels and lower productivity levels compared to employees with lower noise exposure (less than 90

dBA). Furthermore, Dewangan and Patil (2015) conclude that production could be increased and absenteeism decreased by reducing the dust exposure of employees, in doing so, the working environment will improve, and health risk to employees will decrease.

Wilkinson (2015) found that substance use is increasing in the workplace with three out of four alcohol users and 70 percent of drug users being employed. It is projected that in South Africa, the use of alcohol and drugs costs the economy at least R9 billion a year.

Ahmed, et al. (2016) mention that despite consistent growth in mentally demanding jobs only a few studies have been reported on how these stressful jobs could increase an employee's fatigue. It is important to focus on the blue- and white-collar employees' work fatigue. Previous research only focuses on substance use and not levels of substance use. Consequently, existing studies mention blue- and white-collar employees, but do not focus on the semi-skilled blue-collar, skilled blue-collar, low-level white-collar and intermediate white-collar employees as identified according to some of the mining companies in South Africa. Therefore, in this study, focus will be given to the relationship between employee fatigue and levels of substance use of semi-skilled blue-collar, skilled blue-collar, low-level white-collar and intermediate white-collar employees.

Fatigue studies suggest that demographics of an employee could play a role in the experience of fatigue (Di Milia, Smolensky, Costa, Howarth, Ohayon, & Phillip, 2011). However, a few studies have addressed the link between fatigue and both individual and work outcomes. This study addresses the gap in the literature by examining the relationship between fatigue (individual human factors, non-work factors, environmental conditions, work-related factors, work schedule and planning, and night shift work), sick leave/absenteeism, substance use and demographical variables.

Furthermore, the study will investigate if a relationship between fatigue and substance use exists as well as if a relationship between fatigue, absenteeism and demographical information of employees exists. The researcher will then further investigate alcohol and substance use amongst blue-collar and white-collar employees.

RESEARCH OBJECTIVES

The main objective of this research is to determine whether or not a relationship between employee fatigue, level of substance use, absenteeism and demographical information is

apparent. The result of such an investigation will offer the potential prevention of employee fatigue through understanding the aforementioned relationships.

The study also aims to determine:

- which group of employees, white- or blue-collar employees, have a higher level of substance use; and
- which group of employees, white- or blue-collar employees, have a higher level of human fatigue in the mining industry.

In the subsequent section of the article, a literature review focusing on employee fatigue, as categorised by the Code of Good Practice: Government Gazette of Mine Health and Safety Act 1996 (No. R 1025); substance use of employees; employee absenteeism as well as the relationships between employee fatigue, substance use, absenteeism amongst blue- and white-collar employees, is provided. Thereafter, the research design, results, conclusion and recommendations are discussed.

LITERATURE REVIEW

Employee Fatigue as categorised by the Code of Good Practice: Government Gazette of Mine Health and Safety Act 1996 (No. R 1025)

Frone and Tidwell (2015, p. 284) state that Mines in the South African mining industry are affected by employee work fatigue as a critical safety issue and emphasis that "despite the importance of this construct, relatively little attention had been paid to its conceptualisation and measurement". Furthermore, Frone and Tidwell (2015) explain that definitions and measures of fatigue have been insufficient as they fail to focus on the desirable characteristics of a work fatigue measure.

The Mine Ventilation Society of South Africa (2013) identifies several categories of fatigue namely, visual, bodily, mental, nervous, chronic, circadian and fatigue brought about by monotonous activity, arising from some of the following causes: high intensity and long duration of physical or mental work, environmental stressors (e.g. noise and heat), physical problems, worries and conflicts, pains and illnesses, circadian rhythms, stress, and poor or inadequate nutrition.

Employee fatigue, according to the Code of Good Practice within the Government Gazette of Mine Health and Safety Act 1996 No. R 1025 and the Ergomax group (2013), can be divided into different factors, such as *individual human factors* that focus on mining employees' alcohol use, health conditions, and general factors (body weight and height). The second factor, the *non-work factor*, includes average hours of sleep, sleep conditions, activities outside of work, travelling time to and from the mine to employees' residence in town, weekend activities, nutrition, and fatigue management training. The third factor focuses on *environmental conditions* such as exposure to noise, dust, vibration, temperature, heavy lifting, hazardous materials, as well as awkward body postures, restricted ceiling height and travelling distance to the workplace itself. The fourth factor deals with *work-related factors* such as repetitive work, physical work, mental work, work pressure, last leave cycle, overtime and whether or not an ergonomics risk assessment was ever done on the employee. The fifth factor is concerned with *work schedule and planning* and considers the average weekly working hours, the length of shift hours, scheduling of work hours, the direction of shift rotation, type of shift, starting times of shifts, the number of breaks within shifts and the number of shifts per week. The sixth factor relates to *night shift work* and assesses whether or not the employee worked the night shift; and if the employee did work night shifts, the further questions focus on the length of the night shift, the number of night shifts worked in succession, a period of rest following night shift cycle and lastly, the breaks during night work.

Figure 2 gives the different factors that contribute to employee fatigue. It is important to note that these factors are interlinked with one another and might influence an individual employee simultaneously or at different time periods.

Figure 2 Wheel of fatigue factors (Compiled by the researcher, 2017)

Regarding the first factor, it is important to note that "The terms human factors and ergonomics are used interchangeably by some, whereas others differentiate the two terms" (Handyside & Suresh, 2010, p. 123). It is, therefore, important to distinguish between human factor and human error. The human factor, "describes accident causality when the cause is attributed to the characteristics or behaviour of an individual or organisation, rather than structural or mechanical failure or some environmental or other contextual factors that are outside our control" (DeCola & Fletcher, 2006, p. 10).

The Ergomax group (2013) use the guidelines as defined in Code of Good Practice: Government Gazette of Mine Health and Safety Act 1996 No. R 1025 to identify individual human factors as characteristics of work/employee fatigue. These characteristics include gender, alcohol use, health conditions and general factors such as age, tenure, body weight and height.

In a study conducted by Jones, Hocine, Salomon, Dab and Temime (2015), focusing on demographicsal (age, sex and years of experience in the profession) and occupational predictors for fatigue and stress, it is found that females where meaningfully more probable than males to report a current state of tiredness. Furthermore, the average age of a mine's workforce may differ significantly from other mines as it is impacted by the location and age of a mine itself. The impact of age on work capability is questioned once the average age reaches 40 years as physical capability is reduced when age increases. A decrease in physical and mental capability is

determined in many mine employees over the age of 45 years, this is particularly true when new or unfamiliar requirements are placed on them (McPhee, 2004; Parker, Worringham, Greig, & Wood, 2006; Stedmon, Howells, Wilson, & Dianat, 2012).

Beaulieu (2005) states that another important individual human factor associated with fatigue is alcohol use, as a legally intoxicated person and a tired employee exhibit the same levels of performance impairments. Furthermore, sleep is profoundly impacted by alcohol as it is a powerful somnogen; severe alcohol consumption lessens the time to fall asleep, however, it affects the quality of sleep in the second half of the night. Insomnia was also found to be a direct result of withdrawal in alcoholics (Thakkar, Sharma, & Sahota, 2015). This results in economic and social consequences such as reduced productivity, higher accidents and occupational disease rates, absenteeism, higher staff turnover and increased employee compensation rates, liability rates, and vehicle insurance (Beaulieu, 2005).

The second factor as stipulated by the Code of Good Practice is non-work factors and are characterised by average hours of sleep, sleep conditions, activities outside of work, travelling time to and from work, weekend activities, nutrition, fatigue management training and extended travelling time (Ergomax group, 2011). This is supported by Hajare and Dule (2012) who state that fatigue can be characterised by two measures; firstly non-work related fatigue, which is significantly different between individuals and is best managed at an individual level; and secondly, work-related fatigue which is similar for different individuals performing the same task.

Furthermore, the causes of fatigue can be broadly categorised as non-work related and work-related (Hazzard, Johnson, Dordunoo, Klein, Russell, & Walkowiak, 2013; Safe at work Australia, 2013; Hossain, Reinish, Kayumov, Bhuiya, & Shapiro 2003). Non-work related fatigue comprises of the influences of sleep disorders as well as medical and psychiatric illnesses, while work-related fatigue transpires as a result of failure to accomplish adequate restorative sleep (Hossain et al., 2003).

Dawson (2000) states that non-work related factors contribute to overall fatigue by reducing the chance for sleep and recovery. While Kitney (2013) argues that lack of sleep or being awake for too long, generally greater than 17 hours, is the most noteworthy and principal cause of fatigue as this can be associated with the effects of alcohol in the bloodstream. Seventeen hours of

wakefulness is equal to a blood-alcohol-level of 0.05, whereas 20 hours of wakefulness is equal to a blood alcohol level of 0.10.

With regards to non-work related factors, Bureau (2014) explains that employees that reported sleeping more than 9 hours or less than 6 hours a night, were at a higher risk of a prolonged absence from work due to sickness. He concludes that the ideal duration of sleep to obtain the lowest risk of sickness absence is 7 to 8 hours per night; 7 hours, 38 minutes for females, and 7 hours, 46 minutes for males. Lallukka, Kaikkonen, Härkänen, Kronholm, Partonen, Rahkonen and Koskinen (2014) examined numerous sleep measures as factors of sickness absence. The findings offer that sickness absence amongst males is associated with sleep disturbances excluding excessive daytime sleepiness, and insomnia-related symptoms, early morning awakenings, and being more tired than others. For females, the use of sleeping tablets is reported as the most common factor concerning sleep measures. Finally, the study concludes that a reduction of up to 28percent in absenteeism costs could be achieved if sleep disturbances could be completely addressed.

A study conducted on fatigue management among mining department shift employees in Ghana found that for employees to determine whether or not they are fatigued, a benchmark must be set with regards to their ability to sleep. This is an important benchmark as most of the participants report that they feel fatigued due to a lack of sleep (Asare et al., 2013). The quality of sleep, or lack thereof, is probably the most important aspect when it comes to fatigue. Some of the causes that might cause sleep disruption and poor quality of sleep are interrupted sleep or extra responsibilities when it comes to family life. Some familiar routine selections that can cause fatigue have been identified which include lack of sleep (Theron & van Heerden, 2011; Headway, 2016), poor quality of sleep (Kitney, 2013), sleep disturbances (Theron & van Heerden, 2011), sleep disorders (Dawson, 2000; Kitney, 2013), an overstimulated sleeping environment (Headway, 2016), lack of regular exercise and poor health and fitness levels (Lewis & Wessely, 1992; Theron & van Heerden, 2011; Work Cover Tasmania, 2013) and nutrition (Dawson, 2000; Theron & van Heerden, 2011).

Asare et al. (2013) explain that tiredness can also be caused by the travelling time from the place of residence to the workplace itself. Especially, if employees travel anything from half an hour to an hour in each direction, per day, as this has the potential of employees feeling tired even before their shift starts. Work Cover Tasmania, (2013) and Kitney, (2013) further confirm that travelling for work and extended commuting times, causes fatigue.

Other non-work factors that should be mentioned include emotional issues such as relationship pressures (Kitney, 2013; Work Cover Tasmania, 2013) and individual differences in coping strategies (Dawson, 2000). As confirmed by Headway, (2016) an overstimulated sleeping environment causes fatigue thus an individual should make sure their sleeping space is comfortable.

The third factor pertains to the environmental conditions of an employee, which also play a significant role in work pressures, staffing, scheduling and external environmental factors such as exposure to humidity, heat and ergonomic stressors that have an impact on employee fatigue. Employee fatigue and shift work are affected by three staffing problems namely, when employee complement and work pressures are disproportioned, absenteeism of employees (whether planned or unplanned) and lastly, fluctuations in work pressures. (Lerman, Eskin, Flower, George, Gerson, Hartenbaum, Hurst, & Moore-Ede, 2012; Yumang-Ross, & Burns, 2014).

Employee fatigue can be reduced during the shift by focusing on ergonomic issues, temperature and lighting (Yumang-Ross & Burns, 2014). Noweir (1984) conducted a study concerning the productivity, work rule violations, absenteeism, and accidents within the textile mills and discovered that the employees working in low noise exposure departments had less disciplinary actions, less production output and more absenteeism compared to those employees working in high noise exposure departments. The greatest difference between high and low noise exposure departments was shown firstly by disciplinary actions, trailed by production incentives, production efficiency and lastly, absenteeism.

Some industries place a limit on some risks an employee can be exposed to such as hazardous materials, noise or physical handling (Occupational Health and Safety Committee Manual, 2014). Department of Labour (2007) confirms that factors such as noise, artificial light, heat, humidity, and vibration all contribute to fatigue.

Noise, defined as an “undesirable sound”, is a side effect in many industries, although this is especially accurate for the mining industry (Sensogut, 2007, p. 939). Although noise exposure has little consequences on manual work performance, mental concentration, however, demands subtle or understated noise levels (The Mine Ventilation Society of South Africa, 2013). Noise exposure and noise-induced hearing loss continue to be a widespread complication in mining. Nearly half the workforce in South African mines are exposed to deafening noise according to available data (Hermanus, 2007; Donoghue, 2004). Melamed and Bruhis (1996) explain that

when employees are exposed to continuous noise conditions, their cortisol level rises, combined with elevated levels of accumulated fatigue and irritability post-shift. The figure below indicates the different aspects of environmental conditions.

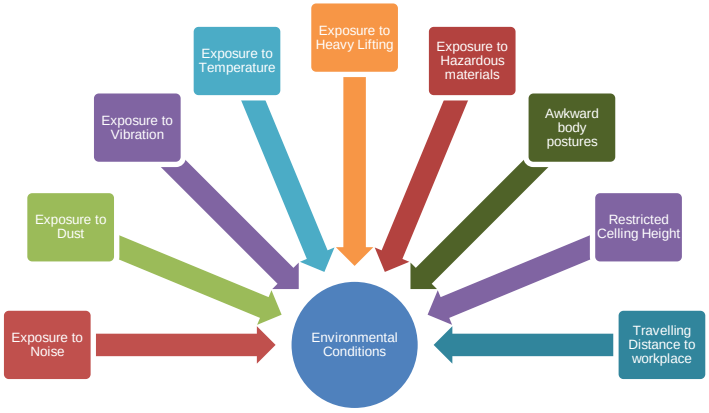

Figure 3 Environmental conditions (Complied by the researcher, 2017)

The fourth factor is concerned with work-related factors; this factor includes repetitive work, physical work, mental work, work pressure, last leave cycle, overtime, and whether or not an ergonomics risk assessment has been conducted on the employee.

While Hajare and Dule (2012) identify the aspect of the task being undertaken, too many successive night shifts, unexpected work, overtime, emergencies, breakdowns and call-outs, and the feature of the working environment (e.g. extreme temperature and noise) as causes of work-related fatigue. Hossain et al. (2003) confirm that work-related fatigue is the consequence of the cumulative effects of prolonged and intense sleep deprivation. Additionally, work-related fatigue is associated with the misalignment of an individual's desired sleep-wake schedule, and the output of the circadian pacesetter in the brain, inadequate sleep hygiene and extended duration of waking hours before start of shift. Shift employees are, consequently, especially susceptible and at a heightened risk of the consequences of increased sleepiness, chronic fatigue and reduced alertness and performance.

Theron (2014) states that it is essential for employers to understand that fatigue is not the same as being tired; employees who are tired will recover after adequate rest or sleep. However, fatigue is characterised by many symptoms such as muscle weakness, impaired hand-and-eye coordination, poor concentration, slow reflexes, lack of reasonable responses, reduced ability to pay attention, and blurred vision. Unrealistic amounts of work (Murphy, 1927), repetitive work, physical work, mental work, work pressure, last leave cycle, overtime and ergonomics are

characteristics of work/employee fatigue along with the aforementioned characteristics of employee fatigue highlighted by the Ergomax group (2011) can also cause fatigue and extreme and repetitive physical work could lead to increased muscular fatigue (The Department of Labour, 2007).

Asare et al. (2013) found that call outs and overtime are mostly to blame for irregular and unplanned schedules, which in turn, affect employee fatigue. If a work schedule requires an employee to be awake during the night, or if an employee is required to work extended periods of time (overtime) the circadian rhythms of that employee is disturbed. The employee's quality and quantity of sleep are thus affected by this disturbance (Theron & van Heerden, 2011). Ahsberg, Kecklund, Akerstedt, and Gamberale (2000) further confirm that sleepiness can be a cause of fatigue. Nevertheless, observations exist that describe altered conditions such as physical fatigue, lack of vigour, reduced performance in alertness and activity both mentally and physically, as well as a feeling of lack of interest or energy. Quite possibly, these characteristics of fatigue may be experienced differently with different aspects of shift work.

As mentioned by Cunradi et al. (2005) earlier research advises that self-reported work pressure can be linked with more significant levels of alcohol intake and absenteeism with employees in the transit sector. A unit of urban transit operators was studied focusing on what the interrelationships among short-term absenteeism, alcohol use, and stress-related factors were. For stress-related factors, they concentrated on stressful life events, job stressors, and occupational fatigue. A study by Vignoli, Guglielmi, Bonfiglioli and Violante (2016) on how job demands and work-family conflict, cause absenteeism in the workplace concludes that emotional exhaustion facilitates the connection between job demands and absenteeism, and emotional fatigue is a cause of absenteeism. When they included emotional fatigue in the examination, job demands were linked with higher absenteeism levels.

Kocakülâh, Galligan, Mitchell and Ruggieri (2009) confirm that there are numerous causes of stress or stressors and can originate anywhere in the organisation. Job security worries, job dullness, long working hours, and dangerous working conditions can all be classified as stressors. Health problems that can arise from the stress caused by the stressors mentioned above which includes back pain, heart disease, poor mental health and gastrointestinal disturbances. Stress can often cause disobliging behaviours such as smoking and high levels of alcohol intake.

In a study by Mikalachki and Chapple (1977) that examined the effect on absenteeism focusing on the skill required for the job, the employee's age, health, overtime and the base pay rate found employees worked overtime to accomplish a set income for limited time or days spent at work and used this strategy to spend less time on the job.

