THE PREVENTION OF WORK-RELATED/OCCUPATIONAL INCIDENTS AND ACCIDENTS CAUSED BY HUMAN ERROR IN THE SOUTH AFRICAN AUTOMOTIVE MANUFACTURING INDUSTRY

BY

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ABSTRACT

The purpose of this study was to examine how work-related incidents and accidents caused by human error can be prevented in the South African automotive manufacturing industry, a sector that contributes significantly to the economy but remains vulnerable to occupational injuries and operational disruptions. The study further aimed to develop a practical framework to strengthen safety management and reduce the recurrence of human error. A qualitative research approach was adopted within an interpretivist paradigm. Thirteen participants drawn from management and employees in an automotive organisation were interviewed through semi-structured and face-to-face interviews.

Thematic analysis, supported by ATLAS.ti software, was used to identify recurring patterns, perceptions, and experiences of safety practices. The findings revealed that human error incidents arise from multiple, interconnected factors, including inadequate training, fatigue, poor communication, insufficient supervision, limited organisational accountability, and gaps in safety management systems. These results underscore that fragmented interventions are insufficient; effective prevention requires an integrated approach that combines technical controls, behavioural strategies, and strong organisational leadership.

In response, the study developed the Human Error Incidents Prevention Framework (HEIPF), which integrates internal and external factors, decision-making processes, workplace conditions, and employee involvement to reduce error-related incidents. The framework contributes to strengthening safety culture, improving employee well-being, enhancing operational efficiency, and increasing profitability. Theoretically, the study advances knowledge of the interplay between human, organisational, and technical factors in occupational safety, while it offers the automotive industry an adaptable, evidence-based framework for reducing human error in high-risk environments. Ultimately, this study demonstrates that the prevention of human error in the automotive manufacturing industry is not only a compliance requirement but also a strategic enabler of safety, productivity, and long-term organisational sustainability.

Keywords: Accidents, Incidents, Human error, Human factor, Incidents prevention, Control measures, Safety culture, Hazard identification, Risk assessment, Root cause analysis, Training and competence.

OKUCASHUNIWE

Inhloso yalolu cwaningo kwakungukuthola ukuthi izigameko kanye nezingozi zasemsebenzini ezidalwe ubudedengu babantu zingagwemeka kanjani embonini ekhiqiza izimoto eNingizimu Afrika, okungumkhakha ongenisa umnotho omkhulu kodwa osasalele emuva ngokulimala kwabantu emsebenzini nangokuphazamiseka kokusebenza. Ucwaningo bekuhloswe ngalo futhi ukuthuthukisa indlelakusebenza engasetshenziswa ukuqinisa ezokuphepha kuphinde kunciphe amaphutha enziwa abantu. Kusetshenziswe ucwaningo lwekhwalithethivu ngaphakathi kwe-interpretivist paradigm. Ababambiqhaza abayishumi nantathu, okuhlanganisa abaphathi nabasebenzi embonini yezimoto, kwenziwe kubo imposambuzo ngokohlelo lokuqoqa imininingo ngendlela evulelekile, kubonanwa ubuso nobuso. Kwasetsheniswa uhlaziyo ngokwengqikithi, lusekwa wuhlelokusebenza lwe-ATLAS.ti, ukuhlonza okwenzeka kuphindelela, okucatshangelwayo kanye nokwenzakalayo mayelana nezokuphepha.

Iziphumo ziveze ukuthi izigameko zamaphutha abantu zenzeka ngezizathu ezahlukene, okubalwa kuzo nokungaqeqeshwa ngendlela, ukukhathala, ukuxhumana okungekuhle, ukungagadwa ngokwanele, ukungathathelwa izinyathelo kwezinhlampani kanye negebe ekwengameleni izinhlelo zokuphepha. Lezi ziphumo ziveza ukuthi azanele izinhlelo zokubhekana nalokhu; izindlela ezisebenzayo zokugwema lokhu zihlanganisa ubuchwepheshe, amasu okuziphatha kanye nobuholi obuqinile.

Iziphumo zakha isisekelo sokuthuthukiswa kweHuman Error Incidents Prevention Framework (HEIPF), ehlanganisa izinto zangaphakathi nezangaphandle, izinhlelo zokuthathwa kwezinqumo, izimo okusetshenzwa phaphansi kwazo kanye neqhaza labasebenzi ekunciphiseni izigameko zamaphutha. Uhlelokusebenza lunomthelela ekuqiniseni usiko lokuphepha, ukuqinisa inhlalonhle yabasebenzi, ukwenzangcono indlela yokusebenza nokwandisa inzuzo. Ngokweziphumo, ucwaningo luthuthukisa ulwazi lokubambisana phakathi kwabantu, inkampani kanye nobuchwepheshe kwezokuphepha emsebenzini, luphinde luhlinzeke imboni yezimoto ngohlaka olusekelwe ubufakazi ukunciphisa amaphutha ezindaweni ezinobungozi obukhulu. Kukhona konke, ucwaningo luveza ukuthi ukugwema amaphutha abantu embonini ekhiqiniza izimoto akukhona nje ukuhambisana nomthetho kodwa kuyisu elidala ukuphepha, ukukhiqiza kanye nokwenza kahle kwenkampani isikhathi eside.

KGUTSUFATSO

Sepheo sa phuputso e ne e le ho hlahloba kamoo diketsahalo tse amanang le mosebetsi le dikotsi tse bakwang ke phoso ya motho di ka thibelwang ka teng indasetering ya ho etsa dikoloi Aforika Borwa, lekala le bapalang karolo ya bohlokwa moruong empa le dutse le le dikotsing tse amanang le mosebetsi le ditshitiso tse amanang le tshebetso. Sepheo sa phuputso e ne e boetse e le ho etsa moralo wa tshebetso o kgonang ho sebediseha ho matlafatsa taolo ya polokeho le ho fokotsa diketsahalo tse iphetaphetang tsa diphoso tse etswang ke batho. Mekgwa ya ho tshwara diinthaviu le ho sheba ditsela tseo ho sebetswang ka tsona ho utlwisisa ka botebo le ho tla ka ditheori tse ntjha o sebedisitswe patlisisong e entsweng ketsahalong ya nnete ya batho/dintho tse fuputswang, eo diphetho tsa yona e leng tsa nnete tse sa akaretswang. Ho tshwerwe diinthaviu tse nang le dipotso tse hlophisitsweng le tse sa hlophiswang, moo mofuputsi a buisanang molomo le molomo le bolaodi le bankakarolo ba leshome le metso e meraro ba indasetering ya dikoloi. Mokgwa wa ho hlahloba lesedi le bolelang ka mehopolo, maikutlo le diketsahalo tseo bafuputswa ba bileng ho tsona, o tshehetswang ka lenaneo la khomphyutha la ATLAS.ti o sebedisitswe ho bolela diketsahalo tse iphetaphetang, mehopolo le dintho tse etsahetseng tse mabapi le dintho tse etswang ho netefatsa polokeho.

Lesedi le fumanweng le bontshitshe hore diketsahalo tsa diphoso tse etswang ke batho di hlaha mabakeng a mangata a amanang, a kenyeletsang thupello e sa lekanang, mokgathala, ho se fane ka lesedi ka tshwanelo, ho se etse mosebetsi o lekaneng wa bookamedi, boikarabelo bo bonyane lehlakoreng la mokgatlo le dikgeo mekgwatshebetsong ya taolo ya polokeho. Diphetho tsena di hatella bohlokwa ba hore dintho tse etswang, ditshebeletso kapa diporojeke tse sa tsamaellaneng le ho hloleha ho sebedisana ha di a lekana; thibelo e sebetsang hantle e hloka mokgwa o kopanyang dikarolo tse fapaneng tse sebetsang kaofela di kopane, tse kopanyang ditaolo tsa setegniki, mawa a ho kgothalletsa boitshwaro bo lebelletsweng le boetapele bo matla ba mokgatlo.

Lesedi le fumanweng e bile motheo wa ho tla ka Moralo o hlophisitsweng o etseditsweng Ho thibela dintho tse lebisang diphosong tse etswang ke batho (Human Error Incidents Prevention Framework (HEIPF), o kopanyang dintho tsa ka hare le tsa ka ntle, ditselatshebetso tsa ho nka diqeto, maemo a sebaka sa mosebetsi le ho kenyeletswa hwa mohiruwa diketsahalong tsa ho fokotsa diphoso. Moralo o bapala karolo matlafatsong ya

tlwaelo ya ho sebetsa ka polokeho, ho matlafatsa maphelo a bahiruwa, ho matlafatsa tshebetso le ho phahamisa phaello. Ho ya ka theori, phuputso e ntshetsa pele tsebo ya kamano e pakeng tsa batho, dintho tse etsahalang mokgatlong le tse amanang le setegniki polokehong ya bahiruwa mosebetsing, ha nneteng e fa indasteri ya dikoloi moralotshebetso o kgonang ho fetolwa, o itshetlehileng ka bopaki wa ho fokotsa diphoso tsa batho ditikolohong tse nang le kotsi e kgolo. Ka mora ho etsa kapa ho nahana dintho kaofela, phuputso ena e bontsha hore ho thibela diphoso tse etswang ke batho indasetering ya dikoloi ha se tlhoko ya ho phethahatsa ho ya ka melawana le ditataiso tsa tshebetso feela empa ho boetse ho etsa hore ho be le polokeho, tlhahiso le kgonahalo ya indasteri ya ho laola dikotsi tse amanang le tikoloho le ho hlahisa menyetla e netefatsang kameho e ntle le ho kgona ho ba le phaello ya nako e telele.

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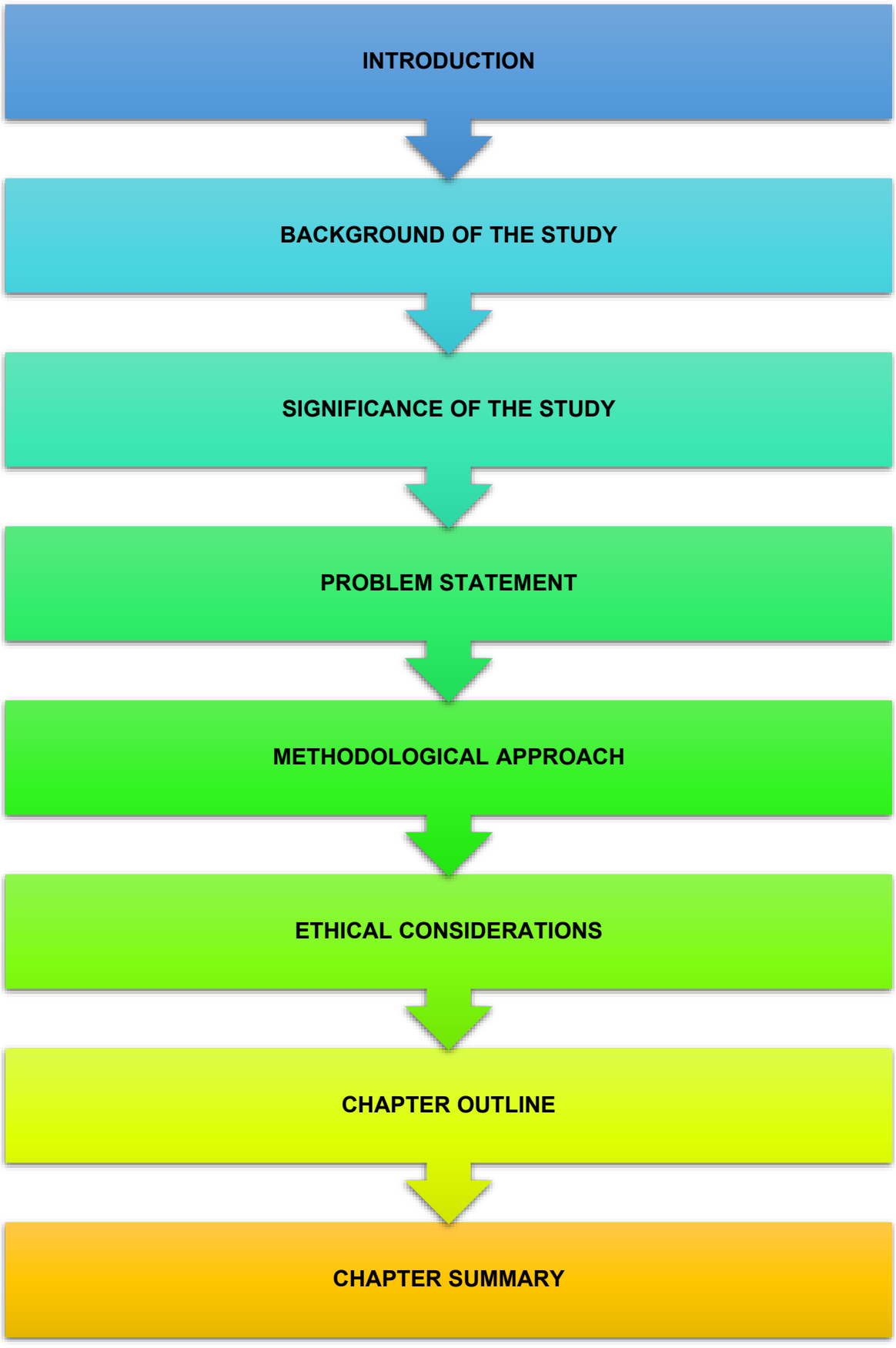
ABBREVIATIONS AND CONCEPTS/DEFINITIONS

AI	Artificial Intelligence
AR	Augmented Reality
BBS	Behaviour Based Safety
CA	Corrective Action
CEO	Chief Executive Officer
COIDA	Compensation for Injuries and Diseases Act No. 130 of 1996
DB	Decibel
EHS	Environmental Health and Safety
ESM	Environmental Management Systems
ETA	Event Tree Analysis
FMEA	Failure Mode and Effect Analysis
FTA	Fault Tree Analysis
GDP	Gross Domestic Product
GMR	General Administrative Regulation
HARPI	Harmful Agents Risk Priority Index
HAV	Hand-Arm Vibrations
HAZOP	Hazard Operability Analysis
HEIPF	Human Error Incidents Prevention Framework
HRA	Human Reliability Analysis
HSE	Health and Safety Executive
IoT	Internet of Things
IRs	Regulatory Institutions
ISO	International Organization for Standardization
JHA	Job Hazard Analysis
LOPA	Layer of Protection Analysis
MOL	Ministry of Labor
NEMA	National Environmental Management Act
NIHL	Noise-Induced Hearing Loss
NIT	Noise-Induced Tinnitus
OAM	Organisational Accident Model
OHS	Occupational Health and Safety
OHSA	Occupational Health and Safety Act No. 85 of 1993
ORS	Occupational Risk Assessment

POPIA	Protection of Personal Information Act
PPE	Personal Protective Equipment
REBA	Rapid Entire Body Assessment
SART	Situation Awareness Rating Technique
SCM	Swiss Cheese Model
SMS	Safety Management System
SOP	Safety Operating Procedure
STAMP	System Theoretical Accident Model
SWP	Safe Work Procedure
UK	United Kingdom
UNISA	University of South Africa
U.S. OSHA	United States Occupational Health and Safety Administration
VR	Virtual Reality

CHAPTER 1 – INTRODUCTION AND BACKGROUND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1.1 INTRODUCTION

The automotive manufacturing industry is a global industry which contributes significantly to the fiscus of South Africa (Fazi, Mohamed & Basri, 2019: 1). Human error is found as a fundamental concern amongst organisations such as automotive manufacturing organisations, affecting production errors and accountability leading to organisations injuries or fatalities (Yeow, Ng, Tia & Chow, 2020: 1; Koshiba, Wakui & Ito, 2024: 225). Human errors are the greatest source of organisations' accidents and injuries in the manufacturing sector (Nees, Sharma & Shore, 2020: 1; Yeow, et al., 2020: 3). In addition, Önal and Dandıl, (2025: 34968) concur that, many workplace accidents are caused by infringements of occupational health and safety regulations, even in the face of regular safety inspections. Human error cannot be eliminated in South African automotive industry (Önal & Dandıl, 2025: 34968). Zare, Hoboubi, Farahbakhsh and Jahangiri (2022: 8), argue that it is thus essential to classify and analyse human error and measure human consistency, and diminish errors or avoid unfortunate consequences.

