

Determining the key enablers for a uniform safety culture in the South African iron ore mining industry

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ABSTRACT

A well-designed and mature safety culture is very important for mining companies to ensure that their employees are safe. This can be achieved through the establishment of effective strategies and procedures that are designed to improve the safety performance of their organisation. One of the most important factors that a mining company should consider when it comes to developing its safety culture is having a uniform, mature safety culture throughout its organisation. Moreover, research has shown that employees of mines that have low incidence rates have high safety maturity scores.

Despite the various factors that have contributed to the reduction of the overall incident rate in South Africa's mining industry, the number of reported incidents has increased. The lack of risk awareness is believed to be the cause of the increasing number of disturbing incidents. The goal of this study was to analyse how employees and managers view the safety culture of an iron ore mining company in South Africa. The study also used the findings from the literature to identify the various factors that can improve the safety performance of the company.

The success of an organisation's occupational health and safety (OHS) performance is not only beneficial to its employees but also contributes to its financial success and is a legal and moral obligation. A poor record of safety can lead to the termination of several workers and even cause an entire company to close.

The literature review revealed that a well-designed and mature safety culture is very important for a company to ensure that its employees are safe. This can be achieved through the establishment of effective strategies and procedures that are designed to improve the safety performance of the organisation. However, many organisations fail to address the various factors that can improve the safety performance of their organisations.

Despite the respondent's positive perceptions about the safety culture of their company, the survey revealed that the level of safety culture in the South African iron ore mining company remained unsophisticated. This suggests that the country's mining industry still has a long way to go before it reaches a level of maturity and uniformity. Although the study was only focused on a single organisation, the findings

revealed that the various factors that can affect the safety performance of a mining company can also appear in the general larger mining environments. This suggests that the current precarious situation in the industry might be due to the lack of proper safety culture.

The results of the study revealed that older employees are more knowledgeable about the current safety environment than younger ones. This suggests that the focus should be placed on the safety of younger workers, as they are still learning about the procedures and operations of the company. The survey results also revealed that the missing elements of the safety culture could lead to more accidents in an organisation. This suggests that the current situation in the industry might be due to the lack of proper safety culture.

Studies have shown that a company's safety culture can have a significant impact on its performance. It can also help employees develop a better understanding of the organisation's operations. Unfortunately, most accidents and incidents happen due to the negligence of workers. Although the guidelines in a safety management system can help determine employee behaviour, investigations have shown that most of these incidents and accidents are caused by the negligence of workers. The study found that a lack of compliance with safety regulations was a major issue in an organisation, which could lead to more accidents. The recommendation is to establish a monitoring and evaluation system that is designed and implemented by a management team. Although the study found that the safety culture of an organisation is on the way to becoming uniform and mature, it noted that there are still areas where it can improve. One of the most important factors that the management and workers can consider when it comes to improving the safety culture of an organisation is to work together to achieve zero harm.

Although everyone is responsible for the safety and health of their employees, management must still make sure that the organisation's safety culture is regularly emphasized. This can be done through regular discussions with employees about the various safety issues that affect the organisation. Having a positive attitude towards the establishment of a safe environment can help motivate employees to work harder and contribute to the company's success. In addition to being unhealthy, an unsafe

environment can also affect the productivity of employees. Having a well-designed and uniform safety culture can help an organisation establish a strong brand identity.

KEYWORDS: occupational health and safety, organisational culture, safety culture; safety climate; iron ore mining environment

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ABBREVIATIONS AND ACRONYMS

CTF	culture transformation framework
EOF	elimination of fatalities
HAZOP	hazard and operability study
ILO	International Labour Organisation
LTIFR	lost time injury frequency rate
MHSA	Mine Health and Safety Act
MHSC	Mine Health and Safety Council
MOSH	mining occupational safety and health
NOHS	National Occupational Health and Safety Policy
NWU	North-West University
OHS	occupational health and safety
RCR	recordable case rate
SCS	Statistical Consultation Services
SD	standard deviation
SHE	safety health and environment
SPSS	Statistical Package for Social Sciences
VFL	visual field leadership

CHAPTER ONE

ORIENTATION

1.1 Introduction

The rapid emergence and decline of earning capacity in today's business world have led to the drive to reduce costs and improve efficiency. This process is highly prone to generate conditions that can easily remove the level of risk awareness (Fitzgerald, 2005:325). Moreover, the rapid emergence and evolution of technologies in the workplace have greatly affected the way people work. As a result, many changes have been made to improve occupational health and safety (OHS) in the workplace. Most of the traditional hazards and risks were also eliminated through these changes, e.g., plant automation. However, despite the significant improvement in the management of risk, accidents, incidents and injuries, fatalities are still happening in hazardous workplaces (Mustapha, Aigbavboa & Thwala, 2015:57).

Inherently, all activities in small and large-scale mines are hazardous mostly owing to the risk that miners are exposed to when working in them. These risks include flooding, fires, rock falls, slush rush, accidents involving vehicles and machinery, poor ventilation, overexertion, confined spaces, and harmful substances, such as silica dust, mercury, and other chemicals (ILO, 2021). The abovementioned risks are just a few of many in the mining environment but are the main risks (ILO, 2021). However, what is important is that whatever the risks, employees need to be aware of them and comply with the measures that have been implemented to prevent them. The study questioned employees on their adherence to risk prevention measures and risk awareness.

According to the International Labour Organisation (ILO), there is a yearly total of approximately four million workplace accidents worldwide of which 380 000 are fatalities and 2.4 million are casualties because of workplace illness. This amounts to a yearly total of 2.78 million fatalities – one death every 15 seconds (ILO, 2021).

In South Africa, the situation is no different, although there is a 2% decrease year on year in the total number of reported occupational injuries most of which are due to accident repetition (Moodley, 2020), with the average injuries and fatality frequency

rate for the South African mining industry levelling off since 2016. However, between 2007 and 2020 an average of 109 fatalities per annum were still experienced by South African mine workers (Ward, 2021), which indicates that there has been no significant improvement in safety performance (Mantashe, 2020).

The stagnation in safety performance is not an uncommon trend and usually occurs at the end of a safety performance improvement process, which is the most challenging stage since it comprises a change in people's beliefs and values concerning safe behaviour and safety management systems. The various steps involved in a safety performance improvement process usually involve three phases: implementing engineering controls; establishing a safety management system; and changing people's behaviour towards safety (Brogli, 2016:38).

Only a small number of accidents and incidents happen because of unsafe physical or mechanical workplace conditions (Dawei & Hanzhi, 2012:258). Most can be attributed to the unsafe behaviour of individuals, which causes approximately 80% to 95% of all accidents and incidents (Dawei & Hanzhi, 2012:259). Research conducted by Suman and Leo based on 75 000 industrial accidents indicates that 88% were caused by unsafe behaviour (Suman & Leo, 2017:271). Likewise, Wang *et al.* (2022) recently found that unsafe human behaviour is the cause of 95% of accidents and poor health in China's coal mining industry, which suggests that it might still be a problem in the mining workplace.

Owing to the similarities in the statistics during the last ten years, the management of firms has realised that employees are not perfect and will make mistakes, even though they are provided with the best tools, equipment and working environment and that the work culture tolerates and encourages risk behaviour (Dawei & Hanzhi, 2012:258). For companies to break the boundaries of their safety performance plateau, they need to consider initiatives that address the behaviour of employees to activate the fourth stage in a safety performance improvement process, namely a continuous improvement stage (Godfrey, 2018).

The most common method for controlling employee behaviour is through a control-oriented approach. This approach assumes that employees are motivated to perform a given task only as much as is necessary to complete it. Thus, it is the responsibility of the management of a firm to control and improve the behaviour of its employees

through the enforcement of rules and punishments for non-compliance (Osman, Awang & Hassan, 2015:79). However, developing a safety culture, which is focused on safety performance improvement instead of compliance, would help organisations to shift their mindsets achieve a zero-harm target.

Through a safety performance improvement process, a mature, uniform safety culture would be achieved whereby the safety of every employee is equally important and everyone is responsible for his/her safety (Jasiulewicz-Kaczmarek, Szwedzka & Szczuka, 2015:4877). Therefore, safety-conscious companies recognise that an organisational culture that values safety can make a difference in terms of business success and the life or death of their employees. Moreover, for these firms, safety is embedded in the core of their culture (Warrick, 2017:399).

1.2 Problem statement

When the priorities concerning the safety of a mining organisation are inverted, disasters become the order of the day, especially when its luck runs out. When this prevails, a mining operation needs to ensure safety through a thorough understanding of the consequences of non-compliance with safety standards and procedures, and consistent implementation of safety performance improvement procedures (Mohapi & Zarske, 2019:3). In essence, a firm needs to understand the prevailing safety culture in its organisation (Mohapi & Zarske, 2019:3).

Many mining companies pride themselves on their excellent safety management systems and controls (Mantashe, 2020). However, the engagement and participation of their employees in improving their safety performance often reach a plateau, which has been the case in the iron ore mining environment of South Africa. Nevertheless, for the last few years, the overall trend in the safety performance in the South African iron ore mining industry has improved substantially, evidenced by the significant decrease in the recorded injury and incident rate of some of the major players including Anglo American, Assmang and Tshipi (Carmen, 2021). This successful safety record was achieved through the unwavering support of the mines' safety drives, never-ending focus on safety management systems and the implementation of safety performance improvement procedures.

Despite the abovementioned improved safety record, there has, however, been an increase in high potential incidents (HPIs), lost time incident frequency rates (LTIFRs)

and exposure to dust and occupational disease (Anglo American, 2021:28). Although iron ore mining organisations did implement the elimination of fatalities (EOF) and risk reduction interventions, risk behaviour was identified as the root cause of 85% of the increase in HPIs, LTIFRs and exposure incidents at Anglo American iron ore mining operations (Anglo American, 2021:28). Thus, a culture of not being aware of risk was identified as a contributing factor to these incidents, which led to an external review of the management of occupational health and safety in the South African iron ore mining industry (Anglo American, 2021:28).

The goal of any mining company should be to have a uniform, mature safety and zero harm culture throughout the organisation and amongst its contractors to ensure good safety performance and that every employee returns home unharmed every day. Therefore, Stern *et al.* (2019) examined the relationship between a mature safety culture and safety performance and concluded that all the stakeholders (employees, contractors, and subcontractors) of mines with low incidence rates had high safety maturity scores.

Following Stern *et al.*'s (2019) research and similar studies and to contribute to knowledge about the creation of a uniform, mature safety culture in iron ore mining organisations, the current study focused on the perceptions of the managers and employees of an iron ore mining company concerning the enablers a uniform, mature safety culture.

1.3 Research objectives

1.3.1 Primary research objectives

The primary objective of the study was to understand how managers and employees of a South African iron ore mining company perceived the safety culture of their firm.

1.3.2 Secondary research objectives

To achieve the primary research objective, the secondary research objectives were to do as follows:

- Conduct a review of the available literature on safety culture to develop insights as a background to the empirical study

- Determine the perceptions of managers and employees of a South African iron ore mining company of the safety culture of their firm in terms of the enablers of a uniform, mature safety culture
- Determine the stages of the development of a uniform, mature safety culture
- Determine whether demographic characteristics caused participants to perceive the key enablers of a mature, uniform safety culture differently.

Based on the above objectives and the literature review, the researcher compiled a questionnaire that would gather participants' perceptions of the safety culture of their firm in terms of five enablers of a uniform, mature safety culture: management and employee commitment; communication and trust; accountability and involvement; risk awareness and compliance; and recognition. The literature review revealed more enablers; however, the researcher focused on these to avoid making the questionnaire too long and unwieldy.

1.4 Scope and study limitations

The scope of the study was managers' and employees' perceptions of the safety culture within the South African iron ore mining environment. The target population included managerial and lower-level employees who were responsible for OHS, production, technical services, engineering, and maintenance in iron ore mines.

Owing to logistical challenges and time constraints, convenience sampling was used to select employees of one of the country's largest iron ore mines. Therefore, because of the selection of only one organisation, generalising statistical inferences to the entire target population should be considered with caution.

The literature sources utilised in the study were readily available in electronic databases and libraries within South Africa until 31 October 2022. This might be considered a limitation.

1.5 Research design and methodology

A research design is a plan that determines the research methodology that a researcher will follow in achieving the research objectives (Bryman & Bell, 2014:382). In the study, a descriptive quantitative research design was followed to obtain

quantifiable data for statistical analysis the results of which would systematically describe the phenomenon under study.

The research methodology involved, firstly, the use of the data collection method of the analysis of documents available in electronic databases and libraries to understand the perspectives of the literature and theory on the phenomenon under study. Secondly, empirical, quantifiable data were gathered from participants through a survey in the form of a questionnaire to understand their perspectives on the topic of research to achieve the research objectives.

1.5.1 Literature and theoretical review

Access to existing research and literature was required to understand the perspectives of the literature and theory on the concepts embodied in the research objectives. Thus, information available on the internet, including peer-reviewed journals, books, organisational publications, and electronic newspapers were accessed via the following databases:

- Boloka: NWU Institutional Repository
- Emerald: International Quality journals
- ProQuest: International dissertations in full text
- SAePublications: South African journals
- ScienceDirect
- Mining Weekly

The following keywords were utilised in the internet search:

- Importance of safety in the workplace
- Significance of safety culture
- DuPont safety culture model
- Factors influencing safety culture
- Safety culture impact on production
- Significant incidents in mining – causes and learnings

- Safety climate

A sound literature theoretical background was established for the empirical study on the managers' and employees' perceptions of the current safety culture in the South African iron ore mining environment to identify gaps that could prevent occupational health and safety performance improvement to the level required for a uniform, mature safety culture.

1.5.2 Empirical study

The population for the study was 10 000 people and the sample size was 600 employees of which 441 responded to the self-administered questionnaire, which was the data collection instrument. Thus, quantifiable, numerical data were collected using the survey data collection method, which had been chosen to ensure that there was no direct contact between the researcher and the participants, which would have been the case if qualitative data through interviews had been gathered. The researcher is in a management position at the mine where the research was conducted and thus aimed to eliminate the possibility that he might influence the participants.

The six components of a safety culture, which were identified through the literature review, were incorporated into the questionnaire, which was the instrument for measuring the participants' perceptions. This questionnaire was distributed to the participants by the first-line managers in selected departments of the company chosen for the study to ensure a high completion rate. The data collected through the questionnaires were treated as confidential and analysed with the assistance of a statistician from the North-West University statistical department using the Statistical Package for Social Sciences (SPSS, 2009), the Statistical Analysis System (SAS, 2003) and Statistica (StatSoft, 2009).

1.6 Significance of the study

This study was significant because it would lead to an understanding of how and to what extent the current organisational mining culture values safety in terms of the strict safety target of zero harm. The study's results indicating the participants' shared safety values, which reflected their organisational culture, would contribute to their organisation's insights into the safety of its work environment and the factors facilitating or inhibiting a mature safety culture. Thus, the study would inform the

workforce including employees, service providers and managers about the safety of the organisation, thereby ensuring organisational performance since there is a direct relationship between safety and production, and improved safety performance will contribute to better production performance.

1.6.1 Significance of the study for managers

The perceptions captured in the study might help managers to gain insight into managers' and employees' perspectives on safety. Moreover, the study might enlighten managers as to how they can ensure a safety culture to protect employees, preserve company property and allow for effective employee and organisational performance. Recommendations based on the study results might be of use to managers in upscaling their safety measures.

1.7 Ethical considerations

The study adhered to research ethical principles because no form of physical or mental discomfort was experienced by the participants. Moreover, each questionnaire was accompanied by a consent form to allow the respondent to decide whether he/she was willing to participate in the study, thereby ensuring that participation was voluntary. In addition, confidentiality and anonymity were ensured because no participant was expected to sign their names on the response sheet, and they were not identifiable through the information that they provided. The names of the respondents and the organisation will be kept strictly confidential, while research information and recommendations will be shared.

1.8 Chapter layout

The chapters in this mini-dissertation are presented as follows:

- Chapter One: Orientation

This chapter provided the following: an introduction to the study; the problem statement; the research objectives; the scope and limitations; the research design and methodology; the significance of the study; ethical considerations, and the chapter layout.

Chapter Two: Literature review

This chapter presents a literature review on the topic of safety culture by covering the following: safety in the workplace; safety culture, key enablers of a uniform safe culture; safety culture maturity models; safety culture change; safety climate; safety culture and organisational hierarchy; the organisational culture; the importance of OHS for organisational success; and the need for safety performance changes.

Chapter Three: Empirical study

This chapter explains the empirical study by covering the following: the research process; the research design and methodology; the development of the questionnaire; the target population; sampling; and the pilot test. In addition, the chapter presents, interprets, and discusses the research results of the descriptive and inferential analyses.

Chapter Four: Conclusion

This chapter concludes the study by covering the following: the study motivation; an overview of the research objectives; conclusions; recommendations; limitations; and future research and recommendations are made based on the findings of the literature review.

1.9 Conclusion

Mining companies need to understand the enablers of a uniform, mature safety culture to formulate strategies for ensuring them throughout their organisation. This would have a positive influence on the safety behaviour of employees and the safety performance of the organisation. Moreover, the goal of any mining company should be to have a mature safety culture that is uniform throughout the organisation, including contractors to ensure good safety performance. As indicated earlier in the chapter Stemn *et al.* (2019:345) found that the employees of mines with low incidence rates had high safety maturity scores.

Although over the last few years, the overall incident figures in South African industries have dropped well below historical rates, recent safety statistics reveal an increase in reportable incidents in the iron ore mining industry. A lack of risk awareness was identified as a contributing factor toward the cause of many disturbing incidents within

the iron ore mining operations of Anglo American (Anglo American, 2021:28). Therefore, the researcher set out to understand how managers and employees of a South African iron ore mining company perceive the safety culture of their firm in terms of the enablers of a uniform mature safety culture, which were identified in the literature to make recommendations for safety performance improvement.

1.10 Chapter summary

Chapter One has presented an overview of the study by introducing it and explaining the problem statement; the research objectives; the scope and limitations; the research design and methodology; the significance of the study; ethical considerations and the chapter layout. The next chapter will be a literature review.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Chapter One gave an overview of the study and the dissertation, whilst the objective of this chapter is to conduct a review of the available literature on safety culture to develop insights as a background to the empirical study. This chapter presents a literature review on the topic of safety culture by covering the following main topics: safety in the workplace; safety culture; and the organisational culture. In addition, this chapter explains these main topics in detail, although a particular emphasis is placed on the key enablers of a mature, uniform safety culture, which underpinned the empirical study, which is explained in Chapter Three.

2.2 Safety in the workplace

The concept of safety in any context refers to the acceptance of the smallest possible risk, where risk is the product of the consequence and likelihood of possible damage that might occur (Aven & Reniers, 2013:223). In the workplace, it is the responsibility of an organisation to manage its risks to create a safer work environment and maximise its profits. Those organisations that fail to manage their risk are either too risky or require drastic changes to improve their safety performance (Zou & Sunindijo, 2013:92).

The root cause of major accidents, such as the Chernobyl disaster, has been cited as the lack of a security culture in an organisation rather than mechanical failure (Hudson, 2007:698; Knegtering & Pasman, 2009:162). Many noteworthy incidents have been attributed to organisational culture shortfalls, such as the Space Shuttle Columbia disaster (NASA, 2003:184); the Clapham Junction railway crash (Hidden, 1989:230); the Ladbroke Grove rail crash (Cullen, 2001:248); and the Waterfall rail accident (Mcinerney, 2005:482).

Bonsu *et al.* (2017:59) conducted a study to demonstrate how an accident analysis framework can be used to identify the causes of mining accidents in South Africa. The framework was developed using the multiple elements of the Swiss Cheese model, the Incident Cause Analysis Method ICAM), and the Nertney Wheel model. The

researchers collected data on 91 accidents that occurred at a platinum mine in South Africa from 2010 to 2012. The results of the analysis revealed that the most common cause of these accidents was human error, with 45% of all cases being attributed to routine violations. However, the physical environment of the workers was also identified as the most common workplace factor in these accidents, which caused 39.6% of all the accidents analysed. In addition, inadequate leadership was identified as the most common systemic factor that caused the accidents. Out of the 91 accidents analysed, over 50% were attributed to inadequate leadership (Bonsu *et al.*, 2017:59).

Over the past 20 years, the standards of OHS in the South African mining industry have improved. This improvement has been characterised by a move from a purely reactive approach (where safety measures are only put in place after an accident occurs) to a more proactive one (where measures are put in place to prevent accidents from happening). In some cases, the industry has reached a point of compliance with health and safety regulations, where the industry is meeting the minimum legal requirements for safety. This improvement in OHS performance is an indication of the growing importance of worker safety in the industry. (Mantashe, 2020). The traditional OHS techniques used to improve safety management and risk identification include employee participation (EP), process safety information (PSI), process hazard analysis (PHA), operating procedures (OP), training (TNG), contractor management (CONT), pre-startup safety review (PSSR), mechanical integrity (MI), hot work permit (HWP) and management of change (MOC). However, traditional techniques are limited to physical, mechanical, electrical, and environmental safety factors and do not take human behaviour into account (Shariff, Aziz & Majid, 2016:56).

There are several ways to achieve high levels of OHS, although not all will ensure sustainable safety performance. Some of these methods have strict procedures and systems that control risks in the workplace or create a safety culture in which everyone is personally involved, which requires the development of employees' trust and an understanding of the psychology of how they behave (Land, 2021).

Although a positive safety culture is linked to world-class safety performance, many organisations are still not fully aware of the steps necessary to create it and there is no common understanding of the concept (Stemn, *et al.*, 2019:351). Moreover, the

literature mainly focuses on the surface of safety culture, which is known as safety climate. Thus, the study excludes the psychological motivation behind employee behaviour towards occupational health and safety.

2.3 Safety culture

To create a mature, uniform safety culture in a diverse workforce that consists of permanent and service provider employees, the concept of a safety culture must be understood first. The concept of a safety culture is not a new phenomenon, as it was first suggested in 1987 in the OECD Nuclear Agency report following the Chernobyl disaster (International Nuclear Safety Advisory Group, 1999:2). Moreover, the concept has gained widespread acceptance as indicating an organisation’s commitment to employee safety through the reduction of fatalities, injuries and workplace diseases and incidents (Choudhry, Fang & Mohammed, 2007:1009).

There are a variety of definitions of the concept of a safety culture, some of which are shared by the public and research bodies as listed in Table 2.1 below. The common elements of the definitions are culture, safety, and risk management. In addition, an organisation’s commitment to a safety culture includes minimising the risks associated with occupational hazards in compliance with health and safety values, attitudes, behaviour patterns and competencies, which employees should (Tetzlaff *et al.*, 2021:202).

Table 2.1 below presents the definitions of a safety culture together with their sources.

Table 2.1: Definitions of a safety culture

Safety culture is the collective attitudes and beliefs of various groups, which influence how they behave concerning risk management systems (Hale, 2000:7).
Safety culture refers to the various aspects of an organisation that have an impact on employees' attitudes and behaviour when it comes to increasing or decreasing risk (Guldenmund, 2000:251).
Safety culture is an integral part of an organisation's culture, and it influences members' attitudes and behaviour towards safety and health (Cooper, 2000:111).
Safety culture is an area of organisational culture that affects the way people treat each other. It influences their attitudes and behaviour when it comes to safety performance (Mohamed, 2003:81).
Safety culture is a guiding principle that informs and encourages people to take actions that are designed to prevent accidents and minimise risk (Richter & Koch, 2004:705).

The safety culture of an organisation is a set of guiding principles and beliefs that an organisation has concerning occupational health and safety (Choudhry *et al.*, 2007:1009).

Safety culture is an arrangement of values, attitudes and behaviours that support the safety of employees. This system of policies, procedures and practices is designed to reduce employees' exposure to hazards and prevent accidents (Fernández-Muñiz, Montes-Peón & Vázquez-Ordás, 2007:628).

The concept of safety culture has been widely used in the field of the high-risk industry. It highlights the role of social forces within an organisation to promote safety. Understanding this concept is the most effective way of improving safety performance compared with more demanding systems/procedures and improved supervision (Antonsen, 2018:128).

2.3.1 Enablers of a mature, uniform safety culture

A safety culture like any culture is enabled by its observable artefacts, espoused values and basic assumptions (Guldenmund, 2018:23). Artefacts are easily observable and are what you see, hear, and feel. The most obvious artefact of an organisation is its architecture and design of the building, which gives a superficial indication of its culture and has an immediate emotional impact. Moreover, in the case of a safety culture, artefacts such as visible signage may indicate an organisation's commitment to health and safety. However, moving to the next level, which is espoused values, will provide a deeper understanding of the culture (Guldenmund, 2018:23).

Espoused values are what individuals consider useful, valuable, and important and the principles that they follow. Asking employees about their perceptions of health and safety would reveal whether an organisation has espoused the values of a safety culture. However, there might be inconsistencies between the values and the visible behaviours. Therefore, the basic assumptions, which would indicate an organisation's culture, including a safety culture need to be understood (Guldenmund, 2018:23).

According to Guldenmund (2018:24), basic assumptions, which are the core beliefs that underlie any culture, are often taken for granted by the people in an organisation. Basic assumptions are seldom discussed or confronted, which makes them incredibly hard to change. Therefore, learning to re-evaluate and alter core beliefs is hard, as it can destabilise an organisation and cause anxiety. People tend to interpret events according to their basic assumptions (Guldenmund, 2018:24). Therefore, to ensure a

safety culture, these basic assumptions need to be questioned by an organisation asking, “Are we safe? What are we not doing to ensure safety?”

It is very important, therefore, to define and understand the different enablers of a safety culture. Goncalves Filho and Waterson (2018:192) reviewed various safety culture maturity models to determine the enablers of a uniform, mature safety culture. Table 2.2 below lists the categories of the enablers indicated by the models and their literature sources (authors).

Table 2.2: Enablers of a mature, uniform safety culture

Category / Author	Ashcroft <i>et al.</i> 2005	Parker <i>et al.</i> 2006	Fleming 2007	Kirk <i>et al.</i> 2007	Gordon <i>et al.</i> 2007	Fleming and Wentzell 2008	Reiman & Pietikainen 2010	Law <i>et al.</i> 2010	Goncalves Filho <i>et al.</i> 2010	Vongitayapirom <i>et al.</i> 2013	Tappin <i>et al.</i> 2015	Jespersen <i>et al.</i> 2016	Jabonete and Concepcion 2016	Saunders <i>et al.</i> 2017	Σ
Communication	x	x	x	x	x		x	x	x	x	x		x	x	12
Organisational learning	x			x	x	x	x	x	x	x		x	x		10
Management commitment	x	x	x	x	x		x			x	x		x	x	10
Competency	x	x	x	x	x	x	x	x		x	x		x		11
Employee involvement		x	x		x		x		x	x	x			x	8
Compliance	x	x				x		x	x	x	x		x		8
Trust	x			x	x		x	x				x	x		7
Accountability		x	x		x					x	x			x	6
Risk awareness	x	x	x	x							x		x		6
Recognition		x	x			x				x			x		5
Planning and goal setting		x			x		x			x					4
HSE and profitability/productivity		x			x					x					3
Contractor/supplier/stakeholder management		x			x					x					3
Working under pressure						x					x			x	3
Audits & benchmarking		x			x					x					3

Source: Goncalves Filho & Waterson (2018:192)

Table 2.2 above shows fifteen key enablers of a mature, uniform safety culture maturity. However, of the enablers listed, the lowest scores were for concern for health, safety and the environment (HSE) and productivity/profitability; contractor/supplier/stakeholder management; working under pressure; and audits and benchmarking. This indicated that few authors considered them enablers of a safety culture. The highest scores were for **communication; competency; compliance; accountability; learning; commitment; risk awareness; planning and goal**

setting; recognition; trust; and involvement. These were considered by many authors as the key enablers for the development of a mature, uniform safety culture in the study. Except for planning and goal setting, these enablers were included in the questionnaire that was completed by the participants in the study (see Appendix D). The eleven enablers, which were commonly supported in the literature are explained below.

2.3.1.1 Commitment

In the context of OHS, commitment refers to the level of involvement and dedication of an organisation or individual towards ensuring a safe and healthy work environment. This can include a commitment to following OHS policies and procedures, investing in safety training and equipment and actively promoting a culture of safety in the workplace (Baker & Haugen, 2008).

Studies have shown that a strong commitment to OHS can play a significant role in improving safety in the workplace. For example, a study published in the Journal of Safety Research ((Baker & Haugen, 2008) found that companies with a strong safety culture and a high level of management commitment to OHS had lower rates of workplace accidents and injuries compared to those with a weaker commitment. Another study published in the International Journal of Injury Control and Safety Promotion (Hakansson & Hwang, 2009) found that companies with high levels of management commitment to OHS were more likely to implement effective safety programs and procedures, which in turn led to a reduction in the number of workplace accidents and injuries.

Commitment to OHS is important for creating a safe and healthy work environment and can help to ensure that workers are aware of the hazards associated with their tasks and have the necessary skills and equipment to work safely. By promoting a culture of safety and encouraging a high level of commitment to OHS, companies can help to prevent accidents and injuries in the workplace (Hakansson & Hwang, 2009).

A growing number of studies reveal that employees' perception of the organisation's commitment to safety is very important in shaping a positive safety culture (Ajmal *et al.*, 2021:269). Employees want to conform to the culture of the organisation or “the way things are done” (Tsao, Hsieh & Chen, 2017:53). True commitment should be more than just stating that safety and health are important. It should be accompanied

by employee attitudes and behaviour that ensure health and safety (Bayram, 2018:64). It is the responsibility of top managers to show their commitment to safety by displaying appropriate behaviour and attitudes, including the amount of time they spend on safety issues (Alruqi, Hallowell & Techira, 2018:166). If the management team does not visibly demonstrate its commitment to safety, it will be sending ambiguous messages to the employees, especially when they try to introduce safety procedures to which they do not adhere (Ajmal *et al.*, 2021:269).

It is, however, challenging for managers to maintain the safety of their workforce amidst the pressure of production (Hong, Ramayah & Subramaniam, 2018:180). The pressure to increase production can create a challenging environment for managers to maintain the safety of their workforce. This can be because of various reasons:

- Time constraints: In the face of tight deadlines and production targets, managers may prioritise production over safety, which can lead to a compromise in safety measures and standards.
- Resource allocation: Safety initiatives often require significant investments in terms of time and resources. With production targets to meet, managers may feel the need to allocate resources to production-related activities, leaving safety initiatives short-changed.
- Conflicting interests: In some cases, managers may feel that the interests of production and safety are at odds with each other. For instance, they may feel that slowing down production to ensure safety will negatively impact their performance and reputation.
- Lack of safety culture: Without a strong safety culture in the workplace, managers may find it difficult to motivate their workers to prioritize safety, making it challenging for them to maintain a safe working environment (Hong *et al.*, 2018:180).

Overall, the pressure to increase production can create a challenging environment for managers to maintain the safety of their workforce. However, with proper planning, leadership, and resources, it is possible to balance production and safety, creating a safer and more efficient working environment (Hong *et al.*, 2018:180). Management can achieve this by ensuring that safety is a priority, even in situations where vital

production output is lost. Consequently, the more managers are committed to safety, the more employees are trained to follow procedures and enforce safety regulations (Hong *et al.*, 2018:180). Thus, commitment from management and permanent/service provider employees to safety as a priority over production is a key enabler for the development of a mature, uniform safety culture in a mining organisation.

2.3.1.2 Competency

Competency in the context of occupational health and safety (OHS) refers to the knowledge, skills, and abilities required to perform a task or job safely and effectively. This includes an understanding of OHS principles and practices, as well as the specific requirements and procedures required for a particular job or task (Baker & Haugen, 2008).

Studies have shown that ensuring competency in OHS can have a positive impact on safety in the workplace. For example, a study published in the *Journal of Safety Research* (Baker & Haugen, 2008) found that companies that provided regular training and education on OHS to their employees had lower rates of workplace accidents and injuries compared to those that did not. Another study published in the *International Journal of Injury Control and Safety Promotion* (Hakansson, & Hwang, 2009) found that workers who received proper OHS training were more likely to follow safe work practices and take necessary precautions to prevent accidents and injuries.

Competency in OHS is important for ensuring that workers are equipped with the knowledge and skills needed to perform their jobs safely. By promoting competency, companies can ensure that workers are aware of the hazards associated with their environment.

Competency is a key enabler of a safety culture, although this requirement is often overlooked when ensuring the safety of operations (HASpod, 2019). Competency is a combination of the skills and knowledge required to minimise risks and ensure a safe work environment (HASpod, 2019). Thus, managers and employees should have the ability to recognise operational risks and use the appropriate strategies to manage them in the interests of safety.

2.3.1.3 Compliance

Compliance in OHS is the process of meeting the legal and regulatory requirements related to workplace safety and health. This includes adhering to standards, guidelines and regulations set by relevant governing bodies such as the Occupational Safety and Health Administration (OSHA) in the United States, the Health and Safety Executive in the UK (HSE) and similar organisations in other countries (Baker & Haugen, 2008).