The fifth factor is work schedule and planning. Shift work, sleep disturbance and deficiency, as well as irregular working hours, lead to fatigue that can impact an employee's health (Yumang-Ross & Burns, 2014). Bartlett, (2014) identifies numerous factors that can cause fatigue including, shift scheduling and length, rest periods in between shifts, time of day the shifts are scheduled, the repetitious nature of the work that needs to be performed as well as the physical demand. Jones et al. (2015) further indicate that increased fatigue could be associated with a longer work day, overtime, working night shifts and rotating shift work. Satisfactory resting times in the middle of shifts is essential, particularly after any injuries. Dinges, Pack, Williams, Gillen, Powell, Ott and Pack (1997) also found that long shifts, or extended arrangements of work days, may have more significant effects on physical fatigue.

Many jobs in the mining industry now feature extended working hours (shift lengths of 10 to 12 hours and higher workloads) as a drive towards achieving a higher level of employee productivity. Although the issues of fatigue and stress are getting the much-needed attention, at the moment, the concerns go further than that as extended working hours have emphasised the need for further research and information regarding the effects of exposure on a daily basis to different risks (McPhee, 2004).

Theron and van Heerden (2011) state that shift work is one of the shared workplace issues that can lead to fatigue. Sleeping during the night is one of the designs of the human body and the circadian clock, located in the brain, controls this part of the body and the circadian rhythm harmonises with day and night. When the employee works at night or when his body is supposed to be asleep he is confusing this circadian clock.

The Mine Ventilation Society of South Africa, (2013) offers that employees who work night shifts are more susceptible to chronic fatigue, drug use and poor eating. They recommend that employees working nightshifts should be between the ages of 25 and 50 as older employees succumb to these stresses more readily. Further recommendations include a 24 hour rest period after an isolated or consecutive night shift, short shift rotations and a rest period with a meal high in energy for each shift.

The sixth factor relates to night shift work. This factor assesses whether or not the employee works night shifts, and if so, additional questions are posed to the employee, which focus on the length of the night shift, the number of night shifts worked in succession, if a period of rest following night shift cycle has been taken, and lastly, the number of breaks taken during night work.

Yumang-Ross and Burns (2014) identify insufficient sleep duration and lack of sleep as contributing factors towards employee fatigue. As part of a study by Sirois (2009), who evaluated shift work practices, one finding offers that compensation costs for employees that were fatigued are up to four times higher than those of non-fatigued employees. Research has been published on 8-hour versus 12-hour shift durations, the pattern of consecutive workdays versus non-work days, fixed shifts, and forward rotations. Accident and injury rates increased after employees worked four consecutive night shifts compared to working consecutive day shifts (Coombs, 2015; Caruso, 2014; Tucker & Folkard, 2012). The South African Basic Conditions of Employment Act 75 of 1997 allows an employee to work 45 hours a week with a maximum of 10 hours overtime; this translates to a 10-hour shift duration.

Asare et al. (2013) and Moore (2009) identify different causes that may have an impact on human fatigue, namely sleep deprivation, sleep disorders, illness or disease, therapeutic side effects, heavy stressful physical or mental exertion and stimulant drug usage. One of the significant factors causing fatigue in the mining industry is the exposure to noise, closely followed by heat and dust.

Asare et al. (2013) explain that for employees to determine whether or not they are fatigued, a benchmark must be set with regards to their ability to sleep. A lack of sleep is the main reason, reported by participants, as to why they feel fatigued. It is a significant indication of participants that their alcohol consumption is a direct result of the level of stress they experience. Nunn, Samson and Krystal (2016) state that sleep is essential for proper human cognitive functioning and health, thus, employees working shifts, leading to changes in circadian rhythms and chronic sleep deprivation, are exposed to increased risks for hypertension, heart disease and obesity.

Mehta and Parasuraman (2014) state that mental fatigue is well acknowledged with affecting muscle function and motor performance, although it is not clear what its influence is on the development of voluntary physical fatigue. Muscle fatigue or physical fatigue is defined by

Latash, Danion, and Bonnard(2003) as the incapacity to preserve an essential force level after continued use of the muscle.

Substance use of employees

Substance use, specifically the use of illicit drugs and heavy drinking, is a universal problem. Despite all the deterrence efforts, substance use is no less predominant now than in the past and reaches into all aspects of our daily lives; this includes the workplace (Bacharach, Bamberger, and Biron, 2010). Older research findings mention that subsidiary task during the workday is one of the most common types of test used, as the diminishing agent (fatigue) decreases the employee's ability to process information (Brown, 1962).

High levels of fatigue can be a result an employee workload or alcohol use of an employee (Stein, Allen, & Cook, 1985). The fatigue effects of various drugs have been difficult to distinguish from other effects of the drugs in epidemiological studies (Haworth, Triggs, & Grey, 1988).

In a study focusing on the comparison of the damages caused by alcohol and sleep deprivation, Yegneswaran and Shapiro (2007) note that hand-eye coordination is reduced after being awake for 24 hours; this is equivalent to having a blood-alcohol concentration of 0.08 percent. Employees suffering from alcohol associated problems may also coincide with drug-related problems and even mental health and other health problems (MacAskill, Parkes, Brooks, Graham, McAuley, & Brown, 2011).

Over the past 30 years, the drinking customs of females have changed, with an increase in reasonable drinking since the 1960s, although, there is still a vast variance in drinking customs between gender (Bergman & Kallmen, 2002). Higher levels of illicit drug use and impairment can be found in susceptible subgroups, for instance, 10.6 percent of young females in the United States, working in high-risk professions reported using illicit drugs in the workplace, and 11.4 percent reported impairment in the workplace. Whereas 28.0 percent of young males in the United States, working in high-risk professions, reported using illicit drugs in the workplace, and 26.3 percent reported impairment in the workplace (Frone, 2009).

In a study conducted in Scotland by MacAskill et al. (2011), it is indicated that the group most likely to engage in excessive drinking were young males and the highest consumption of alcohol came from males residing in the greatest disadvantaged areas of the country. The age groups of

18-24 and 40-64, the highest levels of consumption and conceivable dependence are evidenced. Kirst, Mecredy, Borland and Chaiton (2014) link increased substance use to young adulthood where substances such as cigarettes, illicit drugs and alcohol are consumed to the point of it being a problem. Twenty-five to thirty-seven percent of young adults initiate smoking, and 25-39 percent increase their frequency of cigarette smoking during young adulthood.

Employees' absenteeism

Munro (2007) states that one of the most significant problems a manager has to face on a day-to-day basis is absenteeism, which affects service delivery as well as staff attitude as it puts pressure on those employees who are at work and it could have financial implications for the organisation. Absenteeism is a complex phenomenon since its rate and progression are influenced by, as already mentioned, social factors, work-related factors, organisation factors, and individual factors (Janssen et al., 2003). Different definitions of absenteeism are observable in existing literature. Robbins, Odendaal and Roodt (2016, p. 15) define absenteeism as, "the failure of an employee to report for work as scheduled, regardless of the reason." Cascio and Boudreau (2008, p. 44) define absenteeism as, "any failure of an employee to report for or to remain at work as scheduled, regardless of the reason." Absenteeism is also defined by Milkovich and Boudreau (1994) as how often and for how long employees do not go to work. Furthermore, Van der Merwe and Miller (1988, p. 3) define absenteeism as, "an unplanned, disruptive incident; but more specifically, it can be seen as non-attendance when an employee is scheduled for work."

Hawks (2016) defines absenteeism as the usual pattern of missing work on a moderately recurrent basis. Some reasons why employees are absent from work include sick days, vacation days and occasionally, employees simply do not report for duty. Absenteeism can be divided into two categories namely; culpable absenteeism, when no legitimate reason can be given by the employee for his absence, and non-culpable absenteeism, when an employee can provide a legitimate reason for being absent from work.

Bakker, De erouti, De Boer and Schaufeli (2003) state that absenteeism can be divided into two different components, namely, frequency and duration. Absence frequency is considered to indicate the employee's motivation and is seen as voluntary absenteeism. It refers to the number of times an individual is absent during an exact period, irrespective of the length of each of those instances. Absence duration, on the other hand, is considered to indicate involuntary absenteeism

as it focusses on the incapability rather than the disinclination to come to work. It focuses on the length of time an employee has been absent from work for a specific period regardless of the number of absence spells.

The decision of an employee to report him or herself sick from work can be classified into two main explanations; firstly, withdrawal hypothesis (this is where employees withdraw themselves from aversive work circumstances) and secondly, reaction to job stress (the employee conceives stress as the failure to cope with job demands). The withdrawal hypothesis and reaction to job stress present the theory that employees may use absenteeism as a mechanism for coping and that it is not merely a behavioural reaction to dissatisfaction. Higher absence rates have been associated with more than a few stressors (factors thought to cause negative psychological reactions such as tension, nervousness and fatigue) such as workload and role problems (Bakker et al., 2003).

Mikalachki and Chapple, (1977) state the aspects affecting absenteeism can be clustered under three wide-ranging headings: 1) environmental aspects, 2) organisational aspects and, 3) individual aspects. In the context of this study, the researcher will focus on individual aspects affecting absenteeism. Absenteeism of a person can be affected by his social conditioning (age and education); the better the employee's education and younger the age of the employee, the greater the absenteeism. The experience of physical and mental stress being experienced also affects the employee's absenteeism. Issues such as leisure activities, alcohol and drug use and family conflict will all affect the attendance patterns of employees. The gender of an employee might also be a factor for absenteeism as female employees have been found to have greater health difficulties, partly due to menstrual cycles, and thus are absent more often. Employees who are young, educated, financially secure, who experience mental and physical stress, who are compensated for absence by secondary payments, experience uninteresting jobs and poor supervision will tend to be absent from work. Porter and Steers (1973) categorise numerous factors in the working environment into four groups, namely, organisation-wide factors, immediate work environment factors, job-related factors, and lastly, personal factors. Furthermore, this is supported by Porter and Steers (1973) that found that some fluctuations in each of these groups are reasonably connected continuously to one or both forms of withdrawal.

A study by Cunradi et al. (2005) found that to deal with stress-related factors, employees use short-term absenteeism as a coping mechanism. The connotation amongst absenteeism and stress-related factors differ by gender and drinking status. Female operators, who are current

drinkers, show a stronger association between stressful life events and absenteeism than the female operators that avoid alcohol. Male drinkers and avoiders show a meaningful correlation between occupational fatigue and absenteeism, whereas this was not the case with females. No relationship is found between regularity of job stressors and absenteeism, or between supposed severity of job stressors and absenteeism, among male and female drinkers and those that avoided alcohol. Additionally, the study found that substantial or problem drinkers are at higher risk for short-term absenteeism in comparison with operators without alcohol problems.

The principal reasons for unscheduled absences, including personal illness and family issues, are unlikely to deteriorate any time soon. It should be taken into account that it is critical for individuals to seek periodic medical attention, including regular health check-ups, although these visits are usually scheduled and planned absences (Kocakülâh, Galligan, Mitchell, & Ruggieri, 2009).

Romero and Strom's (2011) findings indicate that females have a higher absenteeism rate than males, employees that are older have a lower absenteeism rate as compared to younger employees and lastly, employees with higher tenure have a more moderate absenteeism rate. Trait effect, self-esteem, alcohol use, anxiety and depression are all individual difference that is found to have a minimal effect on the absenteeism rate of employees.

The following personal characteristics are selected by Spencer and Steers (1980) for a study concentrating on the impact of individual factors and perceived work experience on employee turnover and absenteeism because of their possible importance in employee withdrawal (turnover and absenteeism) behaviour. Firstly, age, followed by tenure in the organisation, tenure in the position, gender, and lastly, education. A higher relationship was found between absenteeism and personal characteristics than with turnover and individual characteristics. Furthermore, the relationship between work experiences and absenteeism and the relationship between work experience and turnover, is of a comparable size.

Additionally, in a study conducted in Cape Town, Pretoria, Bloemfontein, and Durban, in South Africa, determining how long travel distances impact on absenteeism rates uncovers that absenteeism increases due to the distance travelled and the difficulty of the journey (Fourie, 1987). Additionally, Koslowsky, (1997) states that past research merely considers travel time from home to the employees' workplace, disregarding the travel time from the workplace to the employee's home. Travel time is an important element as it affects the stress levels of

employees. Fitzgerald, Kirby, Murphy, & Geaney (2016) state that absenteeism can be reduced by integrating health promotion policies intended to prevent and manage excess weight, improve diet quality and increase physical activity levels of employees. The frequency of absenteeism is remarkably enhanced by central obesity, while consistent moderate physical activity decreases absenteeism.

Fritzsche, Wegge, Schmauder, Kliegel, and Schmidt, (2014) discuss the various work-related factors influencing absenteeism, included in this discussion is the ageing workforce. The study investigates immediate effects of team-level factors on absenteeism and performance; the results indicate that increased absenteeism and increased error rates are strongly related to a high physical workload. Additionally, the inclusion of females in the team is connected with shorter periods of absenteeism and higher performance.

In a study that examines the effect on absenteeism focusing on the skill required for the job, the employee's age, health, overtime and the base pay rate, the findings indicate that employees work overtime to accomplish a set income for limited time or days spent at work and use this strategy to spend less time on the job (Mikalachki & Chapple, 1977). The unpredictability of absenteeism has also been identified by Ehrenberg, (1970) as a cause for overtime.

Work scheduling and planning also impact on absenteeism, as a study by Walker and de la Mare, (1971) shows that when comparing absenteeism rates of permanent day shift employees and permanent night shift employees, the night shift employees show higher long-term absenteeism. However, no clear difference in short-term absenteeism rates is evident. The findings of the study also offer that employees who work rotating shifts show lower absenteeism rates compared to employees working day shift; the most remarkable finding is that no relationship could be established between absenteeism and overtime.

Relationship between employee fatigue, substance use and absenteeism

The relationship between workplace absenteeism and alcohol use remains confusing for researchers. Many researchers specialising in absence research have concluded that no other individual and workplace factor have a more compound effect on absenteeism as that of employee alcohol use (Gmel & Rehm, 2003; Harrison & Martocchio, 1998). Fundamental to this difficulty are two main problems.

Harrison and Martocchio (1998) state the first problem to be the supposed nature of the alcohol–absenteeism relationship, specifically the amount of alcohol consumed as opposed to the way it is consumed. Most previous researchers grounded their studies on the reasoning that quantity and frequency of the consumption of alcohol are connected to absenteeism by the amplified danger of chronic health complications and injury associated with higher levels of drinking. McFarlin and Fals-Stewart (2002) found evidence that the alcohol–absenteeism relationship may be ruled by a temporary or severe impairment mechanism. Regardless of these findings, research has mostly abandoned the likelihood that the amount of alcohol consumed is a predictor of absenteeism.

Bacharach, Bamberger, and Biron (2010) confirm that the second problem focuses on the alcohol-absence relationship, with a specific focus on the degree to which it may be provisional upon the interpersonal situation at work. Ames, Grube, and Moore (2000) and French, Zarkin, Hartwell, and Bray (1995) state that it is improbable for investigators to fully comprehend the accurate nature of the alcohol-absence relationship due to the fact that the influence of the consumption of alcohol on employee absenteeism is in all probability going to differ as a determination of workplace conditions, and that no theoretic model exists that can describe such control effects.

For instance, the absence of employees might have significant implications for the other employees in that department, compelling them to work overtime, or complete tasks that they do not have suitable training for (Goodman & Garber, 1988). The alcohol drinking employee may feel more or less obliged to attend work irrespective of the quantity of alcohol that he or she has drunk, contingent on the nature of the relationship between the alcohol consuming employee and his or her fellow employees. It is, therefore, likely that the level of alcohol consumption may serve as a predecessor of employee absenteeism and may be contingent on the employee's relationship with his or her supervisor (Bacharach et al., 2010).

Blum, Roman, and Martin (1993) note that when employees consider their supervisors to focus more on attendance policy implementation, the degree of alcohol consumption may be less predictive of absence. These employees are expected to use presenteeism as a successful screen to avoid being singled out as a troubled employee. Bamberger and Biron (2007) and Rentsch and Steel (2003) agree with these ideas, proposing that the interpersonal context at work may serve as a significant influence, training the effect of the diversity of employee and workplace factors on absenteeism.

To prevent substance use in the workplace, it is of utmost importance that one must first understand the predictors of substance use. Earlier research attempts to identify factors that may predict the use of and dependence on illicit drugs and alcohol. Some of the critical indicators of misuse that have been determined by recent studies include interpersonal problems, arrest history, multiple opioid uses and use for no identifiable reason (Cochran, Flentje, Heck, van den Bos, Perlman, Valuck & Carter, 2014). Therefore, to determine whether or not a relationship between fatigue and substance use can be established, one first needs to analyse the role of substances in fatigue and the role of fatigue in substance use. In other words, are employees using substances to combat fatigue or is the use of substances the cause of the fatigue that employees experience?

A study conducted on workplace substance use norms as predictors of employee substance use and impairment explains that both workplace injunctive (highlights what a person should do in a given situation) and descriptive norms (highlights what others do in a given situation) are important predictors of substance use. Furthermore, descriptive norms can persuade conformity for the sake of fitting in with a specific group at work while injunctive norms may be more assumed and may thus effect behaviour in an assortment of contexts. Thus, knowing and understanding these predictors is imperative for any organisation as work-related employee substance use and impairment may be related to decreased productivity and increased risk of accidents and injuries at work. It is important to note that exposure to employee substance use in the workplace has several negative outcomes for employees who refrain from the use of substances at work and can include poor workplace safety, amplified work pressure, and diminished morale (Frone, 2009).

Richards (2004) conducted a study on the patterns of, and motivations for illicit drug use among long-haul truck drivers. The study focuses on the link between substance use and work-related fatigue, and investigates the use of substances as a fatigue countermeasure. Some employees have a false belief that the use of substances relieves fatigue (Mediscreen, 2014). In the study conducted by Richards (2004) on truck drivers, the results show that nearly all the drivers use licit (legal) drugs at work as fatigue countermeasures, and most participants report this to be the norm. All the drivers justify their use of substances, whether it be licit (legal) or illicit (illegal), as fatigue countermeasures. All the drivers in this study are of the opinion that their driving skills improve when using substances as it lessens the feeling of road fatigue. These participants

further state that when the substance loses effect, the onset of fatigue is realised and more of the substance is needed to obtain the desired result (Richards, 2004).