Young (2021: 40) states that employees who are unsure of the true safety requirements in each working environment develop a level of distrust between them and the organisation's leadership. Training in occupational risk prevention is essential, not because it is a requirement for enhancing workplace health and safety but to improve the employee's safety, reduce hazards, and encourage safe behaviour (Bayram, Arpat, & Ozkan, 2022: 2; Benson, Obasi, Akinwande & Ile, 2024: 1). Chmiel, Lauren and Hansez (2017: 98) state that even if an employee's attitudes and beliefs fit with the safety management practice, safety management is doomed to fail at some point without top-level management commitment. When executive management puts safety as a top priority, they must provide evidence to support their assertion.

1.2. BACKGROUND OF THE STUDY

The manufacturing industry is the primary source of wealth in any country (Sharma & Sayal, 2021: 95). Therefore, it is crucial to prevent work-related/occupational incidents and accidents, particularly those caused by human error. When the United Kingdom (UK) was classified as the 11th largest manufacturing nation in the world in 2014, the

accident rate in the manufacturing sector was 23%, which was less than a quarter (Reporting of Injuries, Diseases and Dangerous Occurrences Regulations, 2014). Comparatively, Malaysia saw a reduction in this rate, which was around 20% in 2015 and a decrease from 35% in 2009 (Alkhaldi, Pathirage & Kulatunga, 2017: 823). The Malaysian, statistics from Bahrain's Ministry of Labor (MOL) revealed that there are many occupational accidents across all industry sectors, where human error is a major factor in these incidents (Alaradi, 2010: 2; Rafieyan et al., 2022: 1). Although other countries have noted a reduction in human error incidents and accidents. South Africa is still experiencing high rate of such incidents. As SHA Risk Specialists (2024: np), showed that according to estimates, there are about 198 000 workplace accidents and 22,000 occupational disorders that are contracted annually in South Africa. This amounts to 220,000 work-related incidents annually.

Human error is a common type of accident causation within the South African automotive industry (Liao, Liu, Su, Shi & Luo, 2018: 1). Historically several organisational accidents were reported with many of them caused by human error which resulted in the loss of lives (Alkhaldi et al., 2017: 822; Hendrycks, Mazeika & Woodside, 2023: 25). Furthermore, such incidents have resulted in undesirable consequences like minor injury or illness, property damage and loss of productivity (Groysman, 2024: 14).

This study is based on incidents and accidents caused by human error in an automotive organisation within South Africa. In this study, an ‘accident’ is defined as a sudden or undesired circumstance or process that results in damage to the environment, property, and personal injury (Ali & Shukla, 2018: 1142). An incident is defined as a situation that could result in an accident or have a negative impact on a person, machine, material, or the environment (Ali & Shukla, 2018: 1142). In addition, Sand (2019: 1) defined the term "incident" as a situation that endangers the operations of the organisation by jeopardising their accessibility, privacy, and honesty as well as harming the surrounding area, its inhabitants, or the environment.

Human error is defined as an unsafe act committed by the individual that would negatively affect the working environment, production and employees (Yeow, et al.,

2020: 4). Human error accounts for 30% to 90% of all incidents and accidents, making it one of the major factors that lead to incidents and accidents in organisations (Farhadi, Mohammadfam, Kalatpour & Ghasemi, 2022: 1). Similarly, 88% of incidents and accidents are due to human error within mechanical industries (Pouya, Hazrati, Vosoughi, Mosavianasl & Habibi, 2017: 1596).

Human error has a negative impact on the team and individual performance in many organisations. Research has demonstrated that these areas can be minimised or even avoided by taking lessons from these errors and gaining an awareness of causation and its effects (Marquardt, 2019: 327). Therefore, preventing human error is a crucial factor in enhancing safety protocols in the South African automotive manufacturing industry.

However human error does not occur in isolation in the working environment. It is influenced by multiple factors that shape human performance. As Ahmed and Onan Demirel, (2020: 3) argue that performance-shaping elements influence human performance and have cognitive and physiological properties. Several factors influence human performance, including the working environment, which includes noise levels, illumination, temperature, and humidity. Secondly, the layout of controls, information, and control display relationships on control surfaces need to be considered. Furthermore, the layout and space of workstations, accessibility in everyday working situations, and emergency escape routes also need to be considered.

A well organised workplace enhances the workflow and minimises the distractions leading to increase the production (Homavazir: 2023: 21). Finally, industrial signage and labelling, such as label visibility and legibility, position, and information, are all factors to consider. When these performance shaping factors are poorly designed or inadequately managed, they increase cognitive strain and create conditions in which errors are more likely to occur. Therefore, mistakes often reflect weaknesses in systems rather than individual shortcomings. For this reason, learning from incidents becomes a critical component of improving workplace safety. Examining and understanding the causes and consequences of errors might help reduce or prevent incidents and accidents (Marquardt, 2019: 327). Knowledge of the manufacturing industry is essential to reduce

workplace accidents and injuries (Jozan, Lotfata, Khalid & Tabesh, 2025: 1). Deliberate violations are linked to behavioural practices, not capabilities, training, or physical qualities, but rather a lack of accountability or exemption (Sobral, 2018: 76).

1.3. SIGNIFICANCE OF THE STUDY

The rationale for this study is rooted in the urgent need to address the persistent challenge of human error in the South African automotive manufacturing industry, a sector that is both labour-intensive and safety critical. Despite the presence of occupational health and safety legislation and various organisational policies, incidents and accidents caused by human error continue to result in serious injuries, fatalities, financial losses, reputational damage, and reduced productivity (Ayuni, Yusuf & Dwiyanti,.2022: 288). This study, therefore, seeks to bridge a critical gap by examining not only the technical and procedural dimensions of workplace safety but also the organisational, behavioural, and cognitive factors that shape human performance in high-risk environments (Farhadi, et al, 2022: 1).

Repeated incidents erode employee morale, foster stress and anxiety, and compromise trust in organisational systems (Reiman, Kaivo-Oja, Parviainen, Takala & Lauraeus, 2021: 1). These psychosocial consequences illustrate that safety cannot be reduced to compliance with procedures alone but requires a culture that prioritises open reporting, employee well-being, and transparent investigations (Irshad, Ahmed, Demirel & Tumer, 2019: 1). By proposing and validating the Human Error Incidents Prevention Framework (HEIPF), this study provides a structured and evidence-based approach to transforming safety management from reactive responses to proactive prevention.

From an academic standpoint, the framework advances current research on safety and human error by showing that incident prevention cannot be fully explained through single factor approaches. Instead, it offers a structured, integrative model that connects technical controls, organisational systems, and behavioural factors into an integrated analytical perspective (Nkosi, Gupter & Mashinini, 2020: 6; Mariana, Sahroni & Gustiyana, 2018: 2611). By viewing human error as a systemic issue rather than an individual failure, the framework contributes to theoretical discussions within safety

science and organisational studies. It advances understanding of the dynamic interaction between engineering controls, leadership practices, and individual behaviours, establishing a solid platform for further empirical studies.

In practical terms, the framework offers the South African automotive manufacturing industry a clear guide for designing and evaluating safety measures. It emphasises the importance of moving beyond isolated training programs or technical solutions by integrating automation, supervisory responsibility, fair investigation processes, fatigue management, and situational awareness initiatives into a coordinated system. For practitioners, this holistic approach results in more consistent supervision, better decision-making, and fewer preventable incidents. Therefore, the framework serves not only as a theoretical model but also as a practical tool that can guide policy development, leadership practices, and frontline risk management.

The HEIPF demonstrates the necessity of integrating technical measures (such as engineering controls and automation), organisational interventions (such as leadership accountability, consistent supervision, and fair investigations), and behavioural strategies (such as training, situational awareness, and fatigue management) (Nkosi, Gupter & Mashinini, 2020: 6; Mariana, Sahroni & Gustiyana, 2018: 2611). The practical recommendations outlined in Chapter 6 reinforce that organisations cannot rely solely on regulatory compliance but must invest in sustainable safety management practices that address the root causes of human error (Pouya, et al., 2017: 1596).

1.4. PROBLEM STATEMENT

Yeow et al. (2020: 1) have revealed that human error is the most common unobtrusive cause of incidents and accidents in production plants. Human error is a major concern in manufacturing organisations and has been connected to multiple workplace fatalities and injuries. The automotive manufacturing organisations and has been connected to multiple workplace fatalities and injuries. Human error accounts for about 80% of all workplace incidents (Alkhaldi et al., 2017: 824).

Only a few studies have looked at how human error attributions influence people's perceptions (Nees et al., 2020: 2). Similarly, human error in manufacturing organisations, such as automotive organisations is not well researched (Salone, 2018: 18). According to scientific studies, the human aspect of safety management has not received much consideration when determining the causes of workplace accidents, furthermore, the available literature on the subject was primarily designed for mechanical applications and was found to be insufficient to explain the accident causalities in manufacturing (Reyes, De La Riva, Maldonado, Woocay, & De La O, 2015: 6499).

Ineffective management, mitigation, or elimination of the effects of human errors frequently occur during the maintenance phase of mechanical systems (Nkosi, Gupter & Mashinini, 2020: 6). Due to the lack of awareness and understanding, organisations rarely focus on eliminating human errors from their safety management system (SMS). In contrast, other aspects of human error, such as training, are frequently considered. Human Reliability Analysis (HRA) is frequently regarded as a time-consuming task requiring considerable knowledge (Kumar, Singh, Bilga, Singh, Singh, Scutaru, & Pruncu, 2021:1471). However, there is a lack of focus on the human aspect of HRA, as well as a failure to consider how human errors may impair the system's safety performance (Song & Kim, 2025: 3).

1.5. RESEARCH OBJECTIVES

The purpose of the study was to explore the causation of occupational work-related human error incidents and accidents and to develop an integrated framework that addresses their reoccurrence in automotive manufacturing organisations.

1.5.1 Primary objective

The primary objective of this study is to investigate the causation of occupational work-related human error incidents and accidents and the methods that can be used to prevent their re-occurrence in automotive manufacturing organisations in South Africa.

1.5.2 Secondary Objectives

The study sought:

- To identify control measures that are in place to prevent human error incidents and accidents in automotive manufacturing organisations in South Africa.
- To examine the effectiveness of these preventative measures in preventing future incidents and accidents.
- To review the health and safety management systems in automotive manufacturing organisations in South Africa.
- To develop a framework for the prevention of occupation-related human error incidents and accidents

1.5.3 Research questions

The following questions were formulated from the research objectives for the study:

- What are the causes of occupational work-related human error incidents and accidents in an automotive organisation?
- What methods are used by automotive organisations to examine the occurrence of work-related human error incidents and accidents within their manufacturing plants?
- What control measures are in place to prevent human error incidents and accidents?
- How effective are the control measures that are in place to prevent the re-occurrence of work-related human error incidents and accidents?
- What can be done to verify the effectiveness of the currently used health and safety management practices?

1.6. METHODOLOGICAL CONSIDERATIONS

Research philosophy is a set of beliefs on the collection, analysis, and use of data on phenomena under research (Dileep, 2022: 3). This study used the interpretivism paradigm. The researcher gained additional insight using the interpretivist approach by focusing on experiences and perceptions on work-related human error incidents and accidents in the automotive industry.

The inductive research methodology was used in this study as it involves an orderly procedure for examining the qualitative data, where analysis is directed through an

evaluation objective (Khalil & Saleem, 2021: 36). The inductive approach focused on producing a theory from collected data on work-related human error incidents and accidents in the automotive industry.

A qualitative research method was employed in this study as it enhanced the researchers' understanding of the technical community by making distinctive results for getting quicker to the phenomenon studied (Aspers & Corte, 2019: 139). The qualitative method was adopted as it entails several techniques that aided in the translation, description, decoding, and analysis of data gathered to obtain qualitative data related to the cause of incidents and accidents caused through human error.

The research strategy assists in thoroughly reviewing the issue under inquiry (Hanafizadeh, 2022: 74). This study made use of semi-structured interviews that are suited for identifying previously unidentified qualitative trends and problems to discover new research interest, and phenomenological studies (Rahman, 2019: 2). The interview guide was developed by the researcher and reviewed by the supervisors and statistician before requesting ethical clearance.

The population is a set of units to which the research findings were applied (Shukla, 2020: 2). The population for the study was based in the automotive manufacturing industry within South Africa.

The primary data for the study was obtained through qualitative semi-structured interviews using open-ended questions. Thirteen participants were interviewed in this study. Interviews were conducted face-to-face in designated areas. Data was analysed using thematic analysis and coding software.

A discussion on methodological considerations is covered in Chapter three of this study. Issues of quality of the research (validity and reliability of the study) are also addressed detailed.

1.7. ETHICAL CONSIDERATIONS

For this study to be conducted ethical approval was requested from the University of South Africa (UNISA) Research Ethics Committee. Permission was granted on 12 September 2024 with ethics approval No. 2324 (Annexure C). In addition to the ethics approval, the researcher was granted permission through a gatekeeper letter by the automotive manufacturing industry. The researcher ensured the confidentiality of participants throughout the study and ensured that their identities were safeguarded while at the same time protecting their dignity.

1.8. CHAPTER OUTLINE

This dissertation followed the chapter outline indicated below:

1.8.1 Chapter 1. Introduction and Background

This chapter provided a comprehensive introduction to the study. It highlighted the background and the significance of the study. In addition, it outlined the research objectives and methodological considerations.

1.8.2 Chapter 2. Literature Review

This chapter covers the literature review and elaborates on studies related to human-error in industry, specifically in the manufacturing sector. It highlights the causes of human error incidents and accidents focusing on the automotive manufacturing organisations. In addition, it reviews health and safety workplace challenges and failures, factors influencing compliance with safety regulations, incidents and accidents, accident controls and prevention, and incident and/or accident investigation.

1.8.3 Chapter 3. Research Methodology

This chapter reviews the research methodology for the study. It focuses on the problem statement, research objectives, and research questions. In addition, it outlines the research philosophy, research design, population and sample of the study, research instrument, data collection, pre-test study, and data analysis.

1.8.4 Chapter 4. Data Analysis

This chapter discussed data gathered in this study to extract meaning, patterns, and insight. The chapter goes further to discuss the findings reflecting on the literature review and the researcher's interpretation.

1.8.5 Chapter 5. The Proposed Human Error Incidents Prevention Framework

This chapter presents the proposed Human Error Incidents Prevention Framework (HEIPF) explaining the basis of each component and its alignment to best practice.

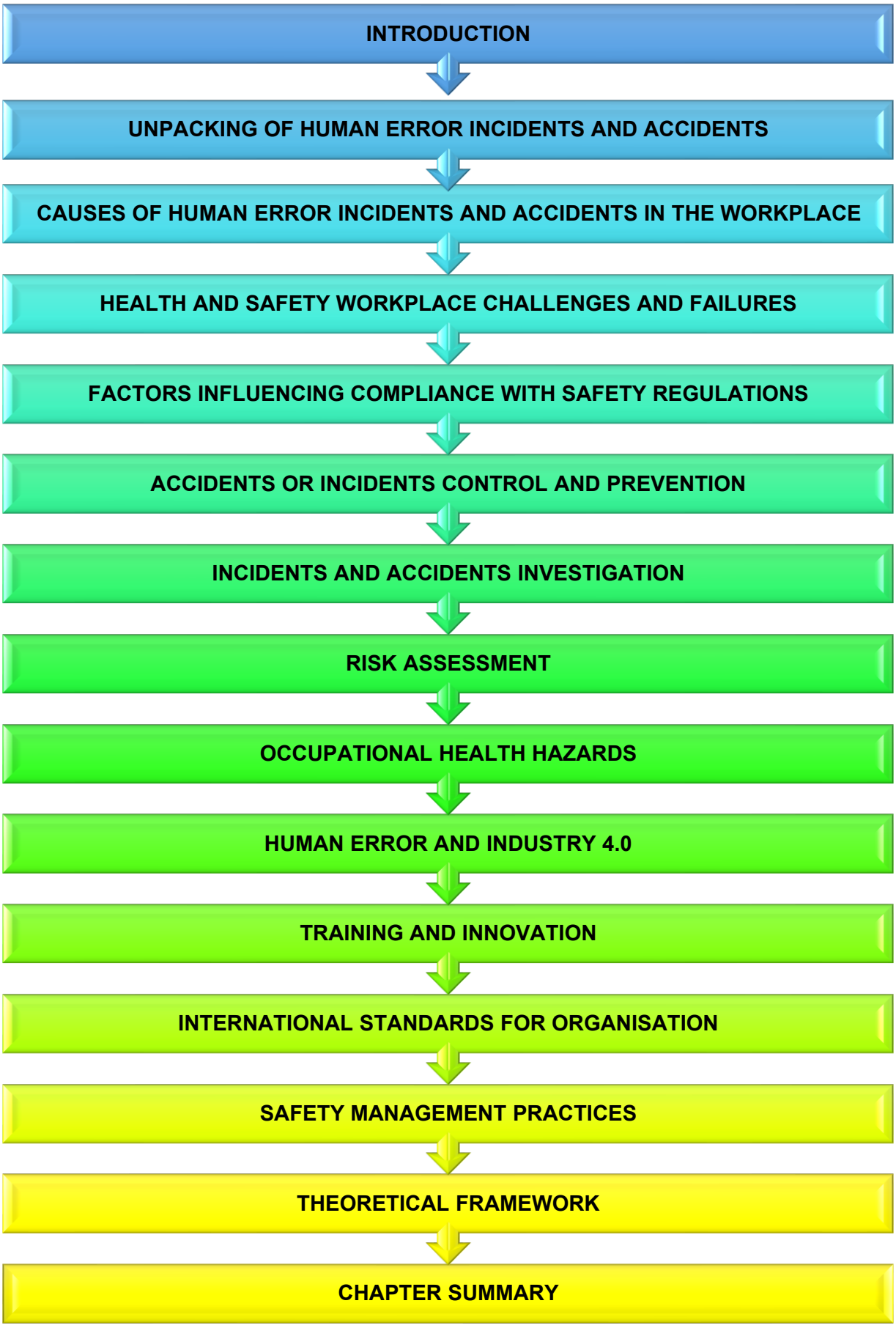
1.8.6 Chapter 6. Conclusions and Recommendations

This chapter outlines the research recommendations based on the research findings from Chapter 4 and ends with a conclusion of the study. Areas of future research directions are also presented.