Studies have shown that compliance with OHS regulations and standards can have a positive impact on safety in the workplace. For example, a study published in the *Journal of Safety Research* (Baker & Haugen, 2008) found that companies that consistently complied with OHS regulations had lower rates of workplace accidents and injuries compared to those that did not comply. Another study published in the *International Journal of Injury Control and Safety Promotion* (Hakansson & Hwang, 2009) found that companies that had high levels of OHS compliance and effective reporting systems had better safety outcomes compared to those that did not prioritize compliance.

It is important to note that compliance is not just a matter of following regulations and standards, but also of continuously improving OHS practices and processes. By promoting compliance, companies can ensure that they are following best practices for workplace safety and health and that they are taking all necessary steps to prevent accidents and injuries in the workplace (Hakansson & Hwang, 2009).

Managerial and employee compliance with safety procedures and regulations is a key enabler of a mature, uniform safety culture. For example, wearing the appropriate personal protective equipment (PPE) and following safety instructions and steps would ensure safety in an organisation. Safety regulations should be enforced, and if a safety violation is detected, it should be reported immediately, and action should be taken (Republic of South Africa, 1996b:1). Non-compliance with these regulations is a clear sign of a weak safety culture. Moreover, an organisation that values discipline but does not punish those who break the rules lacks credibility and would not be respected by the workforce. Therefore, safety regulations must be implemented and enforced, and a lack of discipline in managing compliance should not be tolerated (Petitta *et al.*, 2017:78).

The enforcement of compliance protects the employer, although rules and procedures need to be perceived as relevant to the work environment or employees will resent them and use shortcuts. It is, therefore, important that employees are made aware of the need for safety and trained accordingly. Moreover, they should be allowed to take part in the development of safety rules and procedures that are relevant to the ownership of the company, to ensure applicability and buy-in (Salguero-Caparrós *et al.*, 2020:117).

Compliance with safety rules and procedures comprises two elements. The first is that management needs to ensure that the safety rules and procedures are relevant to the workplace and enforce compliance with them, even using consequence management whereby formal processes are followed to address inappropriate workplace behaviour. The second is the level of responsibility of employees to comply willingly with safety rules and procedures (Petitta *et al.*, 2017:78).

2.3.1.4 *Accountability*

"Accountability" in the context of OHS refers to the responsibility of individuals, organisations and businesses to ensure that their activities and policies comply with OHS standards and regulations (Baker & Haugen, 2008). Studies have shown that accountability can play a significant role in improving safety in the workplace. For example, a study published in the Journal of Safety Research (Baker & Haugen, 2008) found that accountability measures, such as clear policies, procedures and regular monitoring, helped to reduce incidents of workplace accidents and injuries.

Another study was published in the International Journal of Injury Control and Safety Promotion (Hakansson & Hwang, 2009). found that companies with high levels of accountability and effective reporting systems had lower rates of workplace accidents and injuries compared to those with lower levels of accountability. It is important to note that accountability in OHS is not just the responsibility of management, but of all individuals in the workplace. By promoting accountability, companies can create a culture of safety that helps to prevent accidents and injuries and ensure that everyone in the workplace is working together to promote a safe and healthy environment (Hakansson & Hwang, 2009).

Accountability is a key enabler of a mature, uniform safety culture because staff members must be aware of their responsibilities in ensuring their and their colleagues'

safety (Kim *et al.*, 2019:51). To build accountability, safety objectives and targets must be clearly stated and constantly reviewed in terms of their achievement

2.3.1.5 *Learning*

Learning in OHS refers to the process of acquiring new knowledge and skills related to workplace safety, as well as incorporating that knowledge into one's practices and behaviours. It encompasses both individual and organisational learning to continuously improve safety performance (Guo *et al.*, 2017; Chen *et al.*, 2019).

Studies have shown that learning plays a crucial role in improving safety in the workplace. For example, a study by Guo *et al.* (2017) found that organisations that invest in training and education for their employees are more likely to have a positive safety culture and lower incidents of accidents and injuries. Another study by Chen *et al.* (2019) found that regular safety training and education can lead to improved employee awareness of potential hazards and increased compliance with safety policies and procedures.

In conclusion, learning is an important aspect of OHS, as it helps employees and organizations acquire the knowledge and skills necessary to effectively manage workplace safety. Continuous learning and improvement can lead to increased safety awareness, compliance with safety policies and procedures, and ultimately a reduction in workplace accidents and injuries.

Learning about OHS is a key enabler of a mature, uniform safety culture, which means that employers need to consider the extent to which their employees are trained to follow safety procedures. Moreover, as having infrequent safety lectures in the classroom is not enough, safety training programmes should be conducted on a rolling basis to ensure that all employees are trained effectively (Marquardt, 2019).

An organisation with an effective safety culture encourages its employees to share their experiences and learn from others. Moreover, management should use information gathered from employees to develop effective safety measures and re-evaluate existing ones. It is also important that organisations learn from health and safety problems and identify the root causes to prevent future mishaps (Nævestad, 2008).

An organisation needs to have a structured learning system, which involves regular, formal training in the classroom about OHS and the lessons learnt from safety incidents and the findings of root cause analyses (RCAs) conducted of safety breaches.

2.3.1.6 *Trust*

Trust in OHS refers to the belief and confidence employees have in their organisation and its leadership to prioritise and effectively manage workplace health and safety (Cooper, 2017). It encompasses both trust in management's commitment to OHS as well as trust in its ability to implement measures to ensure a safe work environment (McAtamney & Corlett).

Research has shown that trust plays a significant role in improving workplace safety. For example, a study by Lu, Chen and Yang. (2017) found that employees who trust their employer are more likely to report workplace safety incidents and take action to prevent future incidents. Another study by Xie *et al.* (2019) found that employees who trust their employer are more likely to comply with safety policies and procedures, which can reduce the incidence of accidents and injuries.

Trust in OHS is a crucial factor in promoting a safe work environment. Building trust in management's commitment to and ability to effectively manage OHS can lead to increased reporting of safety incidents and compliance with safety (Li *et al.*, 2021:2-3). Trust within an organisation is a key enabler for building a mature, uniform safety culture. Therefore, both permanent and service provider employees should feel that management trusts their judgement of safety-related issues Xie *et al.*, 2019).

An organisation's safety culture should be built on the concept of no blame whereby people are encouraged and rewarded for their efforts in ensuring safety and providing safety-related information (Lu *et al.*, 2017). However, maintaining employee trust is challenging, as there may be underlying issues that cause resistance to trust, which are intertwined with many of the safety culture elements (Li *et al.*, 2021:2-3).

2.3.1.7 *Risk awareness*

Risk awareness OHS refers to the understanding and recognition of potential hazards and the associated risks in the workplace, to reduce or eliminate them (McAtamney & Corlett, 2017). For example, employees who are aware of the risk of repetitive strain

injuries from prolonged computer use can take measures to avoid it, such as taking regular breaks, using ergonomic equipment and stretching exercises. In this way, risk awareness can improve safety in the workplace (Cooper, 2017).

Another example of risk awareness in action is in the construction industry, where workers are trained to recognise and assess potential fall hazards, such as heights, openings, and slippery surfaces. By being aware of these hazards and implementing appropriate control measures, such as scaffolding and fall protection systems, construction companies can reduce the risk of serious injury or death from falls (McAtamney & Corlett, 2017).

Overall, risk awareness is an important component of a comprehensive OHS program and is crucial for creating a safe and healthy work environment. By promoting risk awareness, organizations can identify hazards and implement effective controls to reduce the risk of harm to employees and other stakeholders (HSE, n.d.; OSHA).

OHS risk awareness in an organisation is a key enabler of a mature, uniform safety culture. Therefore, employees need to understand the possible harmful events that might occur if precautions are not taken to ensure employee health and safety. Moreover, risk awareness involves knowing the risks, their likely impact and how they should be managed. However, although the conscious mind allows a person to focus on a few things at a time, the subconscious mind allows the carrying out and repetition of actions without thinking (Borys, 2009:2-3), which means that people often do not constantly monitor and respond to safety risks (Borys, 2009:2-3). This means that companies need not only to train employees in habitual safety actions to ensure automatically safe behaviour but also to be habitually aware of risks.

2.3.1.8 Recognition

Recognition in OHS refers to the act of acknowledging and appreciating the efforts of employees for their positive contributions to the organization's safety culture. Research has shown that recognition is a key factor in promoting positive behaviour and can significantly influence the overall safety performance of an organization.

For example, according to a study by Baqir et al. (2020a), recognition of good safety performance can be a powerful tool for positive reinforcement as it motivates employees to meet desired safety outcomes and thus contribute to the organization's

safety culture. Similarly, another study by Hong, Ramayah & Subramaniam (2018) found that recognising and rewarding employees for their safe work practices can help to promote safety behaviours and reduce accidents in the workplace. Therefore, recognition in OHS plays a critical role in improving safety performance and promoting a positive safety culture within organizations.

Recognition of the good safety performance of permanent and service provider employees is a key enabler of a mature, uniform safety culture. According to Baqir *et al.* (2020a), recognising good safety performance is a powerful tool for positive reinforcement, as it motivates employees to meet desired safety outcomes, thus contributing to an organisation's safety culture. Recognition of good safety performance serves as a positive reinforcement for employees and motivates them to maintain or improve their safety performance. This can help to establish a strong safety culture in an organisation, where employees are motivated to prioritise safety and make it a priority in their work practices.

A positive safety culture can lead to numerous benefits, including reducing the frequency and severity of workplace accidents, improving employee morale and engagement, and boosting the reputation of the organization. In turn, this can lead to increased productivity and profitability.

Therefore, organisations must have mechanisms in place for recognizing and rewarding good safety performance. This could take the form of awards, bonuses, or other forms of recognition. By recognising the efforts of employees who contribute to the safety culture, organisations can motivate them to continue prioritising safety and encourage others to follow their example. Safety reward programmes with prizes, for example, would motivate employees to conform to safety cultural norms and their behaviour would comply with the safety regulations (Baqir *et al.*, 2020b:9).

2.3.1.9 *Planning and goal setting*

In the context of OHS, planning and goal setting refer to the process of establishing objectives and strategies for achieving a safe and healthy work environment. This can involve identifying hazards and assessing risk, setting safety goals, developing, and implementing safety policies/procedures and monitoring progress towards these goals over time (Baker & Haugen, 2008).

Studies have shown that effective planning and goal setting can play a significant role in improving safety in the workplace. For example, a study published in the Journal of Safety Research (Baker & Haugen, 2008) found that companies with well-developed safety plans and clear goals for improving safety were more likely to experience reductions in the number of workplace accidents and injuries. Another study published in the International Journal of Injury Control and Safety Promotion (Hakansson & Hwang, 2009) found that companies with strong safety management systems, which often included effective planning and goal setting, had lower rates of workplace accidents and injuries compared to those with weaker safety management systems.

Effective planning and goal setting are important for creating a safe and healthy work environment and can help to ensure that resources are allocated in a way that supports OHS objectives. By establishing clear goals for improving safety, and monitoring progress towards these goals over time, companies can help to prevent accidents and injuries in the workplace and promote a culture of safety (Hakansson & Hwang, 2009).

McAttamney and Corlett (2017) and Cooper (2017) indicate how planning and goal setting can be powerful enablers of a strong OHS culture in an organisation. The literature indicates that this could be achieved by doing the following:

- **Establishing Priorities:** Planning and goal setting can help an organisation to establish its OHS priorities. By setting specific and measurable goals, the organisation can focus its resources and efforts on the most important safety issues (ISO, 2018).
- **Improving Coordination:** Effective planning and goal setting can help an organisation to coordinate its OHS activities and ensure that everyone is working towards the same objectives. This can help to avoid duplication of effort and ensure that resources are being used effectively (WHO, 2019).
- **Encouraging Involvement:** Involving employees in the planning and goal-setting process can help to build a sense of ownership and encourage their involvement in OHS initiatives. This can help to create a safety culture where everyone feels responsible for the safety and works together to achieve safety goals (HSE, n.d.).

- **Measuring Progress:** Planning and goal setting provides a framework for measuring progress and evaluating the effectiveness of OHS initiatives. This can help organisations to identify areas for improvement and make necessary adjustments to achieve better results (OSHA, n.d.; BSI, 2007).

2.3.1.10 *Involvement*

Involvement in OHS refers to the active participation of employees in the development, implementation, and maintenance of OHS programmes and initiatives within an organisation. This can include activities, such as reporting hazards, providing feedback on safety policies, participating in safety committees, and training, and taking an active role in maintaining a safe workplace.

Research has shown that employee involvement in OHS is associated with improved safety outcomes, as employees who feel invested in the safety of their workplace are more likely to work safely and report hazards. For example, a study by Dong and Wang (2019) found that employee involvement in OHS initiatives was positively associated with a reduced number of accidents and injuries in the workplace.

Similarly, a systematic review by Godfrey, Lockett and Wright (2021) found that employee involvement was an important factor in the success of OHS programmes, as it helped to create a culture of safety and increased employee engagement. The authors concluded that involving employees in OHS initiatives is a key factor in reducing workplace accidents and injuries.

According to Dong and Wang (2019), employee involvement in OHS initiatives was positively associated with a reduced number of accidents and injuries in the workplace. Godfrey *et al.* (2021) also found that involving employees in OHS initiatives is a key factor in reducing workplace accidents and injuries.

A key enabler of a mature, uniform safety culture is thus the active, daily involvement of employees in safe organisation operations. Low levels of safety involvement whereby safety is mainly dependent on safety officers and frontline managers will not motivate people to be visibly involved in safety. Moreover, when employees at all levels of the organisation ensure safety as part of their regular working routine, the organisation can be confident that it has persuaded them to value safety (Roughton, Crutchfield & Waite, 2019:101).

The involvement of employees in workplace decision-making might also greatly influence safety performance. An organisation that values safety will motivate its workforce to make informed decisions in the interest of safety. Moreover, management needs to be connected to its employees to motivate them and prevent defensiveness and refusal to adhere to safety measures (Mohammadi, *et al.*, 2018:389).

2.3.1.11 Communication

Communication in OHS refers to the exchange of information, feedback and instructions between employees, managers, and stakeholders within an organisation. Effective communication is essential for ensuring a safe working environment, as it helps to promote awareness of safety issues, establish clear expectations and responsibilities, and encourage a positive safety culture (Johnstone & Ferrett, 2018).

Research has shown that communication can play a crucial role in improving OHS outcomes. For example, regular safety meetings and training sessions can keep employees informed and engaged in safety initiatives. Clear communication of policies and procedures can help ensure everyone understands their responsibilities and follows safe practices. Open and two-way communication can also help identify potential hazards and improve incident reporting (Simmons, 2017).

An effective organisational communication system that ensures that management and permanent/service provider employees receive the same message concerning security is a key enabler of a mature, uniform safety culture. Therefore, communication in an organisation must be top-down, bottom-up and horizontal to ensure the distribution of safety information. Moreover, communication should be both formal and informal between management and employees (Ederer *et al.*, 2019:38-39).

According to the MHSA, an organisation should have a structure and environment that encourages its employees to feel free from intimidation, punishment, or victimisation when they raise issues or ask questions (Republic of South Africa, 1996b:1). If employees are passionate about an issue, they must communicate their concerns and expectations to higher levels of authority. Face-to-face communication is also key to cultivating a good reporting culture, as it builds trust and ensures transparency (Ederer *et al.*, 2019:38-39), which is a crucial enabler for the overall safety improvement of the organisation

2.3.2 Safety culture maturity models

The International Atomic Energy Agency (IAEA) and DuPont's safety culture maturity models are described in this section because they use the abovementioned enablers of a mature, uniform safety culture in varying degrees and indicate phases in the development of a mature, universal safety culture. However, different parts of an organisation may exhibit characteristics that are associated with all or some of the phases. Therefore, it is crucial that an organisation first assesses its current safety maturity stage before attempting to improve its safety culture (Goncalves Filho & Waterson, 2018:193).

2.3.2.1 The International Atomic Energy Agency (IAEA) model

The IAEA model indicates three levels of an organisation's safety culture with the third level indicating that an organisation has reached the stage of safety culture maturity (De Castro *et al.*, 2013:234).

During the first phase, an organisation values safety only as an external requirement that it must fulfil to succeed and sees it as a technical issue that can be achieved through compliance. In this case, safety compliance is seen as meeting the requirements of external bodies, such as the government and other regulatory institutes. The organisation also has little awareness of their workforce's attitude to safety and their safety (International Atomic Energy Agency, 2002:17). During the first phase, the following would occur in an organisation:

- Safety problems are solved through a reactive approach;
- Little to no safety communication between organisational departments and functions;
- Autocratic decision-making about safety issues;
- Strong presence of a “blame” culture;
- Safety rules are enforced by management with no accountability for compliance by the employees;
- Limited safety training and learning from incidents;
- Employees are seen as components of the system;

- The relationship between management and employees is confrontational and argumentative; and
- Results-driven reward system.

During the second phase, an organisation's safety goals are often considered important despite the external requirements. Safety management is usually focused on procedures and solutions. However, behavioural issues are seldom considered when it comes to improving safety. In this phase, safety culture is perceived as the process of achieving and maintaining goals and objectives. This phase of the safety culture maturity model is often followed by a failure to reach or maintain a plateau in terms of health and safety performance (International Atomic Energy Agency, 2002:18). During the second phase, the following would occur in an organisation:

Increase in appreciation of the impact of cultural issues on safety improvements;

- Safety communication is encouraged by management;
- Management's remedial action for safety incidents is to implement more controls, stricter safety requirements and retraining;
- Management ensures that clear safety objectives are communicated and safety goals are reached;
- Increased eagerness to learn from others;
- Achievements that exceed goals are recognised;
- Increased teamwork; and
- The organisation is still reactive as opposed to proactive when solving safety problems.

The third phase of the IAEA safety culture model involves an organisation continuously improving its health and safety by planning and implementing a broad range of procedures to ensure safety culture maturity (International Atomic Energy Agency, 2002:19). During the third phase, the following would occur in an organisation:

- Early detection of safety issues with a proactive implementation of solutions
- Collaboration between departments concerning safety issues

- Safety always has priority over production
- Effective participation and learning from safety investigations and no blame shifting
- Effective coaching from management to improve performance
- Appreciation for organisational learning
- Employees' contribution to safety improvement is valued and recognised
- Management and employee relationship is supportive
- Decision-making recognises the impact of cultural issues

2.3.2.2 *The DuPont safety culture model*

Figure 2.1 below presents the DuPont safety culture maturity model with its four levels and the characteristics of each level.

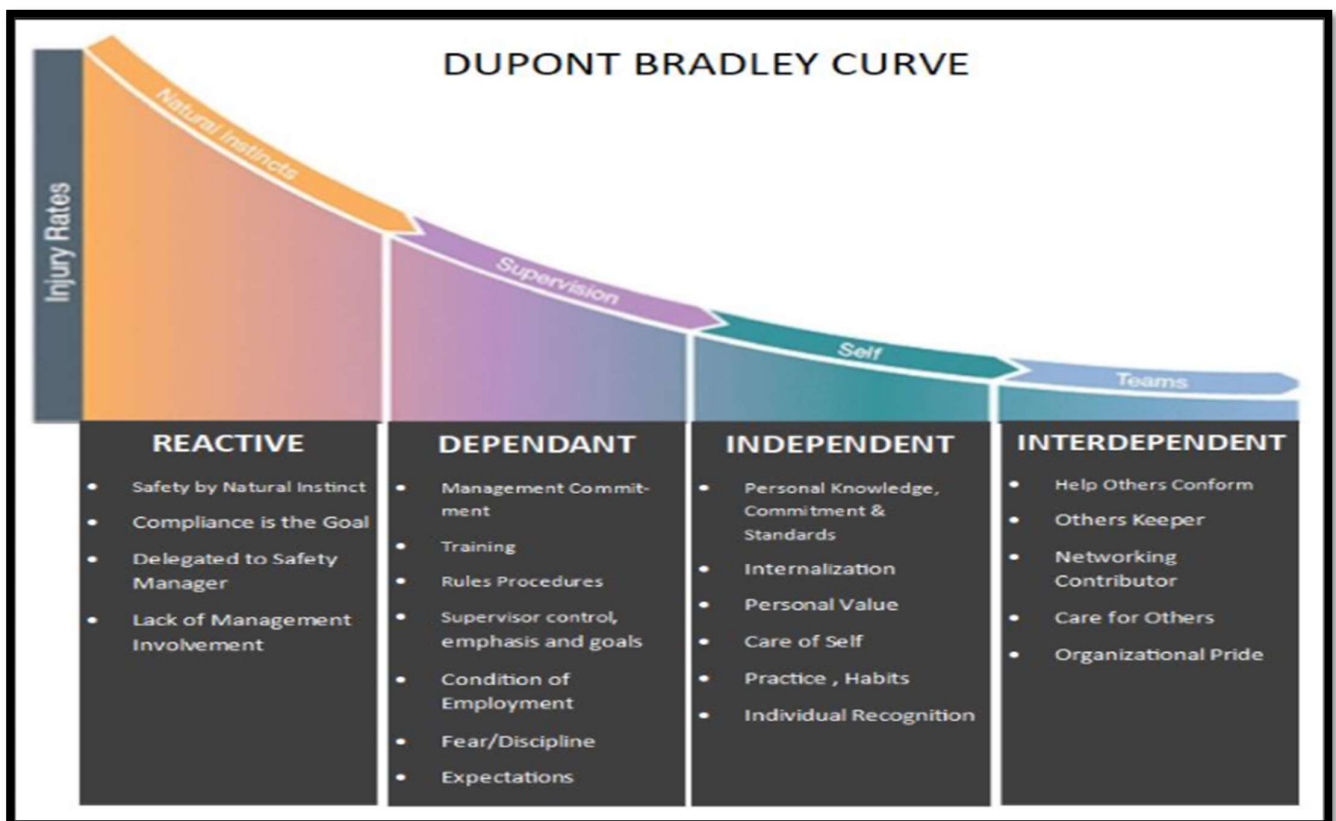


Figure 2.1: DuPont safety culture maturity model

Source: Huseman (2017)

The DuPont safety culture model shown in Figure 2.1 above emphasises the significance of a safety culture to the individual employee, which is different from that of the entire organisation. However, interdependent safety culture is the ideal stage of the DuPont model when everyone is responsible for the safety of their co-workers (DuPont Sustainable Solutions, 2021).

The first stage of the DuPont model is similar to that of the IAEA model in that it indicates a reactive safety culture focused on compliance with regulations and standards, which a management team is expected to enforce. Moreover, it is dependent on natural instincts (Huseman, 2017).

The second stage of the DuPont model indicates a dependence safety culture whereby safety is dependent on supervisors and the level of commitment shown by the senior management team to the safety measures. However, the level of commitment will always reach a plateau, which, in turn, will lead to a plateau in safety performance (DuPont Sustainable Solutions, 2021).

The third stage indicates an independent safety culture whereby an organisation moves beyond the safety performance plateau of the second stage, which depends on the individual's efforts (the self). This can be challenging because many of the changes needed to create an independent safety culture are costly and take a long time to implement. Thus, the bigger the magnitude of the change, the greater the cost and the longer the time will be to establish a mature, uniform safety culture (DuPont Sustainable Solutions, 2021).

Employees are, moreover, expected to develop safety standards and demonstrate their commitment by following them. While safety procedures and rules are still in place, employees are also made aware of their safety choices without relying on guidance (DuPont Sustainable Solutions, 2013).

The fourth and final stage of the model indicates an interdependent safety culture whereby employees have a sense of responsibility not only for their safety but also for their colleagues and work in teams. Moreover, interdependent safety culture is built on mutual trust and commitment to helping others to improve their safety performance. Thus, creating an interdependent safety culture requires continuous observation and commitment to developing an environment that encourages individuals to develop their personal safety goals (Huseman, 2017).

2.3.3 A mature, uniform safety culture as an enabler of OHS performance

A mature, uniform safety culture is an enabler of the OHS performance of an organisation whereby the number of incidents is reduced. Thus, understanding the level of an organisation's current safety culture enables the identification of the gaps that prevent OHS performance, especially when accident rates reach a plateau and bottom out (Duryan *et al.*, 2020:1). This plateau should not be ignored or restrained by anyone. It is necessary to address the concerns (hearts and minds) of the workers and management to sustain progress in safety performance and go beyond this plateau. This plateau usually occurs after the successful implementation and use of technology, safety systems and safety culture (Chen, McCabe & Hyatt, 2018:434).

Figure 2.12 below shows the evolution of safety performance.

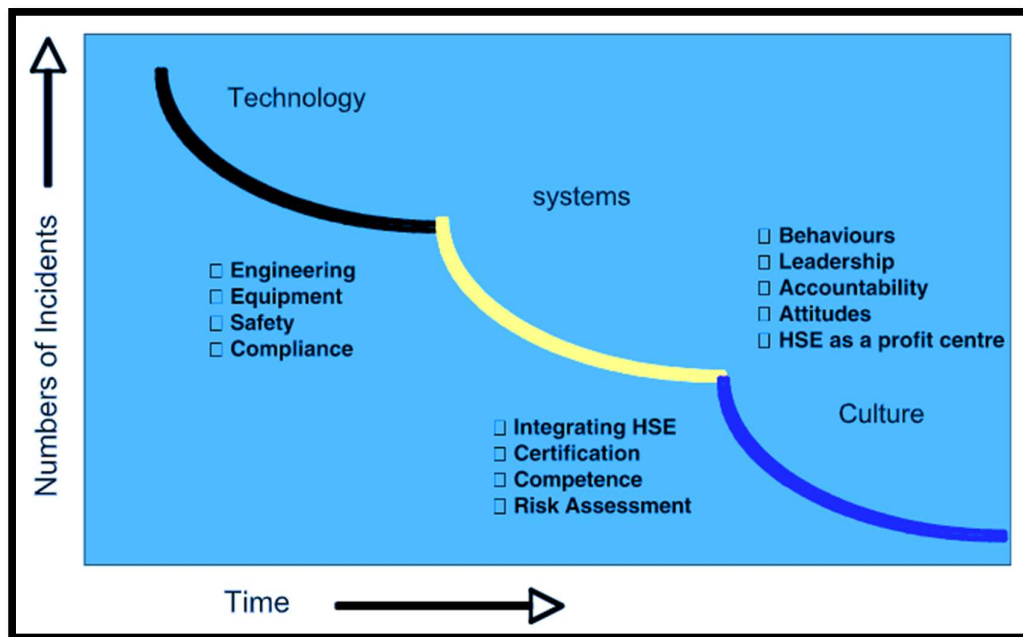


Figure 2.2: Evolution of safety performance

Source: Hudson (2007:700)

Figure 2.2 above refers to the different aspects of safety, which take part in the evolution of safety performance:

- **Technology:** This aspect refers to the use of engineering, compliance, equipment and other technical measures to improve safety. This includes the

design and development of products, processes, and work environments to reduce the risk of accidents, injuries and other harm.

- **Systems:** This aspect refers to the integration of concerns regarding health, safety, and environment (HSE), certification and risk assessment of safety systems and procedures within an organisation. This includes the development of safety policies, procedures, and management systems to ensure that safety is embedded in all aspects of an organisation's operations.
- **Culture:** This aspect refers to the attitudes, behaviours, leadership, accountability, and organisational culture of an organisation with regard to safety, including the promotion of the management of HSE management as a profit centre. This includes the promotion of a positive safety culture, where safety is seen as a priority and is embedded in the values and behaviour of employees at all levels of the organisation.

Figure 2.2 above also indicates that the application and implementation of technological and systems initiatives in an organisation's safety programme can lead to a gradual decrease in the number of incidents and a culture of safety.

2.3.4 Safety culture change

There can never be a change in the safety culture of an organisation unless its leaders are fully prepared for it (Biggs *et al.*, 2013:11). Therefore, they must believe in the change and its effectiveness. However, the process to change an organisation's safety culture is slow and challenging (Biggs *et al.*, 2013:11).

The first step in changing a safety culture is to create a reporting and a "fair-blame" culture. This will allow employees to report even the most reckless incidents without fear of punishment. Moreover, in a "fair-blame" culture, employees would be clear about the expected standards of their work but not afraid to report any reckless acts or incidents (IOSH, 2015:9). Nevertheless, although a "no-blame" culture is often referenced, it has been proven neither achievable nor desirable (Parker and Davies, 2020:646).

Unsafe acts, which are perpetrated wilfully should be severely punished. This would send a strong message to an organisation's employees and management not to

undermine the safety culture. Thus, a culture of fair blame is key to the development of an organisation's risk management system and related to an organisation's understanding of the risks, managing them, and differentiating between accidental, unsafe acts and deliberate contraventions (IOSH, 2015:2).

To know what to change, an assessment should be done to identify the gaps in an organisation's safety culture by evaluating the following factors:

- Senior management's commitment to health and safety performance;
- The extent of employee health and safety communication, education and training;
- The level of workforce involved in the safety improvement process;
- The level of employee responsibility for their safety and that of others;
- The extent of risk-taking behaviour and the tolerance thereof;
- The quality of health and safety performance measurements and enforcement; and
- Scheduled safety culture assessments that initiate safety improvement plans (IOSH, 2015:3).

2.3.5 Safety culture versus safety climate

The concept of safety climate refers to collective perceptions of safety in the workplace at a certain time, whereas a safety culture is a system of safety behaviour, attitudes and values, which have developed over time (Newaz *et al.*, 2019:10; Chen *et al.*, 2018:434). These perceptions are based on the experiences of employees and managers who have worked in the working environment and indicate the extent of the priority of safety against quality and production, which are also important to the organisation (Alruqi *et al.*, 2018:166).

The safety climate is a measure of an organisation's safety culture and is often used to evaluate its level of safety culture maturity (Dahl & Kongsvik, 2018:30). The safety climate of an organisation will endure the most significant and immediate changes following a major safety incident. However, if the safety culture is not sufficiently changed, further incidents may occur (Yule, 2003:9). Moreover, the safety climate is

a dimension of a safety culture based on employees' attitudes and perceptions, which if not supportive of safety rules and regulations, will indicate an immature safety culture (Probst *et al.*, 2019:44).

There is a lack of consensus in the literature on the factors affecting the safety climate of various industries (Hon, Chan & Yam., 2014:11) due to differences in sample size, context, and the naming of the factors. For instance, Seo *et al.* (2004:442) study five factors: management commitment, supervisor support, co-worker support, employee participation and competence level. Olsen's (2010:1515) study also determined five factors but these were organisational support for safety, transitions and teamwork, safety expectations, feedback and improvement and teamwork 5). Wu *et al.*'s (2015) literature review validated various safety climate factors identified in previous studies but formulated a set of core factors: training, safety supervision, safety involvement, safety rules and procedures, and communication. Nevertheless, despite the lack of consensus, it is widely acknowledged that knowledge of the factors can help predict safety outcomes.

The effects of a safety climate on the incidence of accidents and injuries have been researched and the findings suggest that the more positive a safety climate, the lower the accident rate because employees' safety performance is good (Pousette, Larsson & Törner, 2008:404). Moreover, studies suggest that employee behaviour is a mediator of the relationship between safety climate and injuries (Oliver *et al.*, 2002:473). Therefore, social exchange theory proposes that a positive safety climate promotes safety behaviours (Clarke, 2006:315).

If safety is overshadowed by other priorities, such as productivity and customer service, an organisation's safety climate becomes less relevant to the workers. However, a positive safety climate would indicate that safety is prioritised in the workplace and would lead to employees' evaluation of the effectiveness of policies and procedures. Moreover, a positive safety climate would indicate that employees feel valued and even rewarded for their efforts (Zohar, 2003:201).

A negative safety climate is known to be a predictor of injuries, accidents, near misses, the underreporting of safety incidents, insufficient safety knowledge, a lack of safety motivation, non-compliance with safety regulations and a lack of organisational citizenship. Therefore, an organisation should ensure a positive safety climate by

using appropriate tools and resources to measure and improve it, identifying the multiple factors that contribute to it and formulating policies and procedures that promote a safe work environment (Jiang, Lavaysse & Probst, 2019:41).

Mearns *et al.* (2013:123) use the analogy of the concept of “personality and mood” to distinguish the concept of safety culture and climate, respectively. Moreover, a safety culture refers to the relationship between the values, beliefs and practices of an organisation's employees, and a safe climate refers to the perceptions of management and employees' commitment to safety (Mearns *et al.*, 2013:123).

2.3.6 Safety culture measurement

Safety culture is built up over time and refers to the attitudes, values and behavioural norms that endorse safety in an organisation and should underpin the overall strategy and practices of an organisation. As mentioned earlier, the concept of a safety culture became prominent following the 1986 Chernobyl nuclear power plant disaster and is measured to understand how prone an organisation is to accidents, for example (Choudhry *et al.*, 2007:993). Thus, in addition to employee surveys, safety culture measurement is an integral part of many organisations' risk management efforts and the formulation of safety policies and procedures (Mannion, Konteh & Davis, 2009:153).