An important aspect that should be mentioned is that fatigue is a common withdrawal symptom for alcoholism. According to the American Addiction Centre (2016), alcohol is the most commonly used substance in the United States. When alcohol use is disregarded or cut down, alcohol withdrawal symptoms will be experienced by almost half of the individuals who use alcohol as their substance of choice (American Addiction Centre, 2016). Clearview Treatment Programs (2016) state that many treatment programs for alcohol addiction mention that fatigue is a common and large part of the first stage of the program. This is accredited to the possible withdrawal symptoms and the stress that people usually feel during this stage of the program. Cornerstone Care Centre (2015) states that after a prolonged time of being sober, some of the withdrawal symptoms might return (fatigue being one of them), although not in the same severity as at the beginning of the program. This return is attributed to the brain chemistry that is slowly returning to normal.

Based on the information above, it is clear that a relationship between human fatigue and substance use exists. As confirmed by Mediscreen (2014), fatigue may be a symptom of stress or depression, but substance use is an imperative cause of fatigue. Although alcohol is commonly thought to make people more energetic, it substantially lowers the central nervous system and interrupts sleep. Other substances such as cocaine can initially create a feeling of alertness and energy. However, mental fatigue and depression will follow. Heroin users might appear sleepy and apathetic. However prolonged use of the drug will eventually lead to fatigue. Other illicit drugs such as methamphetamine, ecstasy and cannabis also follow the pattern of initial heightened alertness, however, ultimately develops fatigue as a symptom. Alcohol, prescription and other drugs produce fatigue through the damage to the liver and kidney functions of the user's body, making it difficult to process nutrients. Employees using these substances often fail to eat a balanced meal, creating a double nutritional deficit. With regards to the study conducted on truck drivers in Australia, it was found that these drivers follow the same cycle that other substance users follow in that it takes higher quantities of the substance and more frequently to get high and to overcome the proceeded fatigue (Mediscreen, 2014).

Bacharach et al., (2010) researched the work-related consequences of alcohol use and offer that literature specifies that alcohol consumption can form adverse consequences related to work. A positive correlation can be made between moderate consumption of alcohol and employee

absence while high consumption of alcohol has been linked to absenteeism and various other aspects such as accidents, lower scores on technical performance, productivity, and higher health care costs. There is increased possibility and length of absence from the workplace due to this opposing impact on employee health. It is evident that extreme drinking over time has increased the risk for a variety of chronic health problems, which in turn, can be directly related to the level of absence by an employee.

Keough, Zimbardo and Boyd, (1999) state that an abundant amount of studies report numerous individual differences as predictors of substance use, these include: anxiety, neuroticism, depression, ego under control, lower ego resilience, emotional states, extraversion and higher expected dominance, lower impulse control, locus of control, novelty seeking, reward dependence, risk-taking, sensation seeking, and lower socioeconomic status. In addition to these predictors of substance use, there are substantial sex differences in tobacco, drug and alcohol usage. Men are more likely to use cannabis and hard drugs, use more alcohol and are more likely to smoke tobacco according to worldwide data surveys.

According to the Substance Abuse and Mental Health Services Administration (SAMHSA) (2016) the United States' industry is negatively affected by substance use as it causes production loss, workplace accidents and injuries, absenteeism, low morale among employees and increased illness. They further state that research shows that there is a variance in the rate of substance use in various occupations and industries. In the US mining industry, a rate of 17.5 percent of full-time employees aged 18 – 64 reports heavy alcohol use in the past month, while 16.5 percent report the same in the construction industry. A 19.1 percent rate is reported for the food services and accommodations industry with regards to illicit drug use compared to a rate of 11.6 for the construction industry and 5.0 for the mining industry. It is noted that when focusing on the mining industry, the rate percentage did not stay true when controlling for age or gender differences. Thus, indicating that this high rate of 17.5 percent can be attributed to the demographic composition of the mining industry. The Substance Abuse and Mental Health Services Administration (2016) concludes that the lowest rates of heavy alcohol use, illicit drug use and substance use disorders are generally seen in white-collar occupations such as the education, public administration, healthcare, and social assistance industries, while the higher rates are generally seen in more blue-collar occupations found in the mining, construction, accommodations, and food services industries.

Sekulic, Peric and Rodek (2010) explain that individuals in professional occupations (white-collar employees) have a high demand on physical and mental capabilities. The study further identifies that alcohol consumption is more frequently observed in professional males, while professional females are found to smoke more cigarettes. Both males and females use their specific drug of choice as a way to deal with work pressure. Furthermore, it is found that alcohol is the drug of choice for older professional males, whereas married, female professionals use appetite suppressors.

A study by Gleason, Veum and Pergamit (1991) concerning drug and alcohol use at work, expounds that with regard to drug use, a higher reported drug use among males than females is observable; the same is evident among whites and minorities, and employees aged 19 - 23 vs employees aged 24 - 27. The most interesting fact arising from the study is that employees in occupations such as craft employees, operatives and labourers (commonly known as blue-collar occupations) have an on-the-job drug use rate of more than 9.0 percent versus a rate of 4.5 percent for professional employees, and 3.2 percent for employees in management positions (commonly known as white-collar occupations). The last point that stands out from this study is that blue-collar occupations in the mining and construction industries, where working conditions are dangerous, have a high drug use. Regarding alcohol use, the study states that 3.0 percent of all employees report that they missed work and 3.1 percent report that they had gotten drunk while at work during the year before the study. In the mining and construction industries, 3.0 percent of all young employees believe that their drinking leads to them losing their jobs or almost losing their jobs. This contributed to the fact that both these industries are strict with regards to alcohol use on the job due to the dangers it poses to safety.

Cunradi, Ames and Xiao, (2014) found that employees in physically demanding positions (blue-collar employees) are at a higher risk for binge drinking, and more likely to report binge drinking or drug and alcohol use compared to white-collar professionals. Ansoleaga and Castillo-Carniglia, (2013) found that Chilean construction employees have an elevated risk of dangerous alcohol consumption, while Marchand and Blanc. (2011) have a contrasting few. Marchand and Blanc (2011) conducted a study on the Canadian employees and states that blue-collar occupations are less likely to misuse alcohol, and physical job demands are not a predictor for alcohol misuse.

In consideration of the findings from the above-discussed studies, it seems that there is a clear picture that blue-collar employees are more likely to be associated with alcohol and drug use.

However, with the increase in deaths of celebrities due to drug overdoses, all eyes are on the entertainment industry. Countless actors, musicians, and professional athletes have lost their lives to drugs and alcohol or had trouble with the law.

In a study (Cunradi et al., 2005) concerned with alcohol, stress-related factors and short-term absenteeism, the findings indicate that work in the urban transportation industry is often characterised by high-demand/low control job circumstances and employees in blue-collar service industries are frequently exposed to the same conditions. Furthermore, the ethnic and gender configuration of the workforce in these industries is progressively non-white and female, respectively. When tested against comparable socio-demographic configuration and environmental job circumstances known to be related to high absenteeism rates, the results apply to the study of short-term absenteeism in further blue-collar service industries

Fleury, Grenier, Bamvita, Perreault and Carton (2014) conducted a study to determine predictors of substance dependence over a two-year period. This study found that substance dependence is often connected with poor mental and physical health, poor treatment outcomes, and inferior social conditions such as poverty, lack of education, stigmatisation, domestic violence, incarceration, and homelessness. It is evident that most cross-sectional studies investigate variables related to a specific substance (for example alcohol) and none of those studies evaluates variables connected with substance dependence in general.

It is clear from current research that although information is available from the United States with regards to alcohol and illicit drug use, not much is available for South Africa. The researcher is of the opinion that this leaves a vast shortfall in the research field and further research must be encouraged. It is also important according to literature to evaluate the relationship between substance use, absenteeism and fatigue.

Janssen et al. (2003) found several reasons why fatigue might be a significant predictor of sickness absence. Firstly, a high occurrence of fatigue cases are reported in the working population. Furthermore, fatigue is also seen as a disabling condition. Lastly, a considerable amount of employees are given the diagnoses of “adaptive or exogenous reaction” which falls into the job stress, overstrain and burnout group in the Netherlands (Janssen et al., 2003, p. 71). Thus, fatigue is an important symptom of mental stress-related health complaints. Janssen et al.’s (2003) study establish that there is a relationship between fatigue and sickness absence, and after investigating this relationship further, it is clear that fatigue is particularly strongly related to

long-term sickness absence. It is further noted that the risk of fatigue for a quick commencement of short-term sickness absence episodes is also found to be significant.

Akerstedt, Kecklund, Alfredsson and Selen (2007) conducted a study focusing on predicting long-term sickness absence from sleep and fatigue. The study found that longstanding absence due to sickness doubled in Sweden from 1993 to 2001; this is mainly attributed to a response to stress or burnout, although, longstanding absence due to sickness is conventionally attributed to mysculo-skeletal diagnoses. The study concludes that "disturbed sleep and fatigue are predictors of long-term absence and it is suggested that impaired sleep may be part of a chain of causation, considering its effects on fatigue" (Akerstedt et al., 2007, p. 341).

Blue-Collar and white-collar employees: fatigue, substance use, and absenteeism

In a study where white-collar employees' fatigue as a predictive risk indicator for long-term sickness absence is investigated, the findings show that fatigue in white-collar males is potentially associated with medically certified (mental) sickness absence (Roelen, van Rhenen, Groothoff, van der Klink & Bültmann 2014). However, this is not the case with white-collar female employees. Previously, Mehta, Kassam, Leese, Butler, and Thornicroft (2009) and Gaebel, Za'ske, and Baumann (2006) also discovered this gender difference in the relationship between fatigue and sickness absence, which may be clarified by occupational gender separation. A fatigue measurement with the 20-items correctly foretold upcoming mental sickness absence and further distinguished white-collar males with mental sickness absence from white-collar males without mental sickness absence. This is a significant finding as the Checklist Individual Strength (CIS) can be used for screening white-collar employees for risk of mental sickness absence, and employees with a CIS score above 76 could be trained in precautionary occupational health and safety discussions and interventions (Roelen et al., 2014).

Ricci (2007) states that white-collar employees experience fatigue more than blue-collar employees; female employees experience fatigue more than male employees, and the occurrence of fatigue is higher in Caucasian employees than in African American employees. However, a study comparing management, white-collar and blue-collar employees (evaluating among other things gender, age and prolonged fatigue) uncovers that management is less prone to psychological distress and prolonged fatigue compared to white-collar and blue-collar employees (Andrea et al., 2003).

Mine employees report high occurrences of substance use. Two reasons given by employees for this is traditions (including contacting ancestors, social interactions and cultural ceremonies) and mining culture. This desire to use substances is aggravated by stress, dangerous working conditions, and living conditions in the mining hostels (Barnabas, 2015).

Janes and Ames (1989) conducted a study of male blue-collar factory employees in the United States and found that the employees most expected to drink heavily, and experience difficulties with alcohol, are those whose social networks consisted mostly of work associations. Walker and Bridgman (2013) state that differences in alcohol consumption are connected to the position of an employee in the organisational structure, as well as working conditions. With regards to occupational level managers, blue- and white- collar employees, farmers, and fishers appear to have more alcohol-related difficulties than other employees (Marchand and Blanc, 2011).

Cunradi, Lipton and Banerjee (2007) and Dong (2005) have attributed poor working conditions, together with long working hours and stress, with smoking and illicit drug use in blue-collar employees. These poor working conditions may prolong the use of substances among blue-collar employees. Noonan and Duffy (2013) conducted a study on factors associated with smokeless tobacco use and dual use illicit drugs among blue-collar employees and suggested that further research should be conducted as they could not determine why blue-collar employees, who solely use smokeless tobacco, would be less probable to use cannabis. It is thought that it might be connected to cultural norms and peer norms amongst blue-collar employees that do not endorse the use of cannabis (Agrawal & Lynskey, 2009).

Bacharach et al. (2002) used a sample of blue-collar employees and tested an integrative model of employee drinking behaviour. They found that professed tolerant drinking norms both facilitate and moderate the influence of stress and policy implementation changes on problem drinking, but the mediational effects may have higher descriptive possibilities.

Since many high functioning alcoholics have prospered and over-achieved in every part of their life, many are not seen by society as being an alcoholic. White-collar employees, blue-collar employees, students, and stay-at-home mothers are all occupations associated with high functioning alcoholics. These individuals avoid suspicion regarding their alcoholism, by successfully hiding their addiction from family, friends, and fellow employees (Benton, 2011).

When focusing on alcohol use in the workplace and comparing the literature between white-collar and blue-collar employees, it is clear that white-collar employees have received

moderately little consideration. This can likely be attributed to the vast set of survey findings indicating that white-collar employees are less at risk of being reliant on alcohol and having alcohol-related problems compared to blue-collar employees (Walker & Bridgman, 2013).

Walker and Bridgman (2013) found that a feeling of powerlessness could predict heavy drinking and difficulties with drinking, and propose that white-collar employees are no more resistant to heavy alcohol use than blue-collar employees. Researchers have found that white-collar employees who drink at home regarded alcohol as a reward for routine responsibilities such as looking after their children and cooking dinner for the family. A participant in a study by Brierley-Jones, Ling, Smith and Crosland (2013) states that consumption of alcohol after the children have gone to bed makes her feel like an adult again. New research has revealed that despite the public perception that young people are the segment of society most influenced by alcohol, it is indeed white-collar employees who are most culpable of alcohol use. It is suggested, by Moisan, Bourbonnais, Brisson, Gaudet, Vezina, Vinet and Regoire (1999), that job demand could be a cause of psychotropic drug use amid white-collar employees. Their study focused on measuring the relationship between immediate subjection to high psychological pressure and low decision freedom in the workplace and the use of psychotropic drugs among white-collar employees.

Kingfisher (2009) from Corporate Absenteeism Management Solutions (CAMS) released statistics indicating that absenteeism in South Africa is highest amid production and factory employees. Kroon (2015) further confirms there are numerous causes for absenteeism by temporary blue-collar employees, especially AWOP (Absent WithOut Permission) and unpaid (authorised) absenteeism, and this is becoming an issue in the workplace in South Africa. Some important causes identified for absenteeism in the South African context include alcohol use, organisational factors and personal factors.

Johnson (2007) states that typically, higher absence is positively connected with employees with lower income earners, who have fewer responsibilities and who are in highly repetitive, less fulfilling occupations. Thus, blue-collar employees have reliably higher absenteeism rates compared to white-collar employees who have a greater feeling of job satisfaction. Furthermore, it is predicted that a typical employee takes 3.75 sick leave days for every 250 working days, as sick leave ought to be at around 1.5 percent.

A study conducted in Austria in 2004 also found that the absenteeism rate differs between blue-collar employees and white-collar employees. Blue-collar employees are absent more due to illness compared to white-collar employees. Additionally, when blue-collar employees are ill, they are absent from work for up to 16 days compared to 9 days for white-collar employees. However, short-term absenteeism rates due to illness (less than three days) are higher among white-collar employees. Some factors are contributing to these differences between absenteeism rates of blue-collar, and white-collar employees can be attributed to, firstly, greater exposure to health and accident risks in blue-collar occupations, secondly the affiliation between health and income and lastly, the lack of motivation decreases with increasing occupational status (Vogt, 2008).

Metzner and Mann (1953) conducted a study focusing on the relationship between absenteeism and blue-collar and white-collar employees. White-collar males employed in low-skill level jobs and blue-collar males are found to have absenteeism rates inversely related to job satisfaction whereas this was not the case for white-collar females or white-collar males employed in higher level occupations. Taylor (1979) found that white-collar occupations indicate lower absenteeism rates than blue-collar occupations and skilled employees are less absent than semi-skilled employees within blue-collar occupations. Furthermore, Ault, Ekelund, Jackson, Saba and Saurman (1991) as well as Aaviksoo, Baburin, and Kiivet (2003) explain that blue-collar employees have higher absenteeism rates than white-collar employees.

When considering occupational factors, Valirad, Ghaffari, Abdi, Attarchi, Mircheraghi and Mohammadi (2015) discover, in a study focusing on sickness absence, the most important risk factors for absenteeism is shift work. This can be attributed to the fact that white-collar employees rarely come in contact with hazards found in the manufacturing sector and, therefore, are less absent from work. Frequent bending-twisting, heavy lifting and hard physical work are the main physical factors found to affect the incidence of absence due to illness.

Additional studies focusing on the relationship between physical factors and the increase in absence due to illness offer the following contributing factors: exposure to ergonomic factors such as heavy lifting and repetitive movements (d'Errico et al., 2012); severe back bending, over shoulder working and heavy lifting (Lund et al., 2009); as well as physical exposures, lifting and intense physical conditions (Alavinia, van den Berg, van Duivenbooden, Elders, & Burdorf , 2009). Furthermore, a significant relationship was found between physical exposures and sickness absence (Labriola, Lund & Burr, 2006; Aaviksoo et al., 2013).

RESEARCH DESIGN

Research approach

A quantitative cross-sectional survey design was used. This method was utilised to describe the information on the studied population (people or firm) collected at a single point in time (Babbie & Mouton, 2008; Hardy & Bryman, 2004). This design can be used to evaluate interrelationships among variables within a population (Shaughnessy & Zechmeister, 1997). It further explains that this design is also ideal to describe and predict functions associated with correlative research.

Participants

The total sample size consists of 386 employees of a mining company in South Africa and is comprised of the following type of employees: semi-skilled blue-collar (support worker, engineering assistant, security guard, change house cleaner); skilled blue-collar (multi-operators, senior engineering operation, storeman, training clerk); low-level white-collar (supervisors, artisans, training co-ordinator, HR officers); intermediate white-collar (HSE manager, planning manager, mine overseer, HR practitioner, senior geologist and SLC drill and blast engineer); and management (mine engineer, mine manager). The lowest level employees have a level of literacy adequate for a valid completion of the questionnaires.