1.9. CHAPTER SUMMARY

This chapter discussed the background of a study to assist the reader in establishing the research problem or gap in knowledge in work-related human-error incidents and accidents in automotive manufacturing organisations. This chapter presented the background/ content of the study, research question and objectives, and highlighted the significance of the research. A brief outline of the methodological considerations was also presented. Chapter 2 presents the literature review focusing on relevant literature in relation to human-error incidents/accidents within South African automotive manufacturing industries.

CHAPTER 2: LITERATURE REVIEW


INTRODUCTION
UNPACKING OF HUMAN ERROR INCIDENTS AND ACCIDENTS
CAUSES OF HUMAN ERROR INCIDENTS AND ACCIDENTS IN THE WORKPLACE
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FACTORS INFLUENCING COMPLIANCE WITH SAFETY REGULATIONS
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CHAPTER SUMMARY

2.1 INTRODUCTION

This chapter reviews the literature on the major theories and the challenges of preventing work-related/occupational incidents caused by human error in the South African automotive manufacturing industry. Due to the weakness of human beings, anyone can make a mistake. It is crucial that human error incidents and accidents are investigated and addressed to prevent future occurrences in specifically in the South African automotive industry. This chapter also examines the extent to which the main research issues and goals have been handled in earlier investigations.

This chapter includes a literature review of human error incidents and accidents, causes of human error incidents, and accidents in the workplace. In addition, the chapter will review health and safety workplace challenges and failures, and factors influencing compliance with safety legislation. Furthermore, this chapter will elaborate on how incidents and accidents can be controlled and prevented. This chapter explores the incident and accident investigation procedure in the automotive manufacturing industry. It will also look at risk management to identify hazards and assess the risks. Risk assessments include risk identification methods, occupational health, and safety hazards such as physical hazards, chemical hazards, mechanical hazards, ergonomic hazards, biological hazards, and psychosocial hazards.

In addition, human error, the Fourth Industrial Revolution 4.0 (4IR), training and innovation, International Organization for Standardization (ISO), and safety management practices will be explored. The chapter will end with a discussion based on the theoretical framework that will be used in the study, such as the Swiss Cheese Model and the Domino theory. At the end of the chapter, an overview of the literature review and how the research aims to close the knowledge gap is provided. The next section unpacks human error incidents and accidents.

2.2 HUMAN ERROR INCIDENTS AND ACCIDENTS

The automotive manufacturing industry is an international industry that contributes significantly to the fiscus of the country [South Africa] (Fazi, et al., 2019: 1). Literature indicates that human error is a fundamental concern amongst organisations such as

motor manufacturing organisations, affecting production errors and accountability leading to organisations injuries and fatalities (Yeow, et al., 2020: 1). As such human error is said to be the root of all causes of organisation's incidents and accidents that leads to injuries (Nees et al., 2020: 1; Yeow, et al., 2020: 3). Regarding human error, Dekker ended Reason's theoretical framework and nomenclature. 'Unsafe acts', 'violation', 'latent failure', or 'mistakes', in his opinion, were overly negative terms. The conceptualisation of "disregarding misconduct, violations and errors." is faulty since it implies that human faults are objective, ignoring the subjective character of science and its built essence (Le Coze, 2022: 8). Since human error is the primary contributor to industrial accidents, it seems crucial to recognise, anticipate, and analyse human error, evaluate human dependability, and develop effective management strategies to get rid of and minimise errors or avoid unfavourable outcomes (Zare, et al., 2022: 1). Over the past few decades, mechanical failure incident rates have reduced dramatically. Nevertheless, the rate of human error has not decreased at the same rate (Irshad, et al., 2019: 1). However, human error incidents are impossible to prevent in a complex socio-technical system (Huang, Yin, Xu, Zhang & Xu, 2022: 3).

Therefore, preventing human error is important for enhancing safety protocol in the South African automotive manufacturing industry. The next section examines the causes of human error incidents and accidents in the workplace.

2.3 CAUSES OF HUMAN ERROR INCIDENTS AND ACCIDENTS IN THE WORKPLACE

The automotive manufacturing industry addresses the serious consequences of human error, and it is crucial to identify the causes and develop prevention and mitigation strategies (Musavi, Hekmatshoar, Fallahi, Moradi, & Yazdani-Aval, 2024: 7). Human errors in causing or mitigating incidents lead to increased effort, toil, and impact on customers and revenue (Ahmed, Ghosh, Bansal, Zimmermann, Zhang & Rajmohan, 2023: 2). Human errors are caused by inadequate training, poor communication, and flawed equipment design, and significantly result to equipment failures and operational inefficiencies (Khayal, Nafea, Ameir & Mohammed, 2025: 96). However, Schaub and Badke-Schaub (2024: 1056) argue that human errors are caused by human weaknesses, such as lack of knowledge, overlooking details or incorrect decisions.

Insufficient experience, time restrictions, and pressure to perform efficiently can lead to human error during tasks (Sharma & Raju, 2024: 103). Most human error accidents occur due to lack of safety awareness, irregular operations, and failure to implement protective measures among employees (Li, Yao, Luo, Wang, Liu, Huang & Su, 2024: 13). Insufficient use of Personal Protective Equipment (PPE) is a significant cause of such human error accidents, preventing injuries and illnesses (Ludwika & Rifai, 2024: 1).

Mariana, Sahroni and Gustiyana (2018: 2611) postulate that exhaustion is one of the leading causes of human error and is caused by insufficient sleep or interruptions in the usual sleep cycle. This may be due to the shift rotation, where the shift employee is more likely to become fatigued. Fatigue is defined as a sensation of exhaustion, weariness, or a lack of energy, and is one of the most common causes of human error (Mariana, et al., 2018: 2611). Furthermore, Rodríguez-Pérez (2019: 12) states that human error causes manufacturing inaccuracies, and/or such errors have been linked to not following procedures, lack of attention, or lack of training.

In addition, mismanagement or lack of supervision, unclearly written procedures/work instructions, poor organisational philosophy, time pressure, stress and fatigue, incompetency, and equipment design, as well as environmental conditions, can all contribute to human error (Nkosi et al., 2020: 1). In automotive manufacturing industry, the cause of human error incidents and accidents are the root cause of work-related accidents. Unsafe work practices are created through ignoring the safety protocols of equipment and machines, tools, protective equipment defects, improper use of equipment, ignoring control and inspection of equipment, electrical and mechanical tools (Arciniega-Rocha, Erazo-Chamorro, & Szabo, 2023: 4). These are identified as the most frequently immediate causes of human error and workplace challenges and failures (Shafiei, Jabbari, & Tehrani, 2021: 311).

Human error incidents are caused by insufficient organisation resources and the lack of appreciation of the losses that are due to human errors, such as the lack of professionalism, lack of safety awareness, and poor physical and mental health (Reyes,

et al., 2015: 6499; Yang, Wang, Easa & Yan, 2023: 3). Moreover, the automotive manufacturing sector faces many obstacles, including a lack of skilled employees and a changing population in industrialised countries like Germany (Fitzenberger & Kagerl, 2025: 25). The gap that results between employees' actual capabilities and performance requirements can lead to an increase in human errors, for example, because of stress reactions (Klages & Zaeh, 2023: 209). Employees over the age of 54 have a higher risk of suffering severe injuries in workplace accidents than younger employees, this may be because of routine or habitual disregard for risk factors at work as well as physical or mental tiredness that may be accompanied by inadequate or no supervision (Nowakowska & Pajecki, 2022: 539). However, the percentage of unsafe behaviours decreases as employees get older, which may be due to their greater degree of expertise, job experience, and age-related increases in skill (Azadeh & Fam, 2023: 16).

Organisational incidents and accidents resulting from human errors are typically brought on by a lack of safety barriers, failure to learn from past mistakes, lack of co-ordination and preparation, and a poor health and safety culture. Most of these unfavourable situations are connected to out-of-date maintenance standards (Campari, Akel, Ustolin, Alvaro, Ledda, Agnello, Moretto, Patriarca, & Paltrinieri, 2023: 5). Lack of standard procedures, insufficient equipment, a lack of a safety culture, lack of expertise and/or prior training, stress and complexity, and insufficient equipment are all potential human error barriers (Angelopoulou, Mykoniatis, & Boyapati, 2020: 297). The Figure 2.1 below indicates the causes of human error incidents/accidents.

Figure 2.1. Show the causes of human error incidents/accidents

Source: Adapted from Zhang, Feng & Lei (2022: 11) and Rafieyan, Sarvaru and Chan (2022: 5)

The current body of literature concerning human error within the automotive manufacturing sector is lacking in several features: it often attributes blame to the individual. Numerous incident investigations in this industry persist in identifying the operator as the primary offender, rather than addressing the fundamental systemic flaws, despite acknowledging that most errors are induced by the system (Remutula, Claffey, Ward & Carroll, Papakostas, 2025: 1). Insufficient proactive and dynamic data: existing research regularly depends on retrospective accident reports instead of real-time monitoring of how human factors, such as stress levels, fluctuate throughout the shift.

Maximl (2021: n.p.) indicated five leading causes of human in the automotive manufacturing industry. These includes inadequate SOPs, horseplay, stress and

psychosocial discomfort, inadequate workplace education and poor management, supervision, and organisation.

- Inadequate SOP's - incorrect machine setup, out-of-date or not updated machinery, and unclear standard operating procedures are in this category the main contributors to human error. Sendy and Basaria (2023: 3) mentioned that the main reasons for the human factors' failures within the automotive manufacturing industry are unclear SOPs and human error.
- Horseplay - Group employees usually like cracking jokes with their co-employees, and sometimes these jokes can be dangerous, ludicrous, and excessive. In society, horseplay is accepted even though it carries a risk of serious harm to others (Zulkeflee, Faisol, Ismail, Ismail, & Qurtubi, 2023: 42).
- Stress and psychosocial discomfort - These can be caused by noise exposure, intense or unrealistic work demands, especially under time pressure poor communication tools, language barrier, repetition of monotonous work with little breaks in-between, long working hours, poor housekeeping, compact shift schedules/ insufficient recovery times between shifts, and poor working conditions (lighting, ventilation, etc.) (Maximl, 2021: n.p.).
- Lack of work experience - Lack of workplace education includes various aspects that range from ignorance to lack of education. Therefore, human error can be substantially reduced by knowledge and education, which lowers the likelihood of dangerous behaviours and increases safety (Fu, Xie, Jia, Li, Chen, & Ge., 2020: 52).
- Poor management, supervision, and organization - Inadequate safety supervision, incompetent safety personnel, and a lack of support from upper management are further factors that contribute to human error, which is viewed as the primary cause of incidents (Al-Bayati, Rener, Listello, Mohamed, 2023: 250).

Table 2.1 below summarises the four types of human errors and their root causes.

Table 2.1: The four types of human errors and their root cause

Type of human error	Root cause
1. Slips of action	Momentarily tiredness, anxiety, excitement, and distraction
2. Lapses of memory	Losing focus or forgetting to complete a task in the middle of it
3. Rule-based mistakes	A good role misapplied, or a bad rule correctly applied.
4. Knowledge-based mistakes	Inadequate or incorrect comprehension, overconfidence, or overstress

Source: Adapted from Secureframe.com (2023).

The next section examines the health and safety workplace challenges and failures.

2.4 HEALTH AND SAFETY WORKPLACE CHALLENGES AND FAILURES

Zondo (2021: 2) indicated the automotive manufacturing industry is regarded as being one of the most challenging, complex, and dangerous work environments where employees are exposed to a various hazards and other issues that jeopardize their health and safety. Potential hazards are common in automotive manufacturing industry despite the numerous national and international organizations that monitor and enforce safety. For example, vibrations lead to an occupational disease known as ‘Raynauds syndrome’, where the body loses the feeling of touch as a result of a lack of blood supply and nerve damage. Another example is excessive noise from hazardous and noisy machinery that results in noise-induced hearing loss (Umugwaneza, Nkechi, & Mugabe, 2019: 1). In the last few decades, the number of events linked to component failure has fallen dramatically. However, the rate of occurrences linked to human error has not declined at the same rate (Irshad, Hulse, Demirel, Tumer, & Jensen, 2021: 1).

Implementing an Occupational Health and Safety Management System (OHSMS) within the automotive manufacturing industry reduces several human error incidents, which is, however, very difficult due to the many challenges and failure occurring during its implementation (Kunodzia, Bikitsha & Haldenwang, 2024: 1; Akpan, Okon, Agbiji, Eda, Akpan, Inah, Akpabio & Ekpenyong 2025: 5). In today's globalised world, most

automotive industry occupations involve several risks and hazards that, if not managed effectively, could endanger employees (Olokede, Monyei & Ukpere, 2024: 118). Sobrinho, Vaz and Haddad (2025: e4781) mentioned that the European Agency for Health and Safety at Work revealed that one person passes away in the European Union every three and a half minutes.

One of the most common causes of workplace injuries and illnesses is equipment failures and errors (DeBusschere, Byrne, Augustino, Granberg, Pearson & Verble, 2025: 2). Furthermore, Dodoo, Samarraie, Alzahrani, Lonsdale, and Alalwan (2024: 93) mentioned that lack of demand, uncertainty regarding the effectiveness of technology, technical support, and the cost of implementing and maintaining safety systems are also some of the organisational challenges. Another challenge faced by the automotive manufacturing industry is shifting demographics that leads to a growing number of older employees staying in the workplace, age-related physical, psychological, and social factors affect their well-being and safety at work (Hasbullah, Orhun, & Mollahaliloğlu, 2025: 63). Bravo, Viviani, Lavallière, Arezes, Martínez, Dianat, Bragança and Castellucci (2022: 57) discovered that the result of incidents indicate that older employees get involved more often in incidents causing fatal injuries.

For safety scientists, enhancing the safety system through decreasing incidents and accidents remains a challenge as many organisations do not have health and safety departments (Gui, Xuecai, Qingsong, Zonghan, Ping & Ying, 2020: 48; Khan, Felice & Petrillo, 2019: 116; Gui et al., 2020: 48). Due to the enormous consequences of process failures, which include human error consequences and causes of incidents and accidents and failures with severe implications are always a topic of discussion requiring significant attention (Brkića, Golubovićb, Brkicc & Alsharif, 2022: 1). Employers and employees need to understand why accidents happen, how they happen, and how to prevent them, where many different perspectives on accidents have been suggested (Gui et al., 2020: 48).

Employees may engage in risky behaviour due to their inexperience, lack of knowledge, physical limitations, improper attitudes, or failure to wear or use PPE. Other harmful

behaviours include dropping objects carelessly to the floor, working too quickly, lifting incorrectly, and using dangerous equipment (Umugwaneza et al., 2019: 3). Recognising human error accidents are not just an uncommon concept; they are an integrated one that considers elements from the workplace, the environment, and the individual. A failure in the interaction between workers and other workplace conditions appears to be human error. As a result, human error will be more frequent and increase the chance of accidents if one or more of these components are lacking (Alkhaldi et al., 2017: 830).