The goal of safety culture measurement is to provide a comprehensive view of an organisation's overall safety management system and compliance with safety standards and procedures. It is also used to predict the likelihood of various safety-related accidents in an organisation. However, although studies have shown that measuring an organisation's safety culture can predict the likelihood of an accident, they are not yet able to confirm the exact relationship between it and the actual occurrence of an accident (Christian *et al.*, 2009:1103). Nevertheless, it is generally believed that a mature safety culture is associated with a reduced likelihood of an accident and an underdeveloped safety culture would correlate with the possibility of an accident (Singer *et al.*, 2009:399).

Although different dimensions of a safety culture can be measured, the most common method of assessing them is by surveys. These are usually conducted to collect data on the perceptions of the employees about the organisation's safety culture (Mearns *et al.*, 2013:124). Thus, the various dimensions of a safety culture are included in the

survey questionnaire to help employees evaluate the effectiveness of an organisation's safety culture and help them realise that it is safe to discuss safety issues. Moreover, employees' perceptions of safety culture can also be used to make changes, influence the behaviour of workers when it comes to safety and encourages employees to improve their safety performance.

2.3.7 Safety culture and the organisational hierarchy

The literature suggests that measuring perceptions of a safety culture can be influenced by various factors in an organisation (Parand *et al.*, 2011:1184), such as an employee's position within the organisation's hierarchy (Reader *et al.*, 2015:770). Most employees lower in the organisation's hierarchy tend to perceive safety culture as less easy to engage in due to their lack of power. For instance, concerns about safety procedures or issues can be more difficult to address by employees as compared to top management (Parand *et al.*, 2011:1184). Moreover, in organisations with a high-power gradient, employees with less authority are more likely to perceive a safety culture as unachievable. This perception might also be related to a lack of confidence in the safety procedures and practices of the organisation (Reader *et al.*, 2015:770).

Despite the importance of developing a positive and shared safety culture, Antonsen (2009:183) notes that many organisations fail to achieve harmony and consensus because cultural constructs are not always the same across different levels and components of an organisation. Therefore, developing a positive and shared safety culture can be challenging. For example, different perspectives on the development of an organisation's safety culture emerge due to various factors such as the establishment of roles and their position within the organisation's hierarchy, the exercise of power and conflicts over resources (Antonsen, 2009:183).

One of the most common factors that can influence the development of a safety culture is the concept of power distance, as power is often associated with the practices that are part of a strong safety culture. For instance, when it comes to addressing safety issues, employees often must exert pressure on their colleagues, by speaking up to prevent an unsafe act by a colleague (Antonsen, 2017). They can also engage in other forms of power play, such as manoeuvring around authority, by reporting safety incidents involving those in authority. To improve the safety management system,

employees at the lower level need to communicate with those in power (Antonsen, 2017).

Case studies done by Reader & O'Connor (2014) of industrial accidents often suggest that the power-related practices of subordinates can be contributing factors to accidents. For example, in certain aviation accidents, first officers were not able to challenge the behaviour of the captains, which could have led to the incidents. Medical errors, moreover, could have been prevented if nurses had been able to speak up to senior clinicians. In other cases, technical staff members were reluctant to raise safety concerns owing due to a fear of retaliation (Reader & O'Connor, 2014:405).

Thomas, Sexton and Helmreich (2003:956) also refer to the safety culture practices of subordinates due to the power associated with positions held in an organisation. They like Reader and O'Connor (2014:405) indicate that nurses are less likely to report findings that are hard to speak up about and issues related to patient care compared with doctors, for example, who have more authority and status.

Findley *et al.* (2007:875) maintain that senior staff members are more likely to view safety measures more positively than junior staff members. Moreover, perceptions of safety management are different depending on employees' roles and positions. For instance, employees in managerial roles are more likely to have a positive perception of the organisation's safety culture than support staff or frontline workers (Findley *et al.*, 2007:875). In addition, studies reveal that when workers and managers perceive safety culture differently, it can lead to various issues. such as increased risk, decreased performance and organisational conflict (Findley *et al.*, 2007:875).

Different factors should be considered when explaining how different levels of management and workers perceive a safety culture. For instance, employees in different positions may have different levels of experience and knowledge about the organisation's safety culture. Furthermore, owing to the availability of first-hand information about the safety management system, frontline workers have a clearer view of the issues. The role and position of an individual in a hierarchy can influence how he/she communicates and interprets events. For instance, those in the higher levels of a hierarchy use positive, abstract language when describing events, while those in the lower levels use more negative, concrete language (Magee, Milliken & Lurie, 2010:354).

Another factor that can affect how people perceive safety culture is the presence of social risks. If a safety practice involves verbal communication, those in the lower levels of the hierarchy might perceive it as more challenging (Guldenmund, 2000; Holm & Lindqvist, 2010). It is easier for senior staff members to verbally communicate than for junior staff members (Hauge, & Skogstad, 2007; Rouse & Glendon, 1998). However, communication between subordinates and superiors can be asymmetrical depending on the level of the authority gradient (Bienefeld & Grote, 2012). In a hierarchy with a large authority gradient, the flow of information between the two groups is more top-down than bottom-up (Bienefeld & Grote, 2012; Zohar, 2010).

Owing to the varying viewpoints on safety culture, the perception of the management and workers of a safety problem might differ. Moreover, if frontline workers are not given enough opportunities to speak up and challenge their superiors, then they might feel less engaged in the incident reporting process (Zohar, 2010). Similarly, if the safety concerns of subordinates are taken seriously, then they might perceive management as less committed to safety. This could additionally lead to a reduction in the level of engagement in the incident reporting process (Guldenmund, 2000).

Several interventions are often carried out to reduce the power distances between the two groups. For instance, training sessions are often conducted to encourage junior staff members to speak up and challenge their superiors. Other measures are also designed to increase collaboration within the organisation and improve the psychological safety of the workers. One of these is the establishment of a leader inclusiveness policy, which refers to the words and deeds of a leader that indicate an appreciation for the contributions of others (Nembhard & Edmondson, 2006:941).

In the environment of the current study, it was expected that the high-ranking managers would be more likely to perceive the organisation's safety culture as satisfactory because they were not exposed to risk as much as employees at the lower level. This could mean that they had information about the various initiatives for improving safety, but they did not have a good understanding of the specific challenges faced by their subordinates. However, those in the lower levels of the hierarchy, such as artisans, assistants, and operational staff, were less likely to perceive the safety culture as adequate owing to the challenges that they faced and the many safety practices that they had to implement. Moreover, they were less likely

to feel that the organisation has taken adequate action to address the safety issues (Tear *et al.*, 2020:553).

2.4 Organisational culture

Organisational culture has been a controversial and the most academically researched topic in management studies (Abubakar & Isa, 2019:50). It has been acknowledged that the culture of an organisation influences employees' attitudes, values, and behaviour, which, in turn, influences its safety culture (Yulianto, 2020:20). Furthermore, the culture of an organisation is formed by the behavioural norms that its members must follow to ensure the achievement of organisational goals (Schneider, Ehrhart & Macey, 2013:361). However, according to Simoneaux and Stroud (2014:52), the way that the employees of an organisation interact with each other, and other stakeholders can be seen as the organisational culture.

Figure 2.3 below is a diagram of the components of organisational culture as explained in a chapter in the 2013 book titled *Organizational Behavior*, in 8th ed. The diagram indicates in which chapters some of the components are explained.

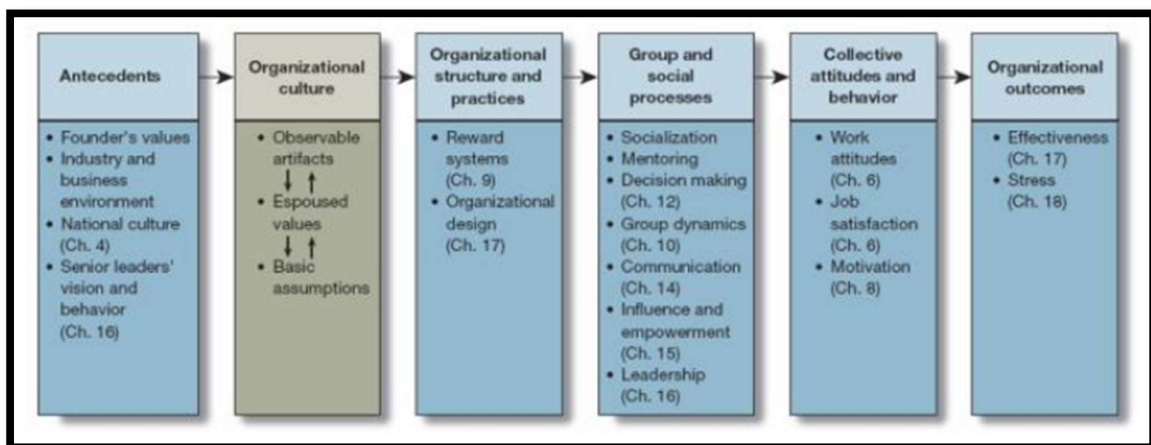


Figure 2.3: Organisational culture

Source: Kreitner & Kinicki (2013:6)

As indicated in Figure 2.3 above, the culture of an organisation is firstly influenced by its antecedents: its founders' values, the industry and business environment, national culture and the vision and behaviour of senior leaders. Therefore, this culture could eventually become entrenched and difficult to change. In particular, the national culture that underpins an organisation's culture might mean that organisational culture

is grounded in geographical, social, linguistic, and religious factors (Abubakar & Isa, 2019:51). Childhood values and beliefs might be part of organisational culture, which refines them in addition to the other cultural influences, which are reflected in the behaviour of the employees (Odor, 2018:24).

Figure 2.3 above also shows that owing to the impact of the preceding factors, discussed above, organisational culture can consist of interrelated observable artefacts, stated values and underlying beliefs that can shape organisational structures and practices, such as the rewards system and organisational design. This, in turn, affects group and social processes within the organisation, including employee socialisation, mentoring, decision-making, group dynamics, communication, individual and group influence and empowerment, and organisational leadership. These processes contribute to the collective attitudes and behaviours towards work, affecting employee job satisfaction and motivation. Ultimately, this chain of organisational components affects organisational effectiveness, but may also result in stress as an outcome.

In the context of occupational health and safety (OHS), an organisation's culture can shape the behaviour and attitudes of its employees to promote overall safety performance and establish safety structures and procedures in pursuit of the organisation's safety goals (Hamdan & Alheet, 2020:204). As described in the previous paragraph, an organisation's culture is made up of interrelated observable artefacts, stated values and underlying beliefs that can influence its structures and practices, as well as group and social processes within the organization. These processes contribute to the collective attitudes and behaviour towards safety and overall performance, making the organizational culture a critical factor in ensuring the success of OHS initiatives.

2.4.1 Organisational culture levels

Organisational culture, which is passed down from one generation to the next through the socialisation process (Schein, 2010:19), manifests itself at three fundamental levels: observable artefacts, basic assumptions, and espoused values. Moreover, these levels differ based on two elements, namely resistance to change and external visibility (Tharp, 2009:4). The concept of the three levels of organisational culture could

be applied to any group or organisation. In Figure 2.4 below, the three levels of organisational culture are shown.

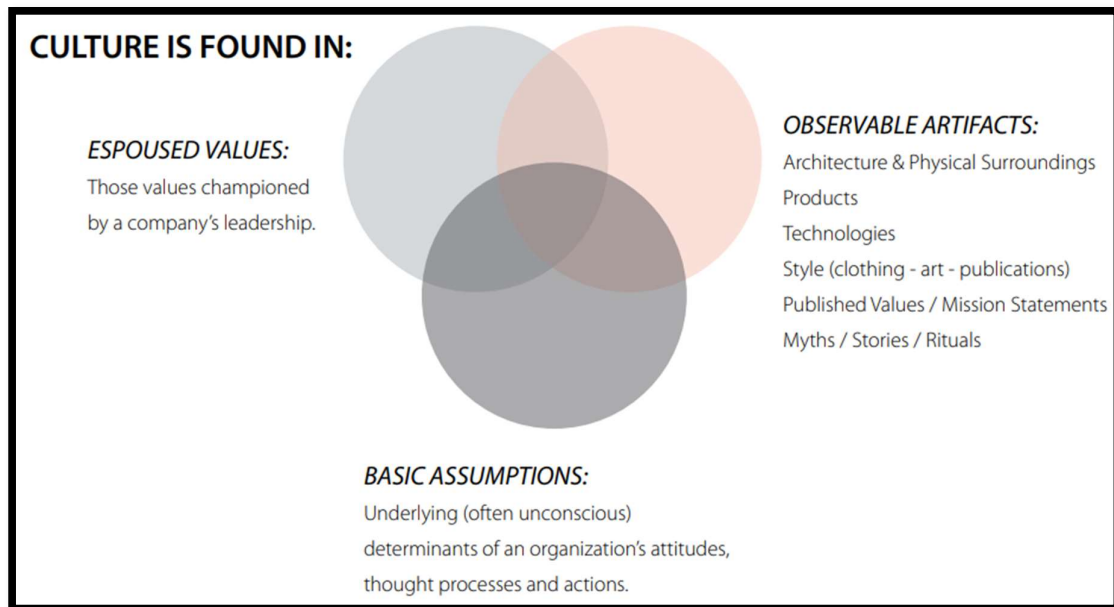


Figure 2.4: Organisational culture levels

Source: Tharp (2009:4)

Figure 2.4 above indicates the three levels, which are explained below. However, the diagram shows that the levels overlap, thereby indicating that each level can only be fully understood if the other two are considered and understood. Moreover, the area in the diagram where all three levels interact indicates the point where the culture of an organisation depends on the equal interaction of the three levels. This interrelationship between the three levels is also explained in the sections below.

2.4.1.1. Artefacts

Artefacts, which are objects that represent the physical features of an organisation, are found at the surface level of organisational culture. lie artefacts. These include displays, language, appearance, and observable rituals (Tharp, 2009:4). Artefacts are also related to the various structures and processes that influence the behaviour of the members of the organisation. It is easy to notice this level of the organisational culture but difficult to understand. Although observers can describe what they see and

feel, they cannot tell the whole story. They need to be informed about the other levels of the organisation's culture to interpret the deeper meaning behind the artefacts. Thus, understanding the espoused values and beliefs of members is an important step in achieving a deeper understanding of the artefacts (Schein, 2010:23).

2.4.1.2 *Espoused values*

Espoused values are those norms and beliefs that are usually preferred by the organisation's top management and are intended to influence employee behaviour. However, they may not always align with the enacted values that employees exhibit. This gap between the two levels of values greatly affects employee performance and is the reason why many employees' behaviour is unexplained. Understanding the next level of organisational culture, namely basic assumptions allow for the accurate prediction of behaviour (Schein, 2010:25) in terms of espoused values.

2.4.1.3 *Basic assumptions*

The level of basic assumptions is the core of organisational culture and is the most resistant to change. The basic assumptions reveal themselves through the behaviour, thoughts, perceptions, and emotions of the employees of the organisation. The basic assumptions are so taken for granted that employees would find any other assumption inconceivable (Schein, 2010:29). Furthermore, understanding the basic assumptions underlying organisational culture can help one interpret the artefacts correctly and obtain insight into the espoused values (Tharp, 2009:5).

2.4.2 *Types of organisational culture*

The literature defines the various types of organisational cultures and their relationship to organisational effectiveness (Schein, 2010; Cameron & Quin, 2011; Deal and Kennedy, 1982; Cox, 1994; Robbins, Judge & Campbell, 2017). These sources provide a comprehensive overview of the various types of organisational cultures and their impact on organisational effectiveness, including the different ways in which organisational cultures can be classified and measured. Additionally, they provide insights into how organisational culture can be managed and changed to promote effectiveness.

The three types of organisational cultures that will be discussed in this chapter are constructive, passive-defensive, and aggressive-defensive cultures. Each culture type

has its own set of normative beliefs that are associated with its members' expected behaviour (Vanesa *et al.*, 2019:38).

Although every organisation has a dominant culture, it is also possible to have various subcultures within the same institution. Therefore, understanding these subcultures can help explain the various dysfunctional behaviours that can prevent an organisation from improving its safety performance. In addition, the subcultures within an organisation can influence its overall OHS performance, and employees may not behave in a way that promotes safe behaviour unless doing so is part of their culture (Vanesa, *et al.*, 2019:39). Moreover, these subcultures might explain the different perceptions and behaviours concerning OHS in an organisation (Odor, 2018:28).

2.4.2.1 Constructive culture

A constructive culture encourages employees to interact with their peers in a way that will help them develop and grow. In addition, this type of culture endorses concepts, such as self-actualisation, accomplishment, association and humanistic-encouraging (Pérez-Mayo, 2020:2).

The concept of self-actualisation indicates an organisation that emphasises creativity and quality, whilst that of accomplishment indicates an organisational culture that values individuals and encourages them to set their own goals. The concept of association suggests an organisation that prioritises interpersonal relationships between employees, whilst the concept of humanistic-encouraging implies an organisation that promotes people-centredness and employee participation in decision-making (Rovithis *et al.*, 2017:10).

2.4.2.2 Passive-defensive culture

In a passive-defensive culture, which is typically characterised by approval, dependence and avoidance, employees avoid engaging in activities that could threaten their job security (Pérez-Mayo, 2020:2). Thus, in a passive-defensive culture, employees value the approval of their superiors who, however, limit employees' input and make them dependent on authority to ensure that they avoid acting independently. This type of culture is most often prevalent in authoritarian organisations that have a high degree of bureaucratic control while emphasising conservatism and traditionalism. It is expected of employees to conform and impress, and because of

this, they tend to shift responsibilities to others to avoid blame (Rovithis *et al.*, 2017:10).

2.4.2.3 *Aggressive-defensive culture*

This culture encourages its employees to approach their work forcefully to safeguard their status and job security by behaving in antagonistic, powerful, competitive and perfectionist ways (Pérez-Mayo, 2020:2). Therefore, employees show patterns of behaviour that is associated with conflict and culture where employees are expected to behave in a way that is consistent with the demands of superiors. Moreover, an aggressive-defensive culture that values hard work and discipline creates internal competition, with the employees being incentivised to perform well to win. Moreover, employees are expected to work hard and stay focused on their goals. They are also expected to avoid making mistakes (Rovithis *et al.*, 2017:10).

2.4.3 *Changing organisational culture*

Most of the time, the debate has been focused on the possibility of changing organisational culture, although it may be deeply embedded. While advocating for cultural change, those who focus on the more superficial aspects of culture usually consider changing the artefacts that are easier to change, compared to the deeper elements, such as values and basic assumptions. However, critics argue that unless the deeper elements, such as values and assumptions, of culture are changed, an organisation would not alter it. Moreover, many of the expected benefits of cultural change are only visible long after its implementation (Mierke & Williamson, 2017:2).

Kurt Lewin, a social psychologist, created a three-stage change model that helps people to manage and stabilise their change process. The model indicates that the three stages termed “unfreezing, changing” and refreezing” involve initiating, managing, and stabilising (Hussain *et al.*, 2018:123).

The first step of unfreezing is creating the motivation to change. This process involves identifying and disproving the usefulness of employees’ existing behaviours and attitudes. The second stage involves learning new concepts and strategies to replace the old ones. This is done by replicating a role model or inventing a new one. The third step of refreezing is ensuring that employees integrate the new behaviours, attitudes,

concepts, strategies, and models into their normal routines, through continuous positive reinforcement to stabilise the change process (Burnes, 2004:985).

Most change models are focused on identifying and addressing the problems that need to be resolved, which typically leads to deficit-based change. An alternative approach, known as appreciative enquiry (AI), is to focus on what the organisation is doing right and how those strengths can be utilised. AI helps people to develop a positive orientation that focuses on the most important issues within an organisation, which helps them to envision a future state where what should be is more than just standard. AI encourages employees to create a shared vision for the organisation, which helps them drive the organisation to be what it could be (Kelly, 2012:48).

2.4.4 The importance of OHS for organisational success

2.4.4.1 *Implications of inadequate safety performance*

(a) Moral implications

Workplace occupational disease, serious injury or fatality should not be regarded as acceptable in the mining industry. Furthermore, every mine worker has the right to return home without having experienced any harm or adverse effects on their health (Kekana, 2019). However, according to the literature (Levine & Soobader, 2003; Lee & Na, 2017), many companies tend to downplay the importance of people, who are their greatest asset, when it comes to safety. In most cases, companies that mostly employ lower or unskilled workers will spend less on employee health and safety than they should. This is because many companies see the cost of safety as an unnecessary expense and underestimate the importance of employee health and safety (ILO, 2019; OSHA, 2021; Lu & Toppinen, 2011).

The literature highlights the negative consequences of this attitude on worker health and safety and the need for policies and regulations to ensure that companies invest in appropriate safety measures (OSHA, 2021). In addition, this unacceptable approach can result in a greater financial expense for the company (Does the ROI, 2020).

The consequences of a lack of concern for OHS were revealed when the South African mining industry suffered a record number of 220 deaths in 2007, which prompted mine employees to down tools on 4 December 2007, demanding better controls to be put in

place to ensure safer mining practices (Kekana, 2019). The concerns that were raised initiated the first-ever presidential request for a comprehensive safety audit of all mines in South Africa (Kekana, 2019).

Since this safety intervention in 2007, there has been a consistent reduction in the number of fatalities in the South African mining industry. According to Minister Gwede Mantashe, the lowest number of fatalities was recorded in 2019 at 51, which is a 37% improvement from the 81 fatalities in 2018. There was also a decrease of 2% and 22.86% in occupational injuries and occupational diseases, respectively (Mantashe, 2020).

Figure 2.5 below indicates the number of fatalities in the South African mining industry from 2006 to 2021.

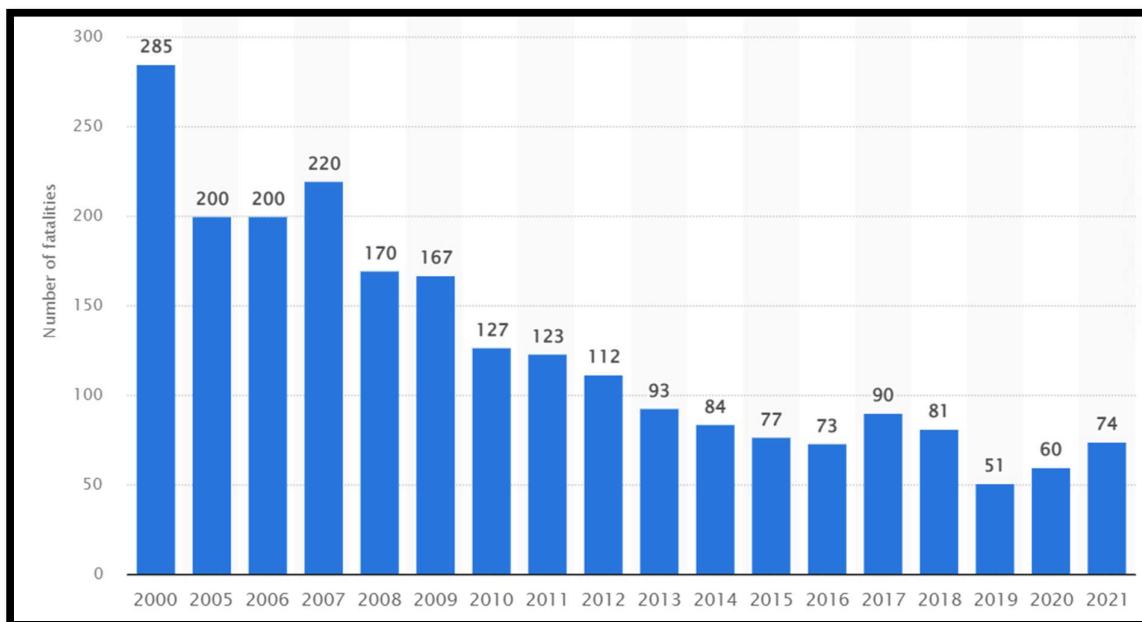


Figure 2.5: Number of fatalities in the South African mining industry

Source: Statista (2022)

As indicated in Figure 2.5 above, in 2021, however, there were 74 fatalities recorded in SA's mining industry, compared to 60 in the previous year. The spike in deaths was concentrated in the deepest mines of which some are 4km deep and thus have a poor safety record, which was the direct cause of the incidents (Mantashe, 2020). Nevertheless, in 2019, the number of mining fatalities in SA was at a record low, as there were only 51 deaths, although the death toll grew by 18% in 2020, as illustrated

in Figure 2.5 above (Statista, 2022). The current trend of fatalities in 2022 indicates that the mining industry will struggle to beat the 2019 performance (Statista, 2022).

(b) Financial implications

Being able to prevent workplace accidents makes economic sense both for society and employers, as occupational accidents are costing organisations and national economies billions of rands (Kekana, 2019). In South Africa, employers contributed R7.3 billion towards the compensation fund for the 2017/2018 financial year, and of this, the compensation fund contributed R3.6 billion to employee benefits because of death, illness, and disability due to workplace occupational injuries and diseases (Kekana, 2019). In addition, most of these costs are legal fees, workers, compensation pay-outs and medical expenses. In addition, employers incur workplace costs due to accidents, such as the cost of repairing defective or damaged equipment, time and money spent on investigations, production loss and the loss of employees because of disability due to accidents or disciplinary sanctions resulting from non-compliance with safety standards, which caused the accident (Kekana, 2019). Moreover, due to workplace accidents, employees face the costs of accommodating permanent disability or the loss of employment and income (Kekana, 2019).

(c) Legal implications

Adherence to OHS standards and regulations is not only a vital step towards providing a safer work environment but also a legal requirement (Löw & Nygren, 2019:441). This is because legislation on safety in the workplace aims to force all parties involved in ensuring OHS to improve their safety performance and maintain an acceptable level of safety in the workplace. Therefore, section 24 of the Bill of Rights of the Constitution of the Republic of South Africa Act 108 of 1996 states, "Everyone has the right to an environment that is not harmful to their health and well-being" (Republic of South Africa, 1996a), which must also be applied to the work environment (Rights, 2021). Likewise, the Occupational Health and Safety Act 85 of 1993 (Republic of South Africa, 1993:1) and the Mine Health and Safety Act 29 of 1996 (Republic of South Africa, 1996b:1) note that employers must take all necessary steps as far as reasonably practicable to ensure that all employees are protected from health and safety risks in the workplace.

Failure to comply with these Acts could have significant implications for both the employer and the employee. For example, in the event of an accident, not only might an employee be harmed but also failure to comply with the regulations could result in an employer being charged with culpable homicide. This is in addition to the possibility of being imprisoned (South Africa, 1993:27). Moreover, when a task in the workplace environment is deemed to be unsafe in terms of the law, the employer could be prohibited from continuing with the task, which in turn results into production and financial losses).

2.4.4.2 Implications of good safety performance

(a) Good business performance

A safe working environment is an integral part of any organisation's success. As there are consequences for non-compliance to OHS legislation, so there are benefits to ensuring good safety performance. Moreover, no company can build and sustain a high level of productivity without ensuring a safe work environment (Shaw, 2019). Therefore, safety performance has become a key component of good business performance and a key organisational performance indicator, which is used to identify areas where a company could improve their operations and make them more sustainable. Furthermore, how an organisation manages the safety of its employees indicates how well it is generally managed and whether it can be a good business partner (Josey, 2017).

The economic effects of OHS on a firm's bottom line and the profitability of a company are numerous. For instance, mitigating the risk of an incident can ensure that the production process will not be interrupted and prevent a drop in productivity. In addition, according to Munnoo (2018), some of the economic benefits of good safety performance include lower insurance, less legal and medical cost; fewer liabilities and accidents; higher productivity, efficiency and quality; a better company image and a greater competitive advantage (Munnoo, 2018). Furthermore, safe working conditions have a positive effect on employee morale and productivity and ensure the retention of customer loyalty and good public relations, because repeated accidents damage a company's reputation (Josey, 2017).

Good safety performance will prevent a company's loss of market position, value creation and reduced competitive advantage due to a poor safety record. Therefore, controlling occupational hazards and risks and preventing occupational incidents and diseases is an essential elements of business management (Munnoo, 2018).

2.4.4.3 Transformation of safety performance

Implementing changes in an organisation's safety performance can be challenging because it involves implementing cultural changes (ABS Group, 2018). However, Fitzgerald (2005:324) maintains that the transformation of an organisation's safety performance can take place in three distinct phases, which involve cultural challenges: acceptance that accidents go with the job; a dramatic improvement due to well-defined initiatives and a change in mindset; and a roller-coaster trend in safety performance (Fitzgerald, 2005:324-325).

Figure 2.5 below depicts the three phases of the transformation of safety performance.

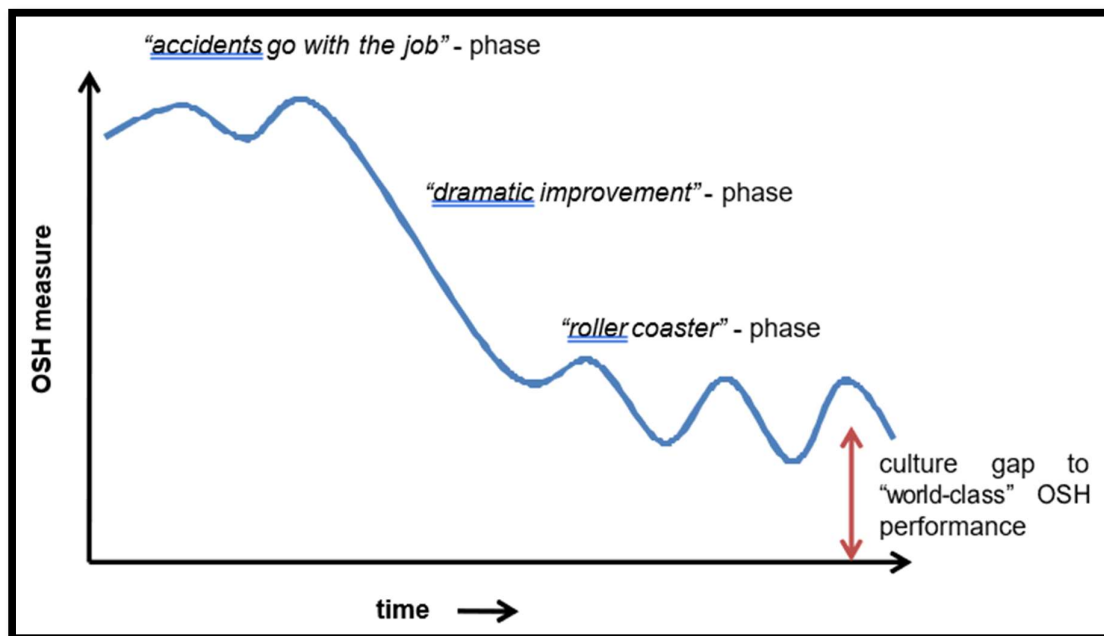


Figure 2.6: Transformation of safety performance

Source: Taylor (2002:23)

Moving beyond the roller-coaster phase of fluctuating safety performance presents a challenge and involves ensuring a mature, uniform safety culture to achieve world-class safety performance (Eccles & Manton, 2019). To do this an organisation needs

to move beyond a compliance-orientated mindset, which often leads to short-term fixes, which address the symptoms of a problem rather than the root causes (Li & Guldenmund, 2018:97). Therefore, a mature, uniform safety culture needs to be established to exit the roller-coaster phase (ABS Group, 2018) and ensure OHS, which depends not only on safe plants and processes but also the attitudes and values concerning the safety of the people in an organisation (Reynolds, 2018).

2.5 Conclusion

Successful OHS performance ensures not only benefits an organisation's employees but also its financial success and a good reputation. Moreover, it is not only a legal obligation but also a moral one. Having a poor OHS record is irresponsible, and risky and can lead to the termination of many employees, depreciation of a company's value and even an organisation closing its doors.

The literature review revealed the importance of a mature, uniform safety culture, as safety management systems and engineering controls are only part of improving safety performance. Moreover, building this culture requires the alignment of management with it and employee engagement. Developing the key enablers of mature, uniform safety culture will lead to successful OHS performance, although many organisations fail to realise their importance and thus do not address them.

2.6 Chapter summary

This chapter presented a literature review on the following main topics: safety in the workplace; safety culture; and organisational culture. The chapter explained these topics in detail, although the particular emphasis was placed on the key enablers of a mature, uniform safety culture, which underpinned the empirical study explained in Chapter Three.

The first section of the chapter focused on the importance of OHS in the workplace, as the human, financial and legal implications and costs of accidents are enormous, especially in South Africa. The chapter highlighted that the implementation of safety management systems has yielded limited results leaving a gap in the OHS of organisations. However, the concept of safety culture has developed to close the safety performance gap. Thus, the chapter explored the complex topic of a safety

culture, especially in terms of a mature, uniform safety culture. In addition, the chapter explored the topic of organisational culture, particularly in terms of OHS.