Descriptive statistics of the sample are provided in Table 4. The majority of employees (27.2 percent) are between 30 and 39 years. More males (82.9 percent) than females (16.8 percent) participated in the study. A total of 3.6 percent of the participants are on an intermediate white-collar level. Low-level white-collar employees comprise 33.4 percent of the participants.

Table 4

Characteristics of participants

Item	Category	Frequency	Percentage
Age	19-29 (1)	129	33.4
	30-39 (2)	105	27.2
	40-49 (3)	75	19.4
	50+ (5)	58	15
	Missing Response	19	4.9
Gender	Male (1)	320	82.9
	Female (2)	65	16.8
	Missing Response	1	0.3
Classification of job	Semi-skilled blue collar (1)	157	40.7
	Skilled blue collar (2)	65	16.8
	Low-level white collar (3)	129	33.4
	Intermediate white collar (4)	14	3.6
	Management (5)	1	0.3
	Missing	8	2.1
Tenure	Less than 1 year (1)	75	19.4
	2 - 5 years (2)	101	26.2
	6 - 10 years (3)	76	19.7
	11 – 20 years (4)	37	9.6
	Longer than 21 years (5)	45	11.7
	Missing Responses	52	13.5

Measuring instruments

The *survey questionnaire* consists of Section A that includes the biographical information of the individuals, such as job title, gender, age, tenure, and job classification (Patterson band – blue- and white-collar employees).

Section B of the questionnaire includes the Fatigue Measurement Instrument (Ergomax, 2013); the Fatigue Measurement Instrument is specifically designed for the diamond mine in the Free State by Ergomax (2013) and is used in all mining operations. This section consists of 44 items that specifically focus on individual human factors, non-work factors, environmental conditions, work-related factors, work scheduling and planning, and night shift work. Typical questions in the Ergomax (2013) measuring tool for individual human factors include health conditions of an employee where the answers constitute a dichotomous “yes” or “no”. Non-Work factors include

average hours of sleep, travelling time and travelling distance. Environmental conditions involve exposure to noise, exposure to temperature and exposure to chemicals. Work-related factors deal with overtime, work pressure, and last leave cycle. Work schedule and planning pertaining to average weekly working hours, a number of breaks within a shift, and length of shift hours. Finally, night shift work involves number of night shifts worked in succession, a period of rest following night shift cycle, and breaks during night shift work. The Likert response scale is used, where the responses equate to a numerical value, i.e. average hours of sleep, for example, 1 = more than 8 hours, 2 = between 6 hours and 8 hrs, 3 = 6 hours or less.

Section C includes Substance Use Measurement (Surujlal & Keyser, 2014). The measurement used to determine employee substance use was developed by Surujlal, Nolen and Ubane (2012). This questionnaire was later validated and shortened by Surujlal and Keyser (2014) to align it with the industrial sector. The questionnaire consists of four sections. Section A consists of eight items that concentrate on substance use patterns, which result from the amount and regularity of alcohol consumption and substance use. Each item is rated on a Likert-type scale of one (every day) to five (once a year or less).

Section D measures absenteeism (Psycones, 2006). The behaviour of employees' absenteeism is measured by using the Psychological Contract Across Employment Situations (Psycones) questionnaire (2003). The behaviour questionnaire on absenteeism consists of four items. Typical questions on this questionnaire range from "*How often have you been absent form work due to your state of health over the last 12 months?*" to "*How often have you gone to work despite feeling that you really should have stayed away due to your state of health over the last 12 months?*"

Data analysis

The data were analysed using the Statistical Program for Social Sciences (SPSS) 24.0. The individual characteristics of the participants as well as the data about individual human factors, non-work factors, environmental conditions, work-related factors, work scheduling and planning, and night shift work, were summarised using descriptive statistics.

Pearson's correlations were utilised to analyse the relationship between employee fatigue and level of substance use, absenteeism and the demographical information of participants. A t-test was conducted to compare which group of employees, white- or blue-collar employees, have a

higher level of substance use and also to determine which group of employees have a higher level of human fatigue.

RESULTS

Descriptive statistics

Since this study takes into consideration the classification of the job, Table 5 illustrates individual characteristics, human fatigue, (Individual Human Factors, None Work Factors. Environment Conditions, Work-Related Factors, Work Scheduling and Planning and Night Shift Work) and substance use of participant by the respective classifications of job (semi-blue collar, skilled blue-collar, low level white and intermediate white-collar employees). These human fatigue factors are categories and defined as in the Code of Good Practice: Government Gazette of Mine Health and Safety Act 1996 No. R 1025.

Table 5

Individual characteristics of job category, human fatigue, and substance use variables of all participants

Variable	Semi-skilled blue-collar	Skilled blue-collar	Low-level white-collar	Intermediate white-collar
INDIVIDUAL HUMAN FACTORS				
Alcohol and substance use - YES				
Alcohol	61.8	46.2	61.2	71.4
Smoking	26.8	24.6	34.1	35.7
Other substances	-	-	0.8	-
All of the above	2.5	-	-	-
None of the above	26.8	41.5	32.6	21.4
Health conditions: Good				
Yes	82.8	69.2	82.2	78.6
No	17.2	30.8	17.8	21.4
NON-WORK FACTORS				
Average hours of sleep				
More than 8 hours	23.3	17.5	8.5	
Between 6 to 8 hours	56.0	61.9	57.4	61.5
6 hours or less	20.7	20.6	34.1	38.5
Sleep conditions				
Good	82.1	77.8	85.0	84.6
Bad	17.9	22.2	15.0	15.4
Extended Traveling Time				
Less than 30 minutes	73.1	83.9	71.3	92.3
One hour	21.4	6.5	14.8	-
Two hours	1.4	1.6	4.1	
More than 2 hours	4.1	8.1	9.8	7.7
Traveling time				
Less than 30 minutes	85.8	98.4	83.5	92.3
One hour	10.8	1.6	13.4	
Two hours	0.7		1.6	
More than 2 hours	2.7		1.6	7.7
Weekend activities				
Highly active (Second work)	15.6	28.3	9.6	8.3
Active (gym, sport)	45.4	30.0	36.0	33.3
Not active (Watching tv)	39.0	41.7	54.4	58.3
Nutrition				

One or less meal per day	14.1	25.0	19.8	15.4
Two meals per day	41.5	28.3	31.4	46.2
Three meal per day	44.4	46.7	48.8	38.5
ENVIRONMENTAL CONDITIONS				
Exposure to noise				
Low	24.0	28.1	16.4	23.1
Medium	32.5	42.2	32.0	53.8
High	43.5	29.7	51.6	23.1
Exposure to dust				
Low	25.5	21.9	13.3	46.2
Medium	29.4	40.6	25.9	30.8
High	45.1	37.5	50.8	23.1
Exposure to vibration				
Low	39.3	39.3	39.8	84.6
Medium	36.0	37.7	39.1	7.7
High	24.7	23.0	21.1	7.7
Exposure to temperature				
Cold	10.9	10.2	1.8	
Medium	55.1	62.7	66.4	90.9
Hot	33.3	27.1	31.9	9.1
Exposure to heavy lifting				
No exposure	23.2	40.0	22.4	46.2
Minimal exposure	59.6	50.0	56.0	53.8
Periodical exposure	17.2	10.0	21.6	
Exposure to hazardous materials				
No exposure	12.5	32.3	29.0	61.5
Minimal exposure	50.0	56.5	53.2	30.8
Periodical exposure	37.5	11.3	17.7	7.7
Awkward body posture				
No exposure	39.1	42.4	25.2	38.5
Minimal exposure	49.7	49.2	55.9	53.8
Periodical exposure	11.3	8.5	18.9	7.7
Restricted ceiling height				
No exposure	74.7	72.2	62.6	100.0
Minimal exposure	24.0	27.8	30.1	
Periodical exposure	1.4		7.3	
Walking travelling distance from car to workplace				
Less than 1 kilometre	44.4	47.6	45.7	69.2
Between 1 to 2 kilometres	30.1	28.6	43.3	15.4
More than 2 kilometres	25.5	23.8	11.0	15.4
WORK-RELATED FACTORS				
Repetitive work				
High repetitive work	25.9	41.0	35.0	23.1
Varying work demand	72.8	59.0	65.0	76.9
Physical work				
Physical demanding	33.1	18.5	18.0	
Time pressure due to heavy workload	22.3	25.9	28.0	18.2
Is work fast paced	8.6	7.4	9.0	27.3
Is work intensive	5.0	5.6	6.0	
Vary work pace & task as desired	30.9	42.6	38.0	54.5
Mental work				
Less than 30 percent physical demanding	26.7	20.3	8.1	7.7
30-60 percent physical demanding	57.5	62.5	49.2	53.8
More than 60 percent physical demanding	15.1	17.2	42.7	38.5
Overtime				
Not at all				
Less than 10 hours per week				
More than 10 hours per week				
Last leave cycle				
Less than 12 months	33.8	36.4	27.5	53.8
Between 12- 18 months	45.9	54.5	57.8	46.5
More than 18 months	19.5	9.1	14.7	
Ergonomics risk assessment				
Yes	70.1	64.1	80.6	100.0
No	29,3	35.9	19.4	
Safety-critical task				
Yes	24.3	25.4	22.0	15.4
No	75.7	74.5	78.0	84.6
Work pressure				
Yes	80.6	72.4	77.8	53.8
No	19.4	27.6	22.2	46.2

WORK SCHEDULE AND PLANNING				
Average weekly working hours				
45 hours	56.1	50.8	25.8	15.4
Between 45-60 hours	39.2	41.3	59.7	61.5
60 hours and more	4.7	7.9	14.5	23.1
Length of shift hours				
	79.5	90.3	68.3	50.0
	15.9	6.5	25.2	25.0
More than 12 hours	1.3		5.7	25.0
Scheduling of work hours				
Regular hours	85.0	91.8	83.7	69.2
Irregular hours	13.6	8.2	16.3	30.8
Direction of shift				
FWD – Rotating (Off/D/N)	26.4	27.9	16.2	
BKW – Rotating (Off/N/D)	18.4	14.8	13.7	
N/A	55.2	57.4	70.1	100.0
Shift type				
Day shift	91.1	90.8	95.3	92.9
Afternoon shift	24.2	26.2	10.1	-
Night shift	93.9	100.0	100.0	-
Shift starting time				
Between 6:00-7:00 AM	95.2	92.5	100.0	100.0
Between 13:00-14:00 PM	2.9	5.0		
Between 19:00-20:00 PM	1.9	2.5		
Number of breaks within shift				
Less than 1 hour	82.7	71.9	61.9	23.1
More than 1 hour	5.3	9.4	9.5	-
N/A	11.3	17.2	21.4	61.5
Smoke breaks only	0.7	1.6	6.3	15.4
Number of shifts per week				
4 shift	2.9	3.7	1.8	
5 shift	96.4	94.4	96.4	100.0
N/A	0.7	1.9	0.18	
NIGHT SHIFT WORK				
Night shift				
Yes				
No				
N/A				
Length of Nightshift				
More than 12 hours				
N/A				
Number of night shifts work in succession				
More than 9 hours up to 6 shifts				
9 hours up to 6 shifts				
More than 12 hours up to 4 shifts				
N/A				
Period of rest following night shift cycle				
More than 48 hours				
48 hours				
Less than 48 hours				
N/A				
Breaks during night work				
N/A				
Regular hours				
Irregular hours				
No breaks				

Pearson's correlations were utilised to analyse the relationship between employee fatigue (Individual Human Factors, None Work Factors. Environment Conditions, Work-Related Factors, Work Scheduling and Planning and Night Shift Work), level of substance use, absenteeism and the demographical information of employees.

In Table 6, the Pearson correlation is shown between individual human factors, level of substance use, absenteeism, and the demographical information of employees.

Table 6

Pearson correlations between individual human factors, level of substance use, absenteeism, and the demographical information of employees

		1	2	3	4	5	6	7	8	9	10	11	12	13
1.	Classification of Job	1												
2.	Gender	0.07	1											
3.	Age	0.21**	-0.03	1										
4.	Tenure	0.27**	-0.18**	0.62**	1									
5.	Weight	0.31**	-0.20**	0.27**	0.14*	1								
6.	Height	0.03	-0.03	-0.09	-0.11	0.10	1							
7.	Alcohol	0.05	0.13*	0.12*	0.07	-0.07	-0.06	1						
8.	Smoking substances	-0.05	0.15**	0.02	0.02	0.02	0.05	0.25**	1					
9.	Other Substances	-0.04	0.02	-0.09	0.03	-0.08	0.01	0.04	-0.03	1				
10.	Different Substance	0.10	-0.02	0.09	0.07	-0.02	.-c	-0.12*	-0.07	-0.01	1			
11.	No use of substances	-0.10	-0.15**	-0.11*	-0.11*	0.04	0.05	-0.81**	-0.44**	-0.04	-0.07	1		
12.	Drink pattern	0.14	0.10	0.28**	0.25**	0.08	-0.00	0.44**	0.19*	0.13	.c	-0.45**	1	
13.	Smoking tobacco	0.11	0.04	0.01	0.08	0.18*	0.13	0.22**	0.79**	-0.11	0.03	-0.49**	0.30**	1
14.	Absenteeism	-0.10	-0.01	-0.01	-0.02	-0.03	-0.09	-0.09	-0.15**	-0.03	-0.02	0.08	-0.13	-0.19*

* Statistically significant $p \leq 0.01$
† Correlation is practically significant $r > 0.30$ (medium effect)
†† Correlation is practically significant $r \geq 0.50$ (large effect)

A statically positive relationship exists between job classification (skilled/semi-skilled) and age and tenure, but a practically significant relationship exists between the classification of job and weight of an employee. A negative statistically significant relationship exists between gender, tenure, weight, alcohol use and smoking substances of an employee and a negative relationship with no substance use. A positive high practically significant relationship exists between age and tenure of an employee. A positive statistical relationship exists between age, alcohol use, no use of substances and levels of substance use of employees. These findings are supported by The Substance Abuse and Mental Health Services Administration (2016) in the US, stating that a rate of 17.5 percent of full-time employees aged 18 – 64 reports heavy alcohol use in the past month within the mining industry, compared to 16.5 percent for the construction industry.

A positive relationship exists between tenure, weights of an employee and levels of substance use and a negative statistically relationship exists with no use of the substance. A positive statistically significant relationship exists between alcohol use, smoking, substances and smoking tobacco is observable and a positive, practically significant relationship with medium levels of substance use, while a large negative effect exists with no use of substances. A negative, statistically significant relationship exists between smoking substances and

absenteeism, but a high positive practical significant relationship exists between smoking substances, no use of substances, and a negative, practical relationship with a medium effect exists between alcohol use and levels of substance use of an employee. A negative, practical significance exists between no use of substances, levels of substance use and smoking tobacco. A negative practical relationship exists between smoking tobacco and absenteeism.

The Pearson correlation between non-work factors, level of substance use, absenteeism and the demographical information of employees is offered in Table 7.

Table 7

Pearson correlation between non-work factors, level of substance use, absenteeism and the demographical information of employees

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Classification of Job	1																
2. Gender	0.07	1															
3. Age	0.21**	-0.03	1														
4. Tenure	0.27**	-0.18**	0.62**	1													
5. Weight	0.31**	-0.20**	0.27**	0.14*	1												
6. Height	0.03	-0.03	-0.09	-0.11	0.10	1											
7. Good	-0.00	0.04	0.14**	0.12*	0.09	-0.04	1										
8. Chronic Diseases	-0.08	0.04	-0.33**	-0.29**	-0.17**	0.03	-0.32**	1									
9. Medication	-0.12*	0.00	-0.23**	-0.18**	-0.03	0.03	-0.22**	0.33**	1								
10. Sleep Disorder	-0.10	-0.06	-0.06	-0.09	-0.08	0.03	-0.19**	0.04	0.05	1							
11. Diabetes	-0.00	0.05	-0.23**	-0.13*	-0.14*	0.02	-0.23**	0.36**	0.09	-0.06	1						
12. Psychological Issues	0.02	-0.09	0.00	0-.02	0.02	0.01	-0.03	0.08	0.16**	0.23**	-0.03	1					
13. Pregnancy	0.04	-0.20**	0.08	0.07	-0.01	.c	-0.03	-0.03	-0.03	-0.03	-0.02	-0.01	1				
14. Financial Stress	0.03	0.06	0.06	0.00	0.04	0.04	-0.13**	0.05	0.03	0.15**	-0.04	0.24**	-0.05	1			
15. Hypertension	-0.06	0.01	-0.33**	-0.22**	-0.13*	0.03	-0.28**	0.30**	0.24**	0.05	0.17**	0.02	-0.03	-0.03	1		
16. Drink pattern	0.14	0.10	0.28**	0.25**	0.08	-0.00	-0.01	-0.20**	0.01	-0.11	-0.11	0.02	.c	0.05	-0.10	1	
17. Smoking tobacco	0.11	0.04	0.01	0.08	0.18*	0.13	0.05	-0.04	0.12	-0.08	0.05	0.11	-0.02	0.18*	-0.01	0.29**	1
18. Absent	-0.10	-0.01	-0.10	-0.02	-0.03	-0.09	0.17**	-0.01	-0.07	-0.14**	-0.00	-0.14**	-0.00	-0.19**	-0.02	-0.13	-0.19*

A positive, statistically significant relationship exists between job classification (Blue/White Collar employees), age and tenure and a practically significant relationship with the weight of an employee and negative relationship with medication of an employee. A positive, statistically significant relationship exists between gender and weight of an employee, but a negative relationship with regards to weight. A relationship exists between age, tenure (positive practically high), weight (statistically positive), chronic diseases (negative medium practically), medication (statistically negative), diabetes (statistically negative), hypertension (practically negative) and levels of substance use (statistically positive). A relationship exists between tenure, weight (statistically positive), good health (statistically positive), chronic diseases

(statistically negative), medication (statistically negative), diabetes (statistically negative), hypertension (statistically negative) and drinking patterns (statistically positive). A relationship exists between good medical condition, chronic diseases (statistically negative), diabetes (statistically negative), hypertension (statistically negative) and smoking tobacco (statistically positive). A practical, positive relationship exists between chronic diseases, medication, diabetes and hypertension and a negative relationship exists between chronic diseases and levels of substance use. A statistically positive relationship exists between diabetes, psychological issues and hypertension of an employee. A statistically positive relationship exists between sleep disorder, financial distress and a negative relationship exists between sleep disorder and absenteeism. A study by Hui and Grandner (2015) found that employees' work-troubled sleeping negatively impacted attendance, work performance and healthcare costs. A statistical relationship exists between diabetes and hypertension of an employee. A statistical relationship exists between psychological issues, financial stress (positive) and absenteeism (negative).