As such the enormous consequences of process failures, which include human error consequences and causes of incidents and accidents, and failures with severe implications are always a topic of discussion requiring significant attention (Brkića et al., 2022: 1). In addition, employees may engage in risky behaviour due to inexperience, lack of knowledge, physical limitations, improper attitudes, or failure to wear or use PPE. Other harmful behaviours include dropping objects carelessly to the floor, working too quickly, lifting incorrectly, and using dangerous equipment (Umugwaneza et al., 2019: 3).

Much effort and research have gone into understanding why accidents happen, how they happen, and how to prevent them from occurring, and many different perspectives on accidents have been suggested (Gui et al*.,* 2020: 48). Failures in safety management are the primary contributor to most accidents, however, at the same time management is the most effective strategy for lowering workplace accidents (Yang et al., 2023: 3). Recognising human error accidents are not just an uncommon concept; but take into account an integrated view that considers elements from the workplace, the environment, and the individual. Failure in the interaction between employees and other workplace conditions appears to be another source of human error. As a result, human error will be more frequent and increase the chance of accidents if one or more of these components are lacking (Alkhaldi, et al., 2017: 830; Aderamo, Olisakwe, Adebayo & Esiri, 2024: 25).

Although it is rarely highlighted worldwide, workplace safety is a significant concern that is particularly prominent in developing countries (Afolabi, De Beer & Haafkens, 2021:1).

In developing countries, Ghana, for example is faced with much more challenges such as inadequate management of occupational health and safety due to the accumulative rate of industrialisation and a weak occupational health and safety framework (Kheni & Afatsawu, 2022: 315). A study by the Directorate of Occupational Health and Safety, Kenya, and studies conducted in Kenya raised concern over the high number of occupational injury incidents that remain unreported (Otieno, Onditi & Monari, 2019: 100). Employee productivity and workplace safety are major concerns in Kenya. Ninety percent of employees in the South African automotive manufacturing industry and sixty percent of the Kenyan automotive manufacturing employees reported having back discomfort because of their jobs, according to a 2017 Government of Kenya-GoK research. Furthermore, the report revealed that inadequate lighting, vibrations, ventilation, dangerous machinery, noise, repetitive motions, high temperatures, and a lack of staff safety training make Kenyan workplaces unsafe (Mutegi, Joshua & Maina, 2023: 2).

Employees who lack or do not have instructions for doing things correctly rely on the training they have received. This results in differences in how the work is conducted, causing work not to be done appropriately and properly, resulting in an error or incident (Pouya, et al., 2017: 1598). Regulatory Institutions (RIs) face challenges related to the lack of a national OHS policy, ineffective management, and the inability to prosecute organisations that violate health and safety standards. Further challenges include the lack of a well-defined framework for regulating health and safety standards (Kheni & Afatsawu, 2022: 315). Additionally, obvious causes of human error accidents include the malfunction or incorrect usage of equipment and a lack of co-ordination (Botti, Meloni, & Oliva 2022:8). The next section will examine the factors that influence compliance with safety regulations.

2.5 FACTORS INFLUENCING COMPLIANCE WITH SAFETY REGULATIONS

Regulatory compliance is a serious component that should not be ignored (Bhole, Sauter, Semper & Kastner, 2025: 13). Regulatory compliance occupies an essential position in HSE interventions in the automotive industry. Compliance to suitable guidelines, laws, and standards is crucial for ensuring employees safety, protecting the

environment, and promoting employee's health (Benson et al., 2024: 11). Advising management, ensuring regulatory compliance, and maintaining OHS management systems are the strategic responsibilities of the OHS professionals (Ismail, Allshahrani, Alghamdi, Hamamah, Alotaibi, Altamimi, Alotaibi, Alotibi, Albughuli, Narqi, Marjrashi, Al Amri, & Al Sharari, 2024, 13468).

Safety rules and regulations must be maintained by the safety representative through routine inspections of the employees while they are working (Afuye, Oladimeji, Aina,Tam & Haddad, 2025: 380). However, employees' devotion to health and safety regulations are placed second to last, demonstrating a lack of awareness among the employees regarding health and safety regulations (Oduoza, Alamri, & Oloke, 2025: 8). Regularly monitoring and reviewing workplace hazards should be carried out to acknowledge potential hazards and implement required precautionary measures (Benson et al., 2024: 15). Applying measures created to comply with legislation and are more concerned with enhanced outcomes than prosecution consequences is what is meant by safety legal compliance (Adebiyi, Olubola, Yusuf, Rasheed & Olawa, 2020: 271). However, compliance is defined as the ability to operate per a command and set of rules (Mohibula, Takebira, Moni & Rahman, 2018: 1). Failure to comply may cause fatalities or serious injuries (James, Ogle-Mustafa & Chichester, 2023: 3; Wang, Zhang, Qi, Zhao, Xia & Weng, 2023: 4). Therefore, the automotive industrial workplace should make it easier for employees to follow safety regulations set forth by the government (Samanta & Gochhayat, 2023: 4).

International organisations use various tools to improve occupational health and safety, including codes of practice, international system standards, information dissemination, and technical advice through workshops and publications. This aims to enhance the ability of the government and its members to prevent workplace accidents and occupational diseases by upgrading the working conditions, hence reducing human error (Umugwaneza et al., 2019: 1). However, Min, Kim, Lee, Jang, Kim, & Song, (2019: 404) postulates that in their quest to increase output, multinational corporations take advantage of labour rules in developing countries, for example - employees work in risky conditions in these developing countries. Due to low perceptions of government

legitimacy and enforcement power, organisations in developing countries such as Vietnam, Kenya, Nigeria, Ethiopia and Ghana frequently choose not to comply with legislation (Malesky &Taussig, 2017: 1).

Internal factors influence the effectiveness of the Occupational Health and Safety Management Systems (OHSMS) implementation such as management commitment, OHS leadership and policies, employee participation, employee morale, sufficient resources, financial performance cost allocation, and company size (Rahmi & Ramdhan, 2021: 1). External elements include OHS legislative enforcement, OHS support and authority, external audit certification, external incentives, consumer pressure, market rivalry, company image, and international trends (Rahmi & Ramdhan, 2021: 1). While organisations may have extensive health and safety rules and regulations, full compliance is impossible to achieve, as organisations confront numerous challenges when implementing an OHSMS (Raliile & Haupt, 2020: 2). This includes managerial errors in decision-making, a lack of or inadequate OHS information and communication, and prioritising productivity over safety (Rahmi & Ramdhan, 2021: 2).

When it comes to how employers value and reward safety, a safe workplace can be seen as one that influences and drives employee attitudes through opportunities (Amine & Antar 2017: 14). All organisations have expectations of proper behaviours and responses towards workplace safety hence individual insights of policies, standards, practices, and procedures define workplace safety climate (Khan et al., 2019: 112). Moreover, Standardised Safe Work Procedures can help decrease human error incidents and accidents (Saotome, Matsubayashi, Yoshioka, Hashimoto, Ito, Oguchi, & Yoshioka, 2023: 2). When employees have greater control over the input process and product of their work, and safety aspects of their job, they perceive management to be more devoted to safety (Nkrumah, Liu, Doe Fiergbor & Akoto, 2021: 1).

OHSMS are established and applied to identify, evaluate, control, and ultimately reduce safety risk and to produce several layers of protection that prevent accidents from occurring. These systems contain plans, methods, policies, and procedures for which there is a formal function managing their progress, implementation, and ongoing

direction (Sajithkuma, 2023: 494). However, the automotive industry has never been mandatory to produce a safety case instead, it is dependent on compliance with general regional and national regulations (Palin & Habli, 2010: 82). The South African Occupational Health and Safety Act 85 of 1993 that applies in automotive manufacturing industry include: the General Safety Regulations (GSR), the General Machinery Regulation (GMR), the Electrical and Mechanical Regulations (Rikhotso, Morodi, Masekameni, 2022: 1; Abanga, Moturi & Makindi, 2023: 1). The central requirements of these regulations are outlined below;

- GSR (2)(5) - Employers are required to train their staff on how to properly use, maintain, and utilise the available safety equipment and facilities (Lexis Nexus, 2021: 26).
- GMR (4)(1) - Employers and machinery users are required to make sure that all individuals authorised to operate the equipment are fully aware of the risks involved and are knowledgeable about the safety precautions that need to be followed (Lexis Nexus, 2021: 289).

The next section examines the accident or incident controls and prevention.

2.6 INCIDENT OR ACCIDENT CONTROLS AND PREVENTION

The human error incident can have more than one cause (Arifin, Arifin, Ahmad, Abas, Juhari, Ali & Mohd Fadzil, 2024: 4). Therefore, this study investigates the innovative techniques to use a thorough Health, Safety, Security, Environment, and Quality (HSSEQ) management framework to prevent significant industrial human error accidents (Bahar, Bilgen, & Sarioguz, 2025: 2). There are several strategies for improving human performance that can be used to systematically minimise the chances of human error, and those strategies can be used to provide mental and social skills that accompany an employee’s technical skills to encourage safe and effective task performance (Sajithkuma, 2023: 494). Moreover, the risks of incidents/accidents due to bad human errors are avoided (Dossou, Torregrossa, & Martinez, 2022: 360). As mentioned in the previous section, employees' performance in terms of safety will improve when they perceive that management is concerned about their safety (Yang, et al., 2023: 3).

It is feasible to implement effective preventive measures in the field of occupational health and safety, which improves our understanding of the causes of these human error incidents and accidents (Nowakowska, & Pajecki, 2022: 528). As indicated in the chapter of this study, human error is defined as an unsafe act committed by an individual that would negatively affect the working environment. The more effective strategy to control human error is to put proper procedures in place (Collazo, 2020: 2). In addition, good human factor engineering should be implemented for control systems, procedures, equipment, and the work environment. Where relevant training and practice should be provided to ensure that the employees have the skills and competencies required to conduct the work process and activity effectively. Effective controls guard against workplace hazards, helping to avoid accidents, illnesses, and injuries, lessen or eliminate health risks for employees, and support employers in creating a safe and healthy work environment (Asanga, 2023, 97). The following hierarchical controls can prevent human error:

- The elimination or reduction of hazards in the strategy and restructuring process.
- Hazards and risks can be reduced by substituting with less hazardous methods or materials.
- Incorporating safety devices.
- Give alerting mechanisms.
- Apply administration controls (work methods, training, and work scheduling).
- Providing PPE is the sixth category of the hierarchy of controls and the last resort (Barnett, 2020: 61; Yeshitila, Kitaw & Jilcha, 2021; 128).

However, Ghasemi, Doosti-Irani, and Aghaei (2023: 161) argue that choosing the best option can be confusing if the Hierarchy Control is not crucially considered, as it provides health and safety practitioners and professionals with guidance in selecting the most appropriate control measures. Engineering controls help to prevent exposure, medical controls help to detect the consequences of exposures early, and legislative controls aid to enforce the application of global occupational health and safety (OHS) rules (Asanga, 2023: 97).

In the automotive manufacturing industry, the challenges need to be identified and evaluated. For example, the necessity that milling, turning, and grinding machines operate for a set amount of time needs to be changed, as does the methodology of material removal (Elira, 2021: 98). In contrast, Kiss, Nagy, and Adam (2020: 52) contend that workplace health and safety should be given more priority, along with the use of less hazardous tools, to assist lower the likelihood of accidents. Moreover, the organisation needs to set aside enough money for PPE and other safety-related expenses (Khan, Felice & Petrillo, 2019: 116). The next section is directed at incident and accident investigation.

2.7 INCIDENT AND ACCIDENT INVESTIGATION

The OHS Act No. 85 of 1993 describes the incident investigation as a process to ascertain how and why failures occur that lead to property damage or personal injury (Storbakken, 2022: 21). The basic direction of an accident investigation is influenced by the aim of the investigation. An incident and accident investigation aims to determine what caused the incident/accident and make safety suggestions (Allford & Wood, 2021: 6). Another purpose is to ensure that the injured employee receives medical assistance as well as workmen's compensation with the COID Act No. 130 of 1996. However, investigations draw clear conclusions about what and who was responsible, with implications for accountability, safety and compensation (MacLean, & Dror, 2023: 4). A poor and incomplete written investigation report may result in an injured employee's claim being denied by the Compensation Claims Commissioner (Storbakken, 2022: 6). As a result, thorough and detailed incident/accident investigations, risk assessments and pre-job safety inspections performed by experienced and competent persons can help significantly to reduce workplace human error incident/accident (Morrish, 2017: 635).

The process of investigating incidents and accidents is a critical function in occupational health and safety management. Incident investigations and similar procedures are to be done in a systematic and timely manner to assess underlying causes and contributing factors; appropriate corrective actions should then be undertaken to prevent occurrence (ISO, 2018: 20). The success of incident investigations depends not only on technical

correctness but also on organization intent-whether it is to blame or to learn, for example, the learning approach is most helpful in moving organisations from a blame culture to one of continuous improvement (Thallapureddy, Sherratt, Hallowell & Bhandari, 2024: 1).

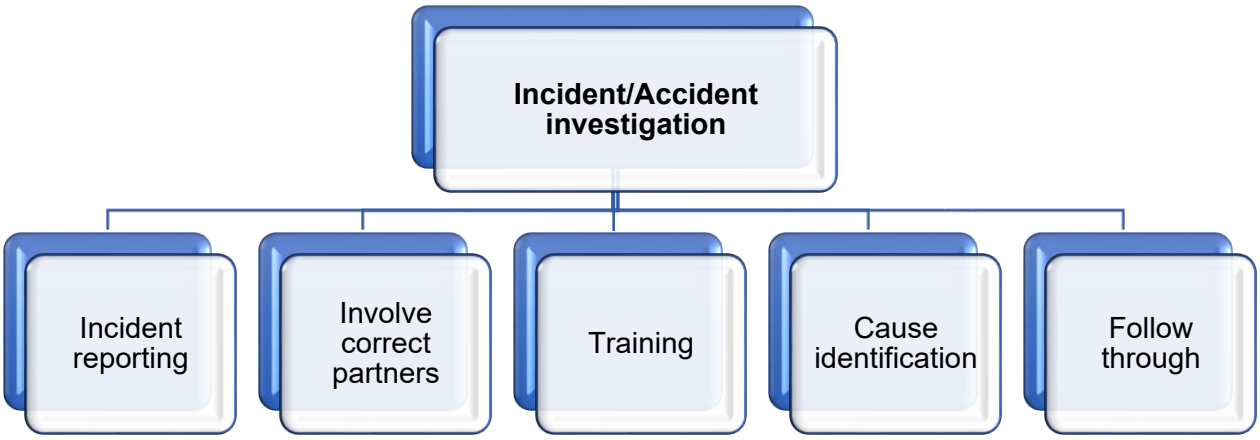
With the aim of improving safety precautions, investigations into incidents or accidents attempt to identify both the immediate and the root causes behind the occurrence. For example, assert that structured investigations by means of root cause analysis, fault tree analysis, and the five Whys greatly enhance the reliability of the corrective actions or risk reduction arising from them. Incident investigations feed into organizational knowledge if the findings are disseminated to the workforce (Majka, 2024: 3; Ehiagwina, Kehinde, Nafiu, Afolabi & Olatinwo, 2022: 1). The feedback loop created by transparent reporting and post-incident communication helps employees understand system weaknesses and promotes safer behaviours (Papadimou, 2025: 130).

Heinrich's domino model states that accidents can be prevented by taking out a contributing element, which will halt the knockdown process. Furthermore, according to Heinrich's model, mechanical risks and dangerous activities create the core factor in the accident order, and their removal renders the preceding factors ineffective (Storbakken, 2022: 140). The incident/accident investigation process would be governed by the policies and procedures described in an organisation's incident management plan, where such documents influence the investigation's efficacy by determining the investigation's aim, scope, direction, and focus (Stemn & Joe-Asare, 2021: 1). Similarly, industrial investigators employed by regulatory bodies and businesses seek to ascertain the causes and mechanisms of events to implement preventive measures that will lessen the likelihood that they will occur in the future (MacLean, & Dror, 2023: 4).