The next chapter will explain the empirical study that investigated the safety culture of South Africa's iron ore mining industry.

CHAPTER THREE

EMPIRICAL STUDY

3.1 Introduction

All mining activities in both small and large mines are inherently dangerous. This is mainly due to the risks that miners are exposed to while working in the mine. These risks include floods, fires, ground collisions, pollutants such as vehicles and machinery, fumed silica, mercury and other chemicals, poor ventilation, confined spaces, and excessive exercise (ILO, 2021). Nevertheless, it has been identified that very few accidents occur due to unsafe physical or mechanical workplace conditions (SM & Gerald, 2017:271). Most of the hazardous incidents which have been reported can be traced back to the dangerous behaviour of individuals (Hudson, 2007:717; Parker *et al.*, 2006:552).

An understanding of safety risks and improvement of safety performance might be accomplished by understanding the minds of management and workers regarding occupational safety, which determines a firm's safety culture. For this reason, the key enablers of a uniform, mature safety culture were empirically investigated in the current study to determine whether the South African iron ore mining firm selected for the research had promoted a safe working environment mentality amongst its management and employees.

The previous chapter outlined the literature on the concepts of safety on the workplace, safety culture and organisational culture. In particular, the key enablers of a uniform, mature safety culture were identified in the literature. This chapter explains the empirical study by covering the following: the research process; the research design and methodology; the development of the questionnaire; the target population; sampling; and the pilot test. In addition, the chapter presents, interprets, and discusses the research results of the descriptive and inferential analyses.

3.2 Research approach

The research process began with the problem statement and researcher objectives concerning the key enablers of a mature, uniform safety culture the details of which are covered in Chapter One. The literature survey explained in Chapter Two was

conducted to unpack the key enablers for a mature, uniform safety culture. This chapter explains the research design, which determined the methodology for choosing, constructing, and testing the data collection instrument, selecting the study population and participants, and collecting the data. Moreover, the statistical data analysis is explained in this chapter. Figure 3.1 below indicates the research process followed in the study.

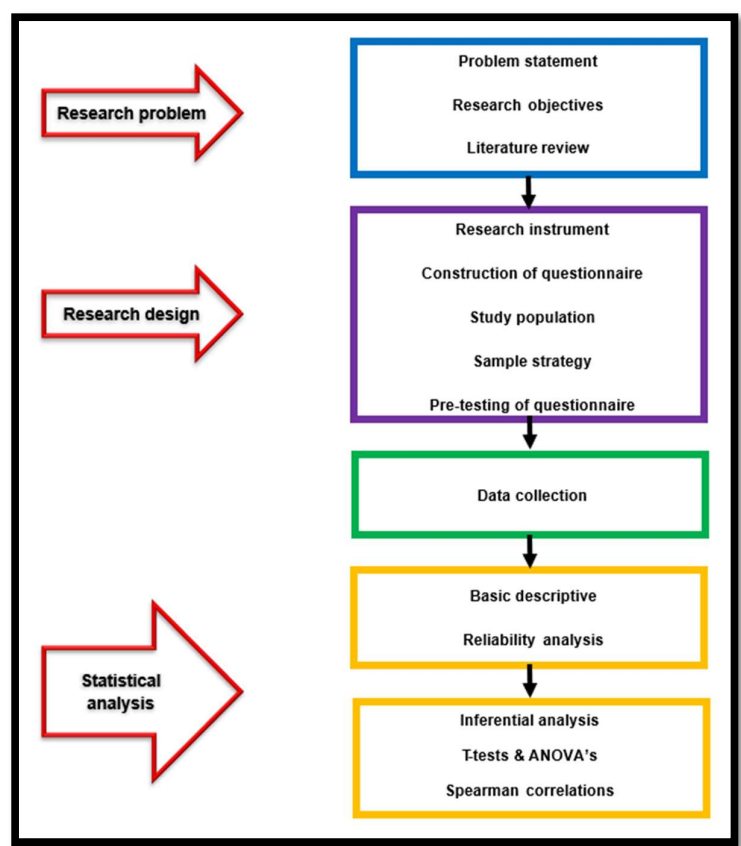


Figure 3.1: Research process

3.3 Research design and methodology

A research design is a plan that determines the research methodology of a study (Bryman & Bell, 2014:382). In the study, a descriptive quantitative research design was followed to obtain quantifiable data for statistical analysis the results of which would systematically describe the phenomenon under study. Thus, quantifiable data were gathered for the empirical study from participants through a survey in the form of a questionnaire to understand their perspectives on the social culture of their firm to achieve the research objectives.

In studies of safety culture, the quantitative method has been predominately used as an adequate approach to measuring organisational culture (Guldenmund, 2007:724). Thus, the quantifiable, measurable, and observable enablers of safety culture were explored through a questionnaire (Ashkanasy, Wilderom & Peterson, 2000:132)

Given the exclusive use of the quantitative approach in the current study to examine organisational safety culture, which has been criticised in past studies, it became, however, evident that the use of the survey questionnaire might have led to a shallow view of culture. Arguably, a deeper level of culture could be investigated using a qualitative approach through observation, focus groups, or individual interviews, together with organisational self-analysis, as noted by Ashkanasy *et al.*, (2000:132). Nevertheless, to meet the research aim and objectives, a self-administered questionnaire was used.

3.3.1 Questionnaire development

The self-administered questionnaire used in this study aimed to determine the level of maturity of the safety culture of the South African iron ore mining firm represented by the participants, based on the key enablers of a mature, uniform safety culture as discussed in the literature review in Chapter Two. The questionnaire was designed in two parts: (1) Demographic information, and (2) Assessment of the key safety culture enablers.

Part 1: Demographic information

The respondents were allowed to specify their gender, age group, department, years of experience, managerial level, and employment type.

Part 2: Assessment of the safety culture

Part two of the survey questionnaire was designed to assess the key enablers of a mature, uniform safety culture through set statements as presented in Figure 3.2 below. A total of 50 statements covering six safety culture enablers were randomly listed and a five-point Likert scale (1= Strongly disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly agree) was used to evaluate the respondents' level of agreement or disagreement with each of the statements. A copy of the questionnaire is attached in Appendix A of this document. Figure 3.2 below indicates the structure of the second part of the questionnaire.

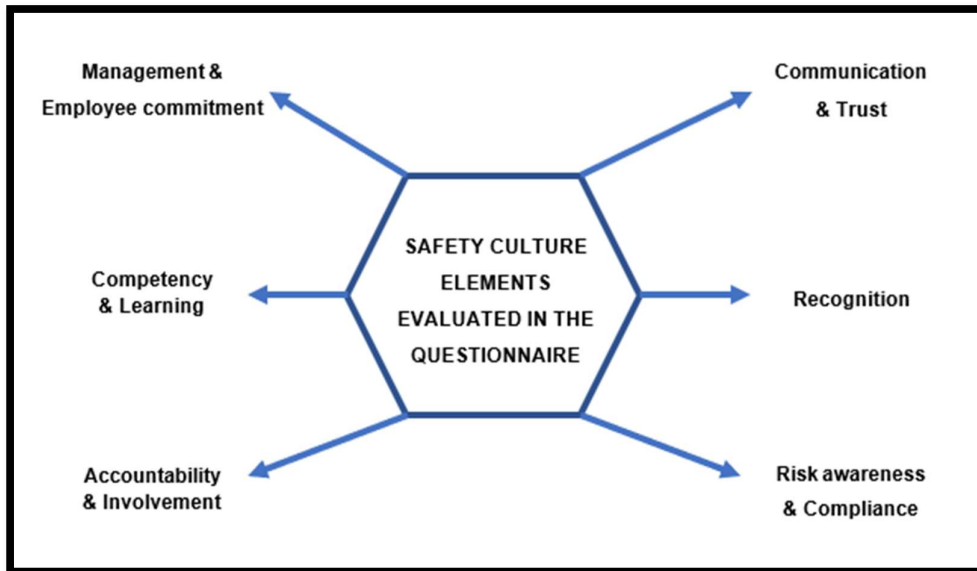


Figure 3.2: Part 2 of questionnaire

Source: Goncalves Filho & Waterson (2018)

The choice of the elements of the firm's safety culture evaluated in the questionnaire was consistent with related academic studies (Goncalves Filho & Waterson, 2018:193) and relevant to the mining environment. Some of the selected components were grouped to simplify similarities and analysis.

3.3.2 Study population

The study population of 10 000 people was inclusive of all iron-ore mining employees from different management levels, namely heads of department (HODs), section/site managers, supervisors, and employees from different departments (C&I automation, diagnostic and reliability, discipline planning, electrical services, civil and mechanical services, operational services, central workshops, DMS engineering, JIG engineering, DMS operations, JIG operations, and SHE).

3.3.3 Sampling

Sampling analysis is a process that involves identifying a small number of elements that are from a larger group of people known as a population. This allows researchers to make informed decisions regarding the larger population. Compared to the analysis of the whole population, sample analysis is more time-efficient and less cumbersome (Bryman & Bell, 2014:175).

Various methods of sampling can be used, including probability/non-probability sampling, simple random sampling, stratified sampling, cluster sampling, systematic sampling and convenience sampling, amongst others. The choice of method will depend on the complexity of the study and the research objectives. It is essential to note that the inferences derived from sampling should be treated with caution, as they are based on a representative subset of the population and provide conclusions about the entire population based on that subset.

In the study, convenience non-probability sampling was used to select 600 employees of one of the country's largest iron ore mines from the above-mentioned. The sample was representative of the study population of 10 000 because they represented the different management levels of the population explained above. However, because of the selection of only one organisation, generalising statistical inferences to the entire target population should be considered with caution.

For the study, a sample of 600 individuals was taken from the operations department's employee database. This group included 5 C&I automation, 5 diagnostic and reliability, 5 discipline planning, 30 electrical services, 235 civil and mechanical services, 20 operational services, 135 central workshops, 75 DMS engineering, 50 JIG engineering, and 40 DMS operations. The proportions of these individuals, which represented the department's size, were determined using easy accessibility.

The questionnaires were distributed and collected by the HR advisors of each of the different departments of interest. More convenient distributing channels such as email or the internet were also utilized, mainly for section managers and supervisors that have access to computers. From the questionnaires distributed to the sample of 600 employees, 411 (n) fully completed questionnaires were returned before the cut-off date which constitutes a 69% response rate. This low figure is mainly due to the high number of participants who are shift workers. They are not always on duty and therefore do not respond well to the survey. Another reason why the response rate was low could be attributed to the workload in the maintenance department. This department's high workload resulted in some participants not completing and even blanking out the questionnaires. Due to the low response rate, the researcher cautions against drawing inferences from the sample.

During the study, the participants' anonymity was maintained. They were not required to provide any information that could be used by the researcher to identify them. This method was also designed to enhance the honesty of the survey's results.

3.3.4 Questionnaire pilot testing

The purpose of pilot testing, which is also known as pre-testing the questionnaire, is considered a useful practice to ensure that a high-quality questionnaire is designed. (Kumari *et al.*, 2020:1698).

Questionnaire piloting allows the researcher to assess whether:

- The instructions of the questionnaire are designed in a simple language to be followed easily.
- To check if all the statements per construct are fully understood by the respondent.
- To check if the statement sequence is logical.
- To determine if the language and wording are understandable and not contradictory.

The questionnaire was piloted with six employees from different departments. Suggestions were made regarding language as well as the ambiguity and sensitivity of the statements. Adjustments were made, and a clean and updated questionnaire was sent to the entire population of interest.

3.4 Data analysis

The data gathered through the questionnaire were statistically analysed to generate descriptive and inferential statistics that could be interpreted considering the research objectives. The following sections explain the statistical data analyses conducted.

3.4.1 Central tendency

Data were analysed in the study to find their central tendency, which is the extent to which all the data values are clustered around the central value, which is determined through the mean. This is calculated by summing up the values of the variables of all

observations and dividing them by the number of observations (Chakrabarty, 2021:18194).

In the study all six constructs were investigated based on a five-point Likert scale where the value of 1 corresponds with “Strongly disagree” and the value of 5 corresponds with “Strongly agree” (2=Disagree, 3= Neutral, and 4= agree). The mid-point of the five-point Likert scale is, therefore, 2,5, which means that all the mean values below 2,5 suggest that most respondents tend to disagree with the statements. The values between 2,5 and 3,5 indicate that respondents tend to neither agree nor disagree (neutral). All the means above 3,5 reflect that most respondents tend to either agree or strongly agree with the statements.

The variance is calculated by identifying the squared difference between an observation and the mean, summing up for all cases and dividing by the number of observations minus one (Bryman & Bell, 2014:200).

The standard deviation also known as SD is calculated as the square root of the variance. The standard deviation explains the average scattering of values around the mean (Bryman & Bell, 2014:200).

3.4.2 Cronbach's alpha

Cronbach's alpha was used to test the reliability of the six constructs in the questionnaire including their items to measure their internal consistency. The purpose of reliability analysis is to ensure that the statements appearing in a questionnaire are measuring the same concept (Field, 2009:674). The higher the Cronbach's alpha coefficient resulting from the test, the more reliable the questionnaire constructs. In other words, if a similar individual response is observed in a series of statements, it can be concluded that the statements are measuring the same constructs. For items to be considered reliable, a generally accepted value above 0.7 is required (Bryman & Bell, 2014:37-38). However, when dealing with psychological constructs, values are realistically expected to be less than 0.7 due to the variety of components measured (Field, 2009:675).

If the alpha value of a group of statements that describe an element of the safety culture is low, this would indicate that some statements in the element are not associated with it. These statements should, therefore, be removed from the construct.

The criterion for determining if a statement should be omitted is "total correlation of items". If the "total correlation of items" is low, the researcher should consider deleting the item. Therefore, in the study, Cronbach's alpha coefficient was calculated for each of the six constructs each of which was described by a series of statements.

3.4.3 Statistical inference

In this study, an independent sample test and analysis of variance (ANOVA) were used to examine the relationships between the safety culture constructs and the demographic variables (age group, gender, age, department, years of service, management level and employment category). The analysis aimed to determine if there was a statistically significant difference between the scores based on the average. For instance, did gender influence participants' responses concerning specific safety culture constructs, such as management and employee commitment (Field, 2009: 328)?

The independent sample t-test, also known as the two-sample t-test, compares the mean of one variable in two case groups. This test is often used to compare groups with dichotomous variables; that is a group with only two categories, such as gender. The ANOVA test in contrast is an extension of the independent sample t-test, which produces a one-way ANOVA of continuous dependent variables with a single category independent variable consisting of three or more categories. ANOVA is used to test the hypothesis that multiple means are the same. If the ANOVA test determines that the means are not the same, a post-test is run in pairs to determine which group means are different. If the p-value is less than 0.05 in either the t-test or ANOVA, the variables in question are statistically significantly related (SPSS, 2009).

The results that are statistically significant at traditional levels may not be substantially significant when measured relative to the magnitude of the effect, while the non-significant results may also be perceived as important. The interpretation of empirical data based solely on statistically significant tests can lead to the misrepresentation of study results. Notably, the current study's sample was one of convenience and not a random sample from the population. Therefore, the statistical significance (p-value) should be treated with caution. Rather, its practical importance should be considered (Bryman & Bell, 2014:36). Therefore, this requires the use of effect sizes, which demonstrate practical importance.

In particular, the effect size used in the study was Cohen's d value. Since Cohen's d value is sample size independent, it is also calculated based on the answers to the questionnaire to determine a substantially significant difference between the independent variables (biological variables in this case) (Field, 2009:32; Thompson, 2001:80). According to Fitts (2020:2), the d-value is interpreted as follows:

- D-value in the region of 0.2 → small effect size, indicating no practically significant difference.
- D-value in the region 0.5 → medium effect size, indicating the practically visible difference.
- D-value in the region greater than 0.8 → large effect size, indicating a practically important/significant difference

3.4.4 Correlation Analysis

The last statistical method used was correlation analysis, which measured how a change in one variable is related to a change in another, thereby showing the relationship between two or more variables (Bryman & Bell, 2014:321). The range of correlation coefficients ranges from -1 for a perfectly negative correlation to +1 for a perfectly positive correlation. In the study, Spearman's rank correlation coefficient was calculated to evaluate how relationships between the safety culture constructs. This correlation coefficient is nonparametric in that it is not based on assumptions such as data normality (Field, 2009:179). A correlation coefficient value of ± 0.1 indicates a low correlation, a value of ± 0.3 means a moderate correlation, and a value greater than ± 0.5 means a substantial correlation between the two variables (Field, 2009:170).

The correlation analysis demonstrates the relationship between two variables but not the causation effect because of the following:

- The third variable problem – in any bivariate correlation, causality between two variables cannot be assumed because there may be other measured or unmeasured variables affecting the result; and
- The direction of causality – correlation coefficients indicate nothing about which variable causes the other to change.

3.5 Results of the data analysis

3.5.1. Demographic analysis results

The analysis of the demographic characteristics, namely, gender, age, departments, years of service, managerial level, and employment of the total sample of 411 employees, is presented, interpreted, and discussed in the sections below.

3.5.1.1 Gender distribution

The results indicated in Figure 3.3 show the gender distribution of respondents who participated in the study. According to the results, the majority (86%) of the respondents were male. This was the expected figure because of the low number of female employees working at mining companies.

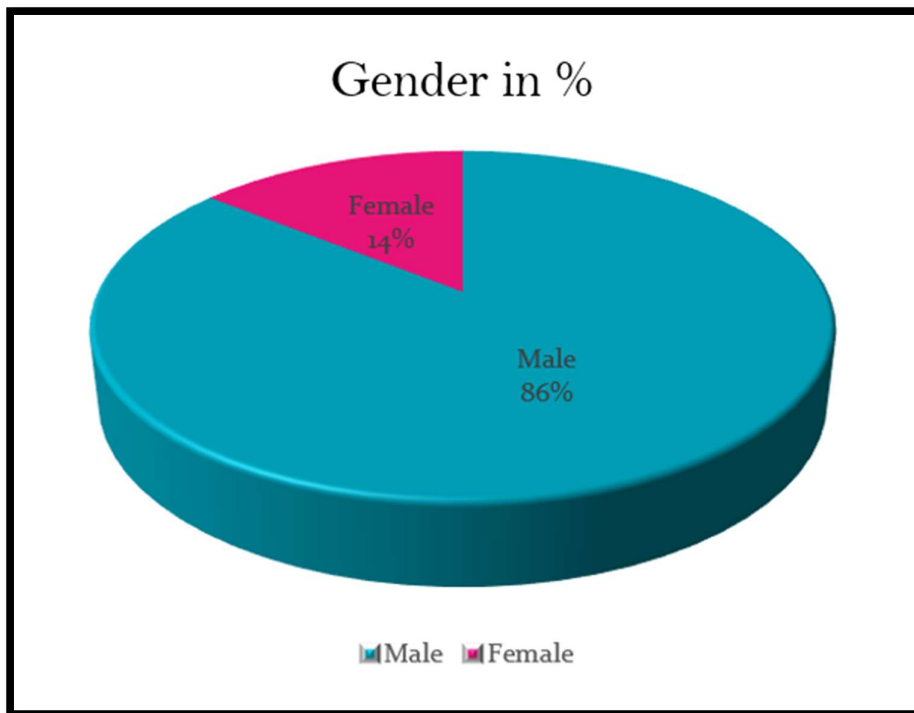


Figure 3.3: Gender

3.5.1.2 Age distribution

Figure 3.4 below shows the age distribution of respondents. The results indicated that most of the respondents were between the ages of 26 to 35 years, followed by those who were between 36 and 45 years. The least populated (2,9%) age group was 56 years and above.

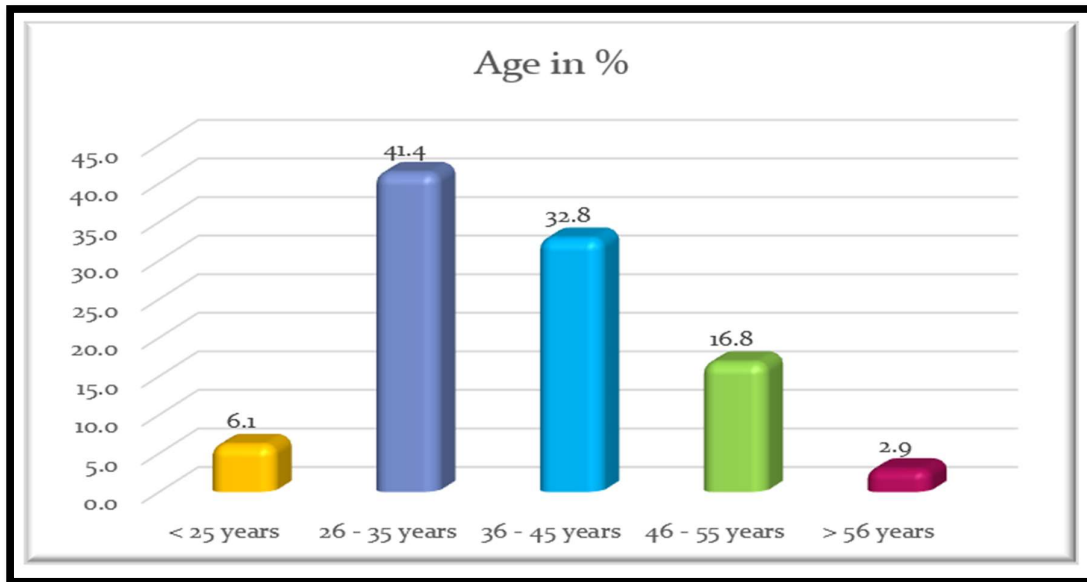


Figure 3.4: Age distribution

3.5.1.3 *Departmental distribution*

According to the results in Figure 3.5 below, the highest number (46,8%) of the respondents were from civil and mechanical services, followed by the central workshops (24,4%).

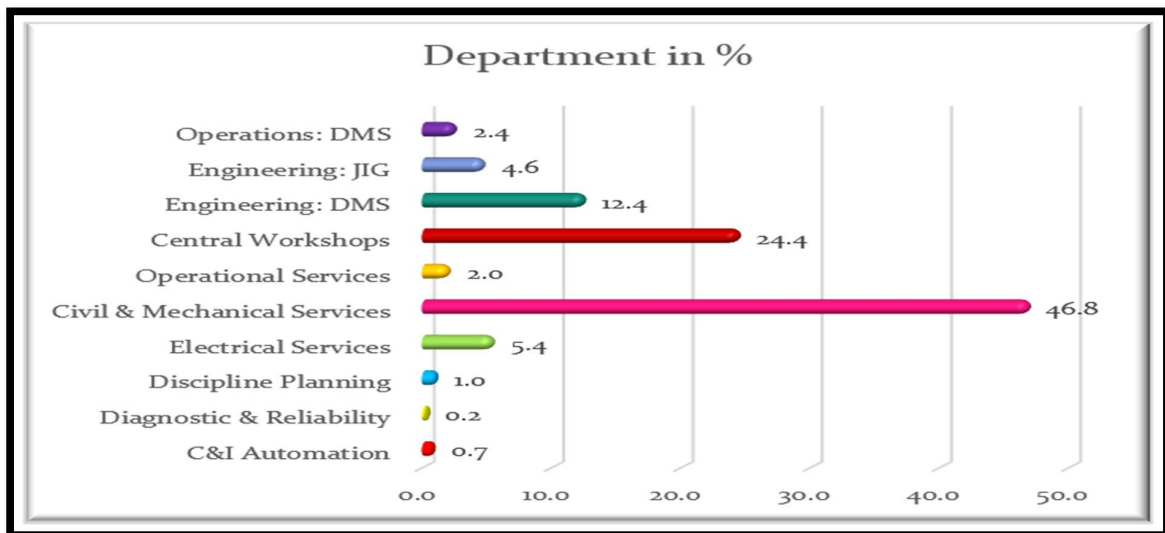


Figure 3.5: Departmental distribution

3.5.1.4 Years of experience

The results in Figure 3.6 below demonstrate that the largest portion of the respondents had from 2 to 5 years of working experience (34,6%). Only 19% of the respondents had less than 1 year of working experience.

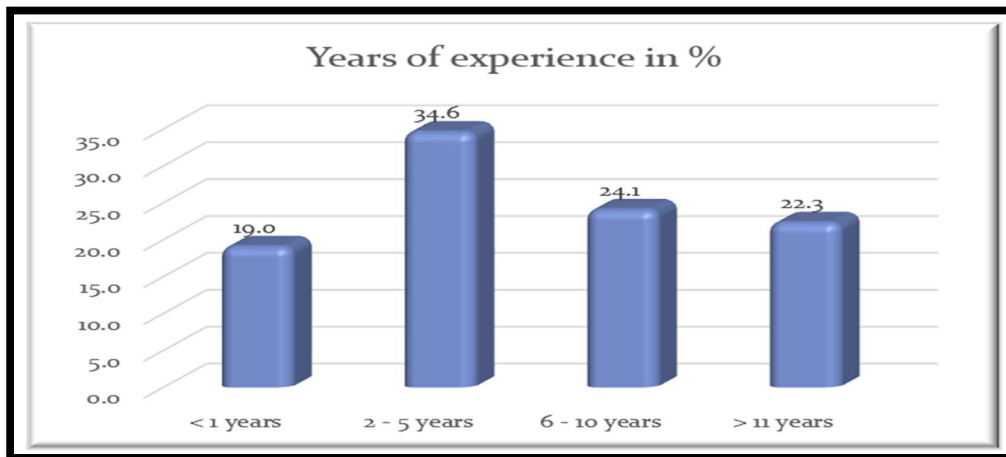


Figure 3.6: Years of experience

3.5.1.5 Management level distribution

According to Figure 3.7 below, 85,4% of respondents were employees and 14,6% occupied management level (supervisor, section manager and HOD) positions.

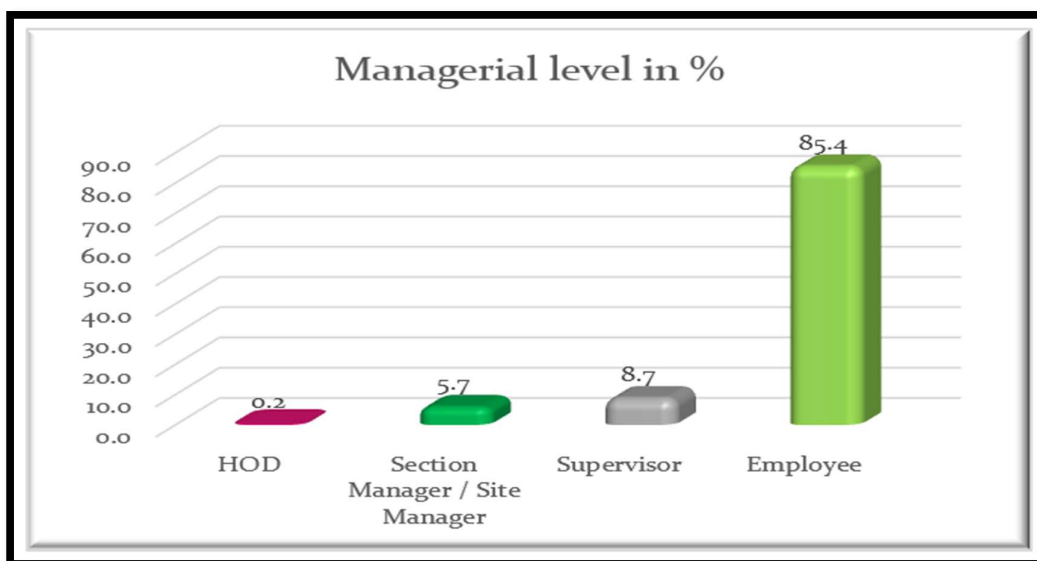


Figure 3.7: Management-level distribution

3.5.1.6 *Employee type distribution*

Figure 3.8 below indicates that the majority (62%) of the respondents were service providers, as compared with mine employees, which was anticipated.

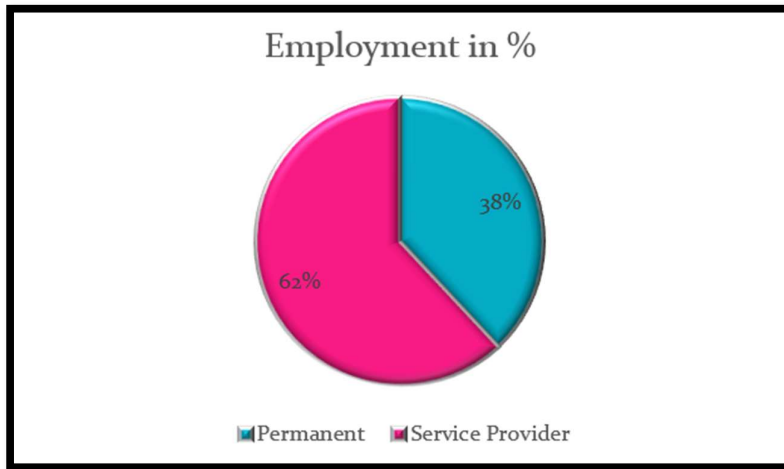


Figure 3.8: Employee type distribution

3.5.2 *Descriptive and inferential statistical analysis*

The data were analysed using the Statistical Package for Social Sciences Version 27 (SPSS, 2021). The statistical analysis was broken down into two phases. Firstly, descriptive statistics were generated for the statements/items/variables. In addition, a reliability analysis was conducted to assess the convergent and internal consistency of the six constructs: (1) management and employee commitment; (2) communication and trust; (3) accountability and involvement; (4) competency and learning; (5) risk awareness and compliance; and (6) recognition. Cronbach's alpha coefficient was used to measure the reliability of the constructs in the study. The coefficients measuring more than 0.7 ($p < 0.07$) were considered reliable, 0.06 acceptable, and those below 0.6 poor (Bryman & Bell, 2014:37-38).

The second phase of the statistical analysis involved the generation of inferential statistics to determine the relationships between the different demographical variables (gender, age, department, years of service, management level and employment level) and the safety culture variables using independent samples t-tests, analysis of variance (ANOVA) and Spearman rank correlation.

3.5.2.1 Descriptive statistics

This section describes the results of the first phase of statistical analysis. Each statement associated with the relevant component is listed with a percentage of the frequency distribution of the response based on the 5-point Likert scale options selected by the participants. The mean and standard deviation of each statement are also displayed. However, not all the items included in the descriptive analysis were computed for inferential analysis, as some items were deleted because of poor correlation. For instance, item AI50 had to be deleted because of its poor contribution of lower than 2 (0.113).

(a) Management and employee commitment

The descriptive statistics of management and employee commitment in Table 3.1 below show that the average of most statements is above 3.5 because most employees agreed with the statements made about management and employee involvement.

Table 3.1: Management and employee commitment

Items	Statements	Frequencies (%)					Descriptive	
		1	2	3	4	5	Mean	Std Deviation
MC1	Sufficient time and effort are committed to safety at the mine.	1,2	1,5	14,1	47,9	35,3	4,15	0,80
MC2	Management listens to safety ideas and concerns and takes appropriate action.	4,6	4,9	14,8	47,2	28,5	3,90	1,02
MC9	Management is involved in safety only after incidents have occurred.	12,7	20,0	14,6	30,7	22,1	3,30	1,35
MC21	Employees regularly assist their fellow colleagues to comply with safety rules.	0,7	2,7	19,2	48,2	29,2	4,02	0,81
MC23	Although safety is regarded as the top priority it is sometimes overlooked due to production or cost.	7,3	6,8	17,0	45,0	23,8	3,71	1,12
MC26	When it comes to safety compliance a lack of discipline is not tolerated by management.	1,2	3,4	13,9	49,9	31,6	4,07	0,83
MC33	Employees are motivated to put in just enough effort necessary to complete the job regardless of safety.	6,1	17,0	25,3	32,8	18,7	3,41	1,15
MC34	Management cares about the safety and health of their sub-ordinates.	4,1	5,8	18,2	49,1	22,6	3,80	0,99
MC38	The reason for not achieving our safety targets is because everyone does not value safety as important.	7,1	12,9	21,4	39,9	18,7	3,50	1,14
MC39	Management commitment to safety is visible through their actions ("walk the talk").	3,2	5,8	20,7	45,5	24,8	3,83	0,97
MC43	Management talks a lot about safety during an accident but when everything goes well, they are quiet.	8,0	16,3	20,4	34,8	20,4	3,43	1,21
MC45	Employees will rather spend more time on a job to ensure it is done safely, than rushing to complete a job.	2,4	8,0	22,1	38,4	29,0	3,83	1,01

The standard deviations show that despite the high consensus amongst most employees, some had different perspectives. For example, a high standard deviation for item MC2 (1.02) indicates that some employees disagreed with the statement.