Table 8 displays the Pearson correlation between environmental conditions, level of substance use, absenteeism and the demographical information of employees.

Table 8

Pearson correlation between environment factors, level of substance use, absenteeism, and the demographical information of employees

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Classification of Job	1																
2. Gender	0.07	1															
3. Age	0.21**	-0.03	1														
4. Tenure	0.27**	-0.18**	0.62**	1													
5. Weight	0.31**	-0.20**	0.27**	0.14*	1												
6. Height	0.03	-0.03	-0.09	-0.11	0.10	1											
7. Exposure to Noise	0.06	-0.24**	-0.08	0.11	-0.05	-0.13	1										
8. Exposure to Dust	0.04	-0.20**	-0.09	0.04	-0.07	-0.03	0.06**	1									
9. Exposure to Vibration	-0.11*	-0.08	-0.07	0.01	-0.13*	-0.07	0.58**	0.39**	1								
10. Exposure to Temperature	-0.06	-0.07	0.00	0.02	-0.06	-0.04	0.23**	0.15**	0.06	1							
11. Exposure to Heavy Lifting	-0.04	-0.28**	0.01	0.12*	0.02	-0.11	0.32**	0.31**	0.24**	0.12*	1						
12. Exposure to Hazardous Materials	-0.04	-0.21**	0.07	0.16**	-0.03	-0.10	0.28**	0.19**	0.29**	0.13*	0.45**	1					
13. Awkward Body Posture	0.05	-0.21**	-0.00	0.13*	0.10	-0.09	0.33**	0.32**	0.29**	0.05	0.35**	0.38**	1				
14. Restricted Ceiling Height	0.08	-0.19**	-0.02	0.09	-0.05	-0.05	0.16**	0.15**	0.14*	0.11	0.29**	0.23**	0.40**	1			
15. Travelling Distance to Workplace	-0.03	-0.12*	-0.11*	-0.02	-0.07	0.03	0.21**	0.14**	0.16**	0.00	0.21**	0.17**	0.21**	0.07	1		

16.	Levels of substance use	0.14	0.10	0.28**	0.25**	0.08	-0.00	-0.06	-0.02	0.01	-0.06	0.06	-0.03	-0.03	-0.02	-0.05	1	
17.	Smoking tobacco	0.11	0.04	0.01	0.08	0.18*	0.13	0.00	-0.07	-0.04	-0.06	-0.11	-0.03	0.02	-0.03	0.02	0.29**	1
18.	Absent	-0.10	-0.00	-0.01	-0.02	-0.03	-0.09	0.17**	0.17**	0.21**	0.11	0.20**	0.08	0.18**	0.17**	0.05	-0.13	-0.19*

A negative statistically significant relationship exists between gender, exposure to noise, exposure to dust, exposure to heavy lifting, exposure to hazardous materials, awkward body posture, restricted ceiling height and travelling distance to the workplace. A positive relationship exists between tenure, exposure to heavy lifting, exposure to hazardous materials, awkward body posture and drinking pattern. A negative relationship between weight and exposure to vibrations is observable. A statistically significant relationship exists between exposure to noise, exposure to dust (statistically significant), exposure to vibration (practically significant), exposure to temperature (statistically significant), exposure to heavy lifting (statistically significant), exposure to hazardous materials (statistically significant), awkward body posture (practically significant), restricted ceiling height (statistically significant), travelling distance to workplace (statistically significant) and absenteeism (statistically significant).

A relationship exists between exposure to dust, exposure to vibration (practically significant), exposure to temperature (statistically significant), exposure to heavy lifting (practically significant), exposure to hazardous materials (statistically significant), awkward body posture (practically significant), restricted ceiling height (statistically significant), travelling distance to workplace (statistically significant) and absenteeism (statistically significant). A statistically positive relationship exists between exposure to temperature, exposure to heavy lifting, exposure to hazardous materials, awkward body posture, restricted ceiling height and absenteeism of employees. A significant statistical relationship exists between exposure to vibration and absenteeism of an employee. A positive statistically significant relationship exists between exposure to heavy lifting and absenteeism of an employee. Studies conducted by d'Errico et al. (2012), Lund et al. (2009), Alavinia et al. (2009), Labriola et al. (2006), and Aaviksoo et al. (2013) found a relationship between sickness absence, physical factors, such as heavy lifting, repetitive movements, awkward body posture, and intense physical conditions. A positive statistically significant relationship exists between awkward body posture and absenteeism of an employee. A positive statistically significant relationship exists between restricted ceiling height and absenteeism of an employee.

Table 9 displays the Pearson correlation between work-related factors, level of substance use, absenteeism and the demographical information of employees.

Table 9

Pearson correlation between work-related factors, level of substance use, absenteeism, and the demographical information of employees

Variable		1	2	3	4	5	6	7	8	9	10	12	13	14	15	16	17
1.	Classification of Job	1															
2.	Gender	0.07	1														
3.	Age	0.21**	-0.03	1													
4.	Tenure	0.27**	-0.18**	0.62**	1												
5.	Weight	0.31**	-0.20**	0.27**	0.14*	1											
6.	Height	0.03	-0.03	-0.09	-0.11	0.10	1										
7.	Repetitive work	-0.09	-0.03	-0.04	-0.09	0.10	0.06	1									
8.	Physical work	0.12*	0.02	-0.02	0.04	0.00	0.05	0.04	1								
9.	Overtime	0.21**	-0.18**	0.11*	0.18**	0.24**	-0.03	0.12*	0.07	1							
10.	Mental Work	-0.01	0.12*	0.03	0.06	-0.00	0.05	-0.01	0.39**	-0.04	1						
11.	Work Pressure	-0.08	0.19**	0.12*	-0.05	-0.11	-0.04	-0.01	0.01	-0.23**	0.09	1					
12.	Last Leave Cycle	0.12*	-0.09	-0.01	-0.00	0.05	-0.05	0.03	-0.05	0.11*	-0.03	-0.05	1				
13.	Ergonomics Risks Assessment	0.05	0.11*	-0.02	-0.01	-0.03	0.04	0.15**	0.11	0.04	0.14*	0.02	-0.07	1			
14.	Safety Critical Task	0.03	0.13*	-0.02	-0.04	-0.07	0.15	0.08	0.11	-0.05	0.08	0.03	-0.08	0.12*	1		
15.	Levels of substance use	0.14	0.10	0.30**	0.25**	0.08	-0.00	-0.07	-0.01	0.08	0.14	0.15	0.00	-0.04	-0.09	1	
16.	Smoking tobacco	0.11	0.04	0.01	0.08	0.18*	0.13	-0.14	-0.11	-0.01	0.06	0.10	0.13	-0.08	-0.01	0.30**	1
17.	Absent	-0.10	-0.01	-0.02	-0.02	-0.03	-0.09	-0.02	-0.00	-0.02	-0.10	-0.15**	-0.03	-0.04	0.02	-0.13	-0.19*

A positive statistical significant exists between the classification of the job, physical work, overtime and last leave cycle. A negative statistically significant relationship exists between gender and overtime, but a statistically significant relationship exists between gender, mental work, ergonomics risks assessment and safety critical task. A positive relationship exists between age, overtime (statistically significant) and drink pattern (practically significant). A statistically positive relationship exists between tenure, overtime and levels of substance use. A practical medium effect relationship exists between physical work and mental work. Singh, Aghazadeh, and Ray (2002) found that a person's physical capabilities are affected by mental tasks. A negative statistical relationships exist between overtime and work pressure of an employee. A positive statistical relationship exists between mental work and ergonomics risks assessment of an employee.

Table 10 displays the Pearson correlation between work schedule planning, level of substance use, absenteeism and the demographical information of employees.

Table 10

Pearson correlation between work schedule planning, level of substance use, absenteeism, and the demographical information of employees

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Classification of Job	1																
2. Gender	0.07	1															
3. Age	0.21**	-0.03	1														
4. Tenure	0.27**	-0.18**	0.62**	1													
5. Weight	0.31**	-0.20**	0.27**	0.14*	1												
6. Height	0.03	-0.03	-0.09	-0.11	0.10	1											
7. Average weekly working hours	0.22**	-0.17**	-0.05	0.07	0.14*	0.02	1										
8. Length of Shift Hours	0.05	-0.11*	-0.14**	0.02	-0.04	-0.04	0.42**	1									
9. Scheduling of work hours	0.00	-0.07	-0.09	-0.04	0.01	-0.04	0.19**	0.30**	1								
10. Direction of Shift	0.20**	0.11*	0.14*	0.03	0.07	0.05	-0.13*	-0.25**	-0.19**	1							
11. Shift Type: Day	0.12	-0.13	0.11	0.11	.[b]	.[b]	-0.03	-0.01	0.07	-0.28*	1						
12. Shift Type: Afternoon	0.14	-0.06	0.18	0.21*	0.02	.[b]	0.01	0.04	-0.32**	0.14	0.00**	1					
13. Shift Type: Night	-0.10	0.03	-0.05	-0.01	0.02	-0.01	-0.03	0.04	0.12	-0.22**	-0.45	-0.15	1				
14. Shift Starting Time	0.21**	0.04	0.14**	0.02	0.11	0.10	0.16**	0.15**	0.04	0.10	-0.02	0.00	0.01	1			
15. Breaks within Shift	0.01	0.14*	0.01	-0.07	0.04	-0.00	0.02	-0.02	0.04	0.05	-0.43**	-0.24*	0.13*	0.00	1		
16. Levels of substance use	0.14	0.10	0.28**	0.25**	0.08	-0.00	-0.15	-0.18*	0.02	0.15	-0.08	0.10	-0.12	0.09	-0.02	1	
17. Smoking tobacco	0.11	0.04	0.01	0.08	0.18*	0.13	-0.07	0.01	0.16*	0.09	0.14	0.12	-0.09	-0.01	-0.13	0.29**	1
18. Absent	-0.10	-0.01	-0.09	-0.02	-0.03	-0.09	0.08	0.03	0.12*	-0.15**	0.12	0.03	-0.06	-0.12*	0.02	-0.13	-0.19*

As seen from Table 10, a statistically positive relationship exists between classification a job, average weekly working hours, the direction of shift and shift starting time. A negative, statistically significant relationship exists between gender and length of shift hours, but a positive relationship exists with the direction of shift and breaks within shifts. A negative relationship exists between the age of an employee and length of shift hours, but a positive relationship exists with the direction of shift, shift starting time and levels of substance use of an employee. A positive statistical relationship exists between tenure, afternoon shift type and levels of substance use of an employee. A negative statistical relationship exists between average weekly working hours and direction of shift, but a positive statistical relationship exists with shift starting time. A negative relationship exists between the scheduling of work hours, direction of shift (statistically significant) and afternoon shifts (practically significant). A negative, statistical relationship exists between the scheduling of work hours, direction of shift and afternoon shift, but a definite relationship exists between the scheduling of work hours, smoking tobacco and absenteeism. A negative, statistically significant relationship exists between the

direction of shift, night shift and absenteeism of an employee. A practical significant negative relationship exists between day shift and breaks within the shift. A study by Frick, Simmons, and Stein (2015) found that employee absenteeism rates are meaningfully higher during afternoon shift compared to morning or night shifts. Furthermore, the afternoon shift, immediately following three-week consecutive night shifts, indicate particularly high absenteeism rates. A negative relationship exists between day shift and breaks within the shift. A positive relationship exists between afternoon shift and breaks within the shift.

Table 11 presents the Pearson correlation between night shift work as fatigue factor, level of substance use, absenteeism and the demographical information of employees.

Table 7

Pearson correlation between night shift work, level of substance use, absenteeism, and the demographical information of employees

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Classification of Job	1												
2. Gender	0.07	1											
3. Age	0.21**	-0.03	1										
4. Tenure	0.27**	-0.18**	0.62**	1									
5. Weight	0.31**	-0.20**	0.27**	0.14*	1								
6. Height	0.03	-0.03	-0.09	-0.11	0.10	1							
7. Night shift	0.07	0.12*	0.01	-0.13*	0.08	0.04	1						
8. Length of night shift	0.12*	0.07	0.04	-0.10	0.12	0.05	0.71**	1					
9. Number of night shift	0.13*	0.04	0.02	-0.10	0.10	0.04	0.62**	0.76**	1				
10. Period of rest following night shift schedule	0.15**	0.09	0.08	-0.10	0.16*	0.04	0.60**	0.71**	0.73**	1			
11. Breaks during night work	-0.15**	-0.06	-0.06	0.06	-0.10	-0.05	-0.72**	-0.68**	-0.57**	-0.65**	1		
12. Levels of substance use	0.14	0.10	0.28**	0.25**	0.08	-0.00	0.01	0.00	0.08	0.09	-0.04	1	
13. Smoking tobacco	0.11	0.04	0.01	0.08	0.18*	0.13	-0.00	0.02	-0.08	-0.05	-0.02	0.29**	1
14. Absent	-0.10	-0.01	-0.01	-0.02	-0.03	-0.09	-0.11*	-0.12*	-0.09	-0.22**	0.13*	-0.13	-0.19*

A positive statistical relationship exists between the classification of the job, the length of the night shift, the number of night shifts and period of rest following night shift schedule, but a negative relationship exists between the classification of job and breaks during night work. A statistical relationship exists between tenure and night shift (negatively) and levels of substance use (positively). A large practical effect exists between the number of night shifts and period of rest following night shift schedule, but a negative relationship exists between the number of night shift breaks. A negative relationship exists between the period of rest following night shift

schedule and absenteeism of an employee. A relationship exists between breaks during night work and absenteeism. Studies have indicated that improved work performance can be associated with napping during night shifts (Smith-Coggins, Howard, and Mac, Wang, Kwan, Rosekind, Sowb, Balise, Levis and Gaba, 2006); better synchronization of circadian rhythms, being able to function as anchor sleep (Minors & Waterhouse, 1981; Daurat & Foret, 2004); and higher tolerance for night shift work (Borges, Fischer, Rotenberg, Soares, Fonseca, Smolensky, & Moreno, 2009).

Next, MANOVA was performed to determine whether or not white- or blue-collar employees have a higher level of substance use.

Table 82 MANOVA - Differences of levels of substance use (frequency and quantity of consumption) among classification of job

Variable	*Wilks' Lambda*	*F*	*df*	*p*	η^2
Classification of job	0.09	1.84	8.0	0.07	0.06

$\eta^2 > 0.25$ = large effect
* Statistically significant difference: $p < 0.05$

As seen from Table 12, no significant difference was found between white- or blue-collar employees' level of substance use. These findings are not supported by the findings of Lindberg et al. (2001) who state that blue-collar employees smoke more and are more dependent on alcohol when compared to white-collar employees. Walker and Bridgman (2013) further state that differences in alcohol consumption are connected to the position of an employee in the organisational structure, as well as working conditions. With regards to occupational level managers, blue- and white- collar employees, farmers, and fishers appear to have more alcohol-related difficulties than other employees (Marchand and Blanc, 2011).

DISCUSSION AND CONCLUSION

The objective of this study was to investigate the relationship, or lack thereof, between fatigue and substance use, as well as if a relationship between fatigue, absenteeism and demographical information of employees exists. From the aetiology of fatigue, it is clear that concept is multidimensional and exists outside and inside the workplace (Tang et al., 2016). In this study, the researcher used the factors of fatigue according to the division of the Code of Good Practice within the Government Gazette of Mine Health and Safety Act 1996 No. R 1025. The code divided fatigue into six different factors: individual human factors, non-work factors,

environment conditions, work-related factors, work scheduling and planning and night shift work that influence employee fatigue. Furthermore, it is clear from existing literature that national level reports are available on employee fatigue as required by the Code of Good Practice, but these reports do not focus on the relationship between the employee fatigue and levels of substance use.

The results indicated that with regards to individual human factors, a positive statistical relationship exists between age, alcohol use, no use of substances and levels of substance use of employees. Such a notion, as previously mentioned, is supported by the Substance Abuse and Mental Health Services Administration (2016) reporting that the mining industry employees engage more in alcohol use as compared to the construction industry. Pearson correlation between non-work factors, level of substance use, absenteeism and the demographical information of employees indicated that a statistically positive relationship exists between sleep disorders, financial distress; and a negative relationship exists between sleep disorders and absenteeism. Hui and Gradner's (2015) findings support this relationship as they state that employees who had trouble sleeping display poorer attendance, work performance and have higher healthcare costs.

Results indicate that, with regards to the Pearson correlation value, between environment factors, level of substance use, absenteeism and the demographical information of employees, a significant statistical relationship exists between exposure to vibration and absenteeism of an employee. A positive, statistically significant relationship exists between exposure to heavy lifting and absenteeism of an employee. These findings are supported by d'Errico et al. (2012); Lund et al. (2009); Alavinia et al. (2009); Labriola et al. (2006); and Aaviksoo et al. (2013) who found that a relationship between and sickness absence and physical factors, such as heavy lifting, repetitive movements, awkward body posture, and intense physical conditions exist. Work-related factors, level of substance use, absenteeism and the demographical information of employees' results, indicate that a statistically positive relationship exists between tenure, overtime and levels of substance use. A practical medium effect relationship exists between physical work and mental work. These findings are supported by Singh et al. (2002) who explain that a person's physical capabilities are affected by mental tasks. The Pearson correlation between work schedule planning, level of substance use, absenteeism and the demographical information of employees shows a practical, significant negative relationship between day shift and breaks within the shift. These findings are supported by Frick et al. (2015) who offer that

employee absenteeism rates are meaningfully higher during afternoon shift compared to morning or night shifts. Furthermore, the afternoon shift, immediately following three-week consecutive night shifts, indicated unusual high absenteeism rates. Lastly, a relationship exists between breaks during night work and absenteeism. These findings are supported by Smith-Coggins et al. (2006), Minors and Waterhouse (1981), Daurat and Foret (2004) and Borges, et al. (2009) who found that improved work performance can be associated with napping during night shifts, better synchronization of circadian rhythms, being able to function as anchor sleep and higher tolerance for night shift work.