Young (2021: 40) states that OHS professionals can establish a plant-wide procedure to control or eliminate occurrences by looking at incident investigation processes. There are five important steps (Figure 2.2) to conducting a successful incident investigation. First is incident reporting, which necessitates the establishment of a framework that encourages and facilitates reporting. Second, in the case of an all-inclusive, full inquiry,

a proper investigation team of individuals must be involved to record all data, build and support an associate-driven process, and obtain subject matter experts' advice and expertise. Third, disregarding the lack of expertise of individuals involved in the study is harmful. Fourth, cause identification - not identifying the correct cause or root of an incident may result in repeated injuries. Fifth, follow-up on gaps that can result in damage to the organisation's credibility.

Figure 2.2. Steps in incident/accident investigation



Source: Adapted from Young (2021: 40)

The next section examines risk management.

2.8 RISK MANAGEMENT

Risk management is the process of identifying potential hazards, assessing risk based on the possibility and seriousness of employees' injuries, illness, and property damage, giving priority to the implementation of preventive measures to reduce these risks, and informing employees of the risk assessment (Gan, 2019: 281). Therefore, risk management is crucial in the automotive industry as it prevents or reduces unanticipated negative effects (Maddeppungeng, Asyiah, Intari, Putro & Setiawati, 2023: 260).

The framework and methodology of the human factor framework reveal three deficiencies in risk management that stem from human errors. These frameworks include ignorance, complacency, and overconfidence. As opposed to complacency,

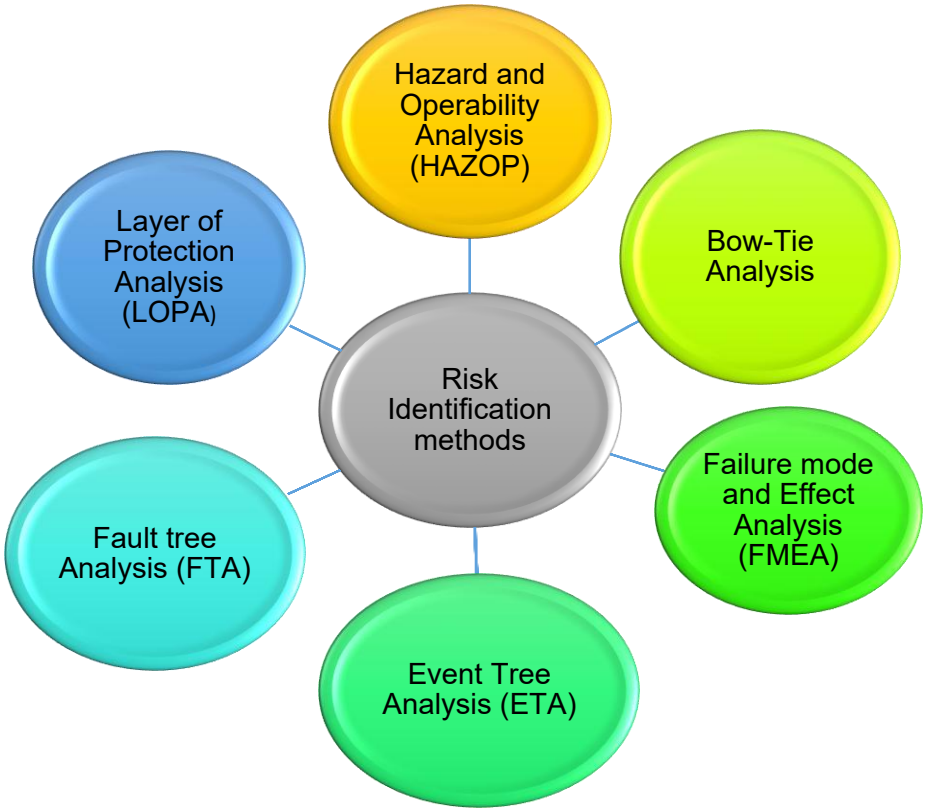
which is the awareness of risk but excessive risk-taking, ignorance is the lack of awareness of risk owing to misunderstanding or lack of knowledge (Xiao, Jiang, Li & He, 2020: 11). Awareness of dangers combined with an inflated capacity for risk management constitutes tolerance and overconfidence (Xiao, Jiang, Li & He, 2020: 11).

2.9 RISK ASSESSMENT

The process of evaluating, ranking, and categorising workplace risks and hazards from the perspective of occupational health and safety is known as an Occupational Risk Assessment (ORA) (Ak, Yucesan & Gul, 2022: 629). Therefore, to identify the risky areas in an automotive manufacturing organisation and execute the most effective working postures or conditions, a comprehensive hazard identification and risk assessment (HIRA) must be conducted (Fazi et al., 2019: 2; Askari et al., 2023: 1). However, researchers elaborated that lack of a comprehensive risk management strategy for OHS might lead to more work-related accidents and illnesses (Askari et al., 2023: 2).

Making improved counteraction plans to eliminate or mitigate risks and increase the safety level for safety-critical systems requires effective risk identification and analysis, which includes crucial procedures like hazard identification and risk evaluation. Organisations in the automotive industry use the disciplined and structured technique Hazard and Operability Hazard and Operability (HAZOP) Studies to identify hazards and evaluate their risk (Mocellin, De Tommaso, Vianello, Maschio, Saulnier-Bellemare, Virla, & Patience, 2022: 3463). For technical system safety, the risk identification and analysis methods are presented in Figure 2.3. These include - Layer of Protection Analysis (LOPA), HAZOP Studies, Fault Tree Analysis (FTA), Failure Mode and Effect Analysis (FMEA), Event Tree Analysis and Bow-tie Analysis (Wu, Lind & Song, 2022: 1).

Figure 2.3. Illustration of the most common risk assessment techniques used in the automotive industry



Source: Adapted from Wu, Lind and Song (2022: 3)

2.9.1 Occupational health hazards

Employees are subject to different types of hazards daily based on the nature of their work and the timeframe of the tasks. These hazards may be physical, biological, chemical, ergonomic, and even psycho-social (James et al., 2023: 2). Research indicates that in industry, ergonomic hazards are 30%, physical hazards 26%, chemical hazards 23%, psycho-social hazards 18%, and biological 3% (Benson, Dimonpoulos, Argyropoulos, Mikellidou & Boustras, 2021: 1). Therefore, all employees need to be aware of any potential hazards associated with their occupations so they may take the appropriate precautions while working (Asanga, 2023, 91). Table 2.2 outlines examples of these occupational health and safety hazards as well as potential health risks.

Table 2.2: Outline of the occupational health and safety hazards

Workplace hazard	Example	Health risks
1. Physical hazards	• Vibrations • Noise • Slip, trip and fall • Heat radiation • Working in confined spaces	• Raynaud's disease/ white finger (Vibration syndrome) • Hearing loss (NIHL) • Skin burn • Heatstroke
2. Chemical hazards	• Corrosion inhibitors, • Drilling fluid/Additives, • Mud pits, • Tanks for storage, and completion.	• Respiratory disease e.g., chemical asthma • Leukemia • Asphyxiates • Eye and skin irritation • Headaches
3. Ergonomic hazards	• Manual handling activities • Repetitive motions • Awkward postures • Frequent lifting • Poor lighting • Lack of support from a co-worker	• Musculoskeletal disorders • Cumulative trauma disorders • Stiffness • Loss of coordination
4. Biological hazards	• Pests • Bacteria • Viruses • Dust • Mists	• Blood-borne diseases • Skin irritation • Airborne pathogens
5. Psychosocial hazards	• Workload • Long working hours • Site isolation • Workplace violence • Lack of support at the workplace • Emotional labour	• Anxiety • Disorder • Depression • Hypertension • Cardiovascular disease

Source: Adaptef from Benson, Dimonpoulos, Argyropoulos, Mikellidou and Boustras (2021: 2) and Lovelock (2019: 7)

2.9.1.1 Physical hazards

The South African automotive manufacturing industry needs to pay attention on human error aspects of safety to reduce the likelihood of accidents by using organisational and physical hazard-related solutions (Bussier, & Chong, 2022: 162). Most of the employees in the automotive manufacturing industry are exposed to physical hazards such as noise, heat and vibrations (Havet, Fournier, Stefanelli, Plantier & Penot, 2020: 13). Certain common physical hazards, like noise, can lead to fatigue or negatively affect employees' emotions, which can further impair their concentration and raise the risk of a safety accident (Ji, Pons & Pearse, 2020: 8). Noise is a physical hazard that can be defined as unwanted sound and it has been the subject of numerous studies in recent years with the intention to prevent it (Benson, et al., 2021: 2).

The most prevalent work-related harm is occupational hearing loss (Asanga, 2023: 89). Hearing damage such as noise-induced hearing loss (NIHL), noise-induced tinnitus (NIT) and deafness might be permanent if noise is frequently beyond the threshold level of 85 Db (Ke, Du & Luo, 2021: 2). Therefore, an employer is required to examine any noise risks that could recommend the need to take specific actions to reduce noise exposure (Mlynski & Kozlowski, 2023: 528).

Increased vibration frequently causes seal failure, which can lead to costly repairs, process disruptions, lower throughput, fines if hazardous materials spill, and fire if the leaked material is flammable (Munirathinam, 2020: 146). As an intense afferent contribution to the human form, the mechanical vibration inducements cause a complex spinal and supraspinal neurophysiological response called the tonic vibration impulse (Yang, Su, Sanchez, Hackney, Butler, 2023: 803). The painful vascular condition known as Raynaud's phenomenon is characterised by abnormal vasoconstriction of the digital arteries, which results in skin blanching. Common occupational exposure to Hand-Arm Vibration (HAV) can result in neurological impairment, myalgia, and vibration-induced Raynaud's phenomenon, also known as vibration white fingers (Maciejewska, Sikora, Maciejewski, Alda-Malicka, Czuwara, & Rudnicka, 2022: 1; Stjernbrandt, Johnsen, Liljelind, Aminoff, Wahlström, Höper, Pettersson, & Nilsson, 2023: 1).

In addition to human error, employees may experience various forms of stress, such as heat stress, which can result in accidents (Umar & Egbu, 2020: 10). Researchers have seen a rise in the incidence of heat-related illness (HRI), which is brought on by extended exposure to heat and humidity among many organisational employees (Lyu, Song, & Watts, 2022: 47). However, in 2015, the United States Occupational Health and Safety Administration (U.S. OSHA) warned that unless organisations implement comprehensive preventive programmes, the number of workplace heat illness and fatality occurrences may rise whereas the Occupational Health and Safety Program's main objective, according to the Japanese Ministry of Health, Labour, and Welfare, is to prevent occupational heat stress (Kakamu, Endo, Hidaka, Masuishi, Kasuga, & Fukushima, 2021: 1).

Some measurements, including heat stress and heat strain, can immediately and simultaneously reflect an employee's physical and psychological condition hence an employee's occupational health issues can develop from both heat stress and heat strain (Xu, Nie, Li, Cheng, & Mei, 2022: 10). However, with suitable heat action plans that include behavioural strategies and biophysical solutions, excess mortality and numerous heat-related health hazards can be avoided (Ebi, Capon, Berry, Broderick, De Dear, Havenith, & Jay, 2021: 698).

2.9.1.2 Chemical hazards

A major factor in the large number of chemical accidents brought on by human error in the automotive industry is the lack of safety awareness and knowledge (Chen & Reniers, 2020: 11). However, a comprehensive human error incident structure to prevent hazardous chemical incidents and accidents are granted for organisations and regulators (Wu, Fu, Han, Jia, Lyu, Wang & Wu, 2022: 1). According to the same study, 76.1% of chemical accidents that happened in South Korea between 2008 and 2018 were the result of human error. This finding emphasises the importance of verifying safety work permits and safety protocols because major accidents happen during routine operations and maintenance procedures (Jung, Woo & Kang, 2020: 6). A chemical hazard is a specific kind of occupational hazard brought on by exposure to chemicals at work, which may have immediate or long-term negative health effects (Bhusnure,

Dongare, Gholve & Giram, 2018: 357). Moreover, chemicals that have the potential to endanger human or animal health, the environment, or property are classified as hazardous chemicals (Mao, Wang, Tang, & Qian, 2019: 997). Regrettably, harmful chemicals are often an unavoidable fragment of chemical synthesis, and some standards take into account the assessment of chemical risks (Bennett, Campbell & Abolhasani, 2019: 14; Sun, Bisschop, Niu & Huang, 2020: 22).

Skin absorption, inhalation, injection, and ingestion are the four main ways that chemicals can enter the body and cause harm (Baig, Sial, Qasim, Ghaffar, Ullah, Haider & Ather, 2024: 77). Examples of chemical hazards are corrosion inhibitors, drilling fluid/additives, mud pits, storage tanks, cementing completion and simulation process, production process, and refining process. Examples of chemical related health risks are respiratory diseases such as chemical asthma, leukemia, eye and skin irritation, and headaches (Benson, et al., 2021: 2).

Human error is most likely the cause of spill accidents, and the most common cause of spill accidents is improper handling of chemicals due to employees' negligence (Kim, Jo, & Roh, 2023: 6). Therefore, when handling these chemical compounds, extra care must be taken to avoid exposure through eye contact and oral intake or inhalation (Ab Rashid, Rasidi, & Rosli, 2023: 27).

2.9.1.3 Ergonomic hazards

The term "ergonomics" refers to the intricate relationship that exists in the workplace between employees and the jobs they perform (Arifin, Ahmad, Abas, & Ali, 2023: 7). There are several issues with large automotive industrial settings that must be resolved before the implementation of suitable and efficient ergonomic job analysis to be more useful (Santos, Folgado, Rodrigues, Mollaei, Fujao, & Gamboa., 2020: 79). The application of ergonomics and human factors has been crucial in improving the automotive industry's performance and safety (Hamer, Waterson, & Jun, 2021: 1). Human errors are due to a variety of factors, and these include inadequate decision-making, faulty information processing, and physical and cognitive workload. The final link in many accidents and failures is a human operator who is held accountable or,

worse, suffers injuries. These vulnerabilities are frequently caused by poor human factors and design flaws, which can result in latent or catastrophic failures (Ahmed & Onan Demirel, 2020: 1).

Musculoskeletal disorders for example, painful muscles are due to work environment parameters and risky actions including, picking up, material handling, and lifting (Fazi et al., 2019: 2). Modern industrial setting, non-invasive sensing technologies that require little preparation time and sophisticated yet quick analytical processes that can provide instantaneous information on human physical load should be used to precisely assess employees' ergonomics (Lorenzini, Kim, & Ajoudani, 2022: 1).

2.9.1.4 Biological Hazards

One of the main health concerns for the human population is thought to be posed by biological hazards, such as infectious disease epidemics (Chan, Huang, Lo, Hung, Wong, & Wong, 2020: 2). However, the use of robots is advantageous as they avoid the dissemination of infection and reduce human error in automotive industry (Holland, Kingston, McCarthy, Armstrong, O'Dwyer, Merz, & McConnell, 2021: 1). The necessity for biological hazard analysis in the work environment to securely identify the harmful variables with biological bases is urgent due to the paucity of knowledge on biological agents in the workplace (Rim & Lim, 2014: 43; Kozajda, & Miśkiewicz, 2025: 93).

Waste, bacteria, viruses, or poisons from biological sources, such as venomous animals and insects, are examples of biological hazards or biohazards that pose a risk to human health (Arifin et al., 2023: 7). In automotive industry, the majority of waste segregation techniques used today involve manual waste sorting by humans. This could be less effective, prone to human error, and dangerous for people's health. When used early in the waste disposal process, automated waste segregation has the potential to increase efficiency, increase classification accuracy, and decrease contamination during recycling (Bishnoi & Rzechowski, 2020: 1; Koskinopoulou, Raptopoulos, Papadopoulos, Mavrakis & Maniadakis, 2021.51).

2.9.1.5 Psychological Hazards

Psychosocial hazard in the context of work is defined as aspects of the design and management of work, and its social and organisational surroundings that may have the potential to cause psychological or bodily injury (Lovelock, 2019: 10). In this regards, Occupational Health and Safety aims to ensure the well-being of employees by preventing health issues, protecting workplaces from harmful factors by providing appropriate environments for mental and emotional capabilities (Umoh, Amuasi, Jimmy, Gyamfi, Djangmason, Fallah & Muchee, 2023: 1).

Stress at work might be brought on by an excessive workload and exposure to various hazards (Agunos, Cruz, & Illescas, 2022: 1252). However, in any organisation, increased productivity is likely to be achieved when psychosocial risks are minimised at work (Umoh, et al.,2023: 22). The effect of psychological discomfort on how safety measures and human error interact has received relatively little attention (Bussier, & Chong, 2022: 162). The next section examines human error and Industry 4.0.