The results further demonstrate that 91,3% of the employees agreed that sufficient time and effort are committed to safety at the mine, and when it comes to safety compliance, a lack of discipline is not tolerated by management (81,5% agreement). According to the management listens to safety ideas and concerns and takes appropriate action (75,7% agreement), and cares about the safety and health of their subordinates (71,7% agreement). Respondents also agreed that management commitment to safety is visible through their actions (70,3%). Moreover, the employees regularly assist their colleagues to comply with safety rules (77,4% agreement). These are important features of a mature, uniform safety culture as discussed in the literature (Alruqi *et al.*, 2018:166; Bayram, 2018:64).

While the results on management commitment to safety are positive, 55,2% of the respondents stated that management talks a lot about safety during an accident but when everything goes well, they are quiet. In addition, 52,8% shared that management is involved in safety only after incidents have occurred. Moreover, while most of the respondents agreed with management's general intention or commitment to stay safe, many respondents were still worried about expressing conflicting views. The results of these findings are worrisome, especially questions about how management is committed to the safety of the organisation, as this presents an unclear message from the organisation regarding management's genuine intention for safety (Ajmal *et al.*, 2021:269).

The most concerning response stated in Table 3.1 above is “when employees do whatever it takes to deliver outcomes to meet the company's expectations without looking at the safety of the environment”. In all, 51,5% of the respondents maintained that employees are motivated to put in just enough effort as is necessary to complete the job regardless of safety. Moreover, 67,4% mentioned that employees will rather spend more time on a job to ensure it is done safely, than rushing to complete a job. Notably, 58,6% of the respondents believed that the reason for not achieving set safety targets is that everyone does not value safety as important. From the above results, it

seems that the majority of the workforce was seeking a transition to a mature, uniform safety culture based on a commitment to safety.

The results presented in Table 3.2 below indicate the reliability test results of 12 statements or items, which were used to form the management and employee commitment construct.

Table 3.2: Reliability analysis – Management and employee commitment

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MC1	0,308	0,694
MC2	0,283	0,696
MC9	0,315	0,696
MC21	0,330	0,691
MC23	0,324	0,691
MC26	0,333	0,691
MC33	0,492	0,664
MC34	0,280	0,697
MC38	0,386	0,682
MC39	0,409	0,680
MC43	0,333	0,691
MC45	0,329	0,690
Cronbach's Alpha 0.707		

The alpha coefficient is 0,707, which is high. This means that all the items make a positive contribution towards the development of the scale; therefore, there was no need to delete any item to improve the alpha coefficient. Moreover, in support of the results, the correlated item-total correlation column indicates that all items are converging together in the same direction, meaning that respondents understood the statements in the same way.

(b) Communication and trust

The descriptive statistics of communication and trust commitment in Table 3.3 below show that the average of most statements is above 3.5 indicating that most of the respondents agreed with the communication and trust statements. However, item CT20 with a high standard deviation of 1,14 shows that some of the respondents tended to disagree that "employees would rather keep safety information such as near misses to themselves." Furthermore, it is observed that Item CT48 scored a low mean

(3,45), which was thus below 3.5, indicating a negative response to the statement about communication and trust: “I feel comfortable that the equipment I work with is safe”. However, the high standard deviation (1,16) of this item demonstrates that a certain number of the respondents agreed with this statement.

Because of the high mean score with low standard deviations, the results show that the highest number of respondents had positive perspectives on communication and trust, more especially on item CT3 (M=4,13) “relevant safety information is communicated to me regularly”, CT5 (M=4,05) “management has an open-door policy for safety issues”, CT25 (M=4,07) “my supervisor/manager trusts my ability to identify hazards and risks” and item CT28 (M=4,20) “I feel comfortable that the equipment I work with is safe”.

Table 3.3: Communication and trust

Items	Statements	Frequencies (%)					Descriptive	
		1	2	3	4	5	Mean	Std Deviation
CT3	Relevant safety information is communicated to me on a regular basis.	1,2	3,6	11,2	49,1	34,8	4,13	0,84
CT5	Management has an open-door policy for safety issues.	1,9	3,2	15,1	47,2	32,6	4,05	0,88
CT13	I feel comfortable to allow others to execute tasks in my area of responsibility.	1,2	3,2	17,0	54,0	24,6	3,98	0,81
CT20	Employees would rather keep safety information such as near misses to themselves.	7,1	12,4	22,1	39,9	18,5	3,50	1,14
CT25	My supervisor / manager trusts in my ability to identify hazards and risks.	1,7	1,9	14,1	52,1	30,2	4,07	0,82
CT28	I feel comfortable that the equipment I work with is safe.	1,0	2,2	9,7	50,4	36,7	4,20	0,78
CT48	The mine has a 'no-blame' culture with an atmosphere of trust.	7,8	11,9	27,0	34,3	19,0	3,45	1,16

By further examining the frequency results it is evident that the majority of the respondents had a positive perspective on communication and trust because they agreed with the statements “I feel comfortable that the equipment I work with is safe” (87,1% agreement), “relevant safety information is communicated to me regularly” (83,9% agreement) and “my supervisor/manager trusts in my ability to identify hazards and risks” (82,3% agreement). Moreover, a relatively high number of respondents

agreed with the statements “management has an open-door policy for safety issues” and “I feel comfortable to allow others to execute tasks in my area of responsibility”. Notably, more than half of respondents were dissatisfied with communication and trust to a certain extent indicated by their responses to the statements “employees would rather keep safety information such as near misses to themselves” (58,4% agreement) and “the mine has a ‘no blame’ culture with an atmosphere of trust” (53,3% agreement).

Overall, the descriptive statistics show that there seems to be an open channel of communication between management and employees. This is a positive observation, although there seem to be aspects of intimidation and retaliation when issues, such as near misses and mistakes occurred. Most of the respondents agreed that employees tend to withhold negative safety information. In the presence of a culture of blame, advancing a culture of safety turns out to be a serious, if not impossible, challenge (Li *et al.*, 2021:2-3).

The results obtained from the reliability analysis of the seven statements used to form the mature, independent safety construct of communication and trust construct indicate an acceptable Cronbach’s alpha coefficient of 0.694. However, the alpha was improved by deleting item CT20 (0,168) because of its lowest contribution to the measuring instrument (questionnaire). Therefore, the improved coefficient generated a score of 0,736 indicating good reliability.

Table 3.4: Reliability analysis – Communication and trust

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CT3	0,491	0,639
CT5	0,561	0,619
CT13	0,495	0,640
CT20	0,168	0,736
CT25	0,314	0,681
CT28	0,472	0,646
CT48	0,446	0,650
Cronbach's Alpha 0.694 Cronbach's Alpha improved 0,736		

(c) Accountability and involvement

The descriptive statistics of accountability and involvement in Table 3.5 below show that the average of most statements is above 3.5 indicating agreement with the accountability and involvement items. Most of the respondents strongly agreed with the statements AI4 (M=4,07) "I am encouraged to share my safety improvement suggestions" and AI11 (M=4,07) "Safety is how we do things around here." Employees showed average agreement for AI40 (M= 3,88) "employees at all levels are involved in decisions when it comes to safety." Notably, the highest number of respondents disagreed that "management is the primary driving force of safety, and not the employees" (M=3,04). However, the high standard deviation (1,31) score indicates that some respondents agreed that management is the primary force for safety.

Table 3.5: Accountability and involvement

Items	Statements	Frequencies (%)					Descriptive	
		1	2	3	4	5	Mean	Std Deviation
AI4	I am encouraged to share my safety improvement suggestions.	2,4	3,2	10,2	53,5	30,7	4,07	0,87
AI7	We often review new and routine tasks to determine safer ways for executing the tasks.	1,7	3,4	12,9	54,3	27,7	4,03	0,83
AI8	Everyone is accountable for their own safety.	2,4	3,4	7,8	40,9	45,5	4,24	0,91
AI11	Safety is how we do things around here.	1,0	3,9	14,4	49,1	31,6	4,07	0,84
AI16	Employees often share tips to each other on how to work safely.	2,2	4,1	12,9	48,7	32,1	4,04	0,90
AI17	There are safety systems in place to manage all hazards.	1,7	3,2	10,2	52,3	32,6	4,11	0,84
AI31	Everyone's safety is equally important, and all employees are accountable for safety.	2,4	2,2	11,7	39,9	43,8	4,20	0,91
AI40	Employees at all levels are involved in decisions when it comes to safety.	3,2	4,6	17,8	49,9	24,6	3,88	0,94
AI50	Management is the primary driving force of safety, and not the employees.	16,3	20,4	21,4	27,0	14,8	3,04	1,31

From the results, it is evident that there was a mutual engagement in accountability and involvement on the part of management and employees, which is key to moving the work forward within the organisations, especially when respondents agree that "everyone is accountable for their own safety" (86,4%), and "there are safety systems in place to manage all hazards" (84,9%). About 84,2% of the respondents agreed that

they were “encouraged to share safety improvement suggestions”. Interestingly, 82% of the respondents agreed with the statements “We often review new and routine tasks to determine safer ways for executing the tasks”, “Employees often share tips with each other on how to work safely” (80,8%), “Safety is how we do things around here” (80,7%), “Employees at all levels are involved in decisions when it comes to safety” (74,5%).

The results collected from the reliability analysis for the seven statements used to form accountability and involvement yielded a Cronbach's alpha coefficient of 0,734 which is acceptable. However, it needed to be improved because of the low contribution of item AI50 (0,113), which was excluded. The improved Cronbach's alpha coefficient accumulated to 0,784, which is above acceptable.

Table 3.6: Reliability analysis – Accountability and involvement

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
AI4	0,518	0,756
AI7	0,543	0,752
AI8	0,447	0,768
AI11	0,539	0,753
AI16	0,479	0,762
AI17	0,512	0,757
AI31	0,426	0,771
AI40	0,453	0,767
AI50	0,113	0,784
Cronbach's Alpha 0,734 Cronbach's Alpha improved 0,784		

(d) Competency and learning

The descriptive statistics of competency and learning in Table 3.7 below show that the average of all but one statement is above 3.5 indicating agreement that the firm's safety culture demonstrated competency and learning. In addition, the statements with which participants agreed had low standard deviation. The competency and learning construct was measured by seven items, and only item CL49 had a mean of 3,45, which was less than 3,50 because an average number of participants disagreed with

the statement (M=3,45) “There are a lot of repeat accidents”. However, this item had a high standard deviation, indicating that a portion of the respondents tended to agree with the statement. indicating

Table 3.7: Competency and learning

Items	Statements	Frequencies (%)					Descriptive	
		1	2	3	4	5	Mean	Std Deviation
CL12	The mine learns from past mistakes and implements appropriate preventative measures as soon as possible.	2,9	3,2	9,5	47,7	36,7	4,12	0,92
CL14	Employees working in the mine undergo comprehensive and meaningful safety training.	2,2	3,2	10,9	49,1	34,5	4,11	0,88
CL32	Most incidents are due to failures arising from the culture of the mine rather than equipment or system failures.	4,1	8,8	21,7	44,3	21,2	3,70	1,03
CL37	Most of the time short-term solutions are given for safety issues that do not address the root cause.	4,6	12,2	25,5	39,9	17,8	3,54	1,06
CL41	Employees have the necessary knowledge and skills to allow them to work safely.	1,5	3,6	11,7	53,8	29,4	4,06	0,83
CL44	The way we conduct incident investigations is indicative of a world-class mine.	1,7	5,1	24,6	43,8	24,8	3,85	0,91
CL49	There is a lot of repeat incidents.	4,1	17,3	26,8	33,3	18,5	3,45	1,10

The results show that a large majority of the respondents agreed with the statements “The mine learns from past mistakes and implements appropriate preventative measures as soon as possible” (84,4% .agreement), “Employees working in the mine undergo comprehensive and meaningful safety training” (83,6% agreement), “Employees have the necessary knowledge and skills to allow them to work safely” (83,2% agreement) and “Most incidents are due to failures arising from the culture of the mine rather than equipment or system failures” (65,5% agreement).

The results further indicate that an average number of respondents agreed with the statements “There are a lot of repeat incidents” (51,8% agreement) and “most of the time short-term solutions are given for safety issues that do not address the root cause” (57,7% agreement). Even though these statements did not achieve low scores, the overall response indicates room for improvement in the competency and learning aspects of the firm’s safety culture. to them cannot be ignored. It is important for management and staff to investigate the roots of such matters.

Table 3.8 below shows the results obtained from the reliability analysis of the seven statements that made up the competency and learning construct. Moreover, the table indicates a Cronbach's alpha coefficient of 0,646, which is moderately acceptable.

Table 3.8: Reliability analysis – Competency and learning

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CL12	0,310	0,623
CL14	0,373	0,606
CL32	0,427	0,586
CL37	0,311	0,626
CL41	0,369	0,608
CL44	0,487	0,571
CL49	0,252	0,647
Cronbach's Alpha 0,646		

(e) Risk awareness and compliance

The descriptive statistics of risk awareness and compliance in Table 3.9 below show that most of the respondents agreed with most of the statements that made up the construct of risk awareness and compliance, given the mean point score is above 3.5. However, Item RC46 has a mean score below 3.5 (M= 3,33) indicating that many respondents disagreed with the statement "Safety systems or procedures are often by-passed by employees to complete their work quicker", Although the high standard deviation score (1,11) suggests that a few of the respondents agreed with the statement.

Table 3.9: Risk awareness and compliance

Items	Statements	Frequencies (%)					Descriptive	
		1	2	3	4	5	Mean	Std Deviation
RC6	Most employees are aware of the hazards in their workplace.	1,5	2,7	11,9	47,4	36,5	4,15	0,84
RC15	We do not deviate from following standards, procedures and JRAs.	2,4	5,8	16,1	46,2	29,4	3,94	0,95
RC18	We often become complacent when it goes well and then incidents occur.	1,5	10,2	19,7	47,7	20,9	3,76	0,94
RC19	I focus on hazard identification daily when doing my work.	1,0	2,4	9,2	50,4	37,0	4,20	0,78
RC24	Doing things safely has become a habit for most employees rather than an obstacle.	1,2	2,4	16,8	54,5	25,1	4,00	0,79
RC27	Safety is seen as a condition of employment.	1,5	1,7	18,0	49,4	29,4	4,04	0,82
RC35	Some employees get away with unsafe acts.	3,4	12,7	27,5	33,8	22,6	3,60	1,07
RC46	Safety systems or procedures are often by-passed by employees to complete their work quicker.	5,8	18,7	26,8	34,1	14,6	3,33	1,11
RC47	There is satisfactory compliance with safety rules.	3,2	6,3	22,1	49,6	18,7	3,74	0,94

The frequency results show that 87,4% of the respondents agreed with the statements “I focus on hazard identification daily when doing my work”, “Most employees are aware of the hazards in their workplace” (83,9% agreement), “Doing things safely has become a habit for most employees rather than an obstacle” (79,6% agreement), and “Safety is seen as a condition of employment” (78,8% agreement). Compliance was indicated by the general agreement with the statement “We do not deviate from following standards, procedures and JRAs” (M= 75,6% agreement). Moreover, many participants agreed with the statements “We often become complacent when it goes well and then incidents occur” (68,6% agreement), which indicates that they knew the importance of constant risk awareness, and “There is satisfactory compliance with safety rules” (68,3% agreement), which indicates that employees generally adhered to the regulations. However, some employees agreed with the statements “Some employees get away with unsafe acts” (56,4% agreement) and “Safety systems or procedures are often by-passed by employees to complete their work quicker” (48,7%), which means that risk awareness and compliance need improvement in the firm.

The results obtained from the reliability analysis for the nine statements making up the risk awareness and compliance construct scored an acceptable Cronbach’s alpha coefficient of 0,679 meaning that all these items had internal consistency.

Table 3.10: Reliability analysis – Risk awareness and compliance

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
RC6	0,315	0,660
RC15	0,388	0,645
RC18	0,386	0,645
RC19	0,221	0,676
RC24	0,473	0,632
RC27	0,398	0,645
RC35	0,266	0,675
RC46	0,356	0,654
RC47	0,414	0,639
Cronbach's Alpha 0,679		

(f) Recognition

The descriptive statistics of recognition in Table 3.11 below show that most of the respondents agreed with most of the statements that made up the construct recognition. Moreover, most of the items have a low standard deviation score supporting the accuracy of the results. However, item RG42 has a high standard deviation value of 1,03 demonstrating that a few of the respondents tended to disagree with the statement “Good safety performance will lead to good business performance.” However, most respondents agreed with the statements “A job well done is a job is done safely” (M= 4,38), “Recognition for good safety performance helps to promote safe behaviour” (M=4,28) and “I am proud to be associated with this mine when it comes to safety” (M=4,17).

Table 3.11: Recognition

Items	Statements	Frequencies (%)					Descriptive	
		1	2	3	4	5	Mean	Std Deviation
RG10	Individual contributions towards safety are recognised by my organisation.	3,9	6,1	20,7	54,0	15,3	3,71	0,93
RG22	I am proud to be associated with this mine when it comes to safety.	0,5	3,4	12,7	45,5	38,0	4,17	0,81
RG29	A job well done is a job done safely.	0,7	1,0	7,8	40,4	50,1	4,38	0,73
RG30	Recognition for good safety performance helps to promote safe behaviour.	1,2	0,5	10,2	44,8	43,3	4,28	0,76
RG36	Good safety performance will lead to good business performance.	2,2	3,2	11,2	38,4	45,0	4,21	0,92
RG42	It is expected of everyone to work safe, but it is rarely recognised.	3,4	10,7	22,4	43,1	20,4	3,66	1,03

In support of the descriptive results, the frequency results show that most of the respondents have a positive perspective of recognition. The descriptive results reveal that a higher number of the respondents agree that “a job well done is a job done safely” (M= 4,38), which is highly supported by frequency results where 90,5% of the respondents strongly agree that “a job well done is a job done safely”, which is a key point for recognition. They are also in agreement that “recognition for good safety performance helps to promote safe behaviour” (88,1%), and they are “proud to be associated with this mine when it comes to safety” (83,5%) because they know that a “good safety performance will lead to good business performance” (83,4%). They further state that “individual contributions towards safety are recognised by my organisation” (69,3%); however, disappointingly “it is expected of everyone to work safely, but it is rarely recognised” (63,5%).

The results obtained from the reliability analysis for the six statements forming recognition have an acceptable Cronbach’s alpha coefficient of 0,602, meaning that all these items have internal consistency.

Table 3.12: Reliability analysis – Recognition

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
RG10	0,252	0,595
RG22	0,397	0,534
RG29	0,452	0,519
RG30	0,426	0,526
RG36	0,364	0,546
RG42	0,200	0,625
Cronbach's Alpha 0,602		

(g) Summary of descriptive statistics

Given the low Cronbach's alpha for some constructs, statements had to be removed from the questionnaire, which meant the remaining statements made a better contribution to the construct in which they were included. For instance, item CT20 of the section of the questionnaire on communication and trust was deleted and item AI50 from the section on accountability and involvement because they lacked internal inconsistency.

Figure 3.9 below indicates the mean scores for each of the six constructs, which were higher than 3,5. This suggests that the participants generally agreed that the key enablers of a mature, uniform safety culture represented by the six constructs and the statements reflecting them were in place in their firm. In addition, Figure 3.9 shows that the overall mean scores of the constructs are accountability and involvement (M=4,08) as the highest, followed by recognition (M=4,07), communication and trust (M= 3,91), risk awareness and compliance (M= 3,86), competency and learning (M= 3,83) and management and employee commitment (M= 3,75) as the lowest score.

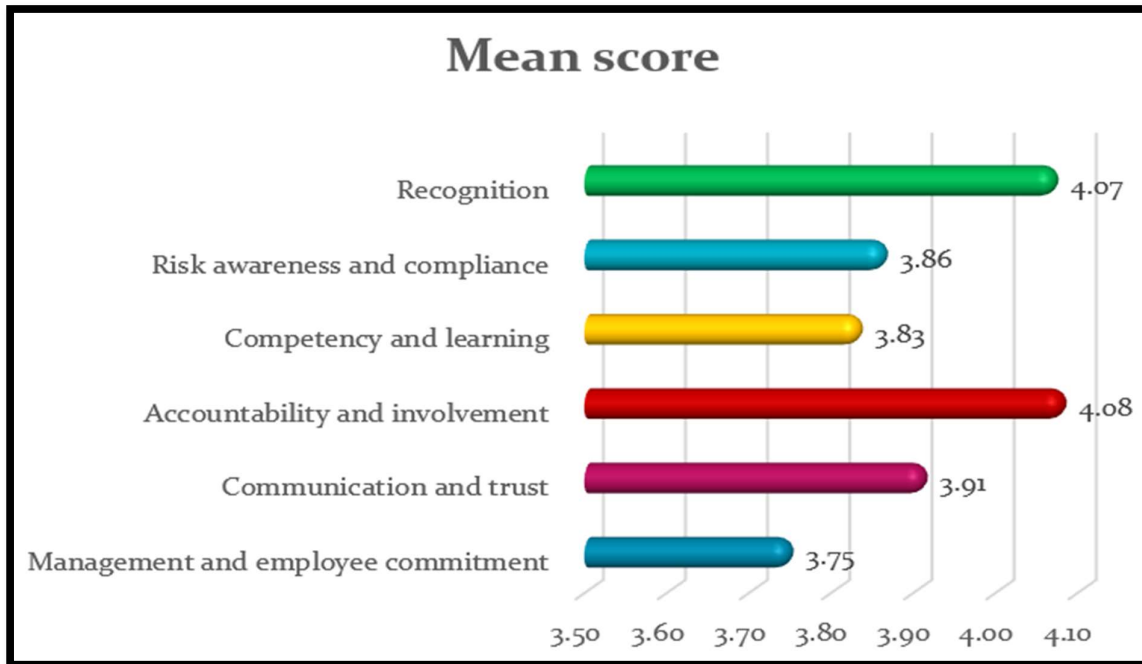


Figure 3.9: Mean scores for safety culture constructs

3.5.2.2 *Inferential statistical analysis*

In the second phase of the statistical data analysis, the relationship between the biographical variables and the six safety culture constructs was investigated. Whether the inferential statistical analysis was to be an independent sample t-test or ANOVA was determined by the nature of the variable and whether it was dichotomous or continuous.

In this section, the statistical significance (p-values) and practical significance (effect size) are presented for the sake of completeness. However, the p-values and inferences for the survey population should be considered with caution, as the sample was selected using convenience sampling as opposed to random sampling. Therefore, the practical relevance to the current sample should be emphasised.

(a) Gender

In this section, the results of the statistical analysis of the relationship between gender and the six elements of safety culture will be presented. However, before determining this relationship, the mean scores, and standard deviations of the perceptions of males and females of the safety culture enablers are compared, as indicated by the descriptive statistics in Table 3.13 below.

Table 3.13: Gender – Descriptive statistics

Safety culture elements	Gender	N	Mean	Std Deviation
Management and Employee Commitment	Male	351	3,77	0,52
	Female	58	3,62	0,43
Communication and Trust	Male	351	3,93	0,55
	Female	58	3,80	0,54
Accountability and Involvement	Male	351	4,08	0,57
	Female	58	4,06	0,50
Competency and Learning	Male	351	3,83	0,56
	Female	58	3,84	0,49
Risk Awareness and Compliance	Male	351	3,88	0,49
	Female	58	3,77	0,47
Recognition	Male	351	4,08	0,51
	Female	58	4,02	0,49

Then, to determine the difference between the scores for each gender, an independent sample test was conducted the results of which are depicted in Table 3.14 below. However, the results reveal an interesting statistical discrepancy in the mean score between males and females for the safety culture element of management and employee commitment because of the p-value below 0.05 ($p < 0.05$: 0,021). This means that the item “management and employee commitment” is perceived differently by males and females.

Table 3.14: Gender – Independent sample t-test

Safety culture elements	<i>t statistic</i>	<i>Degree of freedom</i>	<i>p-value</i>
Management and Employee Commitment	2,353	87,319	0,021
Communication and Trust	1,752	78,548	0,084
Accountability and Involvement	0,319	83,297	0,751
Competency and Learning	-0,228	83,234	0,820
Risk Awareness and Compliance	1,556	78,420	0,124
Recognition	0,902	78,426	0,370

(b) Age

This section presents the results of the analysis of the relationship between the different age groups of the respondents and the six safety culture elements. However, before determining this relationship, the mean scores, and standard deviations of the perceptions of the respondents in different age groups of the safety culture enablers are compared, as indicated by the descriptive statistics in Table 3.15 below.

Table 3.15: Age group – Descriptive statistics

Age group	Management and Employee Commitment		Communication and Trust		Accountability and Involvement		Competency and Learning		Risk Awareness and Compliance		Recognition	
	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation
< 25 years	3,95	0,49	4,00	0,48	4,18	0,44	3,97	0,56	4,17	0,52	4,11	0,42
26 - 35 years	3,74	0,51	3,91	0,60	4,06	0,58	3,81	0,55	3,82	0,52	4,07	0,54
36 - 45 years	3,74	0,54	3,91	0,55	4,10	0,58	3,84	0,58	3,88	0,49	4,08	0,52
46 - 55 years	3,71	0,45	3,86	0,47	4,02	0,50	3,81	0,50	3,79	0,39	4,04	0,43
> 56 years	3,69	0,45	4,02	0,46	4,22	0,41	3,86	0,37	3,93	0,27	3,97	0,46

Then, to determine the difference between the scores for each age group, an ANOVA was conducted the results of which are depicted in Table 3.16. However, the ANOVA results in Table 3.16 show that out of all six safety culture enablers, only one indicates a statistically significant result. According to the results, the risk awareness and compliance items indicate a p-value below 0.05.

This indicates a statistically significant difference between the mean values for different age categories for risk awareness and compliance, (as will be evident in the post hoc results shown in Table 3.21). Moreover, the statistically significant differences between specific groups are indicated in Tables 3.16 to 3.21, which depict the post hoc test results.

Table 3.16: Age group – ANOVA

Safety culture elements	Sum of Squares	Degree of freedom	Mean Square	F stat	P value
Management and Employee Commitment	1,166	4	0,292	1,124	0,345
Communication and Trust	0,513	4	0,128	0,420	0,794
Accountability and Involvement	0,784	4	0,196	0,633	0,640
Competency and Learning	0,589	4	0,147	0,491	0,743
Risk Awareness and Compliance	3,087	4	0,772	3,295	0,011
Recognition	0,238	4	0,060	0,233	0,920

To ascertain which of the age groups caused a discrepancy in risk awareness and compliance, post hoc tests were conducted in which the p-values and effect sizes were assessed between the age groups for the construct risk awareness and compliance. Table 3.17 below depicts the post hoc results and compares the mean scores of the different age categories for the enabler “risk awareness and compliance”.

Table 3.17: Age group – Post hoc tests (risk awareness and compliance)

	< 25 years	26 - 35 years	36 - 45 years	46 - 55 years	> 56 years
< 25 years	-	0,210 (0,304)	0,207 (0,335)	0,237 (0,269)	0,262 (0,584)
26 - 35 years	0,210 (0,304)	-	0,003 (1,000)	0,027 (0,996)	0,052 (0,997)
36 - 45 years	0,207 (0,335)	0,003 (1,000)	-	0,030 (0,995)	0,055 (0,996)
46 - 55 years	0,237 (0,269)	0,027 (0,996)	0,030 (0,995)	-	0,025 (1,000)
> 56 years	0,262 (0,584)	0,052 (0,997)	0,055 (0,996)	0,025 (1,000)	-

Table 3.17 above shows that there is no practically important difference between the different age groups. This indicates that respondents from different age groups have the same perceptions of risk awareness and compliance.

The post hoc results in Table 3.18 below compare the different mean scores of the age categories within the component communication and trust.

Table 3.18: Age group – Post hoc tests (communication and trust)

	< 25 years	26 - 35 years	36 - 45 years	46 - 55 years	> 56 years
< 25 years	-	0,094 (0,932)	0,086 (0,954)	0,137 (0,827)	0,024 (1,000)
26 - 35 years	0,094 (0,932)	-	0,008 (1,000)	0,043 (0,983)	0,118 (0,953)
36 - 45 years	0,086 (0,954)	0,008 (1,000)	-	0,051 (0,971)	0,110 (0,965)
46 - 55 years	0,137 (0,827)	0,043 (0,983)	0,051 (0,971)	-	0,160 (0,886)
> 56 years	0,024 (1,000)	0,118 (0,953)	-0,110 (0,965)	0,160 (0,886)	-

The results in Table 3.18 above show that there is no practically significant difference between all age categories because the p-values are above 0.05 ($p > 0.05$), respectively, indicating that all respondents from different age groups perceive communication and trust in the same way.

The post hoc results in Table 3.19 below compare the different mean scores of the age categories for the component accountability and involvement.

Table 3.19: Age group – Post hoc tests (accountability and involvement)

	< 25 years	26 - 35 years	36 - 45 years	46 - 55 years	> 56 years
< 25 years	-	0,111 (0,885)	0,076 (0,971)	0,153 (0,763)	0,044 (0,999)
26 - 35 years	0,111 (0,885)	-	0,035 (0,982)	0,042 (0,984)	0,155 (0,885)
36 - 45 years	0,076 (0,971)	0,035 (0,982)	-	0,077 (0,882)	0,120 (0,953)
46 - 55 years	0,153 (0,763)	0,042 (0,984)	0,077 (0,882)	-	0,197 (0,790)
> 56 years	0,044 (0,999)	0,155 (0,885)	0,120 (0,953)	0,197 (0,790)	-

The results in Table 3.19 above show that there is no practically significant difference between all age categories because the p-value is above 0.05 ($p > 0.05$), respectively,

indicating that all respondents from different age groups perceive accountability and involvement in the same way.

The post hoc results in Table 3.20 below compare the different mean scores of the age categories for the component competency and learning.

Table 3.20: Age group – Post hoc tests (competency and learning)

	< 25 years	26 - 35 years	36 - 45 years	46 - 55 years	> 56 years
< 25 years	-	0,156 (0,675)	0,122 (0,843)	0,156 (0,739)	0,109 (0,980)
26 - 35 years	0,156 (0,675)	-	0,033 (0,985)	0,001 (1,000)	0,047 (0,999)
36 - 45 years	0,122 (0,843)	0,033 (0,985)	-	0,034 (0,994)	0,014 (1,000)
46 - 55 years	0,156 (0,739)	0,001 (1,000)	0,034 (0,994)	-	0,048 (0,999)
> 56 years	0,109 (0,980)	0,047 (0,999)	0,014 (1,000)	0,048 (0,999)	-

The results in Table 3.20 above show that there is no practically significant difference between all age categories because the p-values are above 0.05 ($p > 0.05$) respectively, indicating that all respondents from different age groups have the same attitude to the component competency and learning.

The post hoc results in Table 3.21 below compare the different mean scores of age categories for the component risk awareness and compliance, which scores a significantly different ANOVA result.

Table 3.21: Age group – Post hoc tests (risk awareness and compliance)

	< 25 years	26 - 35 years	36 - 45 years	46 - 55 years	> 56 years
< 25 years	-	0,349* (0,007)	0,292* (0,046)	0,379* (0,008)	0,247 (0,592)
26 - 35 years	0,349* (0,007)	-	0,057 (0,843)	0,030 (0,992)	0,102 (0,956)
36 - 45 years	0,292* (0,046)	0,057 (0,843)	-	0,088 (0,738)	0,044 (0,998)
46 - 55 years	0,379* (0,008)	0,030 (0,992)	0,088 (0,738)	-	0,132 (0,907)
> 56 years	0,247 (0,592)	0,102 (0,956)	0,044 (0,998)	0,132 (0,907)	-

Table 3.21 above depicts that a practically significant difference exists between the age categories less than 25 years and 26 to 35 years, with an effect size of 0,349 and a p-value below 0.05 ($P < 0,007$). A practically significant difference was observed between the age categories less than 25 years and 36 to 45 years with an effect size of 0,292 and a significant p-value (0,046) of less than 0,05. The last practically significant difference is observed between the age groups less than 25 years and 46 to 55 years with a practical effect score of 0,379 and a significant p-value of 0,008, which is below 0,05. This indicates that different age groups perceived risk awareness and compliance differently.

Table 3.22 below shows the results of the post hoc tests comparing the different mean scores of the age categories for the enabler “recognition”.

Table 3.22: Age group – Post hoc tests (recognition)

	< 25 years	26 - 35 years	36 - 45 years	46 - 55 years	> 56 years
< 25 years	-	0,041 (0,996)	0,032 (0,998)	0,072 (0,973)	0,141 (0,932)
26 - 35 years	0,041 (0,996)	-	0,009 (1,000)	0,031 (0,992)	0,100 (0,964)
36 - 45 years	0,032 (0,998)	0,009 (1,000)	-	0,040 (0,983)	0,109 (0,952)
46 - 55 years	0,072 (0,973)	0,031 (0,992)	0,040 (0,983)	-	0,069 (0,993)
> 56 years	0,141 (0,932)	0,100 (0,964)	0,109 (0,952)	0,069 (0,993)	-

The results in Table 3.22 above show that there is no practically significant difference between any of the age categories because the p-values are above 0.05 ($p > 0,05$) respectively. This indicates that all respondents from different age groups have the same attitude to the safety culture enabler “recognition”.