The results indicated that no significant difference was found between white- or blue-collar employees' level of substance use. These findings are not supported by Walker and Bridgman (2013) who state that differences in alcohol consumption are connected to the position of an employee in the organisational structure, as well as working conditions. As mentioned above, Marchand and Blanc (2011) found with regards to occupational level managers, blue- and white-collar employees, farmers, and fishers appear to have more alcohol-related difficulties than other employees.

Further research needs to be conducted on the concept fatigue in South Africa within other industries as this concept of fatigue is unique to the South African business environment and needs to be explored further. Cross-sectional designs are a problem when causal relationship between constructs want to be proven. Longitudinal studies need to be performed to assess the long-term relationship between the constructs. In this study, self-reported questionnaires were utilised, and self-reported measurements have limitations. One of the limitations is that participants' motivations to answer the questionnaire could impact the findings of the study.

Studies conducted by Walker and Bridgman, (2013) that heavy drinking and difficulties with drinking could be predicted by a feeling of powerlessness, proposed that white-collar employees are no more resistant to heavy alcohol use than blue-collar employees. White-collar employees are endangering their health by using alcohol as a form of stress relief and/or reward.

Lastly, based on the literature and data collected, the study found that neither white- or blue-collar employees have a higher level of human fatigue. Andrea et al. (2003) found that blue-collar workers ($B = 2.18$, $p < .001$) are at higher risk of continued fatigue in comparison to management. Whereas Ricci (2007) states that white-collar employees experience fatigue more than blue-collar employees; female employees experience fatigue more than male employees,

and the occurrence of fatigue is higher in Caucasian employees than in African American employees.

RECOMMENDATIONS

The impact of fatigue is seen not only in its effect on the outside and within the lives of employees in the mining industry. As seen from investigations, fatigue can be fatal to employees such as in the case of Uranium'Ezulwini mine where a fatal accident took place after a rock fall, resulting in the death of one employee; and at Harmony Gold's Kusasalehu, an employee disappeared after a seismic event. Mr David Msiza, the chief inspector of mines in South Africa's Department of Mineral Resources at the time, found that inadequate living conditions, fatigue and poor nutrition were the causes of the fatalities (Matomela, 2011).

The South African mining industry has seen numerous high-profile accidents where fatigue had either a fundamental or contributing role (Schutte, 2010) and, therefore, it is important to encourage further research to allow for the management of fatigue from a more inclusive approach. It is recommended that employers develop and implement a fatigue risk management plan in consultation with employees that focuses on promoting a healthy work environment through annual measurements of employee fatigue; a fatigue management training program for employees, not just on an ad hoc basis but rather on an ongoing basis; information sharing sessions or pamphlets; and lastly, creating an employee assistance program that promotes the management of fatigue in the workplace by making employees more aware of consequences if they experience fatigue.

Lastly, it is strongly recommended that the Government Department of Mineral Resources (DMR) employ very strict penalties on mines that do not comply with the Code of Good Practice.

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CHAPTER 4

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

Conclusions from the literature and the empirical results presented in this study, in accordance with the general and specific objectives, will be discussed in this chapter. Additional consideration will be given to the limitations of the study and recommendations will be made to the Mine and academia with regards to further research.

4.1 Conclusions from Literature and Empirical Results

The first objective as discussed in Chapter 2 (article 1) was to investigate the current state of research on the phenomenon of employee fatigue in the mining industry in South Africa by analysing national and international research conducted in this field. A substantial literature review was conducted with regards to the first objective. This study comprised of a comprehensive overview of the concept of fatigue by analysing the historical and current points of view, in addition to the national and international research conducted in this field. Furthermore, this chapter focused on approaches and models of fatigue, in addition to the measurement of the concept, and relevant legislation in the mining industry.

This study found that although fatigue is not a relatively new phrase in research, the same cannot be said about employee fatigue. With regards to the various definitions as set in Chapter 2, there is one consistent theme, that fatigue is a result of prolonged mental and physical exertion. Using this as a reference point, the researcher defined employee fatigue as a state of prolonged mental and/or physical exertion caused by responsibilities being performed by an employee in a work environment.

Review of the literature has attempted to trace how conceptualisation of the concept fatigue has evolved over the years by focusing on the historical development of the concept and measurement thereof. Whitehead (2009) states that a vast quantity of instruments has been established to measure fatigue. Fatigue measurement instruments, as mention by Beurskens, Bültmann, Kant, Vercoulen, Bleijenberg, and Swaen (2000), can be separated into unidimensional instruments and multidimensional instruments. Smets, Garssen, Bonke, and De Haes (1995) state that using unidimensional instruments eliminates the opportunity for a more comprehensive explanation of fatigue as only one dimension of fatigue can be

introduced and significantly highlighted with the phrasing of a single question. These scales are relatively brief; and are repeatedly characterised by respectable levels of internal consistency and test-retest reliability (Percy, 2012). The dimension most frequently focused on is severity (Whitehead, 2009). Multidimensional scales offer a thorough qualitative and quantitative assessment of fatigue and offer adjustable psychometric data (Percy, 2012). They focus on collecting data on numerous dimensions, in other words, these scales allow for broader knowledge of fatigue, most frequently incorporating two to seven factors, thus not merely focusing on the intensity, but also include duration, daily pattern, and effect on daily activities. Other dimensions often included are the impact of fatigue on mental, behavioural, and social functioning. The more significant part of multidimensional measures use a Likert scale and are evaluative in the determination (Whitehead, 2009).

The South African legislation leaves a lot to be desired with regards to fatigue. Some progress has been made with the Department of Mineral Resources (DMR) issuing an instruction in the Government Gazette on the 19th of December, 2014. This publication gives South African mines guidelines for a mandatory code of practice for risk-based fatigue management (Code of Good Practice: Government Gazette of Mine Health and Safety Act 1996 No. R 1025).

In Chapter 3, the researcher addressed the last three specific objectives as mentioned in Chapter 1. Here, the focus was firstly, to determine whether or not a relationship between employee fatigue and level of substance use and absenteeism of employees exists. The researcher used Pearson correlations to determine the relationship between fatigue, level of substance use and the demographical information of employees. The researcher also utilised the classification of fatigue according to The Mine Ventilation Society of South Africa (2013) and the Ergomax group (2013) identifies several categories/factors of fatigue, which are consequently discussed.

The first category refers to individual human factors. “The terms human factors and ergonomics are used interchangeably by some, whereas others differentiate the two terms” (Handyside & Suresh, 2010, p. 123). The Ergomax group, (2013) identifies the following individual human factors as characteristics of work/employee fatigue: gender, alcohol use, health conditions and general factors such as age, tenure, body weight, and height. In this study, it was found that a positive statistical relationship exists between age, alcohol use, no use of substances and levels of substance use of employees. These findings are supported by

the Substance Abuse and Mental Health Services Administration (2016) in the US, where the results indicate that in the mining industry, a rate of 17.5 percent of full-time employees aged 18 to 64 reported past month heavy alcohol use compared to 16.5 percent for the construction industry.

The second category is concerned with non-work factors. Hajare and Dule (2012) state that non-work related fatigue is significant between individuals and is best managed at an individual level. Furthermore, Hossain, Reinish, Kayumov, Bhuiya, and Shapiro (2003) state that non-work related fatigue comprises of the influences of sleep disorders, medical and psychiatric illnesses. In this study, it was found that a statistically positive relationship exists between sleep disorders, financial distress; and a negative relationship exists between sleep disorders and absenteeism. These findings are supported by the results of Hui and Grandner (2015) who found that troubled sleeping negatively impacted attendance, work performance and healthcare costs of employees. As confirmed by Headway, (2016) an overstimulated sleeping environment causes fatigue. Thus, an individual should make sure their sleeping space is comfortable.

The third category is identified by the Ergomax group (2011) and identifies exposure to vibration, noise, dust, temperature, heavy lifting, and hazardous materials, as well as awkward body postures, restricted ceiling height and travelling distance to the workplace itself as characteristics of environmental conditions. In this study, it was found that a significant statistical relationship exists between exposure to vibration and absenteeism of an employee. A positive statistically significant relationship exists between exposure to heavy lifting and absenteeism of an employee. These findings are supported by the findings of d'Errico and Costa (2012) ; Lund, Christensen, Vaez, Labriola, Josephson, Villadsen and Voss (2009); Alavinia, van den Berg, van Duivenbooden, Elders, & Burdorf (2009); Labriola, Lund & Burr (2006); and Aaviksoo, Baburin, and Kiivet (2013) who state that a relationship between sickness absence and physical factors, such as heavy lifting, repetitive movements, awkward body posture, and intense physical conditions is apparent.

The fourth category identified by Ergomax (2011) is concerned with work-related factors. In this study, it was found that a statistically positive relationship exists between tenure, overtime and levels of substance use. A practical medium effect relationship exists between physical work and mental work. These findings are supported by the results of Singh, Aghazadeh, and Ray (2002) who explain that a persons' physical capabilities are affected by

mental tasks breakdowns. These findings are also not supported by the findings of Hajare and Dule (2012) that identifies the aspect of the task being undertaken, too many successive night shifts, unexpected work, overtime, emergencies, and call-outs, and the feature of the working environment (e.g. extreme temperature and noise) as causes of work-related fatigue. Hossain et al. (2003) confirm that work-related fatigue is the consequence of the accumulative outcome of prolonged and intense sleep deficiency and is interdependent with the arrangement of an individual's anticipated sleep-wake schedule and the productivity of the circadian pacesetter in the brain; insufficient sleep hygiene: and extended length of waking hours before start of shift. Shift employees are especially susceptible and at a heightened risk of the consequences of increased sleepiness, chronic fatigue and reduced alertness and performance. Asare, Schmitt and Bernhagen (2013) found that call outs and overtime are mostly to blame for irregular and unplanned schedules, which in turn, affect employee fatigue.

The fifth category that Ergomax (2011) identifies is work schedule and planning. In this study, it was found that a practical significant negative relationship exists between day shift and breaks within the shift. These findings are supported by the results of Frick, Simmons, and Stein (2015) who found that employee absenteeism rates are meaningfully higher during afternoon shift compared to morning or night shifts.

The relationship between fatigue and shift work has been investigated considerably and sleep deficiency, which may be anticipated in hot areas, have been indicated to cause cognitive and motor performance impairments among drivers from all industries (Donoghue, 2004). Ergomax (2011) indicates that average weekly working hours, the length of shift hours, scheduling of work hours, the direction of shift rotation, type of shift, starting times of shifts, the number of breaks within shifts, and the number of shifts per week are also characteristics that should not be ignored. Four types of breaks are identified by The Mine Ventilation Society of South Africa, (2013) include, firstly, spontaneous breaks, which are determined by the employee him or herself; secondly, disguised breaks, which are characterised by resting although the employee creates the impression that he or she is still busy with the task that was given to them; thirdly, breaks incorporated into the job i.e. natural breaks between tasks; and lastly, prescribed breaks, for example, a set lunch time or tea break. The outcome of these breaks produces prevention measures for fatigue, permitting the time for regeneration and social contact. A balance between higher production outputs and the quantity or working

hours can be accomplished for certain tasks, however, getting to the optimum point remains the challenge. These findings are supported by Frick, Simmons, and Stein (2015) that found that afternoon shift, immediately following three-week consecutive night shifts, indicated particularly high absenteeism rates. Lastly, a relationship exists between breaks during night work and absenteeism.

Furthermore, in Chapter 3, Article 2 it was found that a relationship exists between breaks during night work and absenteeism. These findings are supported by the findings of Smith-Coggins, Howard, Mac, Wang, Kwan, Rosekind, Sowb, Balise, Levis and Gaba (2006) who explain that improved work performance can be associated with napping during night shifts, better synchronization of circadian rhythms, being able to function as anchor sleep, (Minors & Waterhouse, 1981; Daurat & Foret, 2004) and higher tolerance for night shift work (Borges, Fischer, Rotenberg, Soares, Fonseca, Smolensky, & Moreno2009). The last category identified by Ergomax (2011) is night shift work. Here, Ergomax (2011) concentrate on the length of the night shift, a number of night shifts worked in succession, a period of rest following night shift cycle, and lastly, the breaks during night work as characteristics of fatigue when focusing on night shift work.

Theron and van Heerden (2011) state that shift work is one of the shared workplace issues that can lead to fatigue; sleeping during the night is one of the designs of the human body and the circadian clock, located in the brain, controls this part of the body, and the circadian rhythm harmonise with day and night. When the employee works at night, or when his/her body is supposed to be asleep, this circadian clock is confused.

In conclusion, the Mine Ventilation Society of South Africa (2013) states that the responsibility of fatigue and stressors, anthropometry, work physiology and disbursement of energy, posture, environmental conditions and stressors, load management, working hours and eating practises, the effects of night work and shift work, noise and vibration, as well as indoor climate are some of the important points that play a part in the understanding and application of ergonomics to the workplace.

The second objective within Chapter 3, Article 2 was to determine which group of employees, white- or blue-collar employees, have a higher level of substance use. In this study, it was found that no difference exists between white- or blue-collar employees' level of substance use. These findings are not supported by Walker and Bridgman (2013) who

mention that differences in alcohol consumption are linked to the position held by an employee within an organisational structure, as well as working conditions. With regards to occupational level managers, blue- and white- collar employees, farmers, and fishers seem to have more alcohol-related difficulties than other employees (Marchand and Blanc, 2011).

The last objective of article 2 was to determine which group of employees, white- or blue-collar employees, have a higher level of human fatigue. Andrea, Kant, Beurskens, Metsemakers, & Van Schayck, (2003) found that blue-collar workers ($B = 2.18$, $p < .001$) were at a higher risk of continued fatigue in comparison to management, whereas Ricci, Chee, Lorandeau, and Berger (2007) found that white-collar employees experience fatigue more than blue-collar employees; female employees experience fatigue more than male employees, and the occurrence of fatigue is higher in Caucasian employees than in African American employees. Therefore, more research is needed with regards to occupational level and human fatigue.

4.2 Limitations

The current study has certain limitations that are imperative to note. Firstly, limited information could be found with regards to fatigue in the South African Mining industry as only 532 000 search results were generated in contrasted with 1 784 611 search results for fatigue. Furthermore, Dall (2015) found that limited research exists, specific to the mining industry, regarding fatigue causes, which include shift work, long working hours, overexertion and disruption of sleep and mentally or physically demanding work and an environment where fatigue can flourish. Specifically, limited information could be found with regards to fatigue and environmental factors, and the aforementioned's impact on absenteeism. Secondly, this study did not investigate the impact of prescription drugs on fatigue, sick leave and absenteeism as it was not included in the questionnaire or study. Lastly, Ergomax (2013) structured the measurement in a yes/no categorisations of fatigue; this has not only limited the validity and reliability of the questionnaire, it further limited the statistical analyses of data.

4.3 Recommendations

Aside from the limitations stated above, the current study also has significant recommendations for both the organisation and further research.

4.3.1 Recommendations for the organisation.

The following recommendations can be made to the organisation. It is primarily important that the organisation develop and implement a fatigue risk management plan in consultation with employees. It is imperative that this plan, firstly, focuses on promoting a healthy work environment through annual employee fatigue measurements; secondly, develop and implement an employee fatigue management training program; thirdly, initiate information sharing sessions or pamphlets; and lastly, create an employee assistance program that promotes the management of fatigue in the workplace.

It is further recommended that a fatigue likelihood scale be used for the second round of measurements, as this will ensure validity and reliability of the questionnaire. The scales should be adopted and should replace current yes/no categorisations of fatigue. Improved identification of fatigue as a contributing factor will be supported by fatigue coding so that reports across jurisdictions are consistent and comparable.

A Likert scale is proposed to measure sick leave; this scale should be adopted as the validity and reliability of the questionnaire is proven.

4.3.2 Recommendations for future research.

Specific recommendations with regards to further research can be made. Firstly, the field of Industrial Relations can address the gap in the current literature relating to the topic of employee fatigue; this research will allow the much-needed information to reach the appropriate people. This research can lead to further studies in the field as other researchers and organisation can use the research outcomes to better equip themselves to deal with the same problems that might be costing them unnecessary losses in production, revenue, and skills. The impact of fatigue is seen not only in its effect on job performance, but also on the lives of employees in the mining industry. A fatal accident after a rock fall, at Uranium’Ezulwini mine, resulting in the death of one employee. At Harmony Gold's

Kusasalehu site, an employee disappeared after a seismic event. Both investigation reports indicated that inadequate living conditions, fatigue and poor nutrition were the causes for the fatalities (Matomela, 2011). The South African mining industry has seen several high profile accidents where fatigue played either a fundamental or contributing role (Schutte, 2010) and, therefore, it is important to encourage further research to allow for the management of fatigue from a more inclusive approach.

4.3.3 Recommendations for Government.

A strong recommendation is made that the Government Department of Mineral Resources (DMR) employ very strict penalties on mines that do not comply with the Code of Good Practice.

4.4 Chapter Summary

Conclusions concerning the theoretical and empirical objectives were drawn, and the research limitations were discussed. Furthermore, the researcher made recommendations to the mine in addition to academia, for further research.

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ANNEXURES

Annexure A – Ethical Clearance Certificate

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Ms Rochelle Fourie

[12663301]

11 August 2016

"Fatigue, substance use and sick leave of employees in a mining environment"

Dear Ms Fourie,

This letter serves to confirm that your research proposal has been accepted and approved by the **Optentia Research Committee**.

The ethics application is referred to the Humanities & Health Research Ethics Committee (HHREC).

Best Regards,

Prof. S. (Ian) Rothmann

Director: Optentia Research Focus Area

Annexure B - Guidelines for Mandatory Code of Practice for risk based fatigue management at mines

No. R. 1025 19 December 2014

MINE HEALTH AND SAFETY ACT, 1996 (ACT NO 29 OF 1996

GUIDELINE FOR A MANDATORY CODE OF PRACTICE FOR RISK-BASED FATIGUE MANAGEMENT AT MINES

I **DAVID MSIZA**, Chief Inspector of Mines, under section 49 (1) of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) and after consultation with the Council, hereby issue the guideline.