2.10 HUMAN ERROR AND THE INDUSTRIAL REVOLUTION (IR)

The automotive industry has grown to be a sophisticated and highly automated one. Because of the increased automation and complexity, a work environment has emerged where human dependability and human-machine interface are now crucial for success, particularly for high-risk jobs (Petruni, Giagloglou, Douglas, Geng, Leva, & Demichela, 2019: 1). The human factor is gradually being relegated to the background by the fourth industrial revolution. Reducing the likelihood of errors and human error is the main goal (Shahbakhsh, Emad & Cahoon, 2022: 16). The workplace and employees are significantly impacted by the automation and digitalisation brought about by the fourth industrial revolution (Coldwell, 2019: 1). The manufacturing sectors have experienced rapid technical progress and development from industry IR 1.0 to IR 4.0 (Kadarisman, Wijayanto & Sakti, 2022: 11).

The emergence of IR 5.0 is predicated on the observation or presumption that industry 4.0 prioritises digitalisation and AI-driven technologies over the original values of sustainability and social justice to increase production effectiveness and versatility

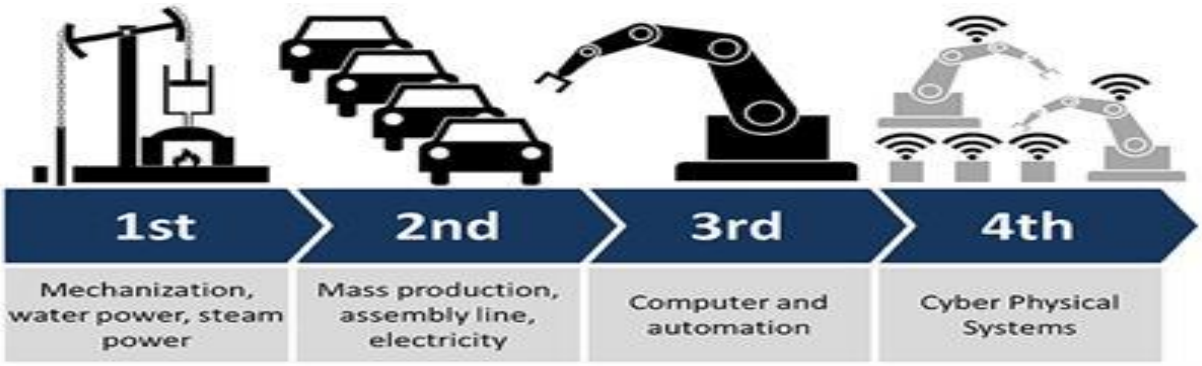
(Islam, Sepanloo, Woo, Woo, & Son, 2025: 4). Industrial Revolution 5.0 (IR 5.0) evolved as an ideal form of industry that goes beyond productivity and efficiency to respect human values and meet essential demands for society (Golovianko, Terziyan, Branytskyi & Malyk, 2023: 104). Industrial Revolution 5.0 seeks to revolutionise the manufacturing sector and bring in a new era of long-term viability specificity, and effectiveness. Since IR 5.0 could open new doors for growth and innovation in a variety of industries, its relevance goes beyond the industrial sector (George & George, 2023: 23). However, technological advancements enable effective manufacturing processes and changes human work, which may pose new risks to an employee's well-being and test their current skills and knowledge (Reiman, Kaivo-oja, Parviainen, Takala, & Lauraeus, 2021: 1). The biggest threat to current cyber-physical systems is human behaviour (Angelopoulou et al., 2020: 297).

Moreover, there is widespread concern about the possibility of low-skilled workers losing their jobs due to the high level of automation, which has the potential to lead to an economic imbalance and increased inequality in society (Santhi & Muthuswamy, 2023: 939). Because of the changing technology and business model needs employees are at high risk in the 4.0 industrial revolution since they must be considerably faster and perform new tasks quicker. (Ulu & Birgun, 2024: 1). As such, human operators must learn new skills since they will increasingly be required to monitor automated equipment or make judgments that are backed by the system (Angelopoulou et al., 2020: 297). However, human errors can be eliminated if all systems can be automated (Guastello, 2023: 15).

System engineers did not take human variables into account while designing systems at the start of the IR 3.0 because they were unaware of their importance. However, after looking at several accidents, systems engineers discovered that human variables must be considered when designing. An increasing number of human factor practitioners joined the design team by the end of the IR 3.0. Their mandate is to examine how operators utilise the system and how human error affects productivity loss and accidents (Harel, 2019: 8). Industry 4.0 pushes human interaction to the margins with the aim of reducing the likelihood of errors and human error (Shahbakhsh et al., 2022: 16).

Ever since the industrial revolution started in the 1700s, there have been several industrial revolutions that have contributed significantly to the advancement of modern development. The agricultural sectors were replaced by mechanical looms in the 1700s, which further improved the economic structure. These looms were powered by steam and water on mechanical equipment. When electrical energy was introduced in 1870, it led to the Second Industrial Revolution and the formation of the mass production system. These revolutions relied on the number of human capabilities to achieve more with the development of electronics came the third Industrial Revolution (Alaloul, Liew, Zawawi & Kennedy, 2020: 225). The term 'digital revolution' refers to the advancement of technology from analogue electronic and mechanical devices to modern digital technology. The internet, artificial intelligence, and the digital revolution serve as the foundation for the Fourth Industrial Revolution (IR 4.0), which emerged in 2011. (Khin, & Kee, 2022: 1; Melnyk, Matsenko, Kalinichenko, Holub & Sotnyk, 2023: 35). 2022 has the entrance of the Fifth Industrial Revolution (IR 5.0) emerged in 2022 anchored on personalisation, robotics, and the cognitive system. IR 5.0 goes beyond manufacturing process and includes a human-centric approach with a focus on sustainability (TWI, n. d; Melnyk, Matsenko, Kalinichenko, Holub, & Sotnyk, 2023: 35). The stages of the Industrial Revolution are illustrated in Figure 2.4.

Figure 2.4. The Industrial Revolution



Source: Adapted from Santhi and Muthuswamy (2023: 948)

2.11 TRAINING AND INNOVATION

Health and safety as a theoretical correction have the purpose to minimise risks through preventive techniques and training (Rodríguez-Martín, Rodríguez-Gonzálvez, & Domingo, 2023: 22). However, the current research and the Labour Inspectorate's most recent activity report indicate that the primary cause of workplace accidents in the automotive industrial sector is either a lack of training for employees, or their training is either incomplete or inadequate (Muresan, Milosan, Machedon-Pisu, Reit, Senchetru, & Oancea, 2021: 1; Sabran, Rahim & Mohammad, 2021: 11). Training in occupational risk prevention is essential, not least because it is a requirement for enhancing workplace health and safety (Vidal-Gomel, 2017: 133). However, Zhang, Meng, Ge and Tan (2022: 17), argues that although managers in the automotive industry recognise human error, they are ignorant of prevention and continue to emphasise training as a means of preventing it, even though this results in staff fatigue from frequent safety trainings.

Organisations should be sure to provide training sessions and a quick overview of their offerings, services, and corporate structure to all new employees (Paramanantham & Liyanage, 2023: 20). OHS training seeks to improve the safety climate by developing, acquiring, and extending the knowledge and skills necessary to carry out work in a safe manner (Rauh, Koller, Schäfer, Meixner, Bogdan, & Viberg, 2021: 164). However, OHS training is an abandoned topic in safety research (Dahl, Rundmo & Olsen, 2022: 1). In this regard, human factors like knowledge, behaviour modification, situation awareness, risk perception, and industrial environments significantly influence the design and evaluation of education and training initiatives (Micheli, Vitrano & Calabrese, 2021: 7). Therefore, employee operation errors can be effectively reduced with specific training and attention to personnel's technical proficiency, safety awareness, and psychological well-being. Innovation is not always visible from the outside, as evidenced by its internalisation into better operations; the most significant innovations frequently occur as process innovations within the organisation (Yang et al., 2023: 3).

However, the internalisation of innovation into improved operations indicates that innovation is not always outwardly noticed; many times, the most relevant innovations are happening inside the company as process innovations (Kang & Stephens, 2022:

395). Innovative research has shown that decreasing human errors is necessary to improve organisational performance. To do this, the organisation must have a vision or purpose statement regarding identified errors and a general justification and conscious strategy (Paramanantham & Liyanage, 2023: 20). Therefore, future Environmental Health and Safety (EHS) research in the automotive industry should prioritise exploring and implementing emerging technologies like Internet of Things (IoT), Artificial Intelligence (AI), and robotics to improve performance, manage risks, and drive innovation in manufacturing processes (Abatan, Jacks, Ugwuanyi, Nwokediegwu, Obaigbena, Daraojimba, & Lottu, 2024, 2024: 539). (ISO). Virtual reality (VR) and simulation offer very valuable training for hands-on experience in a controlled situation, improving learning efficiency (Sushereba, Militello, Wolf, & Patterson, 2021: 13).The next section examines the International Standards for Organisation

2.12 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

Through compliance with guidelines and requirements, the automotive industry manages risk through the application of organisational standards, particularly the International Organization for Standardization (ISO), (Björnsdóttir, Jensson, de Boer & Thorsteinsson, 2022: 629). ISO is intended to support businesses of all kinds and sectors. It is anticipated that the implementation of the new international standard, ISO 45001, will result in a decrease in the global rate of occupational accidents and illnesses (Šolc, Blaško, Girmanová & Kliment, 2022: 303). Long-term personnel and organisational performance can be enhanced by the implementation of this integrated ISO system (Suwardi & Nurcahyo, 2022: 1137). Implementing quality, environmental, and safety management systems in businesses has grown in importance for the organisations (Bala, Ferroukhi & Chibani, 2022: 176).

The ISO created a set of standards known as ISO 9001: 2015 for quality management, ISO 14001 for environmental management, and ISO 45001: 2018 for occupational health and safety management to support the adoption of a process approach to management for organisations to function effectively. Within this framework, a process is defined as any action that takes inputs and transforms them into outputs (Pauliková, Chovancová & Blahová, 2022: 1; Bakhit, 2023: 31).

The following ISO management systems are being used in the automotive manufacturing industry.

2.12.1 ISO 9001: 2015 – Quality Management System (QMS)

An international standard that may be implemented by organisations of all sizes and in all industries is the ISO 9001: 2015 quality management system (Wang, 2022: 1556). Pačaiová and Ižaríková (2019: 46) state that one of the most important justifications for management in the automotive manufacturing industry is quality. ISO 9001: 2015 forms the foundation for the quality management system and other significant industry standards (Hudáková, Mäkká & Kardoš, 2023: 47). Within the automotive sector, ISO 9001: 2015 seeks to guarantee a flawless supply chain for the creation, manufacturing, and maintaining of automotive as well as the provision of parts (Neves, Salgado, Beijo, Lira & Ribeiro, 2021: 4). Organisations choose to implement the ISO 9001:2015 quality management standard to minimise discrepancies and human errors in their processes. By doing so, they hope to improve their overall operational performance through the adoption of a process-oriented approach, continuous improvement, and risk-based decision-making, which are all emphasized in the standard (Lopes, Polónia, Gradim, & Cunha, 2022: 52). Implementing Total Quality Management (TQM) accentuates the importance of involving all employees in the company's overall endeavours to eradicate any faults, or non-conformities (Pačaiová & Ižaríková, 2019: 46).

2.12.2 ISO 14001: 2015 – Environmental Management System (EMS)

Environmental degradation is intimately associated with the operations of manufacturing industries (Widiatami, Pitaloka, & Nurkhin, 2022: 1). Most organisations create their EMSs by the specifications provided by the ISO 14001: 2015 standard (Chen, Lujan-Blanco, Fortuny-Santos, & Ruiz-de-Arbulo-López, 2020: 6). Adopting ISO 14001: 2015 reduces the possibility of disputes arising among employers and employees over the provision of a respectable and healthy work environment, boosts employee productivity through time and cost efficiency, and creates a more planned and organised means of bridging the environmental regulations' fulfillment (Fahmi, Mustofa, Rochmad, Sulastri, Wahyuni & Irwansyah, 2021: 15).

2.12.3 ISO 45001: 2018 – Occupational Health & Safety Management Systems (OHSMS)

ISO 45001: 2018 is intended to support organisations of all kinds and sectors in their efforts to lower global rates of occupational incidents and accidents (Purwanto, 2020: 1982). Furthermore, ISO 45001:2018 aims to lessen the impact of workplace incidents and accidents by offering a structure to enhance employee safety, lower hazards, and establish a safer working environment (Ballantyne, 2019: 7). However, for an organisation to implement an ISO 45001 in line with occupational health and safety management system, it must determine which areas are essential to their ability to fulfil operational tasks efficiently and offer a work environment that is safe for employees (Górny, Dziegielewska & Konarkowska, 2023: 1154).

An organisation can proactively improve OHS performance in preventing injury and poor health by following the procedures provided by ISO 45001: 2018, an international standard that establishes requirements for occupational health and safety management systems and provides information on their implementation (Fahmi, et al., 2021: 15). Additionally, Šolc, et al. (2022: 294) state that using the ISO 45001 standard is one of the crucial actions that companies may do to guarantee better health and safety. Górny et al., (2023: 1154) state that one of the advantages in implementing ISO 45001: 2018 for an automotive manufacturing industry is the capacity to eliminate hazards and problems, which translates into decreased operating expenses that arise from neglecting to provide the necessary working conditions, inadequate or ineffective reductions in workload, and illnesses and human error incidents and accidents related to the place of employment. Organisations can tackle impediments and limit behaviours that may result in workplace accidents by implementing OHS (Črv, 2023: 24).

2.13 SAFETY MANAGEMENT PRACTICES

Safety management aims to control risky human behaviour and unsafe conditions, putting safety management decisions and objectives into practice. Preventing accidents, preventing injuries from happening accidentally, and minimising unintentional losses are all safety management goals. (Yang, et al., 2023: 3). Therefore, employers have an

obligation to educate employees about workplace hazards, help them recognise hazards, and provide resources to help them reduce and manage their exposure to those hazards (James et al., 2023: 1).

There are three categories of health and safety management: (1) failure safe for quality, (2) safety aims to reduce harm on site, and in some situations, (3) ensure that no employee is harmed on-site at all by anticipating potential risks and taking preventative action. Additionally, lean strategy helps plan for safety and health through assessment, identification, and control of anticipated risk in the Plan of Conditions and Work Environment, or Environmental Safety Management (ESM). Prioritising occupational health risks using the Harmful Agents Risk Priority Index (HARPI) can make managers' decisions about how to allocate resources for easier control measure implementation (Askari, Poursadeqiyan, Sahl Abadi, Mahdinasab, & Farhadi, 2023: 1). Control measures typically entail putting up the conditions necessary for achieving them as well as planning for the employees' overall safety. The final advanced lean tool is health and safety improvement management, which comprises organising the conditions for site employees' health and safety (Babalola, Ibem, & Ezema, 2019: 39).

Researchers seem to find the issue of human error to be very relevant, and this is supported by their desire to increase industrial safety by any means necessary (Wróbel, 2021: 9). This will assist in creating a consistent initial safety management strategy for future development in later design stages by providing a methodical and itemised initial list of safety controls (Banda, Kannos, Goerlandt, van Gelder, Bergström, & Kujala, 2019: 3).

The following points describe the objectives of industrial safety management (Bhusnure, et al., 2018: 358):

- Recognise the negative effects of industrial risks
- Describe the connection between risks and hazards
- Examine the routes by which industrial risks are exposed
- Identify the many types of toxicity caused by industrial risks

- Be familiar with the most toxic environmental hazardous substances
- Examining all possible accident risks is essential for industrial safety to prevent employee fatalities and permanent disabilities. It also helps to identify any material or machine damage that could cause a loss for the entire company.
- Accidents that cause work stoppage and output loss must be eliminated
- By minimising any risk, accidents in the workplace can be avoided
- Worker's compensation costs, insurance premiums, and all accident-related expenses must be decreased
- All employees must be educated

2.14 LEADERSHIP ENGAGEMENT AND ACCOUNTABILITY

To understand whether there is a commitment of leadership toward safety and the corresponding employee safety behaviours, active involvement of leaders is required. Safety leadership is defined as a significant predictor of the behaviour of employees towards safety, supported by the research in which best organisations with safety leadership can drastically influence the incidence rates (Payne, Roache, Subero & Zhang, 2025: 214; Schwatka, Dally, Brown, Tenney & Newmanet, 2020: 160). This type of proactive leadership can manifest through structured safety activities, such as regular safety walks and participation in incident investigations, fostering an environment where employees feel supported in their safety efforts (Sankar, Anandh & Prasanna, 2024: 1002).