(c) Different departments

In this section the relationship between the different departments of the respondents with the six safety culture enablers. Table 3.23 below shows the descriptive statistics of each safety culture enabler for each different department.

Table 3.23: Descriptive statistics for different departments

Department	Management & Employee Commitment		Communication and Trust		Accountability and Involvement		Competency and Learning		Risk Awareness and Compliance		Recognition	
	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation
C&I Automation	3,389	0,210	4,048	0,218	4,417	0,260	3,810	0,675	3,630	0,280	4,333	0,167
Discipline Planning	3,333	0,180	4,143	0,350	4,469	0,438	3,643	0,247	3,611	0,192	4,125	0,285
Electrical Services	3,534	0,417	3,604	0,540	3,818	0,638	3,714	0,501	3,682	0,441	3,939	0,533
Civil & Mechanical Services	3,819	0,537	3,964	0,564	4,152	0,544	3,868	0,575	3,920	0,501	4,142	0,487
Operational Services	3,990	0,528	4,000	0,477	4,141	0,557	4,286	0,464	4,181	0,603	4,229	0,177
Central Workshops	3,593	0,360	3,741	0,473	3,980	0,517	3,697	0,375	3,673	0,368	3,928	0,449
Engineering: DMS	3,868	0,503	4,104	0,460	4,159	0,449	3,978	0,557	4,031	0,427	4,176	0,431
Engineering: JIG	3,838	0,788	4,030	0,838	3,816	0,812	3,729	0,850	3,965	0,789	3,798	0,871
Operations: DMS	3,683	0,495	3,943	0,443	4,163	0,483	3,914	0,614	3,878	0,414	4,100	0,615

Then, to determine the difference between the scores for the different departments, an ANOVA was conducted the results of which are depicted in Table 3.24. However, the ANOVA results in table 3.24 show that the department diagnostic was removed from the analysis because it had less than one case. As a rule of thumb, an ANOVA test is only generated when there is more than one case. Interestingly, four of the safety culture enablers, namely management and employee commitment, communication and trust, risk awareness and compliance, and recognition reveal a p-value <0.05, respectively, indicating a statistically significant difference between different departments regarding perceptions of these four elements.

Table 3.24: Different departments – ANOVA

Safety culture elements	Sum of Squares	Degree of freedom	Mean Square	F stat	P value
Management and Employee Commitment	6,833	8	0,854	3,430	0,001
Communication and Trust	7,985	8	0,998	3,438	0,001
Accountability and Involvement	6,182	8	0,773	2,609	0,059
Competency and Learning	5,507	8	0,688	2,356	0,517
Risk Awareness and Compliance	7,787	8	0,973	4,321	0,000
Recognition	5,800	8	0,725	2,954	0,003

The post hoc tests the results of which are in Table 3.25 below determined which of the departments were causing the difference in the scores for the four above-mentioned enablers. In other words, post-tests were performed to assess the p-values and effect sizes of the different departments for each of the six elements.

Table 3.25 below shows the results of the post hoc tests comparing the different mean scores of the different departments for management and employee commitment.

Table 3.25: Different departments – Post hoc tests (management and employee commitment)

	C&I Automation	Discipline Planning	Electrical Services	Civil & Mechanical Services	Operational Services	Central Workshops	Engineering: DMS	Engineering: JIG	Operations: DMS
C&I Automation	-	0,056 (1,000)	0,145 (1,000)	0,430 (0,864)	0,601 (0,697)	0,204 (0,999)	0,479 (0,796)	0,449 (0,878)	0,294 (0,878)
Discipline Planning	0,056 (1,000)	-	0,201 (0,998)	0,486 (0,596)	0,656 (0,443)	0,260 (0,984)	0,534 (0,501)	0,504 (0,657)	0,350 (0,959)
Electrical Services	0,145 (1,000)	0,201 (0,998)	-	0,285 (0,218)	0,455 (0,401)	0,059 (1,000)	0,334 (0,181)	0,304 (0,584)	0,149 (0,997)
Civil & Mechanical Services	0,430 (0,864)	0,486 (0,596)	0,285 (0,218)	-	0,171 (0,990)	0,223* (0,008)	0,049 (1,000)	0,019 (1,000)	0,136 (0,996)
Operational Services	0,601 (0,697)	0,656 (0,443)	0,455 (0,401)	0,171 (0,990)	-	0,396 (0,433)	0,122 (0,999)	0,152 (0,998)	0,306 (0,933)
Central Workshops	0,204 (0,999)	0,260 (0,984)	0,059 (1,000)	0,223* (0,008)	0,396 (0,433)	-	0,274* (0,040)	0,244 (0,575)	0,090 (1,000)
Engineering: DMS	0,479 (0,796)	0,534 (0,501)	0,334 (0,181)	0,049 (1,000)	0,122 (0,999)	0,274* (0,040)	-	0,030 (1,000)	0,184 (0,978)
Engineering: JIG	0,449 (0,878)	0,504 (0,657)	0,304 (0,584)	0,019 (1,000)	0,152 (0,998)	0,244 (0,575)	0,030 (1,000)	-	-0,154 (0,997)
Operations: DMS	0,294 (0,878)	0,350 (0,959)	0,149 (0,997)	0,136 (0,996)	0,306 (0,933)	0,090 (1,000)	0,184 (0,978)	0,154 (0,997)	-

Table 3.25 above shows that practically important differences exist between civil and mechanical services and central workshops with a practical effect size of 0,223 and a p-value of 0,008 (<0.05). Respondents from civil and mechanical services scored higher for management and employee commitment than respondents who work for central workshops. Another practically significant difference can be observed between central workshops and engineering: DMS, with a practical effect size of 0,274 and a p-value of 0,040 <0.05 , indicating that the respondents who worked in the central workshops had a more positive attitude towards management and employee commitment than those who worked in engineering: DMS.

Table 3.26 below shows the post hoc test results for the different departments for communication and trust.

Table 3.26: Different departments – Post hoc tests (communication and trust)

	C&I Automation	Discipline Planning	Electrical Services	Civil & Mechanical Services	Operational Services	Central Workshops	Engineering: DMS	Engineering: JIG	Operations: DMS
C&I Automation	-	0,095 (1,000)	0,444 (0,919)	0,084 (1,000)	0,048 (1,000)	0,306 (0,988)	0,056 (1,000)	0,018 (1,000)	0,105 (1,000)
Discipline Planning	0,095 (1,000)	-	0,539 (0,655)	0,179 (0,999)	0,143 (1,000)	0,401 (0,873)	0,039 (1,000)	0,113 (1,000)	0,200 (0,999)
Electrical Services	0,444 (0,919)	0,539 (0,655)	-	0,360 (0,077)	0,396 (0,695)	0,138 (0,976)	0,491* (0,009)	0,426 (0,223)	0,339 (0,777)
Civil & Mechanical Services	0,084 (1,000)	0,179 (0,999)	0,360 (0,077)	-	0,036 (1,000)	0,222* (0,025)	0,140 (0,776)	0,067 (1,000)	0,021 (1,000)
Operational Services	0,048 (1,000)	0,143 (1,000)	0,396 (0,695)	0,036 (1,000)	-	0,259 (0,929)	0,104 (1,000)	0,030 (1,000)	0,057 (1,000)
Central Workshops	0,306 (0,988)	0,401 (0,873)	0,138 (0,976)	0,222* (0,025)	0,259 (0,929)	-	0,362* (0,003)	0,289 (0,447)	0,201 (0,970)
Engineering: DMS	0,056 (1,000)	0,039 (1,000)	0,491* (0,009)	0,140 (0,776)	0,104 (1,000)	0,362* (0,003)	-	0,074 (1,000)	0,161 (0,995)
Engineering: JIG	0,018 (1,000)	0,113 (1,000)	0,426 (0,223)	0,067 (1,000)	0,030 (1,000)	0,289 (0,447)	0,074 (1,000)	-	0,087 (1,000)
Operations: DMS	0,105 (1,000)	0,200 (0,999)	0,339 (0,777)	0,021 (1,000)	0,057 (1,000)	0,201 (0,970)	0,161 (0,995)	0,087 (1,000)	-

Table 3.27 above shows a practically significant difference between civil and mechanical services and central workshops with an effect size of 0,222 and a significant p-value of 0,025 <0.05 , indicating that respondents working in civil and mechanical services scored communication and trust higher than those who worked in the central workshops. Another practically significant difference can be observed between engineering: DMS and electrical services with an effect size of 0,491 and a significant p-value of 0,009 <0.05 , indicating that respondents who worked under

engineering: DMS had a stronger perception of communication and trust compared to those who worked in the central workshops. One more practically significant score was observed between central workshops and engineering: DMS with an effect size of 0,362 and a significant p-value of 0,003 <0.05, showing that respondents who worked in the central workshops scored higher for communication and trust than those who work in engineering: DMS.

Table 3.27 below shows the results of the post hoc tests comparing the different mean scores of the different departments for accountability and involvement.

Table 3.27: Different departments – Post hoc tests (accountability and involvement)

	C&I Automation	Discipline Planning	Electrical Services	Civil & Mechanical Services	Operational Services	Central Workshops	Engineering: DMS	Engineering: JIG	Operations: DMS
C&I Automation	-	0,052 (1,000)	0,598 (0,691)	0,265 (0,996)	0,276 (0,998)	0,437 (0,909)	0,257 (0,997)	0,601 (0,697)	0,254 (0,999)
Discipline Planning	0,052 (1,000)	-	0,651 (0,408)	0,317 (0,965)	0,328 (0,987)	0,489 (0,708)	0,309 (0,975)	0,653 (0,420)	0,306 (0,990)
Electrical Services	0,598 (0,691)	0,651 (0,408)	-	0,334 (0,143)	0,322 (0,884)	0,162 (0,941)	0,341 (0,256)	0,002 (1,000)	0,344 (0,771)
Civil & Mechanical Services	0,265 (0,996)	0,317 (0,965)	0,334 (0,143)	-	0,011 (1,000)	0,172 (0,208)	0,008 (1,000)	0,336 (0,204)	0,011 (1,000)
Operational Services	0,276 (0,998)	0,328 (0,987)	0,322 (0,884)	0,011 (1,000)	-	0,161 (0,997)	0,019 (1,000)	0,325 (0,891)	0,022 (1,000)
Central Workshops	0,437 (0,909)	0,489 (0,708)	0,162 (0,941)	0,172 (0,208)	0,161 (0,997)	-	0,179 (0,604)	0,164 (0,955)	0,183 (0,985)
Engineering: DMS	0,257 (0,997)	0,309 (0,975)	0,341 (0,256)	0,008 (1,000)	0,019 (1,000)	0,179 (0,604)	-	0,344 (0,316)	0,003 (1,000)
Engineering: JIG	0,601 (0,697)	0,653 (0,420)	0,002 (1,000)	0,336 (0,204)	0,325 (0,891)	0,164 (0,955)	0,344 (0,316)	-	0,347 (0,787)
Operations: DMS	0,254 (0,999)	0,306 (0,990)	0,344 (0,771)	0,011 (1,000)	0,022 (1,000)	0,183 (0,985)	0,003 (1,000)	0,347 (0,787)	-

The results indicated in Table 3.27 above show no significant difference between the observed variables, meaning that all the respondents from different departments perceived accountability and involvement in the same way.

Table 3.28 below shows the results of the post hoc tests comparing the different mean scores of the different departments for component competency and learning.

Table 3.28: Different departments – Post hoc tests (competency and learning)

	C&I Automation	Discipline Planning	Electrical Services	Civil & Mechanical Services	Operational Services	Central Workshops	Engineering: DMS	Engineering: JIG	Operations: DMS
C&I Automation	-	0,167 (1,000)	0,095 (1,000)	0,058 (1,000)	0,476 (0,931)	0,112 (1,000)	0,168 (1,000)	0,080 (1,000)	0,105 (1,000)
Discipline Planning	0,167 (1,000)	-	0,071 (1,000)	0,225 (0,996)	0,643 (0,585)	0,054 (1,000)	0,335 (0,958)	0,086 (1,000)	0,271 (0,995)
Electrical Services	0,095 (1,000)	0,071 (1,000)	-	0,153 (0,942)	0,571 (0,207)	0,017 (1,000)	0,263 (0,607)	0,015 (1,000)	0,200 (0,988)
Civil & Mechanical Services	0,058 (1,000)	0,225 (0,996)	0,153 (0,942)	-	0,418 (0,445)	0,170 (0,209)	0,110 (0,933)	0,138 (0,979)	0,047 (1,000)
Operational Services	0,476 (0,931)	0,643 (0,585)	0,571 (0,207)	0,418 (0,445)	-	0,589 (0,077)	0,308 (0,856)	0,556 (0,264)	0,371 (0,878)
Central Workshops	0,112 (1,000)	0,054 (1,000)	0,017 (1,000)	0,170 (0,209)	0,589 (0,077)	-	0,280 (0,067)	0,032 (1,000)	0,217 (0,954)
Engineering: DMS	0,168 (1,000)	0,335 (0,958)	0,263 (0,607)	0,110 (0,933)	0,308 (0,856)	0,280 (0,067)	-	0,248 (0,741)	0,063 (1,000)
Engineering: JIG	0,080 (1,000)	0,086 (1,000)	0,015 (1,000)	0,138 (0,979)	0,556 (0,264)	0,032 (1,000)	0,248 (0,741)	-	0,185 (0,994)
Operations: DMS	0,105 (1,000)	0,271 (0,995)	0,200 (0,988)	0,047 (1,000)	0,371 (0,878)	0,217 (0,954)	0,063 (1,000)	0,185 (0,994)	-

The results indicated in Table 3.28 above indicate no significant difference between the observed variables, meaning that all respondents from different departments perceived competency and learning in the same way.

Table 3.29 below shows the results of the post hoc tests comparing the different mean scores of the different departments for risk awareness and compliance.

Table 3.29: Different departments – Post hoc tests (risk awareness and compliance)

	C&I Automation	Discipline Planning	Electrical Services	Civil & Mechanical Services	Operational Services	Central Workshops	Engineering: DMS	Engineering: JIG	Operations: DMS
C&I Automation	-	0,019 (1,000)	0,052 (1,000)	0,290 (0,981)	0,551 (0,737)	0,044 (1,000)	0,401 (0,889)	0,335 (0,968)	0,248 (0,997)
Discipline Planning	0,019 (1,000)	-	0,071 (1,000)	0,308 (0,935)	0,569 (0,573)	0,062 (1,000)	0,419 (0,745)	0,354 (0,914)	0,267 (0,990)
Electrical Services	0,052 (1,000)	0,071 (1,000)	-	0,238 (0,391)	0,499 (0,214)	0,008 (1,000)	0,349 (0,097)	0,283 (0,611)	0,196 (0,976)
Civil & Mechanical Services	0,290 (0,981)	0,308 (0,935)	0,238 (0,391)	-	0,261 (0,844)	0,246* (0,001)	0,111 (0,863)	0,045 (1,000)	0,042 (1,000)
Operational Services	0,551 (0,737)	0,569 (0,573)	0,499 (0,214)	0,261 (0,844)	-	0,507 (0,090)	0,150 (0,996)	0,216 (0,977)	0,303 (0,917)
Central Workshops	0,044 (1,000)	0,062 (1,000)	0,008 (1,000)	0,246* (0,001)	0,507 (0,090)	-	0,357* (0,001)	0,292 (0,258)	0,204 (0,931)
Engineering: DMS	0,401 (0,889)	0,419 (0,745)	0,349 (0,097)	0,111 (0,863)	0,150 (0,996)	0,357* (0,001)	-	0,066 (1,000)	0,153 (0,991)
Engineering: JIG	0,335 (0,968)	0,354 (0,914)	0,283 (0,611)	0,045 (1,000)	0,216 (0,977)	0,292 (0,258)	0,066 (1,000)	-	0,087 (1,000)
Operations: DMS	0,248 (0,997)	0,267 (0,990)	0,196 (0,976)	0,042 (1,000)	0,303 (0,917)	0,204 (0,931)	0,153 (0,991)	0,087 (1,000)	-

Table 28 shows a practically significant difference between civil and mechanical services and central workshops with an effect size of 0,246 and a significant p-value of 0,001 indicating that respondents working in civil and mechanical services scored higher for risk awareness and compliance than those who worked in the central workshops. Moreover, another practically significant difference was observed between central workshops and engineering: DMS revealing an effect size of 0,357 and a significant p-value of 0,001, thereby showing that respondents who worked in the central workshops had a stronger perspective of risk awareness and compliance than those working in engineering: DMS.

Table 3.30 below shows the results of the post hoc tests comparing the different mean scores of the different departments for recognition.

Table 3.30: Different departments – Post hoc tests (recognition)

	C&I Automation	Discipline Planning	Electrical Services	Civil & Mechanical Services	Operational Services	Central Workshops	Engineering: DMS	Engineering: JIG	Operations: DMS
C&I Automation	-	0,208 (1,000)	0,394 (0,933)	0,191 (0,999)	0,104 (1,000)	0,405 (0,899)	0,157 (1,000)	0,535 (0,722)	0,233 (0,999)
Discipline Planning	0,208 (1,000)	-	0,186 (0,999)	0,017 (1,000)	0,104 (1,000)	0,197 (0,997)	0,051 (1,000)	0,327 (0,956)	0,025 (1,000)
Electrical Services	0,394 (0,933)	0,186 (0,999)	-	0,203 (0,669)	0,290 (0,891)	0,011 (1,000)	0,237 (0,631)	0,141 (0,992)	0,161 (0,995)
Civil & Mechanical Services	0,191 (0,999)	0,017 (1,000)	0,203 (0,669)	-	0,087 (1,000)	0,214* (0,015)	0,034 (1,000)	0,344 (0,095)	0,042 (1,000)
Operational Services	0,104 (1,000)	0,104 (1,000)	0,290 (0,891)	0,087 (1,000)	-	0,301 (0,775)	0,053 (1,000)	0,431 (0,500)	0,129 (1,000)
Central Workshops	0,405 (0,899)	0,197 (0,997)	0,011 (1,000)	0,214* (0,015)	0,301 (0,775)	-	0,248 (0,089)	0,130 (0,981)	0,172 (0,981)
Engineering: DMS	0,157 (1,000)	0,051 (1,000)	0,237 (0,631)	0,034 (1,000)	0,053 (1,000)	0,248 (0,089)	-	0,378 (0,107)	0,076 (1,000)
Engineering: JIG	0,535 (0,722)	0,327 (0,956)	0,141 (0,992)	0,344 (0,095)	0,431 (0,500)	0,130 (0,981)	0,378 (0,107)	-	0,302 (0,826)
Operations: DMS	0,233 (0,999)	0,025 (1,000)	0,161 (0,995)	0,042 (1,000)	0,129 (1,000)	0,172 (0,981)	0,076 (1,000)	0,302 (0,826)	-

Table 3.30 above shows a practically significant difference between civil and mechanical services and central workshops with an effect size of 0,214 and a significant p-value of 0,015, thereby demonstrating that respondents from civil and mechanical services scored higher for recognition than those working in central workshops.

(d) Years of experience

In this section, the relationship between the years of experience of the respondents and the six safety culture elements is analysed. However, before determining this relationship, the mean scores, and standard deviations of the perceptions of the participants with different years of experience with the safety culture enablers are compared, as indicated by the descriptive statistics in Table 3.31 below.

Table 3.31: Age group – Descriptive statistics

Age group	Management and Employee Commitment		Communication and Trust		Accountability and Involvement		Competency and Learning		Risk Awareness and Compliance		Recognition	
	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation
< 1	3,91	0,57	4,04	0,59	4,17	0,60	3,86	0,67	3,99	0,57	4,15	0,57
2 - 5	3,77	0,51	4,00	0,55	4,08	0,58	3,87	0,54	3,90	0,47	4,10	0,52
6 - 10	3,79	0,47	3,89	0,49	4,08	0,51	3,90	0,49	3,87	0,45	4,06	0,44
> 11	3,55	0,42	3,72	0,53	4,01	0,53	3,69	0,47	3,73	0,40	3,99	0,47

To determine whether a statistically or practically significant difference exists between the different years of experience categories, an ANOVA test was conducted. The results of the ANOVA test, as shown in Table 3.32 below, indicate that the key enablers of management and employee commitment, communication and trust, competency and learning, and risk awareness and compliance each reveal a p-value < 0.05 indicating a statistically significant difference between the mean values scored by the different years of experience categories on these four components.

Table 3.32: Years of experience – ANOVA

Safety culture element	Sum of Squares	Degree of freedom	Mean Square	F stat	P value
Management and Employee Commitment	5,497	3	1,832	7,474	0,000
Communication and Trust	5,566	3	1,855	6,432	0,000
Accountability and Involvement	1,038	3	0,346	1,122	0,340
Competency and Learning	2,370	3	0,790	2,675	0,047
Risk Awareness and Compliance	2,843	3	0,948	4,212	0,006
Recognition	1,156	3	0,385	1,525	0,208

To determine which of the years of experience groups is causing the different scores within these four components, post hoc tests were conducted to find the p-values and mean score values for the different years of experience groups and each of the four enablers. The results for the post hoc tests comparing the scores of the different years of experience categories for the enabler “management and employee commitment” are shown in Table 3.33 below

Table 3.33 below shows that the differences between the years of experience categories of less than 1 year and more than 11; between 2 to 5 years and more than 11 years and between 6 to 10 years and more than 11 years are of practical importance resulting in p-values of less than 0.05, respectively. This implies practically significant differences between the groups, thereby meaning that these groups, respectively, based on their different years of experience perceived management and employee commitment differently.

Table 3.33: Years of experience – Post hoc tests (management and employee commitment)

	< 1 year	2 – 5 years	6 – 10 years	> 11 years
< 1 year	-	0,141 (0,192)	0,122 (0,375)	0.355* (0,000)
2 – 5 years	0,141 (0,192)	-	0,019 (0,992)	0.214* (0,009)
6 – 10 years	0,122 (0,375)	0,019 (0,992)	-	0.232* (0,008)
> 11 years	0.355* (0,000)	0.214* (0,009)	0.232* (0,008)	0.232* (0,008)

The results for the post hoc tests comparing the scores allocated by different years of experience categories for the enabler “communication and trust” are shown in Table 3.34 below.

Table 3.34: Years of experience – Post hoc tests (communication and trust)

	< 1 year	2 – 5 years	6 – 10 years	> 11 years
< 1 year	-	0,041 (0,952)	0,150 (0,268)	0.319* (0,001)
2 – 5 years	0,041 (0,952)	-	0,109 (0,422)	0.278* (0,001)
6 – 10 years	0,150 (0,268)	0,109 (0,422)	-	0,169 (0,142)
> 11 years	0.319* (0,001)	0.278* (0,001)	0,169 (0,142)	-

Table 3.34 above depicts that the mean difference between the years of experience categories of less than 1 year, above 11 years as well as between 2 and 5 years were significant. This indicates that respondents who had less than 1 year of working experience scored higher for communication and trust than those who had more than 11 years of working experience. Also, those who had 2 to 5 years of working

experience scored higher for communication and trust than those with more than 11 years of working experience.

The results for the post hoc tests comparing the scores for different years of experience categories on the component accountability and involvement are shown in Table 3.35 below.

Table 3.35: Years of experience – Post hoc tests (accountability and involvement)

	< 1 year	2 – 5 years	6 – 10 years	> 11 years
< 1 year	-	0,088 (0,681)	0,096 (0,675)	0,159 (0,261)
2 – 5 years	0,088 (0,681)	-	0,007 (1,000)	0,070 (0,789)
6 – 10 years	0,096 (0,675)	0,007 (1,000)	-	0,063 (0,869)
> 11 years	0,159 (0,261)	0,070 (0,789)	0,063 (0,869)	-

The results shown in Table 3.35 above reveal that for the key enabler “risk awareness and compliance”, the differences between the different years of experience are non-significant, indicating that there was no difference in how respondents from different years of experience perceived risk awareness and compliance.

The results for the post hoc tests comparing the scores for different years of experience for the key enabler “competency and learning” are shown in Table 3.36 below.

Table 3.36: Years of experience – Post hoc tests (competency and learning)

	< 1 year	2 – 5 years	6 – 10 years	> 11 years
< 1 year	-	0,004 (1,000)	0,036 (0,973)	0,169 (0,191)
2 – 5 years	0,004 (1,000)	-	0,032 (0,970)	0,173 (0,090)
6 – 10 years	0,036 (0,973)	0,032 (0,970)	-	0,205* (0,052)
> 11 years	0,169 (0,191)	0,173 (0,090)	0,205* (0,052)	-

Table 3.36 above shows that there is a significant difference in scores for the enabler “competency and learning” between the years of experience for 6 to 10 years and more than 11 years, given the significant p-value of 0,052 on the overall mean score of 0,205. This means that respondents who had 2 to 5 years of working experience scored higher for competency and learning than those who had been in the industry longer (who had more than 11 years of working experience).

The results for the post hoc tests comparing the scores for different years of experience for the key enabler “risk awareness and compliance” are shown in Table 3.37 below.

Table 3.37: Years of experience – Post hoc tests (risk awareness and compliance)

	< 1 year	2 – 5 years	6 – 10 years	> 11 years
< 1 year	-	0,090 (0,546)	0,115 (0,389)	0,255* (0,004)
2 – 5 years	0,090 (0,546)	-	0,025 (0,978)	0,165 (0,052)
6 – 10 years	0,115 (0,389)	0,025 (0,978)	-	0,140 (0,188)
> 11 years	0,255* (0,004)	0,165 (0,052)	0,140 (0,188)	-

Table 3.37 above shows that there is a significant difference in scores for the enabler “risk awareness and compliance” between the years of experience for less than 1 year and more than 11 years, given the significant p-value of 0,004 on the overall mean score of 0,255. This means that respondents who had less than 1 year of working experience scored higher for risk awareness and compliance than those who had been in the industry longer (who had more than 11 years of working experience).

The results for the post hoc tests comparing the scores for different years of experience for the key enabler “recognition” are shown in Table 3.38 below.

Table 3.38: Years of experience – Post hoc tests (recognition)

	< 1 year	2 – 5 years	6 – 10 years	> 11 years
< 1 year	-	0,053 (0,879)	0,096 (0,601)	0,159 (0,182)
2 – 5 years	0,053 (0,879)	-	0,042 (0,921)	0,105 (0,414)
6 – 10 years	0,096 (0,601)	0,042 (0,921)	-	0,063 (0,829)
> 11 years	0,159 (0,182)	0,105 (0,414)	0,063 (0,829)	-

Table 3.38 above shows no significant difference between the mean scores of different years of experience for recognition. This means that respondents with different years of working experience perceived recognition in the same way.

(e) Managerial level

In this section, the relationship between the managerial level of the respondents and the six safety culture elements is analysed. However, before determining this relationship, the mean scores, and standard deviations of the perceptions of the respondents at different managerial levels of the safety culture enablers are compared, as indicated by the descriptive statistics in Table 3.31 below. Only two management levels (section/site manager and supervisor) were considered., as the management level of HOD was removed from the analysis because there was only one case. The descriptive statistics are set out in Table 3.39 below to describe the different mean scores of the different management levels' responses to the statements on the key enablers.

Table 3.39: Managerial level – Descriptive statistics

Managerial level	Management and Employee Commitment		Communication and Trust		Accountability and Involvement		Competency and Learning		Risk Awareness and Compliance		Recognition	
	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation
Section Manager / Site Manager	3,66	0,40	3,85	0,54	4,09	0,57	3,84	0,43	3,87	0,41	4,14	0,34
Supervisor	3,62	0,39	3,91	0,47	4,19	0,56	3,84	0,45	3,74	0,38	4,15	0,39
Employee	3,77	0,53	3,91	0,56	4,07	0,56	3,82	0,56	3,87	0,51	4,05	0,53

The ANOVA results in Table 3.40 below determine whether there are statistically significant differences between the mean scores, and the results indicate that there is no significant difference in the mean scores of the six safety culture elements across different management levels.

Table 3.40: Managerial levels – ANOVA

Safety culture elements	Sum of Squares	Degree of freedom	Mean Square	F stat	P value
Management and Employee Commitment	0,850	2	0,425	1,633	0,197
Communication and Trust	0,083	2	0,041	0,134	0,874
Accountability and Involvement	0,487	2	0,243	0,781	0,459
Competency and Learning	0,023	2	0,012	0,039	0,962
Risk Awareness and Compliance	0,568	2	0,284	1,177	0,309
Recognition	0,435	2	0,217	0,847	0,429

Table 3.40 above indicates that the respondents at different management levels perceived the six safety culture key enablers in the same way.

The results of the post hoc tests comparing the different management levels for the component management and employee commitment are shown in Table 3.41 below. Moreover, the results reveal that there is no significant difference in the mean scores

of the management levels for management and employee commitment indicating that respondents from different managerial levels perceived management and employee commitment in the same way.

Table 3.41: Managerial levels – Post hoc tests (management and employee commitment)

	Section Manager / Site Manager	Supervisor	Employee
Section Manager / Site Manager	-	0,042 (0,950)	0,104 (0,612)
Supervisor	0,042 (0,950)	-	0,146 (0,244)
Employee	0,104 (0,612)	0,146 (0,244)	-

The results of the post hoc tests comparing the managerial levels for the enabler “communication and trust” that there is no significant difference in the mean scores of the managerial levels for communication and trust, indicating that there is no difference in how respondents from different managerial levels perceived communication and trust.

Table 3.42: Managerial levels – Post hoc tests (communication and trust)

	Section Manager / Site Manager	Supervisor	Employee
Section Manager / Site Manager	-	0,055 (0,927)	0,062 (0,863)
Supervisor	0,055 (0,927)	-	0,007 (0,997)
Employee	0,062 (0,863)	0,007 (0,997)	-

The results for the post hoc tests comparing the scores of different management levels for the enabler “accountability and involvement are shown in Table 3.43 below. The results show no significant difference in the mean scores of the different managerial

levels for accountability and involvement indicating that there is no difference in how respondents from different levels perceived accountability and involvement.

Table 3.43: Managerial levels – Post hoc tests (accountability and involvement)

	Section Manager / Site Manager	Supervisor	Employee
Section Manager / Site Manager	-	0,102 (0,774)	0,021 (0,983)
Supervisor	0,102 (0,774)	-	
Employee	0,021 (0,983)	0,124 (0,426)	-

Table 3.44 below depicts no significant difference in the mean scores of different management levels on competency and learning, thereby indicating that there is no difference in how respondents from different levels perceived competency and learning.

Table 3.44: Managerial level – Post hoc tests (competency and learning)

	Section Manager / Site Manager	Supervisor	Employee
Section Manager / Site Manager	-	0,000 (1,000)	0,022 (0,982)
Supervisor	0,000 (1,000)	-	0,022 (0,973)
Employee	0,022 (0,982)	0,022 (0,973)	-

The results of the post hoc tests comparing the scores of the different management levels for the enabler “risk awareness and compliance” are presented in Table 3.45 below. From the results, it is evident that there is no significant difference in the mean scores of the managerial levels for risk awareness and compliance, thereby indicating

that there is no difference in how respondents from different levels perceived risk awareness and compliance.

Table 3.45: Managerial level – Post hoc tests (risk awareness and compliance)

	Section Manager / Site Manager	Supervisor	Employee
Section Manager / Site Manager	-	0,138 (0,549)	0,005 (0,999)
Supervisor	0,138 (0,549)	-	0,133 (0,280)
Employee	0,005 (0,999)	0,133 (0,280)	-

The results of the post hoc tests comparing the scores of the different levels for the enabler “recognition” are recorded in Table 3.46 below. From the results, it is observed that there is no significant difference in the mean scores of the different managerial levels for recognition, thereby indicating that respondents from the different levels perceive recognition in the same way.

Table 3.46: Managerial level – Post hoc tests (recognition)

	Section Manager / Site Manager	Supervisor	Employee
Section Manager / Site Manager	-	0,015 (0,994)	0,084 (0,719)
Supervisor	0,015 (0,994)	-	0,099 (0,513)
Employee	0,084 (0,719)	0,099 (0,513)	-

(f) Employment status

This section reports on the relationship between employment status and the six safety culture variables. The study considered the employment status of permanent and service provider employees. The descriptive statistics for the respondents' perceptions of the variables are set out in Table 3.47 below.

Table 3.47: Employment status – Descriptive statistics

Safety culture elements	Employment	N	Mean	Std Deviation
Management and Employee Commitment	Permanent	156	3,59	0,38
	Service Provider	254	3,85	0,55
Communication and Trust	Permanent	156	3,71	0,51
	Service Provider	254	4,04	0,53
Accountability and Involvement	Permanent	156	3,91	0,56
	Service Provider	254	4,19	0,53
Competency and Learning	Permanent	156	3,73	0,46
	Service Provider	254	3,90	0,59
Risk Awareness and Compliance	Permanent	156	3,69	0,40
	Service Provider	254	3,97	0,51
Recognition	Permanent	156	3,98	0,44
	Service Provider	254	4,13	0,53

The independent sample t-test results in Table 3.48 below determine whether there are statistically significant differences between the mean scores, and the results indicate that there is a statistically significant difference in the mean scores of all the safety culture variables because of their p-values of <0.05. This indicates that all six safety culture elements were perceived differently by respondents who were permanently employed or were service provider employees.