DAVID MSIZA

CHIEF INSPECTOR OF MINES

Reference Number:	DMR 16/3/2/4-B2
Last Revision Date:	28 July 2014
Date First Issued:	First Edition
Effective Date:	30 November 2014

DEPARTMENT OF MINERAL RESOURCES

MINE HEALTH AND SAFETY INSPECTORATE

GUIDELINE FOR THE COMPILATION OF A

MANDATORY CODE OF PRACTICE FOR

GUIDELINE FOR THE COMPILATION OF A MANDATORY CODE OF PRACTICE FOR RISK-BASED FATIGUE MANAGEMENT AT MINES

CHIEF INSPECTOR OF MINES

DATE

mineral resources
Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

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PART A: THE GUIDELINE

1. FOREWORD

1.1 **Fatigue** is more than simply feeling tired or drowsy. It is caused by prolonged periods of physical and/or mental exertion without enough time to rest and recover.
1.2 **Fatigue** is associated with multiple factors which among others include spending long periods of time awake and having an inadequate amount and/or quality of sleep over an extended period.
1.3 **Fatigue** can significantly affect an individual's capacity to function. Its side-effects include decreased performance and productivity, and increased potential for injuries to occur.
1.4 **Fatigue** management is a responsibility that must be shared between employer and employee – it involves factors that occur both in and outside of the workplace.

1.5 The aim of this Guideline is to provide a framework to assist the employer of every mine to prepare a risk-based Code of Practice (**COP**) on Fatigue Management.

2. LEGAL STATUS OF GUIDELINES AND CODES OF PRACTICE

In accordance with Section 9(2) of the **MHSA**, an employer must prepare and implement a **COP** on any matter affecting the health or safety of employees and other persons who may be directly affected by activities at the mines if the Chief Inspector of Mines requires it. These **COP**s must comply with any relevant guideline issued by the Chief Inspector of Mines (Section 9(3)). Failure by the employer to prepare or implement a **COP** in compliance with this guideline is a breach of the **MHSA**.

3. THE OBJECTIVES OF THE GUIDELINE

This guideline has been developed to assist employers in achieving the objectives of risk-based fatigue management at any working place, which are to assist mines to:

3.1 Develop strategies for controlling risks of **fatigue** effectively;
3.2 Develop site specific **fatigue** management plans and programmes; and
3.3 Look at factors to be considered when managing **fatigue**.

4. DEFINITIONS AND ACRONYMS (Arrange alphabetically)

"Bio-roster" means a biologically-compatible roster that takes into account the effects of circadian rhythms, sleep cycles and the additive effect of fatigue during the working week.

"Circadian rhythm" means the internal cycle of roughly 24 hours that regulates the physiological and behavioural activities of all living organisms – also referred to as "the body clock".

"COP" means Code of Practice;

"EAP" means Employee Assistance Programme;

"Fatigue" means reduced mental and physical functioning caused by sleep deprivation and/or being awake during normal sleep hours. This may result from extended work hours, insufficient opportunities for sleep, failure to use available sleep opportunities, or the effects of sleep disorders, medical conditions or pharmaceuticals which reduce sleep or increase sleepiness.

"FMC" means Fatigue Management Committee;

"FMP" means Fatigue Management Programme;

"MHSA" means Mine Health and Safety Act, 1996 (Act No. 29 of 1996), as amended;

"MHSC" means Mine Health and Safety Council;

"MQA" means Mining Qualifications Authority;

"Risk" means the likelihood that occupational injury or harm to persons will occur;

"SAQA" means South African Qualifications Authority;

"SETA" means a Sectoral Education and Training Authority established under the Skills Development Act No. 97 of 1998;

"Shift work" means an organisation of work where workers succeed each other at the same workplace while performing similar operations at different times of the day thus allowing longer hours of operation than feasible for a single worker;

"Supervisor" means any individual having authority, in the interest of the employer and is responsible for the day-to-day performance of a group of employees;

"Work schedule" means the hours to be worked for each day, shift, week, month or year, as scheduled by the employer.

5. SCOPE

This guideline:

5.1 Addresses areas of **fatigue** management as required at a mine;
5.2 Addresses areas of **fatigue** management from fatigue risk assessment to interventions that will be developed to mitigate the impact of **fatigue**; and
5.3 Covers all employees at a mine.

6. MEMBERS OF TASK COMMITTEE

This guideline was prepared by:

Members of the **Fatigue Task Team**, which comprised of:

Ms. N. Masekoa	(State)
Dr. D. Mokoboto	(State)
Dr. L. Ndelu	(State)
Ms. M.A Hlapane	(State)
Ms. D Lekoba	(State)
Mr. P. Mira	(Labour)
Dr. C. Mbekeni	(Employers)
Dr. C Badenhorst	(Employers)
Ms. M Kunene	(MHSC Office)

PART B: AUTHOR`S GUIDE

The **COP** must, where possible, follow the sequence laid out in **Part C "Format and Content of the mandatory COP"**. The pages as well as the chapters and sections must be numbered to facilitate cross-reference. Wording must be unambiguous and concise.

IT SHOULD BE INDICATED IN THE COP AND ON EACH ANNEX TO THE COP WHETHER:

(a) The annex forms part of the guideline and must be complied with or incorporated in the **COP** or whether aspects thereof must be complied with or incorporated in the **COP**, or

(b) The annex is merely attached as information for consideration in the preparation of the **COP** (i.e. compliance is discretionary).

When annexes are used the numbering should be preceded by the letter allocated to that particular annex and the numbering should start at one again. (e.g. 1, 2, 3, A1, A2, A3,).

Whenever possible illustrations, tables, graphs and the like, should be used to avoid long descriptions and/or explanations.

When reference has been made in the text to publications or reports, references to these sources must be included in the text as footnotes or side notes as well as in a separate bibliography.

PART C: FORMAT AND CONTENT OF THE MANDATORY CODE OF PRACTICE

1. TITLE PAGE

The title page must include the following:

1.1 Name of mine;

1.2 The heading: "**Mandatory Code of Practice for Risk-based Fatigue Management**;

1.3 A statement to the effect that the **COP** was drawn up in accordance with this guideline **DMR 16/3/2/4-B2** issued by the Chief Inspector of Mines;

1.4 The mine's reference number for the **COP**;

1.5 Effective date of the **COP**; and

1.6 Revision dates.

2. TABLE OF CONTENTS

The **COP** must have a comprehensive table of contents.

3. STATUS OF MANDATORY CODE OF PRACTICE

This section must contain statements to the effect that:

3.1 The mandatory **COP** was drawn up in accordance with Guideline **DMR 16/3/2/4-B2** issued by the Chief Inspector of Mines.

3.2 This is a mandatory **COP** in terms of Sections 9(2) and (3) of the **MHSA**.

3.3 The **COP** may be used in an incident/accident investigation/inquiry to ascertain compliance and also to establish whether the **COP** is effective and fit for purpose.

3.4 The **COP** supersedes all previous relevant **COPs**.

3.5 All managerial instructions or recommended procedures (voluntary **COPs**) and standards on the relevant topics must comply with the **COP** and must be reviewed to assure compliance.

4. MEMBERS OF DRAFTING COMMITTEE

4.1 In terms of Section 9(4) of the **MHSA** the employer must consult with the health and safety committee on the preparation, implementation or revision of any **COP**.

4.2 It is recommended that the employer should, after consultation with the employees in terms of the **MHSA**, appoint a committee responsible for the drafting of the **COP**.

4.3 The members of the drafting committee assisting the employer in drafting the **COP** should be listed giving their full names, designations, affiliations and experience. This committee should include competent persons sufficient in number to effectively draft the **COP**.

5. GENERAL INFORMATION

The general information relating to the mine must be stated in this paragraph.

The following minimum information must be provided:

5.1 A brief description of the mine and its location;

5.2 The commodities produced;

5.3 The mining methods/mineral excavation processes taking care to identify the potential situation and/or sources that could give rise to fatigue;

5.4 The unique features of the mine that have a bearing on the **COP** must be set out and cross referenced to the risk assessment conducted; and

5.5 Other relevant **COPs**.

6. TERMS AND DEFINITIONS AND ACCRONYMS

Any word, phrase or term of which the meaning is not absolutely clear or which will have a specific meaning assigned to it in the **COP**, must be clearly defined. Existing and/or known definitions should be used as far as possible. The drafting committee should avoid jargon and abbreviations that are not in common use or that have not been defined. The definitions section should also include acronyms and technical terms used.

7. RISK MANAGEMENT

7.1 Section 11 of the **MHSA** requires the employer to identify hazards, assess the health and safety risks to which employees may be exposed while they are at work, record the significant hazards identified and **risk** assessed. The **COP** must address how the significant **risks** identified in the **risk** assessment process must be dealt with, having regard to the requirements of Sections 11(2) and (3) that, as far as reasonably practicable, attempts should first be made to eliminate the **risk**, thereafter to control the **risk** at source, thereafter to minimise the **risk** and thereafter, insofar as the **risk** remains, to provide personal protective equipment and to institute a program to monitor the **risk**.

7.2 To assist the employer with the hazard identification and **risk** assessment all possible relevant information such as accident, locality of mine, ergonomic studies, research reports, manufacturers' specifications, approvals, design criteria and performance figures for all relevant equipment should be obtained and/or considered.

7.3 In addition to the periodic review required by Section 11(4) of the **MHSA**, the **COP** should be reviewed and updated after every serious incident/accident involving the conveyor belt installation, or if significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material.

In addition to the periodic review required by Section 11(4) of the **MHSA**, the **COP** should be reviewed and updated after every altered circumstance or if significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material

8. ASPECTS TO BE ADDRESSED IN THE CODE OF PRACTICE

The **COP** must set out how significant risks identified and assessed in terms of the **risk** assessment process referred to in paragraph 7.1, will be addressed. The **COP** must cover at least the aspects set out below, unless there is no significant **risk** associated with that in relation to emergency at the mine.

8.1 Factors to be considered when addressing fatigue at mines

The **COP** should set a process for determining general considerations for **fatigue** management.

8.1.1 *Causes of **fatigue***

Human fatigue is multifactorial and from a health and safety perspective, fatigue is most appropriately conceptualised as either work related or non-work related.

8.1.1.1 *Work-related causes*

Common workplace issues that can cause **fatigue** include:

- Work time arrangements;
- High physical workloads;
- Temperature extremes;
- Excessive noise;
- Work stress; and
- Poor ergonomic design of workstations and equipment.

8.1.1.2 *Non-work-related causes*

Non-work-related causes that are variable on an individual level include the following:

a) Undiagnosed medical conditions – many diseases and disorders can trigger **fatigue**, including:

- Sleep disorders, such as sleep apnoea or restless leg syndrome;
- Chronic **fatigue** syndrome;

- Tuberculosis;
- Chronic pain;
- Heart problems; and
- HIV.

b) Living conditions (housing and nutrition).
c) Alcohol and substance abuse.
d) Lack of exercise.
e) Certain medications.

It is the responsibility of employees to inform the employers of any health condition or medication they are on.

8.1.1.3 *Total worker **fatigue***

The **fatigue** experienced by an individual is usually an accumulation of several of the above factors and can be expressed in the following equation:

$$F_T = F_{SS} + F_{EW} + F_{PF}$$

Where;

F_T	=	total **fatigue**
F_{SS}	=	**fatigue** caused by the shift system/work time arrangements
F_{EW}	=	**fatigue** caused by poor ergonomics, environmental and work factors
F_{PF}	=	**fatigue** caused by personal factors such as insufficient/poor sleep, health, nutrition and personal lifestyle.

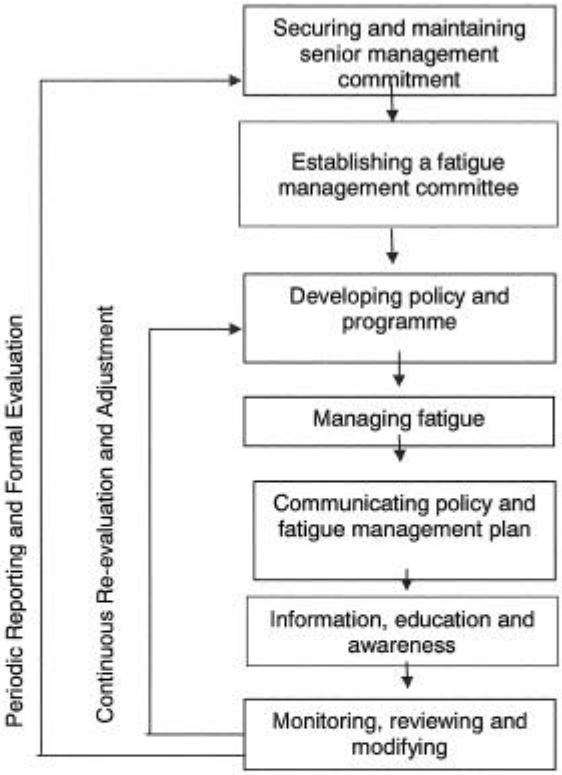
8.2. Development of a fatigue management plan

In general, the goal of a **fatigue** management plan is to maintain and, where possible, enhance safety, performance and productivity in operational settings, and manage the **risk** of **fatigue** in the workplace.

The recommended process of developing and maintaining a successful **fatigue** management plan consists of the following interrelated elements:

a) Securing and maintaining senior management commitment;
b) Establishing a **fatigue** management committee;
c) Developing policy and programme;
d) Managing **fatigue**;
e) Communicating policy and **fatigue** management plan;
f) Information, education and communication; and
g) Monitoring, reviewing and modifying.

Figure 1:
The **fatigue** management plan development process as a flow chart diagram



8.2.1 *Management commitment and Stakeholder Buy-In*

In order for a Fatigue Management Programme (**FMP**) to be effective, senior management must provide visible support, endorsement and allocate sufficient resources to establish, sustain, monitor and optimise the **FMP**.

8.2.1.1 *Assign responsibility for the development of the **FMP***

Management should form a specific committee or assign responsibility to an existing high level Health and Safety Committee to establish and oversee the implementation the **FMP**. This should be a truly representative cross section of the mine's stakeholders; managers and union representatives (preferably health and safety representatives). Responsibilities, authority and accountability for managing **fatigue** within the **FMP** need to be defined. These roles and responsibilities include:

- Creating a statement of safety, performance, business goals and benefits the mine expects to achieve as a result of implementing the **FMP**;
- Identifying and listing of the internal and external resources, support and expertise the mine will require to implement, monitor and improve the **FMP;**
- Developing procedures for handling cases of employee **fatigue**;
- Initialising protocols and objectives to evaluate the FMP. This can include comparative pre and post Key Performance Indicator (KPI) analysis and auditing of compliance; and
- Planning, implementing and executing all facets of the **FMP**.

8.2.2 *Establish a **fatigue** management committee*

Given the complexities involved in the design, implementation, monitoring and review of a **FMP** and the various different disciplines and department's involved, close co-ordination and effective management are essential. The mine should establish a Fatigue Management Committee (**FMC**) at the mine to discuss and address the identified circumstances leading to **fatigue** and the control measures necessary. Action plans should be monitored at committee meetings.

The **FMC** should elect its own chairperson and scribe.

8.2.3 *Develop a policy (to be integrated into health policy)*

The **FMC** should develop the policy which should include:

a) Statement of goals and objectives;
b) Clear roles, responsibilities and accountabilities for managing **fatigue** in the workplace;
c) Documentation of the support and expertise available to the programme;

d) Policies regarding employee alertness and fatigue, including possible disciplinary action for failure to maintain satisfactory levels of alertness on the job; and
e) Plan for reporting and reviewing organisational progress toward **FMP** goals.

8.2.4 *Fatigue Risk Management*

In order for the mines to manage the risks of **fatigue** effectively and efficiently the following steps should be followed:

Step 1: Hazard identification;
Step 2: Risk assessment;
Step 3: Risk control;
Step 4: Monitoring and evaluation; and
Step 5: Documenting **FMP**.
(Refer to Annexure A – C)

8.2.4.1 *STEP 1: Hazard identification*

a) *Identify factors that contribute to **fatigue***

The first step when managing **fatigue** is to identify, and develop a list of all the factors that have the potential to contribute to **fatigue** within the workplace. Factors to consider are work time arrangements, type of work performed, work environment and non-work-related factors.

There are many ways of identifying workplace factors that contribute to **fatigue**. They include:

i. Inspecting workplace rosters;
ii. Consulting with workers (ask them if they regularly feel **fatigued** and about any problems they have encountered, any near misses or unreported injuries);
iii. Consulting with workplace health and safety representatives and committees;
iv. Conducting a health and safety audit; and
v. Analysing injury and incident reports (pay particular attention to injuries and incidents that occur in periods of high **fatigue**, i.e. the latter half of shifts and night work, particularly between 2:00 and 6:00).

b) *Identify the hazards of **fatigue***

i. Shift systems and rostering (See Annexure A);
ii. Ergonomics, environmental and work factors (See Annexure B);
iii. Personal factors (See Annexure C);
iv. **Fatigue risk** worksheets (see annexure D); and
v. Review accident or incident reports (See Annexure E).

8.2.4.2 *STEP 2: **Risk** assessment*

a) Assess the **risks** of **fatigue**

Managing **fatigue** involves assessing the **risks** associated with the workplace factors that contribute to **fatigue**. For each of the **risks**:

- Determine the likelihood of an incident occurring at the workplace, bearing in mind the existing control measures;
- Determine the consequences of an incident occurring at the workplace, bearing in mind the existing control measures; and
- Combine the estimates of the likelihood and consequences to rate the risk.

Site-specific information and evidence of **fatigue**-related incidents could be used to assist in the risk assessment process. In this context review:

- Incident reports;
- Self-reports and complaints from employees;
- Reports from supervisors about any evidence of **fatigue**;
- Aggregate data from any **EAP** (ensure that confidentiality is maintained when using such data); and
- Environmental and medical monitoring and other advice from those with technical expertise in the relevant disciplines.