Leadership communication also includes transparency and empathy about how employees understand the health and safety commitment of the organisation When supervisors hold accountable for safety results, they tend to focus more on safety when making decisions and, consequently, on safety metrics for better performance (Kyambade, Nkurunziza, Sewante, Namatovu & Tushabe, 2024: 3; Haavisto & Linge, 2022: 349). The work advocates for embedding safety performance recommendations in evaluation systems, with the premise that accountability in leadership can improve safety outcomes.

Safety governance structures should have board-level oversight and regular appraisal of safety performance indicators. It is emphasised that organisations with formal safety governance frameworks tend to exhibit stronger risk management practices and consistent safety performance (Umar, 2020: 84). Their research encourages dedicated safety committees at the board level, charged with reviewing safety metrics continuously and developing strategic initiatives to improve safety culture organisation wide. Cultivating a strong safety climate as mentioned by Sankar et al. (2024: 1150) entails commitment by leadership, which presupposes that when leaders demonstrate interest in safety at the organisational strategy level, employees' perception of safety culture is consequently affected. However, Mosarwana and Mogaka (2025: 7) argue, the automotive organisation's leaders prioritise profitability and productivity over safety issues, which frequently results in the latter being marginalised.

2.15 PSYCHOLOGICAL SAFETY AND WELL-BEING SUPPORT

The imperative is to learn the different interventions in mental health and their consequences on the well-being and productivity of employees before adopting them in the employee policy. Research has shown that the organisations can improve their employees' health and reduced their absenteeism by reducing the incidences of human error, particularly in automotive industry as they provide comprehensive institutional support for their employee assistance programs (Bondar, Morrow, Gueorguieva, Brown, Hawrilenko, Krystal, Corlett, & Chekroud, 2022: 208). It is argued that comprehensive programs for employee mental well-being, including special programs for work-related stress and trauma can be effective in reducing absenteeism rates (Wu, Roemer, Kent, Ballard, & Goetzel, 2021: e928; Restrepo & Lemos, 2021: 59).

An important consideration for the culture of organisations that promote open conversations regarding mistakes and issues is fostering psychological safety. Psychologically safe environments were used to experience more learning through mistakes, as employees within such environments are more likely to engage in proactive risk management (Lee, 2020: 29).

2.16 BEHAVIOUR-BASED SAFETY AND EMPLOYEE ENGAGEMENT

Behaviour-Based Safety (BBS) programs have for some time gained recognition as effective mechanisms for enhancing occupational safety. Employee involvement in identifying and mitigating risks offers strong evidence for the correlation between employee involvement and reductions in incident rates. Well-implemented BBS programs can decrease incident rates significantly via systematic observation, constructive feedback, and positive reinforcement strategies, placing particular emphasis on the need to solicit input from employees at all levels of the organisation (Ploscaru, Rotea, Dumitriu & Georgescu, 2023: 74).

Furthermore, recent research emphasises systems thinking in newer models of BBS. Systems thinking views the complex interactions between organisational antecedents and employee behaviour instead of examining behaviours in isolation. For example, Chen, Lin, and Chen (2024: 50) demonstrate that the behaviours of managers are key determinants of employees' safety compliance and participation, thereby calling for an organisational climate that facilitates safety dialogue (Chen, Lin, & Chen, 2024: 51). The peer-to-peer safety observation programs are effective through fostering a joint culture of safety norms (Basahel, 2021: 4102).

2.17 SYSTEMATIC INVESTIGATION METHODOLOGIES

The introduction of standardised protocols that can stand the test of time through process adoption should rank high on the agenda of organisations attempting to ameliorate their incident investigation processes. An understanding of normal work variability that leads to the occurrence of incidents should be an important consideration instead of focusing solely on the identification of deviations from the prescribed procedures. The System Theoretical Accident Model (STAMP) is a fitting approach to investigate how control structures and feedback influence safety in the system (Rojas-Lora, Corral, Zabaleta-Carvajal, López-Ojeda, Fuentes-Mila, Romera-Peregrina, Lerma-Briansò, Plata-Menchaca, Pavón, Sabater, & Cabellos, 2023: 59). The STAMP methodology guides a systematic way of analysing incidents and encourages organisations to consider different perspectives from all levels of operation and specialties to enrich the investigation process.

Multidisciplinary group holding all vantage points, from the front-line employee to technical specialists and human factors experts, has been more effective at nomenclature of a wider series of contributing factors than a homogenous group (Srirampur, Poyyamozhy & Kumbha, 2023: 169; Lundberg et al. 2022: 18). This diversity is crucial because it aids in the exposure of latent conditions and systemic matters that a single-discipline investigation might miss. It is also necessary to train team members from different disciplines so that they can make a useful contribution to the investigation (Brown, Sparapani, Osinski, Zhang, Blessing, Cheng, Hamid, MohamadiPour, Lal, Kothari & Caraballo, 2023: 1). An organisation should also employ a graduated approach in incident investigations, depending on the severity of the incident under investigation.

This approach was discussed by Stemn and Joe-Asare, (2021: 95), aiming at the three-tier model that involves graded investigations such that minor incidents are subjected to simplified analyses, ordinary investigations for moderate incidents, and comprehensive analyses for serious incidents and incidents with high learning potential. The tiered approach is both cost- and resource-efficient, enabling organisations to direct their resources toward areas that require sufficient attention while maintaining thorough investigations across all level incidents. The next section examines theoretical framework-safety theories.

2.18 SAFETY THEORIES UNDERPINNING THE STUDY

This study employs the Swiss Cheese Model (SCM) and the Domino Theory for incident/accident causation analysis. Accident causation models define the origin, course, and effects of an incident, enabling a thorough understanding of its occurrence and progression (Fu, et al., 2020: 47). Accident causation is shown as a linear process in the Domino model and the Swiss Cheese model, which is characteristic of bind of incident models (Li & Fu, 2024: 5; Mariri, 2025: 30). However, the Domino model and the Swiss cheese model differ significantly, though. The dominoes in Heinrich's model represent completely different causative factors than the slices of cheese in Reason's model. While the Swiss cheese model incorporates the additional knowledge gained

from significant industrial incidents, the Domino model was first developed in occupational health in the 1930s (Wong & Pawlicki, 2025: 3}.

The Swiss Cheese Model ignores the root causes of these failures and instead insists that accidents are caused by a sequence of human errors or "holes" in the system. Heinrich's accident causation model has the disadvantage of just considering the human level, ignoring the larger organisational and environmental elements that also play a role in human error incidents and accidents (Shabani, Jerie & Shabani, 2024: 9).

The theory of human error-related incidents/accidents in the automotive manufacturing industry is discussed using SCM.

2.18.1 Swiss-Cheese Model (SCM)

The SCM is the model that James Reason established in 1990, where the description of the SCM for accident rate is that accident occurrence is a penetrated set of organisational faults (Shabani, Jerie & Shabani, 2024a/b: 107). This model suggests that precautionary challenges, which include protocols, training, and equipment, are like cheese slices with holes that can align, permitting an erroneous action to pass through and result in an accident (França & Hollnagel, 2023: 738). The SCM is used to identify how environmental incentives, and internal processes create interruptions and how an organisation can intervene to change resilience amid disruption (Kang & Stephens, 2022: 395). Furthermore, the introduction of the SCM in 1990, transformed the industrial standpoint of human error, and industries began to perceive it systemically (Joe-Asare, Amegbey & Stemn, 2020: 63).

Accident causation models have been improved further throughout time. The most recent accident causation models offer advantages for accident analysis and prevention and are more comprehensive theoretically (Fu, et al., 2020: 48). The SCM cannot appropriately analyse accidents in an extremely automated and complex system (Naeini & Nadeau, 2022: 319). Reasons early work elaborated on factors of human error that initiated the publication of the Organisational Accident Model (OAM), (Larourzee & Le Coze, 2020: 3). The personal approach and the system approach were the two angles from which the OAM examined the issue of human error. The system method looked at the conditions that allowed the error to happen, whereas the personal approach blamed

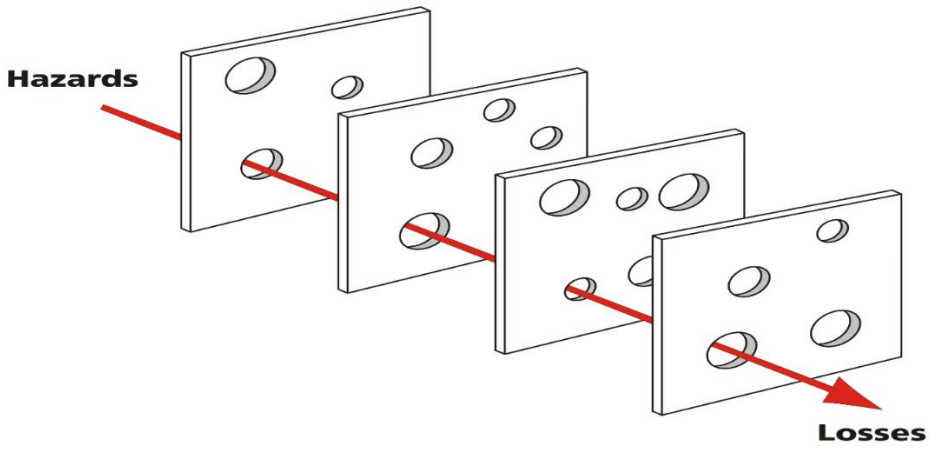
the individual for mistakes. Reason expanded on this significant research on safety failures brought on by human error and incorporated various concepts into the SCM, where he republished the OAM in 1995. This new model presents two pathways (1) human errors and (2) barrier failures (Larourzee & Le Coze, 2020: 3-4).

The SCM has various levels, namely (Smith & Plunkett, 2019:509; Čokorilo, 2020: 7; Mwamba, Masaiti & Simui, 2022: 3; França & Hollnagel, 2023: 738):

- *Organisation influence* - that examines the organisational resource, management, organisational policies, organisational culture and organisational process that rules and administrates the everyday activities within an organisation.
- *Supervision* - in the model relates to insufficient supervision, inappropriate operational plans, failure to accurately identify problems, and supervisory violations in an organisation.
- *Precondition for unsafe performance* **-** in the model relates to environmental factors, condition of operators, and personnel aspects.
- *Unsafe act* – relates to the errors and violations of an employee.
- *Active failures* - refer to unsafe acts.
- *Latent conditions* - refer to hazards and are conditions present in the system before there is a harmful outcome. These conditions become evident when the safety system or defence is violated.

The Swiss Cheese approach: all slices have holes in different places, and when the slices are piled together, all the holes become blocked. Reason addressed this problem to reduce unavoidable human error and to prevent catastrophic accidents (Bialystok, 2021: 1). Reason's SCM (Figure 2.5) of human error defines the relationship between active failures and latent conditions.

Figure 2.5. The Swiss cheese form of Reason's OAM



Source: Adapted from Larouzee and Le Coze (2020: 5)

The next section examines the domino theory.

2.18.2 The Domino Theory

Employees working in the automotive manufacturing industry are subject to a variety of hazards due to their occupation and surroundings. Human error incidents and accidents are a common occurrence in industrial processes that involve the use of high-tech machinery (Attih, Ugbebor & Ugwoha, 2021: 92). The Domino accident causation theory will be applied to the automotive manufacturing industry to gain a better understanding of the contributing variables to the causes of incidents and accidents connected to the workplace as well as the adoption of preventative measures.

Heinrich (1931) created the Domino Theory, which holds that all accidents occur because of a series of events including five elements which are illustrated in Figure 2.7, these include ancestry, the immediate environment, the person themselves, dangerous behaviour or physical hazards, the accident and the harm that resulted from it (Fu, et al., 2020: 63). Heinrich's domino theory encourages the investigation and advancement of the accident cause model, and the theory indicates that injuries can be predicted if a domino piece, or risk factor, is removed from the causal chain based on the domino principle. This can be done because the accident model is easy to comprehend and simple (Fu, et al., 2020: 63; Tanasievici, Caldarescu, Baciu & Matcovschi, 2022: 3). This

criticism alluded to the linear causation theory as outdated and not conducive for accident prevention. It was stemmed from a model that was established in 1930s and forgotten when other factors such as the technical advancements and massive complexities of industries were explored during the same historical timeline. Instead of dissociating the root causes of accidents into five deficient aspects (missing guards, caution, usage, and education or training), the agility of the STAMP or System Theoretic Process Analysis (STPA) should be acknowledged (Leveson and Thomas, 2018.17) and further developed to unearth an even better understanding of how accidents occur as regard to the design, culture, system, and organization associated with human factors in accidents. The true lessons come out of Heinrich's argument somewhat distorted and mistakenly take the investigator or his/her report toward averting shamefully the truthful lampshade.

Though this principle has its limitations and constraints that negatively affect the quality, it still holds some weight in this study for several reasons:

- The theory describes a simple and structured method to identify the root causes of workplace accidents.
- Intervention is obviously stressed in this model; preventing unsafe situations and behaviours can completely abort the accident sequence before an injury occurs.
- The theory fits exactly with the focus of this study, which is human error prevention, especially in behavioral safety and hazard control within the automotive production settings.

Specifically, the theory directly informs the Human Error Incident Prevention Framework (HEIPF) in the following ways:

- Sequential risk identification-he Human Error Incident Prevention Framework (HEIPF) incorporates the Domino principle by identifying multiple types of contributory factors (individual, organizational, environmental) in the sequence building up to an accident.

- Focus on Proactive Intervention - Similarly to removing a domino, HEIPF stresses preventive interventions such as training, supervision, communication enhancement to fix some of the causal links.

- Focus on Unsafe Act Conditions - The Behavioural Safety Management framework and the Hazard elimination strategies come together under the canopy of Heinrich's third domino.

- Shift from Blame to Systemic Prevention - In contrast to the original model, HEIPF expands scientific theory by integrating organizational culture, leadership accountability, and safety climate variables and thus tries to deal with the criticisms of oversimplification.

The Domino Theory, however, has certain limitations when it comes to explaining accidents at the industrial level, which are multi-causal and complex; it, nonetheless, provides a theoretical perspective from which to view the sequence behind workplace incidents. Once teamed with contemporary safety management principles, the related field offers a point by which a holistic, human-error-prevention model can be formed for the automotive manufacturing industry in South Africa.

The concept of dominoes falling on top of one another is used by Heinrich (1950) to explain accidents. As one domino falls, it knocks down the one next to it, and so on, until all the dominoes in the chain are down. Nevertheless, the cycle is broken by taking out just one domino (Hafiz & Adi, 2023: 672). Pursuant to this idea, the key to reducing work accidents is to get rid of unsafe attitudes and working environments (third card). Using the analogy of the domino effect, not all cards will fall if the first and second cards fall, and the third card is gone. The second card and the fourth card are separated by a space or distance. The fourth card will not fall if the second card falls. Ultimately, it is possible to avoid impact losses (card number five) and accidents (card number four) (Sitompul & Simarmata, 2022: 283). Figure 2.7 below illustrates the approach to accident prevention.

Figure 2.6: The approach to accident/prevention- HW Heinrich

Source: Adapted from Iqbal, Alrajawy, Isaac and Ameen, (2021: 6)

2.19 CHAPTER SUMMARY

This chapter started by defining human error incidents and accidents in relation to the manufacturing sector. The prevention of human error incidents and accidents was discussed to identify the causes of human error incidents and accidents. This literature review revealed that most of the human error incidents and accidents are caused by inadequate training, lack of SOPs, lack of safety culture, understaffing, lack of supervision and fatigue.

Existing literature on OHS revealed that the majority workplace challenges and failures lead to human error incidents and accidents. It was noted that most of the employees are exposed to hazard and high-risk environments. Factors influencing compliance with safety regulations were discussed so are the concerns regarding the health and safety legal compliance. These included the improper functioning of the OHSMS. Incident and accident controls and prevention highlighted hierarchy controls that are used to control and prevent human error incidents. Those hierarchy controls are the elimination, substitution, engineering, administration and PPE.