Table 3.48: Employment status and safety culture variables – Independent samples t-test

Safety culture components	<i>t statistic</i>	<i>Degree of freedom</i>	<i>p-value</i>
Management and Employee Commitment	-5,687	403,214	0,000
Communication and Trust	-6,249	338,726	0,000
Accountability and Involvement	-4,910	311,944	0,000
Competency and Learning	-3,214	386,050	0,001
Risk Awareness and Compliance	-6,322	382,165	0,000
Recognition	-3,030	370,288	0,003

(g) Inter-correlations of safety culture variables

The inter-correlation results of the mean responses for the safety culture variables are indicated in Table 3.49 below. The correlation coefficient values in the region of +0,1 are considered small with values +0,3 considered medium and values above +0,5 considered substantial.

Correlation analysis indicated whether there is a statistical relationship between the safety culture variables, as indicated in Table 3.49 below. The results show a positive and significant relationship between all six safety culture variables, which are significant at a substantial level. There is a positive ($r=0.518$) and a significant relationship between ($p<0.000$) management and employee commitment and communication and trust. Moreover, a strong positive ($r=0.652$) and a significant ($p<0.000$) correlation are shown between management and employee commitment and competency and learning as well as between management and employee commitment risk awareness and compliance ($r=0.652$; $P<0.000$). Moreover, a moderately strong correlation exists between management and employee commitment and accountability and involvement ($r=0.462$; $p<0.000$), and recognition ($r=0.452$; $p<0.000$).

Table 3.49: Inter-correlations between safety culture variables

	Management and Employee Commitment	Communication and Trust	Accountability and Involvement	Competency and Learning	Risk Awareness and Compliance	Recognition
Management and Employee Commitment	-	0.518** (0.000)	0.462** (0.000)	0.652** (0.000)	0.652** (0.000)	0.452** (0.000)
Communication and Trust	0.518** (0.000)	-	0.735** (0.000)	0.565** (0.000)	0.578** (0.000)	0.555** (0.000)
Accountability and Involvement	0.462** (0.000)	0.735** (0.000)	-	0.540** (0.000)	0.493** (0.000)	0.652** (0.000)
Competency and Learning	0.652** (0.000)	0.565** (0.000)	0.540** (0.000)	-	0.623** (0.000)	0.534** (0.000)
Risk Awareness and Compliance	0.652** (0.000)	0.578** (0.000)	0.493** (0.000)	0.623** (0.000)	-	0.469** (0.000)
Recognition	0.452** (0.000)	0.452** (0.000)	0.652** (0.000)	0.534** (0.000)	0.469** (0.000)	-

The above results indicate a significant relationship between all six safety culture variables, which were measured through the questionnaire. These results are consistent with the literature findings that the key enablers of a mature, uniform safety culture should not be in force in isolation in the workplace, and all need to be ensured for OHS (the workplace (Alruqi *et al.*, 2018:166; Hong *et al.*, 2018:180). (Roughton *et al.*, 2019:101; Kim *et al.*, 2019:51; HASpod, 2019; Ederer *et al.*, 2019; Petitta *et al.*, 2017:78).

3.5 Conclusion

Despite the respondents' overall perception that the safety culture enablers were in effect in their firm, with mean values greater than 3.5, elements were missing, thereby indicating that the South African iron ore mining company under study has not yet reached the level of a mature, uniform safety culture. Moreover, although the study was confined to a single organisation, the identified defects might appear in the general larger mining environments, thus explaining the recent precarious health and safety performance of the industry. However, this assumption can only be verified by further investigation using a much larger sample size and multiple organisations.

The results of the empirical study show that older employees with many years of service are more aware of the current safety environment compared to younger ones. This suggests that focus should be placed on the attitude to the safety of younger

employees, given that they are new to the organisation and still learning about the operations and procedures of the organisation.

From the overall results, the identified missing safety culture elements should not be left unattended because it could result in more safety incidents in the organisation.

3.6 Chapter summary

This chapter covered the empirical study by, firstly, explaining the study design and methodology used to achieve the research objectives described in Chapter One. Particular attention was paid to the population selection, the sampling method, the sample and the data collection and methods. This was followed by the presentation, interpretation, and discussion of the statistical data analysis.

The target population consisted of all employees and managers (section/site managers and supervisors) from different departments, namely, C&I automation, diagnostic and reliability, discipline planning, electrical services, civil and mechanical services, operational services, central workshops, engineering: DMS, engineering: JIG, operations: DMS, operations: JIG, and SHE. Data were gathered from 411 respondents the majority of which were men and women of all ages, from under 25 up to more than 56 years of age who were employed by service providers (61,8%) or were permanent employees (38,0%). Many of the respondents had two to five years of working experience (33,6%).

Descriptive statistics for each of the six safety culture variables yielded positive results overall. The developed questionnaire proved to be reliable based on the calculated Cronbach's alpha coefficient of 0,06. However, owing to a low internal consistency in some items, some of the statements measuring certain safety culture elements had to be removed. For instance, from the questionnaire section on communication and trust, one statement with a lower contribution to the construct was deleted to improve the quality of the section. One statement was also deleted from accountability and involvement to improve the internal consistency of all the items.

The responses to the statements indicating the enablers of a mature, uniform safety culture averaged well below 3. This indicates that some of the enablers were not in force in the firm and might not be in the industry in general, which can be further investigated with a bigger sample, and more companies.

From the statistical analysis conducted, depending on their demographic characteristics, such as gender, age group, departments, years of experience, and employment status, a significant difference was discovered in participants' perceptions of the extent to which some of the safety culture enablers were in force in their firm. However, no discrepancies were observed in the managerial and employee level scores for the safety culture elements. Furthermore, a positive and significant correlation was identified between all the safety culture enablers.

The following chapter concludes the research report by explaining the motivation for the study and presenting an overview of the research objectives and summaries of the literature review findings and the results of the empirical study. In addition, it makes recommendations for the improvement of the safety culture of an organisation. Then, the chapter presents an evaluation of the study, the study's limitations, and suggestions for future research.

CHAPTER FOUR

CONCLUSION

4.1 Introduction

This chapter concludes the research report study by explaining the motivation for the study and presenting an overview of the research objectives. Moreover, it explains the literature review findings, provides the results of the empirical study, and makes recommendations for the improvement of the safety culture of an organisation. Then, the chapter evaluates the study, indicates the study's limitations, and makes suggestions for future research.

4.2 Motivation for the study

The study was motivated by an interest in determining how and to what extent safety values are part of the organisational mining culture, as the literature indicated that all mining companies have strict safety targets and the goal of zero harm. Thus, the researcher was motivated to understand whether the shared safety values of employees were reflected in the organisational culture and whether they contributed to a safe work environment. Moreover, the need to identify which factors contribute consistently across the hierarchy of the organisation to a safety culture by exploring iron-ore mining employees' perceptions of their firm's safety culture motivated the study. In other words, the study was motivated by a need to determine the key enablers of a mature, uniform safety culture in an iron ore mining company.

4.3 Overview of the study objectives

The primary objective of the study was to understand how managers and employees of a South African iron ore mining company perceived the safety culture of their firm.

To achieve the primary research objective, the secondary research objectives were to do as follows:

- Conduct a review of the available literature on safety culture to develop insights as a background to the empirical study.

- Determine the perceptions of managers and employees of a South African iron ore mining company of the safety culture of their firm in terms of the enablers of a uniform, mature safety culture.
- Determine the stages of the development of a uniform, mature safety culture.
- Determine whether there was a relationship between the participants' demographic variables and their perceptions of the safety culture of their firm in terms of the enablers of a uniform, mature, safety culture.

4.4 Findings from the literature review

A literature review revealed a growing interest in the concept of a safety culture, which leads to the improved safety performance of an organisation and thus mitigates the risk of OHS accidents. Moreover, according to the literature, employee behaviour is determined by an organisation's safety culture, which should be embraced by management and employees.

The literature highlights the moral, financial, and legal implications of inadequate safety in an organisation, which should develop a mature, uniform safety culture and change its culture in terms of its artefacts, basic assumptions, and espoused values. Thus, a company requires safe technology, core safety values championed by the company leadership and held by employees and a fundamental belief in the need for OHS underpinning employees' actions, thoughts, and attitudes. In addition, the literature shows us that an organisation's safety culture evolves as a result of history, the work environment, the workforce, health and safety practices, and management leadership.

Studies show that every organisation or industry has a safety culture. However, the maturity and uniformity of a safety culture depend on several factors, such as employee participation, accountability, risk awareness, compliance with regulations, competence, learning, communication, and trust. Moreover, it is underpinned by the values held by employees and championed by the company leadership, the physical environment such as technology and the underlying assumptions of employees' attitudes, thought processes and actions.

The individual and collective emphasis on safety by employees and management determines the maturity and uniformity of the safety culture. In addition, the attitudes

and values of employees, which are determined by the safety culture of an organisation have a significant impact on organisational safety performance. Therefore, ensuring a mature, uniform safety culture will lead to OHS performance improvement.

4.5 Results of the empirical study

4.5.1 Participants' perceptions

The results revealed that most employees believed that sufficient time and effort was spent on mine safety and that lack of discipline in compliance with safety regulations was deemed unacceptable. Therefore, the management of their firm listened to employees' concerns, took appropriate action, and cared about the safety and health of employees. In addition, participants agreed that management's commitment to safety was reflected in its actions, and employees regularly helped their colleagues to comply with safety regulations.

Most of the respondents maintained, however, that management only talked about safety during and after an accident. Moreover, respondents were worried about expressing views that might have contradicted those of management. In addition, employees did everything possible to meet the production expectations of the company without paying attention to the safety of the environment and were motivated to work as hard as they could to complete a job regardless of safety.

The results showed that most of the respondents agreed that there was communication and trust in the organisation. Furthermore, the descriptive statistics indicated an open channel of communication between management and employees. However, responses suggested intimidation and retaliation when issues such as near misses and mistakes occurred, and most of the respondents agreed that employees tend to withhold information.

The results indicated accountability and involvement of management and employees, and respondents agreed that “everyone is accountable for their own safety,” and “there are safety systems in place to manage all hazards”.

Competency and learning were measured by 7 statements, and the results revealed a strong agreement with 6 of the 7 statements. Moreover, the average number of

participants disagreed with the statement, “There are many repeat cases”, although the high standard deviation indicated that some respondents agreed with it.

The results demonstrated that risk awareness and compliance were in place in the company, as most of the respondents disagreed that “safety systems or procedures are often bypassed by employees to complete their work quicker”. However, a few employees expressed concern about “some employees getting away with unsafe acts” and agreed that “safety systems or procedures are often bypassed by employees to complete their work quicker”.

The key enabler “recognition” was measured by 6 statements, with which most participants agreed, indicating that recognition for good safety performance was recognised in some way in the company. However, a few respondents disagreed that “good safety performance will lead to good business performance”.

The relationship between the different departments of the respondents and the key enablers of a mature, uniform was measured using an ANOVA test. Four of the key enablers (management and employee commitment; communication and trust; risk awareness and compliance; and recognition) had a p-value <0.05 , indicating a statistically significant relationship between the different departments and the four key enablers.

The results showed that older employees who had been in the company for a long time had a more positive perception of the current safety environment. This suggests that they had a good understanding of the safety culture of the organisation, compared with younger employees, who still learning about OHS performance, in general, and specifically, in the firm.

Despite the overall positive perception of the safety culture of the firm in terms of the key enablers of a mature, uniform safety culture, with an average response greater than 3.5, the firm under study needed to improve its safety culture, because not all the key enablers were fully in effect in the organisation. This could suggest that the safety culture of the South African iron ore mining industry might be generally lacking, which would explain its current precarious OHS performance. However, study results are not generalisable, as the study population was limited to a single organisation. Moreover, this assumption can only be validated by further investigation using a much larger sample size.

4.5.2 Safety culture of the iron ore mining company under study

The results of the empirical study revealed that there were significant flaws in the existing safety culture of the iron ore mining firm under study that might have contributed to its precarious health and safety performance. The safety culture of the firm in the study was investigated in terms of the key enablers of a mature, uniform safety culture, which were not fully indicated in the firm's safety culture. However, to a great extent, the key enablers were in force, thereby indicating that the firm was on the way to having a mature, uniform safety culture, as indicated in Table 4.1 below.

The first key enabler "management and employee commitment" was sometimes overlooked because of productivity or cost implications. The second key enabler "communication" was lacking at times, which meant that the organisation was complacent when there was no news of incidents and that some people committed unsafe acts or failed to comply with regulations without being reported.

The third key enabler "accountability and involvement" and the fifth key enabler "risk awareness and compliance" appeared to be fully present in the organisation, although the fourth key enabler "competence and learning" was not always fully in effect, as solutions for safety problems were often short-term and did not address the root cause.

The fifth key enabler "recognition" was not fully in force, because management did not formally recognise good safety performance. Although these shortfalls meant that the firm's safety culture could improve, as indicated in Table 4.1 below, the firm's safety culture was mature and uniform to an extent in terms of the key enablers.

Table 4.1: Positive safety culture characteristics in the iron ore mining environment

Management & employee commitment	Communication & trust	Accountability & involvement	Competency & learning	Risk awareness & compliance	Recognition
• Clear visible management commitment with a strong sense of care towards sub-ordinates. • Management attentively listens to employees' safety suggestions and takes appropriate actions. • Sufficient time and effort is devoted to occupational health and safety. • Most employees tend to assist their fellow colleagues to comply with safety expectations. • Employees would often spend more time on a task in order to ensure safe execution.	• OHS information is regularly communicated. • Management operates an open door policy on safety issues. • Management trusts employees' abilities to identify risks. • Safety information is shared across departmental and organisational borders.	• Employees are encouraged to make safety improvement suggestions. • Regular job risk assessments are conducted to ensure safe behaviour. • All employees are accountable for their own safety and everyone's safety is equally important. • Employees coach others in doing work safely. • Employees at all levels are involved in safety related decisions.	• The organisation learns from past mistakes and implements appropriate preventative measures. • Employees undergo comprehensive and meaningful safety training. • Employees possess the necessary knowledge and skill to work safe. • Safety incident investigations are conducted in a professional manner.	• Employees are aware of the potential hazards in their work environment. • Work instructions and procedures are followed to the letter. • Hazard identification is considered part of the job. • Safety is seen as a condition of employment.	• Employees consider themselves proud to be associated with their organisation. • Employees perceive a job to be done well when it's done safely. • Employees perceive that good safety performance leads to good business performance. • Employees believe that safety recognition promotes safe behavior.

4.6 Recommendations for OHS in organisations

Based on the research outcomes, the following recommendations are made for OHS in organisations:

- Organisations need to implement the key enablers of a mature, uniform safety culture.
- Managers and employees should be committed to improving safety performance.
- Communication and trust need to be established to build an organisational culture that values and ensures OHS. Emails and bulletin boards should be regularly used by managers to communicate with employees.
- All employees and managers need to be accountable and involved in improving safety performance.
- All employees and managers need to be competent in implementing safety policies and procedures and prepared to learn new and revise established safety measures, through ongoing training. Moreover, learning from mistakes should be ensured through formal training sessions.
- Managers and employees need to be trained in risk awareness and forced to comply with legislation and regulations.
- Managers and employees should provide formal and informal recognition for good safety performance.
- Workers need to be provided with appropriate safety equipment, resources, and training.
- Safety performance should be continually monitored and evaluated.
- Organisations need to ensure that appropriate budgets are allocated to maintain workplace safety.
- Leadership should be visible during safety events to motivate employees.
- Employees and managers need to be taught the most important sections (22 and 23) of the Mine Health and Safety Act.

- Protective clothing, other safety equipment, and equipment provided for protection should be properly used.
- Employees and managers need to be mentored to cope with change, be it in safety policies, procedures, or the safe use of new tools or equipment.
- All stakeholders, including mining companies, workers, trade unions and contractors need to work together to reduce the number of injuries and deaths in the industry.

4.7 Evaluation of the study

The primary objective of the study was to investigate how managers and employees of a South African iron ore mining company perceived the safety culture of their firm.

To achieve the primary research objective, secondary research objectives were formulated. These are discussed below in terms of their achievement.

4.7.1 First secondary objective

The first secondary objective was to conduct a review of the available literature on safety culture to develop insights as a background to the empirical study. This objective was achieved through the literature review covered in Chapter Two of the research report. The main topics covered were safety in the work environment, safety culture and organisational culture. In particular, the review explained the key enablers of a mature, uniform safety culture, six of which were used to determine the perceptions of employees and managers of the safety culture of the iron ore mining firm under study.

4.7.2 Second secondary objective

The second secondary objective was to determine the perceptions of managers and employees of a South African iron ore mining company of the safety culture of their firm in terms of the enablers of a uniform, mature safety culture. This objective was achieved through statistically analysing the data gathered from the participants. In particular, the relationships between the key enabler variables were determined. The results revealed a positive and significant relationship between all six variables, which was consistent with the literature finding that there is a single indicator of a mature,

uniform safety culture and all elements are intertwined in promoting safety performance.

4.7.3 Third secondary objective

The third secondary objective was to determine the stages of the development of a uniform, mature safety culture. This objective was achieved through the use of Pearson's correlation analysis, which revealed that safety culture can be divided into different stages of development. Each of these phases represents the maturity of management and employee attitudes and commitment to the continuous improvement of organisational health and safety. In a reactive safety culture, safety is just an instinct and has no real value to an individual or organisation. In a dependent safety culture, employees begin to value safety only to prevent them from being considered non-compliant. The next level of an independent safety culture is shaped by self-preservation. At this stage, employees value safety to avoid being injured. In the final phase, the interdependent safety culture, employees view safety not only for themselves but also for their colleagues. In this culture, employees want to work safely so no one is hurt.

4.7.4 Fourth secondary objective

The fourth secondary objective was to determine whether demographic characteristics caused participants to perceive the key enablers of a mature, uniform safety culture differently. This objective was achieved by performing an ANOVA test. The results revealed that management and employee commitment were perceived differently by males and females. The ANOVA test also revealed that when investigating age, out of all six safety culture elements, only risk awareness and compliance had statistically significant results. Risk awareness and compliance had a p-value below 0.05 indicating a statistically significant difference between the mean values for the different age categories, which meant that risk awareness and compliance were perceived differently by different age groups. However, the different age groups had the same perception of management and employee compliance, communication and trust, accountability and involvement, competency and learning and recognition.

4.8 Limitations of the study

Data were gathered from participants representing only one iron ore mine and therefore the statistical inferences and the results could not be generalised to the whole mining industry. However, the recommendations could be followed by other iron ore mining companies.

The participants were selected using convenience sampling and included managers and subordinate employees responsible for OHS in production, engineering, and maintenance activities. This sampling method might mean an under- or over-representation of the study population. Moreover, the results might be biased, because of why some participants chose to take part and others did not.

4.9 Future research

The following recommendations are suggested for future research:

- Future research could include Schein's typology to explain the psychology of workers' specific behaviours related to OHS.
- A qualitative methodology based on interviews focuses on group discussions and self-analysis could be followed in future studies.
- Future studies could use a mixed or multi-methods methodology to ensure triangulation.
- Future studies could sample participants from local and international iron ore mining organisations to gather rich data.
- Future studies could use a large sample size to ensure generalisability
- Future studies could use probability sampling to select the participants because it allows the selection of a sample, which accurately represents the population.

4.10 Conclusion

Research into safety culture has shown that it has a significant impact on an organisation's safety performance. Furthermore, understanding an organisation's safety culture leads to insights into employee behaviour in the workplace. However, although, employee behaviour should be determined by the safety guidelines contained in the safety management system, investigations show that most accidents

and incidents are due to worker negligence. The results of the current study revealed a lack of compliance with health and safety regulations was a problem in the firm under study, which suggests the risk of incidents and accidents. Therefore, the recommendation is that organisations deploy a monitoring and evaluation system designed and implemented by a principled management team.

After conducting the study, the researcher concluded that the safety culture in this study is on the way to becoming mature and uniform, although there is room for improvement. However, unless workers and management work together as a team to achieve zero harm and improve the safety performance of the organisation, the safety culture will continue to be compromised.

While health and safety are the responsibility of everyone in the organisation, management must make every effort to continually emphasise their importance. Therefore, management should regularly consult with employees about safety issues, thereby motivating employees to have a positive attitude towards establishing a mature, uniform safety culture, which they should value and make part of their belief system. An unsafe workplace is not only unhealthy but also stressful, which affects productivity. A mature, uniform safety culture should be part of a corporate brand, which means that a cultural shift may be needed.

4.11 Chapter summary

This chapter has concluded the research report study by explaining the motivation for the study and presenting an overview of the research objectives. Moreover, it has explained the literature review findings, the results of the empirical study and recommendations for the improvement of the safety culture of an organisation. In addition, the chapter has evaluated the study's achievement of the research objective, indicated the study's limitations, and made suggestions for future research.

The safety culture in the iron ore environment that was studied showed signs of efforts to improve overall OHS performance. However, the identified safety cultural flaws indicate that there was room for improvement in management and employee commitment and involvement; communication and trust; competence and learning; risk awareness and compliance, and recognition. Therefore, the management of the organisation should understand the key enablers of a mature, uniform safety culture and ensure that they are fully in force.

REFERENCE LIST

- ABS Group. 2018. *Safety performance improvement using cultural change - Lessons learned*. Available at:
https://www.icheme.org/media/11397/h11a_thu_1425_eccles.pdf (Accessed on 28 August 2022).
- Abubakar, I. & Isa, U. 2019. A Review of Organisational Culture and Climate in Public Enterprises. *Journal of Humanities and Social Science*, 17(4):50-61.
- Ajmal, M., Isha, A.S.N.B., Sabir, A.A. & Nordin, S.M. 2021. Management Commitment to Safety and Safety Training: Mediating Role of Safety Compliance for Occupational Accidents A Study on Oil and Gas Industry of Malaysia. *Academic Journal of Social Sciences (AJSS)*, 5(3):303-318.
- Alruqi, W.M., Hallowell, M.R. & Techera, U. 2018. Safety climate dimensions and their relationship to construction safety performance: A meta-analytic review. *Safety Science*, 109(1):165-173.
- Anglo American. 2021. *Sustainability Report 2021*,
<https://www.angloamericankumba.com/~media/Files/A/Anglo-American-Group/Kumba/investors/annual-reporting/reports-archive-2021/kumba-sustainability-full-report-2021.pdf> (Accessed on 8 February 2023).
- Antonsen, S. 2009. Safety culture and the issue of power. *Safety Science*, 47(2):183-191.
- Antonsen, S. 2018. Key issues in understanding and improving safety culture. In *Safety cultures, safety models*. C. Gilbert, B. Journé, H. Laroche & C. Bieder Eds. Switzerland: Springer, Cham, 127-136.
- Antonsen, S., 2017. *Safety culture: theory, method and improvement*. 1st ed. London: CRC Press.
- Ashkanasy, N.M., Wilderom, C.P. & Peterson, M.F.(eds.)2000. *Handbook of organizational culture and climate*. London: Sage.
- Aven, T. & Reniers, G. 2013. How to define and interpret a probability in a risk and safety setting. *Safety Science*, 51(1):223-231.

Baker, D. P., & Haugen, J. A. 2008. The impact of management practices on a work-related injury. *Journal of Safety Research*, 39(4):361-369.

Baqir, M., Tariq, M., Raza, N. & Shah, M.N.A. (2020a). Impact of Employee Recognition on Health and Safety Culture in Construction Industry of Pakistan. *Sustainability*, 12(10): 38-45.

Baqir, M., Hussain, S., Waseem, R. & Islam, K.A. 2020b. Impact of reward and recognition, supervisor support on employee engagement. *American International Journal of Business and Management Studies*, 2(3):8-21.

Bayram, M. 2018. The management commitment to OHS, employee satisfaction and safety performance: An empirical study. *International Journal of Latest Engineering and Management Research*, 3(7):63-71.

Bienefeld, N. & Grote, G. 2012. Silence that may kill: When aircrew members don't speak up and why. *Aviation Psychology and Applied Human Factors*, 2(1):1-10.

Biggs, S.E., Banks, T.D., Davey, J.D. & Freeman, J.E. 2013. Safety leaders' perceptions of safety culture in a large Australasian construction organisation. *Safety Science*, 52(1):3-12.

Bonsu, J., Van Dyk, W., Franzidis, J.P., Petersen, F. & Isafiade, A. 2017. A systemic study of mining accident causality: an analysis of 91 mining accidents from a platinum mine in South Africa. *Journal of the Southern African Institute of Mining and Metallurgy*, 117(1):59-66.

Borys, D. 2009. Exploring risk-awareness as a cultural approach to safety: Exposing the gap between work as imagined and work as actually performed. *Safety Science Monitor*, 13(2):1-11.

Brogli, C. 2016. Five steps to improving safety maturity. *Professional Safety*, 61(4):38-39.

Bryman, A. & Bell, E. 2014. *Research methodology: Business and management contexts*. Oxford University Press Southern Africa.

BSI (British Standards Institution). (2007)., *Occupational health and safety management systems - Requirements*. Available at: <https://www.bsigroup.com/> (Accessed on 8 February 2023).

- Burnes, B. 2004. Kurt Lewin and the planned approach to change: a re-appraisal. *Journal of Management Studies*, 41(6):977-1002.
- Cameron, K.S. & Quinn, R.E. 2011. Diagnosing and changing organizational culture: Based on the competing values framework. Hoboken, New Jersey, United States: John Wiley & Sons.
- Carmen Copper Corporation. 2021. *Five largest iron ore mines in South Africa in 2020*. Available at: <https://www.mining-technology.com/marketdata/five-largest-iron-ore-mines-south-africa-2020/?msclkid=8dcb7ddbced111ec87efc7dad1abe501> (Accessed on 21 September 2021).
- Chakrabarty, D., 2021. Model Describing Central Tendency of Data. *International Journal of Advanced Research in Science, Engineering and Technology*, 8(9):2350-2359.
- Chen, D. & Tian, H. 2012. Behaviour-based safety for accident prevention and positive study in China construction project. *Procedia Engineering*, 43(1):528-534.
- Chen, Y., Lu, L. & Li, Q. 2019. The effect of safety training on safety performance in the construction industry. *Safety Science*, 116(1):347-354.
- Chen, Y., McCabe, B. & Hyatt, D. 2018. A resilience safety climate model predicting construction safety performance. *Safety Science*, 109(1):434-445.
- Choudhry, R.M., Fang, D. & Mohamed, S. 2007. The nature of safety culture: A survey of the state-of-the-art. *Safety Science*, 45(10):993-1012.
- Christian, M.S., Bradley, J.C., Wallace, J.C. & Burke, M.J. 2009. Workplace safety: a meta-analysis of the roles of person and situation factors. *Journal of Applied Psychology*, 94(5):1103-1127.
- Clarke, S. 2000. Safety culture: under-specified and overrated? *International Journal of Management Reviews*, 2(1):65-90.
- Clarke, S. 2006. The relationship between safety climate and safety performance: a meta-analytic review. *Journal of Occupational Health Psychology*, 11(4):315.
- Cooper, M. L. (Ed.). (2017). *Handbook of occupational health and safety management*. UK: Routledge.

- Cooper, M.D. 2000. Towards a model of safety culture. *Safety Science*, 36(2):111-136.
- Cox, T. 1994. *Cultural diversity in organizations: Theory, research, and practice*. San Francisco, California, United States: Berrett-Koehler Publishers.
- Cullen, D. 2001. The Ladbroke Grove Rail Inquiry. Her Majesty's Stationery Office, London. Norwich: Crown. 248 p.
- Dahl, Ø. & Kongsvik, T. 2018. Safety climate and mindful safety practices in the oil and gas industry. *Journal of Safety Research*, 64(1):29-36.
- De Castro, B.L., Gracia, F.J., Peiró, J.M., Pietrantoni, L. & Hernandez, A. 2013. Testing the validity of the International Atomic Energy Agency (IAEA) safety culture model. *Accident Analysis & Prevention*, 60(1):231-244.
- Deal, T.E., & Kennedy, A.A. 1982. *Corporate cultures: The rites and rituals of corporate life*. Massachusetts, United States: Addison-Wesley Publishing Company.
- Dong, Y. & Wang, X. 2019. Employee involvement and occupational health and safety performance in the Chinese construction industry. *Journal of Safety Research*, 70, 41-47.
- DuPont Sustainable Solutions. 2013. *The Role of Leadership in Promoting a Safety Culture*. <https://www.consultdss.com/the-role-of-leadership-in-promoting-a-safety-culture/> [Date of access: 27 September 2021].
- DuPont Sustainable Solutions. 2021. *DSS Bradley Curve Infographic*. <https://www.consultdss.com/content-hub/dss-bradley-curve-infographic/>
<https://www.consultdss.com/bradley-curve-infographic/> [Date of access: 27 September 2021].
- Duryan, M., Smyth, H., Roberts, A., Rowlinson, S. & Sherratt, F. 2020. Knowledge transfer for occupational health and safety: Cultivating health and safety learning culture in construction firms. *Accident Analysis & Prevention*, 139(2020):105496.
- Eccles, B. & Manton, M. 2019. *Safety Performance Improvement using Cultural Change -Lessons Learned*. Available at:
https://www.researchgate.net/publication/335858422_Safety_Performance_Improvement_using_Cultural_Change_-_Lessons_Learned (Accessed on 21 July 2021).

- Ederer, C., König-Bachmann, M., Romano, I., Knobloch, R. & Zenzmaier, C. 2019. Midwives' perception of patient safety culture—A qualitative study. *Midwifery*, 71(1):33-41.
- Fernández-Muñiz, B., Montes-Peón, J.M. & Vázquez-Ordás, C.J. 2007. Safety culture: analysis of the causal relationships between its key dimensions. *Journal of Safety Research*, 38(6):627-641.
- Field, A., 2009. *Discovering statistics using SPSS*, 3rd ed. London, UK: Sage.
- Findley, M., Smith, S., Gorski, J. & O'Neil, M. 2007. Safety climate differences among job positions in a nuclear decommissioning and demolition industry: Employees' self-reported safety attitudes and perceptions. *Safety Science*, 45(8):875-889.
- Fitts, D.A., 2020. Commentary on "A review of effect sizes and their confidence intervals, Part I: The Cohen's d family": The degrees of freedom for paired sample designs. *The Quantitative Methods for Psychology*, 16(4):250-261.
- Fitzgerald, M. 2005. Safety performance improvement through culture change. *Process Safety and Environmental Protection*, 83(4):324-330.
- Godfrey, A., Lockett, A. & Wright, D. (2021). Employee involvement in health and safety management: A systematic review of the empirical literature. *Safety Science*, 139. 106088. Available at: <https://doi.org/10.1016/j.ssci.2021.106088> Accessed on 8 February 2023).
- Godfrey, M.J. 2018, April. Implementing continuous improvement in hazard studies. Paper presented at the SPE International Conference and Exhibition on Health, Safety, Security, Environment, and Social Responsibility, Abu Dhabi, UAE, April 2018
- Goncalves Filho, A.P. & Waterson, P. 2018. Maturity models and safety culture: A critical review. *Safety Science*, 105(1):192-211.
- Guldenmund, F.W. 2000. The nature of safety culture: A review of theory and research. *Safety Science*, 34(1-3):215-257.
- Guldenmund, F.W. 2007. The use of questionnaires in safety culture research—an evaluation. *Safety Science*, 45(6):723-743.

- Guldenmund, F.W. 2018. Understanding safety culture through models and metaphors. In *Safety Cultures, Safety Models*. Springer, Cham, 21-34).
- Guo, Z., Du, Y., Wang, Y. & Yang, H. 2017. The relationship between safety training and safety culture in construction organizations. *Safety Science*, 98(1):153-160.
- Hakansson, N. & Hwang, J. 2009. The effect of safety management systems on safety performance: Evidence from the Swedish construction industry. *International Journal of Injury Control and Safety Promotion*, 16(2):85-93.
- Hale, A.R. 2000. Culture's confusions. *Safety Science*, 34(1-3):1-14.
- Hamdan, Y. & Alheet, A.F. 2020. Influence of organisational culture on pro-activeness, innovativeness, and risk-taking behaviour of SMEs. *Entrepreneurship and Sustainability Issues*, 8(1):203-217.
- HASpod. 2019. *The health and safety competent person*. Available at: <https://www.haspod.com/blog/management/health-safety-competent-person> (Accessed on 26 September 2021).
- Hauge, J.I. & Skogstad, A. 2007. Safety culture in petrochemical organizations: A comparative study of the impact of management practices and national culture. *Safety Science*, 45(5):566-581.
- Hidden, A. 1989. Investigation of the Clapham Junction Railway Accident. Available at: <https://www.jesip.org.uk/wp-content/uploads/2022/03/Clapham-Rail-Crash.pdf> (Accessed on 8 February 2023).
- Holm, S. & Lindqvist, S. 2010. Power relations, safety culture and learning. *Safety Science*, 48(2):173-180.
- Hon, C.K., Chan, A.P. & Yam, M.C. 2014. Relationships between safety climate and safety performance of building repair, maintenance, minor alteration, and addition (RMAA) works. *Safety Science*, 65(1):10-19.
- Hong, C., Ramayah, T. & Subramaniam, C. 2018. The relationship between critical success factors, internal control, and safety performance in the Malaysian manufacturing sector. *Safety Science*, 104(1):179-188.