From this information, determine the risk factors that need to be controlled and prioritise actions.

8.2.4.3 STEP 3: ***Risk** Control*

Implement **risk** control measures

Control mechanisms should be put in place to manage the factors (identified through the risk assessment process) contributing to **fatigue** and to reduce the risks from employee **fatigue**.

The controls should address the sources of **fatigue** in the workplace and take into account the factors identified in the personal environment.

Control measures should be introduced using the hierarchy of controls. According to the hierarchy of controls, the ideal solution when managing **fatigue** is to completely eliminate factors that contribute to **fatigue**.

This may involve, for example, the elimination of night shifts and extended working hours. If possible, there are a number of control options that may be used alone, or in combination, to minimise and control exposure to **fatigue**:

These could include:

a) Review and amendment of policies and procedures that are identified as having an effect on employee **fatigue**.
b) Adjustment of shift rosters to the most optimal, using the **Bio-roster** concept. The shift roster should take into account the need for the person to spend time with his/her family and participate in family and community affairs. The shift systems devised shall have the support of employees.
c) Elimination of unnecessary routine from the **work schedule**.
d) Control of the working environment to reduce factors that promote **fatigue** and drowsiness (e.g. physical workload, noise, vibration, temperature, lighting, etc.).
e) Lighting of rest areas to promote wakefulness and assist with adjustment of the **circadian rhythm**.
f) Suitable systems to monitor the performance of workers in safety-critical positions (e.g. drivers and operators) during the course of the shift and, where appropriate, suitable technology to monitor performance during the shift.
g) Regular medical examination and certification of fitness of employees and contractors in safety critical positions. Follow-up at suitable intervals on employees with chronic illnesses that may contribute to **fatigue** through the medical surveillance programme. Provision of education and information on how to best manage the condition to these employees by a suitable medical practitioner.
h) Availability of a suitable and easily accessible source of drinking water to all employees.
i) Designing meals that are provided on night shifts to reduce drowsiness and adverse health effects associated with eating at this time of day.
j) Substitute: introduce safer practices in place of those currently in use, e.g. increasing the length of breaks in a shift:
k) Engineer: introduce engineering controls, e.g. improve ventilation and illumination levels to improve alertness.
l) Administrative controls: introduce procedures and training programmes to support effective control of **fatigue**.
m) Personal protective equipment: carefully manage the use of protective gear as a control measure because it may not provide sufficient reductions in exposures, e.g. hearing protection devices may not provide sufficient attenuation over a 12-hour shift as opposed to an eight-hour shift.

FATIGUE RISK MANAGEMENT TOOL

Hazard Identification	Risk Assessment (Low - Moderate - Higher Risk: Tick applicable box)			Risk Control
MENTAL AND PHYSICAL DEMAND OF WORK	***Low***	***Moderate***	***Higher Risk***	***Interventions***
These include:				
Monotonous work				
Sustained physical or mental effort				
Complex physical or mental tasks				
WORK SCHEDULING AND PLANNING	***Low***	***Moderate***	***Higher Risk***	***Interventions***
Length of shift				
Sequential right shifts				
Breaks during work				
Breaks between work periods				
EXCESSIVE COMMUTING TIMES	***Low***	***Moderate***	***Higher Risk***	***Interventions***
WORK ENVIRONMENTAL CONDITIONS	***Low***	***Moderate***	***Higher Risk***	***Interventions***
Exposure to hazardous substances				
Exposure to extreme temperatures				
Exposure to vibration				
Exposure to noise				
INDIVIDUAL AND NON-WORK FACTORS	***Low***	***Moderate***	***Higher Risk***	***Interventions***
Sleep (amount and quality)				
Chronic conditions				
Alcohol and substance abuse				
Fitness levels (BMI)				
Nutrition				

For ease of reference it is recommended that the **fatigue risk** management charts be used to list the identified hazards, the qualitative **risk** assessment and the interventions that have been put in place to mitigate the **risk** of **fatigue**.

8.2.4.4 *STEP 4: Evaluation*

Monitoring and Evaluation

The **fatigue** management plan should be reviewed at regular intervals to ensure that all relevant hazards are included and to assess the effectiveness of the controls. Some of the specific factors to consider as part of the monitoring and evaluation include:

a) Have the control measures been implemented as planned?
b) Are there any new operational processes that have been introduced?
c) Review available fitness, health, **EAP** and absenteeism data.
d) Review incident data.

8.2.4.5 *STEP 5: Documentation*

Documenting **fatigue** management plan

The fourth step in the **fatigue** management process is to develop and document a plan detailing how control measures will be implemented. The **fatigue** management plan should be integrated as part of an overall occupational health and safety programme. The plan should be:

a) Specific to the mine site.
b) Developed through consultation.
c) Publicly available, e.g. on display.
d) Communicated regularly and appropriately, e.g. in inductions and safety talks.
e) Regularly reviewed to take account of changes in site needs and knowledge about the risks.

It should include:

a) A statement of the principles for managing **fatigue**.
b) Roles and responsibilities of all levels of the organisation.
c) The **risk** assessments that have been undertaken.
d) The **risk** controls that are and will be in place, along with an implementation plan.
e) The support systems that already exist and that will be set up along with an implementation plan, e.g. **EAP**, training programmes and monitoring systems.

8.2.5 *Communicating the policy and **fatigue** management plan*

Careful, but vigorous, communication is critical when 'rolling out' the **fatigue** management plan. Once the policy and the **FMP** framework have been adopted, they must be communicated to the entire workforce of the organisation. The communication framework should also provide and encourage opportunities for family members to be included in the information exchange.

Overall, the **FMP** will benefit from open lines of communication between all stakeholders, including employees, line supervisors, middle managers and senior management.

Providing information to families of employees can stimulate or reinforce the employees' willingness to focus attention on the important issue of **fatigue**.

8.2.6 *Information, education and awareness*

An appropriate information, education and awareness programme should be put in place to create awareness and educate all employees and their families on the impact of **fatigue** in the workplace, their role in managing the risks, and the controls in the workplace.

The programme should provide information and education on:

- The factors that cause **fatigue**.
- The signs and symptoms of **fatigue**.
- The risks of **fatigue** in the daily execution of their duties and the factors that cause **fatigue**.
- The action they can take when feeling the effects of **fatigue** during their shift.
- The impact of **shift work**, the importance of quality sleep and good nutrition to combat the effects of **shift work**.
- How to maintain an environment that will allow good quality sleep.

8.2.7 *Monitoring, reviewing and modifying*

The **FMP** should be subject to periodic assessments (minimum at least every two years) to ensure that it remains appropriate and effective, and can address existing and emerging or changed **fatigue** risks. Targets should be set for key parameters of the **FMP**. The review should cover the testing and auditing of all aspects of the **FMP**, in order to determine if controls are meeting business and safety goals.

The review should strike an appropriate balance between 'leading indicators' and outcome measures. The following are examples of the former:

a) The number of individuals diagnosed and treated with sleeping disorders.
b) The number of individuals who self-report **fatigue** when at work.

Obviously, attention should also be paid to outcomes and these will involve the usual measures such as:

a) Incident / accident rates.
b) Near misses and safety-critical events.
c) Equipment damage.
d) Feedback from employees.
e) Absenteeism.
f) Staff turnover.

PART D: IMPLEMENTATION

1. IMPLEMENTATION PLAN

1.1 The employer must prepare an implementation plan for its **COP** that makes provision for issues such as organizational structures, responsibilities of functionaries and programs and schedules for this **COP** that will enable proper implementation of the **COP**. (A summary of/and a reference to, a comprehensive implementation plan may be included).

1.2 Information may be graphically represented to facilitate easy interpretation of the data and to highlight trends for the purpose of **risk** assessment.

2. COMPLIANCE WITH THE CODE OF PRACTICE

The employer must institute measures for monitoring and ensuring compliance with the **COP**.

3. ACCESS TO THE CODE OF PRACTICE AND RELATED DOCUMENTS

3.1 The employer must ensure that a complete **COP** and related documents are kept readily available at the mine for examination by any affected person.

3.2 A registered trade union with members at the mine or where there is no union, a health and safety representative on the mine, or if there is no health and safety representative, an employee representing the employees on the mine, must be provided with a copy on written request to the manager. A register must be kept of such persons or institutions with copies to facilitate updating of such copies.

3.3 The employer must ensure that all employees are fully conversant with those sections of the **COP** relevant to their respective areas of responsibility.

ANNEXURE A:
Shift systems and rostering (F_{ss})

Work time arrangements and work systems that might have a negative impact on an individual's ability to adjust to **shift work** include but are not limited to:

a) a shift roster with an irregular or unpredictable pattern.
b) more than four consecutive 12-hour night shifts.
c) more than five consecutive 8-hour night shifts.
d) **work schedules**/rosters that do not allow opportunity for continuous sleep of seven to eight hours in each 24-hour period.
e) excessive regular overtime and on-call work.
f) early morning shift start times (before 6:00).
g) backward rotating rosters (day to night to afternoon).
h) shifts lacking appropriate shift breaks.
i) less than 36 hours off after a period of night shift work.
j) 12-hour shifts that involve critical monitoring tasks, heavy physical work, potential exposure to harmful agents/substances.

To assess the **fatigue** risks caused by shift systems and work time arrangements at a mine site, the relevant **risk** factors should be examined in detail in detail (Table 1.1).

Table 1.1:
Risk assessment of shift systems and work time arrangements

Risk factor	Consideration
Shift schedule design factors	
Night shifts, including the number of consecutive night shifts	• Are too many consecutive night shifts worked? • Is more than eight hours' work required over-night shift? • Are tasks requiring sustained physical or mental effort undertaken on night shift? • Are complex physical or mental tasks undertaken on night shift? • Do night shift workers have difficulty getting undisturbed sleep during the day?
Long hours of work in a single shift. This includes travel time, especially to remote sites	• Does one shift involve more than 12 hours in a day (including call-outs)?
Long hours of work across a shift cycle	• Do hours of active work (total time spent at work including overtime) exceed 50 hours in any seven days?
Long hours because of on-call duties	• Are there irregular and unplanned schedules as a result of call-outs? • Is the working day or working week extended beyond 12 hours in a single day or hours in any seven days as a result of call-outs?

Risk factor	Consideration
Short breaks between work shifts	• Is there enough time between work shifts to allow for adequate sleep: – Enough time in a break for five hours' uninterrupted sleep in 24 hours (only for one night)? – Enough time in breaks for 12 hours of sleep in 48 hours (i.e. in two days)? – Enough time in breaks for 50 hours' sleep in 7 days? – Is the break between shifts less than 10 hours?
Short breaks within work shifts	• Are breaks within shifts long enough and frequent enough to allow workers to rest, refresh and nourish themselves?
Shift start/finish times	• Do any shifts start or finish between midnight and 6:00? • Are there split shifts? • Are complex, difficult or strenuous tasks required at the start or end of such shifts?
Changes to rosters	• Do workers get sufficient notice of roster changes? • Is **fatigue** management taken into account in roster changes?

ANNEXURE B:
Ergonomics, environmental and work factors (F_{EW})

Exposure to environmental stressors, physical strain and work stress play an important role in the development of **fatigue**. To assess the **fatigue** risks caused by these factors, they should be examined in detail (Table 1.2).

Table 1.2:
Risk assessment of environmental and work factors

Risk factor	Consideration
Task-related factors	
Repetitive or monotonous work	• Do jobs involve repetitive or monotonous work, e.g. haul truck driving?
Sustained physical or mental effort	• Is the work physically demanding? • Is there time pressure due to a heavy workload? • Is work fast paced? • Is work intensive? • Can workers vary work pace or work tasks as desired? • Do workers have a say over work tasks or how to carry them out?
Complex physical or mental tasks	• Are high vigilance and/or concentration required? • Are there different demands that can be difficult to combine? • Are complex, difficult or strenuous tasks required at the end of shifts or shift cycles?
Adverse working conditions	• Are there adverse working conditions, e.g.: • Exposure to noise? • Exposure to heat? • Exposure to hazardous substances? • Whole body vibration? • Awkward body posture? • Restricted ceiling heights? • Travel distances to workplace facilities.

ANNEXURE C:
Personal factors (F_{PF})

There are human factors and employee choices that might have a negative impact on an individual's ability to remain alert and adjust to **shift work**. In order to assess the **fatigue** risks caused by personal factors the following should be examined in detail (Table 1.3).

Table 1.3:
Risk assessment of personal factors

Risk factor	Consideration
Personal factors	
Excessive commuting times necessary	• Is significant travel to and from work necessary each day so that time for adequate sleep is reduced? • Are long-distance commutes necessary at the beginning of a work cycle?
Socio-economic issues	• Do jobs involve high demand, but low control? • Are there poor social relations at work, e.g. bullying? • Is there a low level of social support from peers and **supervisors** at work? • Second job for pay. • Family commitments.
Health conditions and medication	• To what extent is there evidence of problems as a result of: a) Pregnancy; b) Chronic Diseases; c) Medication; d) Other medical issues; e) Sleeping disorders; and f) Psychological issues.
Alcohol and substance abuse	• Alcohol and/or drug misuse/abuse
Living conditions	• Housing • Nutrition • Poor sleeping conditions • Unfavourable sleeping environment

ANNEXURE D:
Fatigue risk worksheets for FSS/FEW

1. Worksheet A: Example of **fatigue** hazard identification checklist

Are any of these statements true in the workplace?	Yes	No
Many employees work shifts that include nightshifts		
Working overtime/long shifts is common		
Back-to-back shift working is common		
Breaks during shifts are short and do not provide a good rest		
Some people have to drive a long way to work, work long hours, then drive home		
Some shifts start very early (before 7:00)		
Shifts rotate 'backwards' (nights, evenings, day shifts)		
Shifts rotate forwards on a slow pattern		
Safety critical work is often done at:		
— a 'circadian low point'		
— two to four hours into a shift		
— at the end of a shift		
— following mealtimes		
— just before or just after a break (crew member may be tired just before the break, not fully alert after the break)		
Work is mainly very boring and uneventful		
Work is done:		
— in a hot environment		
— where the lighting is low		
— where it's fairly comfortable		
Shift workers don't have any say in the design of shift patterns		
Shift workers' family and friends don't provide much support for their unusual working hours		
There is no realistic support from employers on how to handle problems caused by shift working (e.g. 'education', briefings, counselling)		
Fitness for duty is not checked – especially the amount of sleep someone has had before starting a shift		
Some employees 'moonlight' during scheduled rest periods between shifts		
There is an ageing workforce working nights or long hours		
People rely on tea, coffee or other stimulants to stay alert		
The shift system has been designed entirely by the workforce		
Some people need to take unofficial 'naps' to keep working		

Scoring:
Add the number of ticks in the 'Yes' column. This gives a broad indication only of whether there is an alertness or **fatigue** problem.

- Three or fewer ticks – there is probably no need for action.

- Four to 10 ticks – it would be wise to investigate further and consider solutions.
- More than10 ticks – there is definitely a problem; there should be further investigation and immediate action.

2. Worksheet B: Example of Checklist to interview shift workers to assess the **fatigue risk**

	Yes	No
Do you regularly lose one or two hours' sleep when working shifts?		
Is the quality of sleep you get generally poor – e.g. frequently interrupted (by noise or bright light)?		
Do you sometimes have to work on safety-critical tasks at a 'low point' in the day, e.g. early hours of the morning; mid to late afternoon or after a meal?		
Do you regularly work long shifts – e.g. over 12 hours?		
Do you have enough breaks during the shift?		
Are the breaks long enough?		
Are rest periods between shifts long enough to recover from the previous shift (at least 12 hours)?		
Can you rest properly (or even nap) during breaks?		
Do you feel generally drowsy a lot of the time?		
When changing from night shifts to day shifts, do you feel 'rough' for the first few days?		
Are you noticeably absent-minded or forgetful at work or do you find it hard to concentrate?		
Do you sometimes feel that you just can't move; or don't want to?		
Do you suffer from a lot of heartburn, indigestion or a generally upset stomach?		
Do you find it difficult to get a good undisturbed sleep between shifts?		
At work, do you:		
Often find it hard to concentrate, make clear decisions or take in and act on information?		
Have more than occasional lapses of attention or memory?		
Find your reaction times are slow (for example, responding to an alarm or a threat that builds up in your workplace)?		
Make lots of errors?		
Occasionally fall asleep at work – momentarily or for several minutes?		
Find that you are often irritable?		
Do you have the opportunity and facilities to rest properly (or even nap) during breaks?		

Scoring:
Some of the above are normal and unavoidable effects of **shift work**. This doesn't mean that answering 'Yes' to any of the above is acceptable. If anyone is showing severe or long-term symptoms of **fatigue**, action should be taken

ANNEXURE E:
Review of accident or incident reports

There is evidence that **fatigue** is under-reported in incident investigations. The following will be helpful in identifying whether **fatigue** was an issue:

Consider the time of day the incident occurred. Was it:

- At a 'circadian low point'? (13:00 – 16:00; midnight and 06:00)?
- Close to the end of a shift?
- Within a period of two to four hours from the start of a shift?

Consider the point within the shift cycle when the incident occurred. Was it:

- At changes of shift, for example during the first day shift following a cycle of night shifts?
- At the end of a period of night shifts?

Consider the sleeping patterns of those involved in the incident, in particular, those who seem to have 'caused' the incident. Were they:

- Sufficiently rested during the off-shift period before coming on shift?
- Suffering from disrupted sleep?
- Doing a second job during an extended period of rest days between shifts?

Consider the work environment. Was it:

- Dark?
- Hot?
- Quiet?
- Generally conducive to sleep?

Consider the type of work being carried out. Was it:

- Routine (boring)?
- Work requiring sustained attention or extended concentration?
- Work requiring significant physical effort?
- Safety-critical work that could have been scheduled at another time?

Consider those involved in the incident. Were they:

- Taking any medicines that could have caused drowsiness or lack of attention?
- Taking stimulants (such as caffeine) to maintain their alertness?
- Assessed for fitness for duty before starting work or monitored during the shift for signs of **fatigue**?
- Tired on arrival after a long journey to work?