- Hong, J., Ramayah, T. & Subramaniam, N. (2018). The impact of safety management practices on occupational health and safety performance in the construction industry. *Journal of Cleaner Production*, 170(1): 380-391.
- HSE (Health and Safety Executive). (No date). *The Health and Safety Plan*. (Available at: <https://www.hse.gov.uk/> (Accessed on 8 February 2023)).
- Hudson, P. 2007. Implementing a safety culture in a major multinational. *Safety Science*, 45(6):697-722.
- Huseman, M. 2017. *DuPont Bradley Curve - Should I learn more about safety culture?* Available at: <https://blog.gooddayswork.ag/blog/duPont-bradley-curve-should-i-learn-more-about-it> (Accessed on 27 September 2021).
- Hussain, S.T., Lei, S., Akram, T., Haider, M.J., Hussain, S.H. & Ali, M. 2018. Kurt Lewin's change model: A critical review of the role of leadership and employee involvement in organizational change. *Journal of Innovation & Knowledge*, 3(3):123-127.
- ILO (International Labour Organisation). 2019. *World Employment Report on Occupational Safety and Health and the ILO code of Practice on Safety and Health in the Construction Industry*. Available at: <https://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/occupational-safety-and-health/lang--en/index.htm> (Accessed on 8 February 2023).
- ILO (International Labour Organisation). 2021. *International Labour Standards on Occupational Safety and Health*. Available at: <https://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/occupational-safety-and-health/lang--en/index.htm> (Accessed on 3 September 2021).
- International Atomic Energy Agency, 2002. *Safety Culture in Nuclear Installations Guidance for Use in the Enhancement of Safety Culture*. Vienna, Austria: International Atomic Energy Agency.

International Nuclear Safety Advisory Group. 1999. *Basic Safety Principles for Nuclear Power Plants: 75-INSAG-3 Rev. 1*, Vol. 1082. Vienna, Austria: International Atomic Energy Agency.

IOSH. 2015. *Promoting a positive culture. A guide to health and safety culture*. Leicestershire, UK: Wigston.

ISO (International Organization for Standardization). (2018). *Occupational health and safety management systems – Requirements*. Available at: <https://www.iso.org/> (Accessed on 8 February 2023).

Jasiulewicz-Kaczmarek, M., Szwedzka, K. & Szczuka, M. 2015. Behaviour-based intervention for occupational safety–case study. *Procedia Manufacturing*, 3(1):4876-4883.

Jiang, L., Lavaysse, L.M. & Probst, T.M. 2019. Safety climate and safety outcomes: A meta-analytic comparison of universal vs. industry-specific safety climate predictive validity. *Work & Stress*, 33(1):41-57.

Johnstone, R. & Ferrett, E. 2018. The role of communication in health and safety management. *Journal of Safety Research*, 63(1):29-36.

Josey, S. 2017. *How a successful safety process impacts your business*. Available at: <https://performancesolutionsbymilliken.com/leadership-blog/how-a-successful-safety-process-impacts-your-business/> (Accessed on 24 September 2021).

Kekana, J. 2019. *The cost of health and safety non-compliance*. Available at: <https://www.linkedin.com/pulse/cost-health-safety-non-compliance-juliet-kekana> (Accessed on 24 September 2021).

Kelly, T. 2012. *Taking a positive approach to change management in LIM organisations: The role of Appreciative Inquiry*. Unpublished doctoral dissertation. Charles Sturt University, Bathurst, Australia.

Kim, N.K., Rahim, N.F.A., Iranmanesh, M. & Foroughi, B. 2019. The role of the safety climate in the successful implementation of safety management systems. *Safety Science*, 118(1):48-56.

- Knegtering, B. Pasman, H.J., 2009. Safety of the process industries in the 21st century: A changing need of process safety management for a changing industry. *Journal of Loss Prevention in the Process Industries*, 22(2):162-168.
- Kreitner, R. & Kinicki, A., 2013. Organizational culture, socialization, and mentoring. In *Organizational behavior*, 8th ed. S.P. Robbins & T. Judge Eds. New York: McGraw-Hill, 60-85.
- Kumari, A., Ranjan, P., Vikram, N.K., Kaur, D., Sahu, A., Dwivedi, S.N., Baitha, U. & Goel, A. 2020. A short questionnaire to assess changes in lifestyle-related behaviour during the COVID-19 pandemic. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 14(6):1697-1701.
- Land, J. 2021. *It's All About People: A Practical Guide to Develop a Dynamic Safety Culture!* Available at: <https://www.scribd.com/book/519920402/It-s-All-About-People-A-Practical-Guide-to-Develop-a-Dynamic-Safety-Culture> (Accessed on 8 February 2023).
- Lee, J. & Na, H. 2017. Understanding the cost of safety: A conceptual framework and review of empirical studies. *Safety Science*, 96(1):1-16.
- Levine, D. & Soobader, M.J. 2003. A human capital theory of occupational health disparities. *American Journal of Public Health*, 93(2):250-256.
- Li, Y. & Guldenmund, F.W. 2018. Safety management systems: A broad overview of the literature. *Safety Science*, 103(1):94-123.
- Li, Y., Liu, Z., Qin, K., Cui, J., Zeng, X., Ji, M., Lan, J., You, X. & Li, Y. 2021. Organizational trust and safety operation behaviour in airline pilots: The mediating effects of organizational identification and organizational commitment. *Journal of Air Transport Management*, 92(2021):102-118.
- Lu, L. & Toppinen, A. 2011. The impact of occupational health and safety on firm performance: Evidence from Finland. *Safety Science*, 49(2)143-152.
- Lu, L., Chen, Y. H. & Yang, Y. 2017. Trust, safety climate, and safety performance in the construction industry. *Safety Science*, 98(1):33-41.

- Magee, J.C., Milliken, F.J. & Lurie, A.R. 2010. Power differences in the construal of a crisis: The immediate aftermath of September 11, 2001. *Personality and Social Psychology Bulletin*, 36(3):354-370.
- Mannion, R., Konteh, F.H. & Davies, H.T.O. 2009. Assessing organisational culture for quality and safety improvement: a national survey of tools and tool use. *BMJ Quality & Safety*, 18(2):153-156.
- Mantashe, G. 2020. *Minister Gwede Mantashe: 2019 Mine Health and Safety Statistics*. Available at: <https://www.gov.za/speeches/2019-mine-health-and-safety-statistics-24-jan-2020-0000> (Accessed on 24 September 2021).
- Marquardt, N., 2019. The effect of locus of control on organizational learning, situation awareness and safety culture. In *Safety culture: Progress, trends and challenges*. N. Marquardt, Ed. New York: Nova Science Publishers, 157-218.
- McAtamney, L. & Corlett, E. N. 2017. *Ergonomics: An Introduction*. UK: Routledge.
- Mcinerney, P.A. 2005. Report of the Special Commission of Inquiry into the Waterfall Rail Accident. *Department of Transport*, New South Wales, Australia.
- Mearns, K., Kirwan, B., Reader, T.W., Jackson, J., Kennedy, R. & Gordon, R. 2013. Development of a methodology for understanding and enhancing safety culture in Air Traffic Management. *Safety Science*, 53(1):123-133.
- Mierke, J. & Williamson, V. 2017. A framework for achieving organizational culture change. *Library Leadership & Management*, 31(2):1-16.
- Mohamed, S. 2003. Scorecard approach to benchmarking organizational safety culture in construction. *Journal of Construction Engineering and Management*, 129(1):80-88.
- Mohammadi, A., Tavakolan, M. & Khosravi, Y. 2018. Factors influencing safety performance on construction projects: A review. *Safety Science*, 109(1):382-397.
- Mohapi, G. & Zarske, R. 2019. *Health and safety on South African mines. A best practice report*. Johannesburg, Southern Africa: German Chamber of Commerce and Industry Competence Centre for Mining & Mineral Resources.

- Moodley, R. 2020. Mining sector records 51 fatalities. *SA News*. 24 January. Available at: <https://www.sanews.gov.za/south-africa/mining-sector-records-51-fatalities> (Accessed on 17 July 2021).
- Munnnoo, S. 2018. *The economic impact of health and safety*. Available at: <https://dev.sheqmanagement.com/the-economic-impact-of-health-and-safety/> (Accessed on 25 September 2021).
- Mustapha, Z., Aigbavboa, C.O. & Thwala, W.D. 2015. Application of modified statistical triangle of accident causation in construction health and safety. In *Proceedings of the 19th International Symposium on Advancement of Construction Management and Real Estate* Berlin, Heidelberg: Springer, 57-66.
- Nævestad, T.O. 2008. Safety cultural preconditions for organizational learning in High-Risk organizations. *Journal of Contingencies and Crisis Management*, 16(3):154-163.
- NASA. 2003. Report of the Columbia Accidents Investigation Board. Available at: https://www.nasa.gov/pdf/298870main_SP-2008-565.pdf (Accessed on 8 February 2023).
- Nembhard, I.M. & Edmondson, A.C. 2006. Making it safe: The effects of leader inclusiveness and professional status on psychological safety and improvement efforts in health care teams. *Journal of Organizational Behaviour: The International Journal of Industrial, Occupational and Organizational Psychology and Behaviour*, 27(7):941-966.
- Newaz, M.T., Davis, P., Jefferies, M. & Pillay, M. 2019. The psychological contract: A missing link between safety climate and safety behaviour on construction sites. *Safety Science*, 112(1):9-17.
- Odor, H.O. 2018. Organisational culture and dynamics. *Global Journal of Management and Business Research*, 18(1):23-29.
- Oliver, A., Cheyne, A., Tomás, J.M. & Cox, S. 2002. The effects of organizational and individual factors on occupational accidents. *Journal of Occupational and Organizational Psychology*, 75(4):473-488.

Olsen, E. 2010. Exploring the possibility of a common structural model measuring associations between safety climate factors and safety behaviour in health care and the petroleum sectors. *Accident Analysis & Prevention*, 42(5):1507-1516.

OSHA (Occupational Safety and Health Administration). (No date). Developing and Implementing a Safety and Health Management System. Available at: <https://www.osha.gov/> (Accessed on 8 February 2023).

OSHA (Occupational Safety and Health Administration). 2021. Protecting Workers in Low-Wage Jobs. Available at: <https://www.osha.gov/workers> (Accessed on 8 February 2023).

Osman, R., Awang, N., Hassan, S.A.H.S. & Yusof, N.M. 2015. Level of awareness on behaviour-based safety (BBS) in the manufacturing industry towards reducing workplace incidents. *International Journal of Education and Research*, 3(1):77-88.

Parand, A., Burnett, S., Benn, J., Pinto, A., Iskander, S. & Vincent, C. 2011. The disparity of frontline clinical staff and managers' perceptions of a quality and patient safety initiative. *Journal of Evaluation in Clinical Practice*, 17(6):1184-1190.

Parker, D., Lawrie, M. & Hudson, P. 2006. A framework for understanding the development of organisational safety culture. *Safety Science*, 44(6):551-562.

Parker, J. & Davies, B., 2020. No blame no gain? from a no-blame culture to a responsibility culture in medicine. *Journal of Applied Philosophy*, 37(4):646-660.

Pathiranage, J., 2019. Organizational culture and business performance: an empirical study. *International Journal of Economics and Management*, 24(2):264-278.

Pérez-Mayo, A.R. 2020. *Organizational Culture in the human resource of a Mexican Hotel Organization*. Available at: https://www.ecorfan.org/booklets/booklets_ICREIMMI_2020/5-Ciencias_Sociales/CIER-112.pdf (Accessed on 23 Sept. 2021).

Petitta, L., Probst, T.M., Barbaranelli, C. & Ghezzi, V. 2017. Disentangling the roles of safety climate and safety culture: Multi-level effects on the relationship between supervisor enforcement and safety compliance. *Accident Analysis & Prevention*, 99(1):77-89.

- Pousette, A., Larsson, S. & Törner, M. 2008. Safety climate cross-validation, strength and prediction of safety behaviour. *Safety Science*, 46(3):398-404.
- Probst, T.M., Goldenhar, L.M., Byrd, J.L. & Betit, E. 2019. The Safety Climate Assessment Tool (S-CAT): A rubric-based approach to measuring construction safety climate. *Journal of Safety Research*, 69(1):43-51.
- Reader, T.W. & O'Connor, P. 2014. The Deepwater Horizon explosion: non-technical skills, safety culture, and system complexity. *Journal of Risk Research*, 17(3):405-424.
- Reader, T.W., Noort, M.C., Shorrock, S. & Kirwan, B. 2015. Safety sans Frontières: an international safety culture model. *Risk Analysis*, 35(5):770-789.
- Republic of South Africa. 1993. *Occupational Health and Safety Act No 85 of 1993*. Pretoria: Government Printers.
- Republic of South Africa. 1996a. The Constitution of the Republic of South Africa, Act 108 of 1996. Available at: <https://www.gov.za/documents/constitution-republic-south-africa-1996> (Accessed on 28 August 2022).
- Republic of South Africa. 1996b. *Mine Health and Safety Act No 29 of 1996*. Pretoria: Government Printers.
- Reynolds, J. 2018. *The Three P's: Plant, Process, People*. Available at: <https://reynoldstraining.com/health-and-safety-articles/three-ps-plant-process-people/#:~:text=The%20Three%20P%E2%80%99s%3A%20Plant%2C%20Process%2C%20People%20Poor%20process,across%20all%20aspects%20of%20plant%2C%20process%20and%20people> (Accessed on 25 September 2021).
- Richter, A. & Koch, C. 2004. Integration, differentiation, and ambiguity in safety cultures. *Safety Science*, 42(8):703-722.
- Rights, C.F.E. 2021. *Environmental Violations Reporting*. Available at: <https://cer.org.za/webinars/environmental-violations-portal> (Accessed on 12 July 2021).
- Robbins, S.P., Judge, T.A. & Campbell, T. 2017. *Organizational behavior*, 17th ed. London, United Kingdom: Pearson.

- Roughton, J., Crutchfield, N. & Waite, M. 2019. *Safety culture: An innovative leadership approach*. 2nd ed. Cambridge, United States: Butterworth-Heinemann.
- Rouse, M.B. & Glendon, A.I. 1998. Organisational and psychological predictors of occupational health and safety. *Journal of Occupational Health and Safety - Australia and New Zealand*, 14(1):21-32.
- Rovithis, M., Linardakis, M., Merkouris, A., Patiraki, E., Vassilaki, M. & Philalithis, A. 2017. Organizational culture among levels of health care services in Crete (Greece). *Applied Nursing Research*, 36(1):9-18.
- Salguero-Caparrós, F., Pardo-Ferreira, M.D.C., Martínez-Rojas, M. & Rubio-Romero, J.C. 2020. Management of legal compliance in occupational health and safety: A literature review. *Safety Science*, 121(1):111-118.
- Schein, E.H. 2010. *Organizational culture and leadership*, 4th ed. Hoboken, New Jersey, United States: John Wiley & Sons.
- Schneider, B., Ehrhart, M.G. & Macey, W.H. 2013. Organizational climate and culture. *Annual Review of Psychology*, 64(1):361-388.
- Seo, D.C., Torabi, M.R., Blair, E.H. & Ellis, N.T. 2004. A cross-validation of safety climate scale using confirmatory factor analytic approach. *Journal of Safety Research*, 35(4):427-445.
- Shariff, A., Aziz, H. & Majid, N., 2016. Way forward in Process Safety Management (PSM) for effective implementation in process industries. *Current Opinion in Chemical Engineering*, 14(1): 56-60.
- Shaw, H. 2019. *Improving Business Performance through Health and Safety Improvement*. Available at: <https://www.performancemagazine.org/business-performance-health-safety/> (Accessed on 25 September 2021).
- Simmons, J. 2017. Effective communication in health and safety management. *Safety Science*, 100(1):32-39.
- Simoneaux, S. & Stroud, C. 2014. A strong corporate culture is key to success. *Journal of Pension Benefits*, 22(1):51-53.

- Singer, S., Lin, S., Falwell, A., Gaba, D. & Baker, L. 2009. Relationship of safety climate and safety performance in hospitals. *Health Services Research*, 44(2):399-421.
- SPSS Inc. 2021. SPSS® 17.0 for Windows, Release 17.0.0. Available at: <https://www.ibm.com/products/spss-statistics> www.spss.com (Accessed on 25 July 2022).
- Statista, 2022. *Statista*. Available at: <https://www.statista.com/statistics/702694/mining-industry-fatalities-south-africa/> (Accessed on 25 July 2022).
- StatSoft. 2009. STATISTICA version 9.0. Available at: http://www.statsoft.com.br/downloads/Version_9_Features.pdf (Accessed on 25 July 2022).
- Stemn, E., Bofinger, C., Cliff, D. & Hassall, M.E. 2019. Examining the relationship between safety culture maturity and safety performance of the mining industry. *Safety Science*, 113(1):345-355.
- Taylor, R.H. 2002. Improving health and safety performance – achieving breakthrough. *The Structural Engineer*, 80(1):23-27.
- Tear, M.J., Reader, T.W., Shorrock, S. & Kirwan, B. 2020. Safety culture and power: Interactions between perceptions of safety culture, organisational hierarchy, and national culture. *Safety Science*, 21(1):550-561.
- Tetzlaff, E.J., Goggins, K.A., Pegoraro, A.L., Dorman, S.C., Pakalnis, V. & Eger, T.R. 2021. Safety culture: a retrospective analysis of occupational health and safety mining reports. *Safety and Health at Work*, 12(2):201-208.
- Tharp, B.M. 2009. Defining “culture” and “organizational culture”: From anthropology to the office. *Interpretation a Journal of Bible and Theology*, 2(3):1-5.
- Thomas, E.J., Sexton, J.B. & Helmreich, R.L. 2003. Discrepant attitudes about teamwork among critical care nurses and physicians. *Critical Care Medicine*, 31(3):956-959.

Thompson, B. 2001. Significance, effect sizes, stepwise methods, and other issues: Strong arguments move the field. *The Journal of Experimental Education*, 70(1):80-93.

Tsao, M.L., Hsieh, C.J. & Chen, L.Y. 2017. The role of management commitment and employee involvement in safety management. *International Journal of Organizational Innovation*, 10(2):52-74.

Vanesa, Y.Y., Matondang, R., Sadalia, I. & Daulay, M.T. 2019. The Influence of Organizational Culture, Work Environment and Work Motivation on Employee Discipline. *American International Journal of Business Management (AIJBM)*, 2(5):37-45.

Wang, X., Zhang, C., Deng, J., Su, C. & Gao, Z. 2022. Analysis of Factors Influencing Miners' Unsafe Behaviors in Intelligent Mines using a Novel Hybrid MCDM Model. *International Journal of Environmental Research in Public Health*, 19(12). Available at: <https://ncbi.nlm.nih.gov/pmc/articles/PMC9224353/> (Accessed on 7 February 2023).

Ward, H. 2021. *Statista*. Available at: <https://www.statista.com/statistics/702694/mining-industry-fatalities-south-africa/> (Accessed on 17 July 2021).

Warrick, D.D. 2017. What leaders need to know about organizational culture. *Business Horizons*, 0(3):395-404.

WHO (World Health Organization). 2019. *Occupational health and safety management systems – Guidelines*. Available at: https://www.who.int/occupational_health/publications/ils_ohsms_guidelines/en/ (Accessed on 8 February 2023).

Wu, C., Song, X., Wang, T. & Fang, D. 2015. Core dimensions of the construction safety climate for a standardized safety-climate measurement. *Journal of Construction Engineering and Management*, 141(8):41-58.

Xie, J., Cui, L., Chen, Y. & Zhang, J. (2019). The impact of trust on occupational health and safety behavior: Evidence from China. *Safety Science*, 117(1):117-125.

- Yule, S, 2003. Safety culture and safety climate: A review of the literature. Available at:
<https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.505.35&rep=rep1&type=pdf> (Accessed on 19 October 2022).
- Yulianto, 2020. The Role of Organizational Culture in Improving the Performance of Human Resources in Higher Education. *Technium Social Science Journal*, 12(1):220-234.
- Zohar, A. (2010). Safety climate in industrial organizations: Theoretical and practical implications. *Safety Science*, 48(2), pp.229-240.

APPENDICES

Appendix A: Informed consent

North-West University – South Africa

Master in Business Administration

Title of study: Determining the key enablers for a uniform safety culture in the South African iron ore mining industry.

Researcher: Houston Eilers

Dear Participant

This informed consent form will assist you, as a participant, to decide on whether you would like to take part in this research or not.

You are kindly requested to participate in an academic research study conducted by Houston Eilers, an MBA student from North-West University.

The purpose of this study is to conduct an assessment to determine the key enablers of a uniform, mature safety culture in the South African iron ore mining industry and assess the safety culture of Kumba Iron Ore Sishen Mines. Information from you, as an employee of an iron ore mine, is, therefore, requested owing to your experience of the safety culture of the open cast iron ore mining environment. This study will focus on the primary production and maintenance sections of the iron ore mining organisation.

Further background and items to be noted:

This study aims to present proposals to the senior leadership team of the iron ore mining organisation to enable positive change in the safety culture at the mine.

I, therefore, request that you, the participant, answer all questions honestly. Furthermore, I guarantee your anonymity and overall confidentiality.

Upon completion, I, Houston Eilers will provide the combined results of this study as presented in the final dissertation to participants upon request.

- The duration of the survey will be approximately 10 minutes.
- All the individual responses will be treated as confidential.

- Participation is voluntary and you may, therefore, end your participation in the survey at any point.
- The survey comprises two sections: part one contains demographic questions and part 2 contains questions the answers to which are measured according to a Likert scale.
- The research will not have any adverse effects on participants. Moreover, participants' perceptions and the research results will be always treated with the utmost confidentiality and anonymity (i.e., all phases of the study).

Please note: HR clearance had been obtained from the Manager of Human Resources of Sishen Mine to conduct the study on the mine.

By completing the questionnaire, you verify that you have read and understood the information provided and give your consent to participate in the study voluntarily.

If you have any concerns, you can contact me at:

Houston Eilers

Cell: 084 597 7131

Email: Houston.eilers@angloamerican.com

Appendix B: Ethical clearance



NORTH-WEST UNIVERSITY
YUNIBESITHI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: <http://www.nwu.ac.za>

Economic and Management Sciences Research
Ethics Committee (EMS-REC)

22 November 2021

Mr J Coetzee
Per e-mail
Dear Mr Coetzee,

EMS-REC FEEDBACK: 29102021 – Round Robin
Student: Eilers, HJ (21062293)(NWU-01252-21-A4)
Study leader: Mr J Coetzee - MBA

Your ethics application on, *Determining the key enablers for a uniform safety culture in the South African iron ore mining industry*, which served via Round Robin, refers.

Outcome:

Approved as a minimal risk study. A number **NWU-01252-21-A4** is given for one year of ethics clearance.

Please note that the ethics approval of this application is subject to the Covid-19 protocols.

Kind regards,

Prof Mark Rathbone
Chairperson: Economic and Management Sciences Research Ethics Committee
(EMS-REC)

Appendix C: Confirmation of employer consent



PERSONAL CONFIDENTIAL

KUMBA IRON ORE

Sishen Iron Ore Company (Pty) Ltd

CORPORATE OFFICE
Centurion Gate Building 2B
124 Akkerboom Road
Centurion
0157
South Africa

16 August 2021

Mr HJ Eilers
ID 890320 5303 081

Dear Houston

APPROVAL TO CONDUCT ACADEMIC RESEARCH AT KUMBA, SISHEN MINE

This Letter serves to confirm that the company has granted approval for Houston Eilers employee no 6001617 who is currently employed as a Section Engineering Manager, Engineering Support Services to conduct academic research on the Company premises.

Houston is currently a student at NWU Business School, student No: 21062293 studying towards his MBA. His research topic is:

A study to determine the key enablers for a uniform safety culture in the South African mining industry.

Kind Regards

 6057673

S NKOMOMBINI
MANAGER HUMAN RESOURCES SISHEN

Tel: +27 53 739 1629

Cell: +27 81 085 1278

Email: sipho.nkomombini@angloamerican.com

Results to be shared with the Company.

A member of Anglo American plc group

Centurion Gate, Building 2B, 124 Akkerboom Road, Centurion, 0157. PO Box 0679, Centurion, 0046, South Africa.
T +27 (0) 12 683 7000. F +27 (0) 12 295 0746.

Incorporated in South Africa. Registration Number: 2000/011086/07

Directors: TM Mthembu (Chairman), BA Mazurka (CFO) (Zimbabwean), RJP Fourie, PA Koppeschaar, ACB Molusi, WD Stander, SV Tjebekke
Company secretary: CD Appollis

Appendix D: Safety culture and climate questionnaire

Dear Colleague

Thank you for taking the time to answer this questionnaire. This research aims to identify areas of improvement within the safety culture of the open cast iron ore mining environment to sustain world-class safety performance.

There are no foreseeable risks associated with this study. **Your participation in this study is completely voluntary and anonymous.** All questionnaire responses will be strictly confidential, and data from this research will only be used as part of my MBA mini dissertation. The questionnaire consists of 50 statements associated with safety-related aspects in your daily work environment. It will take approximately 15 minutes to complete.

Yours faithfully

Houston Eilers

MBA final year: North-West University Business School, Potchefstroom

Your response to each statement must be indicated as shown below:

Example:

Please reflect on your honest opinion of the statements to ensure an accurate measure.

Example:					
Use the following scale to indicate your level of agreement or disagreement with each statement:					
1 = Strongly disagree		1 - Strongly Disagree	2 - Disagree	3 - Neutral	4 - Agree
2 = Disagree					
3 = Neutral					
4 = Agree					
5 = Strongly agree					
Mark a cross (x) in the box related to the statement given.					
Questionnaire:					
1	Employee are held accountable for safety violations.	X	2	3	4 5

Section A:

Make a cross (x) on the information which apply to you.							
Section A:							
Please select which of the following applies to you:							
Sexual Orientation:		Age:		Department:		Years of Service:	
Managerial Level:		Employment:					
Male		< 25		C&I Automation	< 1	HOD	Permanent
Female		26 - 35		Diagnostic & Reliability	2 - 5	Section Manager / Site Manager	Service Provider
		36 - 45		Discipline Planning	6 - 10	Supervisor	
		46 - 55		Electrical Services	> 11	Employee	
		> 56		Civil & Mechanical Services			
				Operational Services			
				Central Workshops			
				Engineering: DMS			
				Engineering: JIG			
				Operations: DMS			
				Operations: JIG			
		SHE					

Section B:

Section B: Safety Culture & Climate Questionnaire						
Use the following scale to indicate your level of agreement or disagreement with each statement:		1 - Strongly Disagree	2 - Disagree	3 - Neutral	4 - Agree	5 - Strongly Agree
1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree						
Mark a cross (x) in the box related to the statement given.						
Questionnaire:						
Management & Employee Commitment						
1	Sufficient time and effort are committed to safety at the mine.	1	2	3	4	5
2	Management listens to safety ideas and concerns and takes appropriate action.	1	2	3	4	5
3	Management is involved in safety only after incidents have occurred.	1	2	3	4	5
4	Employees regularly assist their colleagues to comply with safety rules.	1	2	3	4	5
5	Although safety is regarded as the top priority it is sometimes overlooked due to production or cost.	1	2	3	4	5
6	When it comes to safety compliance a lack of discipline is not tolerated by management.	1	2	3	4	5
7	Employees are motivated to put in just enough effort necessary to complete the job regardless of safety.	1	2	3	4	5
8	Management cares about the safety and health of their subordinates.	1	2	3	4	5
9	The reason for not achieving our safety targets is that everyone does not value safety as important.	1	2	3	4	5
10	Management commitment to safety is visible through their actions ("walk the talk").	1	2	3	4	5
11	Management talks a lot about safety during an accident but when everything goes well, they are quiet.	1	2	3	4	5
12	Employees will rather spend more time on a job to ensure it is done safely, than rushing to complete a job.	1	2	3	4	5

Communication & Trust						
1 3	Relevant safety information is communicated to me regularly.	1	2	3	4	5
1 4	Management has an open-door policy for safety issues.	1	2	3	4	5
1 5	I feel comfortable allowing others to execute tasks in my area of responsibility.	1	2	3	4	5
1 6	Employees would rather keep safety information such as near misses to themselves.	1	2	3	4	5
1 7	My supervisor/manager trusts in my ability to identify hazards and risks.	1	2	3	4	5
1 8	I feel comfortable that the equipment I work with is safe.	1	2	3	4	5
1 9	The mine has a 'no-blame' culture with an atmosphere of trust.	1	2	3	4	5
Accountability & Involvement						
2 0	I am encouraged to share my safety improvement suggestions.	1	2	3	4	5
2 1	We often review new and routine tasks to determine safer ways for executing the tasks.	1	2	3	4	5
2 2	Everyone is accountable for their safety.	1	2	3	4	5
2 3	Safety is how we do things around here.	1	2	3	4	5
2 4	Employees often share tips on how to work safely.	1	2	3	4	5
2 5	There are safety systems in place to manage all hazards.	1	2	3	4	5
2 6	Everyone's safety is equally important, and all employees are accountable for their safety.	1	2	3	4	5
2 7	Employees at all levels are involved in decisions when it comes to safety.	1	2	3	4	5

28	Management is the primary driving force of safety, and not the employees.	1	2	3	4	5
Competency & Learning						
29	The mine learns from past mistakes and implements appropriate preventative measures as soon as possible.	1	2	3	4	5
30	Employees working in the mine undergo comprehensive and meaningful safety training.	1	2	3	4	5
31	Most incidents are due to failures arising from the culture of the mine rather than equipment or system failures.	1	2	3	4	5
32	Most of the time short-term solutions are given for safety issues that do not address the root cause.	1	2	3	4	5
33	Employees have the necessary knowledge and skills to allow them to work safely.	1	2	3	4	5
34	The way we conduct incident investigations is indicative of a world-class mine.	1	2	3	4	5
35	There are a lot of repeat incidents.	1	2	3	4	5
Risk Awareness and Compliance						
36	Most employees are aware of the hazards in their workplace.	1	2	3	4	5
37	We do not deviate from following standards, procedures and JRAs.	1	2	3	4	5
38	We often become complacent when it goes well and then incidents occur.	1	2	3	4	5
39	I focus on hazard identification daily when doing my work.	1	2	3	4	5
40	Doing things safely has become a habit for most employees rather than an obstacle.	1	2	3	4	5
41	Safety is seen as a condition of employment.	1	2	3	4	5
42	Some employees get away with unsafe acts.	1	2	3	4	5

4 3	Safety systems or procedures are often bypassed by employees to complete their work quicker.	1	2	3	4	5
4 4	There is satisfactory compliance with safety rules.	1	2	3	4	5
Recognition						
4 5	Individual contributions towards safety are recognised by my organisation.	1	2	3	4	5
4 6	I am proud to be associated with this mine when it comes to safety.	1	2	3	4	5
4 7	A job well done is a job done safely.	1	2	3	4	5
4 8	Recognition for good safety performance helps to promote safe behaviour.	1	2	3	4	5
4 9	Good safety performance will lead to good business performance.	1	2	3	4	5
5 0	It is expected of everyone to work safely, but it is rarely recognised.	1	2	3	4	5
Thank you for completing this questionnaire.						

Appendix E: Proof of language and technical editing



DR MAUREEN LILIAN KLOS
PROFESSIONAL EDITOR
BA; STD; BEd (*cum laude*); MEd (*cum laude*); DEd
Registered with the SAPEG (reg. no. KLO004)
maureenklos@gmail.com

EDITOR'S DECLARATION

I,

DR MAUREEN LILIAN KLOS,

Being the holder of the following qualifications:

BA; STD; BEd (*cum laude*); MEd (*cum laude*); DEd

Hereby certify that I am the English language editor of the following document:

DETERMINING THE KEY ENABLERS OF A UNIFORM, MATURE SAFETY CULTURE IN
THE SOUTH AFRICAN IRON ORE MINING INDUSTRY

by

H.J. Eilers

I hereby certify that I have edited the language, formatting and referencing in the above-mentioned document in their entirety. I assume no responsibility or liability for any post-editing errors or omissions.

20 September 2022