This chapter highlighted five steps to conduct an incident investigation, which includes the incident reporting, involving the correct partners, training, cause identification and follow-up. Risk management indicated the three shortcomings in risk management resulted from human errors identification in the context and technique of the human factor framework – which has three pillars: *ignorance, complacency,* and *overconfidence*. The importance of planning ahead before starting the job was reiterated. Five types of hazards were identified which include: physical hazards, chemical hazards, ergonomic hazards, biological hazards, and psychosocial hazards.

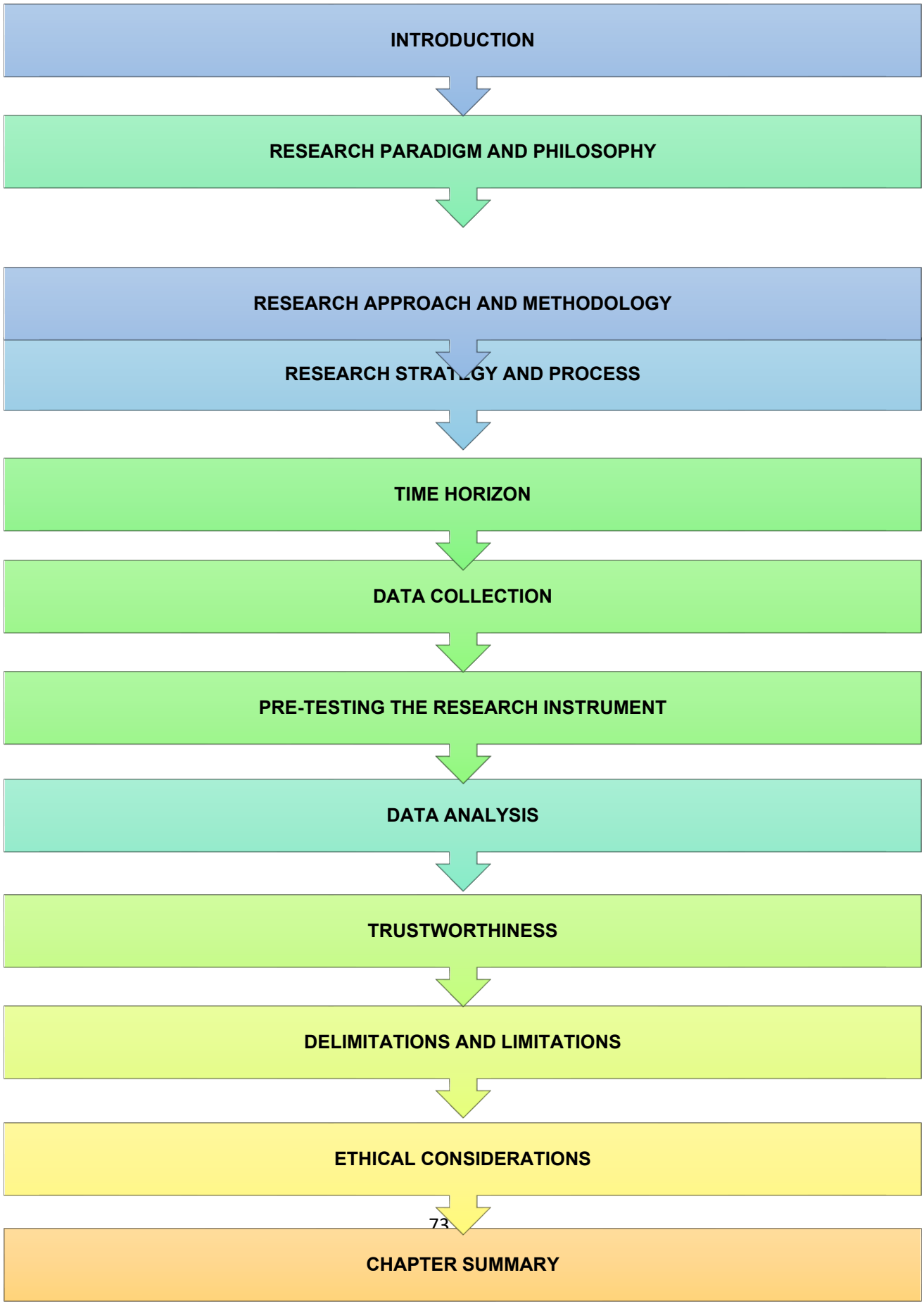
ISO standards (ISO 45001, ISO 9001, and ISO 14001) were also discussed as one of the tools that the automotive industry uses as to manage risks that may lead to human error incidents. It was also shown that the industrial revolution eras (IR 1.0 to IR 5.0)

caused considerable progress in advancing OHS controls and risk mitigation approaches.

Safety management practices clarified that researchers seemed to find the issues of human errors very relevant. The Swiss Cheese Model and the Domino theory were also presented as valuable reference theories to understand variables that cause incidents and accidents and therefore serve as the basis to tailor interventions.

The next chapter presents the research methods and related methodological considerations applied in this study.

CHAPTER 3 - RESEARCH METHODOLOGY



3.1 INTRODUCTION

The research methodology is the plan of how the research will be designed and conducted, the participants involved in the study, and how the data will be gathered. This study was conducted using a qualitative research method. The strategies and approaches that were used when conducting the research and for addressing the research questions are included in the research methodology chapter (Mishra & Alok, 2017: 1).

As presented in Chapter 1 (Section 1.5.1) of this study, the primary objective is to investigate the causation of occupational work-related human error incidents and accidents and the methods that can be used to prevent their re-occurrence in automotive manufacturing organisations in South Africa. The next section examines the research design.

3.2 RESEARCH DESIGN

Research design is a plan adopted by a researcher before data collection commences to achieve the research objective (Asenahabi, 2019: 76). Similarly, the research design is a systematic framework that occurs when a researcher begins research. As such, the researcher selects the specific methodology, strategy, and applications to complete the research systematically (Maqsood, 2021: 2). The purpose of research design is to translate a research problem into data for analysis to provide pertinent answers to research questions at a minimal cost (Asenahabi, 2019: 76).

This study used the phenomenological method as it aimed to understand the meanings and fundamental structure of human experience, and focusing on identifying the common properties instead of examining individual characteristics (Kim & Lee, 2020: 454). Moreover, the phenomenological technique allows for the investigation of a person's consciousness, to comprehend the essence itself, the manner in which life is experienced, and the meanings that surround them, and how these are defined in a person’s mental life (Fuster Guillen, 2019: 220). Qualitative research methodologies have the ability to offer distinct and significant insights into perceptions, experiences, and behaviours (Cuthbertson, Robb, & Blair: 2020: e94). Therefore, this qualitative study

employed the phenomenological research design, which assisted the researcher in discovering new thoughts from an individual's view.

3.3 RESEARCH PARADIGM AND PHILOSOPHY

Research philosophy is a set of beliefs on the collection, analysis, and use of data on phenomena under research (Dileep, 2022: 3). A research philosophy typically offers a theory about the nature of the study, as well as creating and supporting the knowledge of the studies reality (Mauthner, 2020: 76). This study employed an epistemological philosophy, as it is a philosophical theory that examines the nature of knowledge and what it consists of (Moahi, 2022: 245). The study adopted the epistemological concept of interpretivism, which holds that reality is socially constructed and shaped by individuals' experiences and interpretations. This paradigm can capture lived experiences in extensive detail, which makes it pertinent to this research (Pervin & Mokhtar, 2022: 424).

In the South African automotive manufacturing industry, human error incidents and accidents emerge from a complex interaction of organisational frameworks, workplace culture, and operational practices. Subsequently, interpretivism enables the researcher to investigate how managers and employees perceive risks, production requirements, and safety procedures in their daily duties (Emam & Hans, 2025: 179). Human error in the South African automotive manufacturing industry is thus seen not as an isolated technical failure but as a phenomenon shaped by workplace interactions. The interpretivism paradigm guides methodological choices that focus on qualitative data, participant perspectives, and contextual analysis (Lim, 2023: 13). It is therefore appropriate for gaining an in-depth understanding of human error within the South African automotive manufacturing industry. However, interpretivism becomes a challenge when complex variables and context-related elements are present.

The idea that people cannot be investigated in the same way as physical phenomena leads to the notion of viewing humans as distinctly different from physical phenomena and which gives their meanings greater depth (Alharahsheh & Pius, 2020: 41). Researchers gained additional insight by using the interpretivism approach by focusing

on experiences and perceptions in a particular social situation (Alharahsheh & Pius, 2020: 39).

3.4 RESEARCH APPROACH AND METHODOLOGICAL CHOICE

This study used an inductive approach anchored on an extensive literature review. An inductive research approach involves an orderly procedure for examining the qualitative data where analysis is directed through an evaluation objective (Saleem, 2021: 36). When constructing a novel theory about the link between dependent and independent variables of a research issue, the inductive research approach is applicable as it focuses on producing theory from collected data (Ganesha & Aithal, 2022: 66; Williams & Moser, 2019: 47). In the current study, a systemic development of an inductive approach to the problem from the ground up was laid out Rather than haunting full-fledged tests of human error reasons, the study took a formative approach to explorations; data were procured from real-life experiences of participants and some documented incidents. The transcripts of the interviews and the incident reports were streamed over many times to see if they show repeating elements of human error sans pre-determined categories. Basically, from the data, the initial codes originated from participants' own delineation of factors causing errors, thus allowing for concrete things to rise-up freely in the data unencumbered by precluded dispositions about traditional theories.

The codes related to one another were aggregated into much wider categories, solely based on their inherent similarity and inter-relationships within the data set. From such emergent patterns, theoretical frameworks were generated conceptually that would explain the relationships among the identified variables and errors due to human blunder by starting from data that would be grounded rather than by deductively concluding from pre-existing theory. By following this strategy, the study was able to capture those context-specific attributes and earlier unidentified variables.

As indicated in Chapter 1, this study used the qualitative approach. Hameed (2022: 1) explains that the purpose of qualitative research is to learn what people claim to think and feel, it is about a participant’s feelings and impressions. The goal of the research methodology is to clarify the justification for the research strategy that is required to

support the data collection techniques, method analyses, and other essential work components (Oluyori, 2022: 17).

Qualitative research consequences are presented mainly through interviews, record keeping and documental analysis, by questioning people or observing settings, and analysing the data by reviewing interview records and/or field notes (Patten & Newhart, 2018: 22). This qualitative method entailed use of several techniques assisted with translating, describing, decoding, and analysing the data gathered to obtain scientific data related to the cause of human error incidents and accidents.

3.5 RESEARCH STRATEGY AND PROCESS

The research strategy assists in thoroughly reviewing the issue under inquiry (Hanafizadeh, 2022: 74). There are four aims that the research strategy outlines as an overarching plan. These include (1) determining priorities for general research, (2) building research capacity, (3) developing and promoting high standards of research practice, (4) facilitating the translation of evidence into practice (Collins & EGPRN, 2022: 137).

This study made use of semi-structured interviews that were suitable for identifying previously unidentified qualitative trends and problems to discover new research and phenomenological studies (Rahman, 2019: 2). Semi-structured interviews are a method to gathering data that combines predetermined questions that helps both the interviewer and the interviewee stay within the topic area (Islam & Aldaihani, 2022: 6; Ruslin, Mashuri, Rasak, Alhabsyi, & Syam, 2022: 29). The pre-developed interview guide was developed by the researcher and consisted of open-ended questions. The supervisors and research consultant reviewed the interview guide before requesting ethical clearance and commencing with data collection.

This step-by-step description was given to demonstrate how the research was carried out to meet the desired objective.

- **Step 1: Research planning and conceptualisation**

The study began by identifying the problem and created their research objectives and research questions. The theoretical background was established through a comprehensive literature review which specifically targeted existing knowledge gaps.

- **Step 2: Development of data collection instrument**

The duration of interviews with participants implementing the interview guide was between 45 minutes and 60 minutes.

- **Step 3: Ethical clearance and permissions**

Ethical approval was obtained prior to data collection. Participants were informed about voluntary participation, confidentiality, and their right to withdraw. Written informed consent was obtained.

- **Step 4: Sampling and recruitment of participants**

A non-probability sampling method called convenience sampling was used. A purposive sampling strategy was employed to select participants who possessed relevant knowledge and experience related to the research topic.

- **Step 5: Data collection**

Data was collected through semi-structured interviews. The interviews were audio-recorded with participants' consent, and field notes were taken.

- **Step 6: Data transcription and organisation**

Audio recordings were transcribed verbatim, reviewed, and prepared for analysis.

- **Step 7: Data analysis**

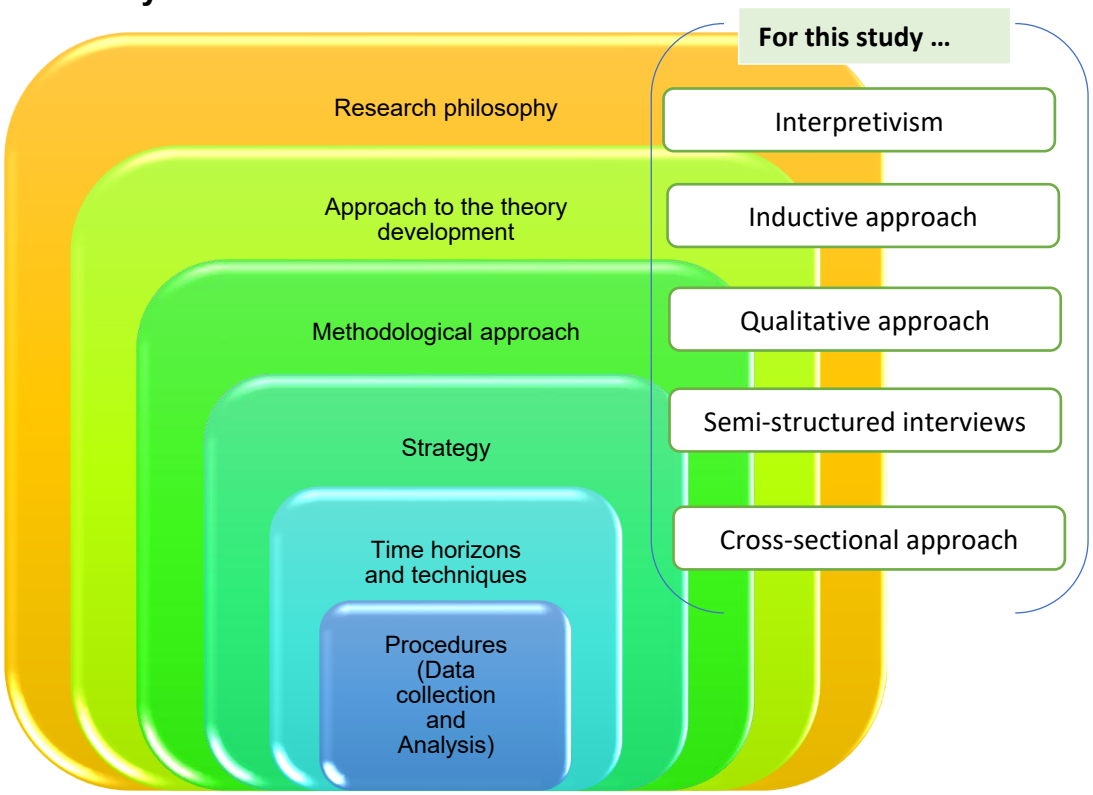
Thematic analysis was done through coding, categorisation, and theme development aligned with the research objectives.

- **Step 8: Interpretation and reporting**

Themes were interpreted in relation to the theoretical framework and existing literature and presented systematically in Chapter 4. This structured approach enhances the rigour, trustworthiness, and transparency of the study.

The research process, as outlined by Saunders, Lewis, and Thornhill (2019:108) in the research onion (Figure 3.1) illustrates the six layers of the research onion that underlie the choice of data collection method or procedures, where the outer two layers, research ideologies and research approaches, are removed.

Figure 3.1. The six layers of the research onion



Source: Adapted from Assadpour, Ghalehnoee and Bahramian (2023: 3)

3.6 TIME HORIZON

The term ‘time horizon’ describes the timeframe that is used to assess and report on the costs and effects of the actions (Husereau, Drummond, Augustovski, De Bekker-Grob, Briggs, Carswell, Caulley, Chaiyakunapruk, Greenberg, Loder, & Mauskopf, 2022: 17). The time horizon can be short term, medium term, and/or long term (Cuhls, 2020: 4). However, time horizons are chosen according to data availability (Haas, Khalighi, De La Fuente, Gerbersdorf, Nowak, & Chen, 2020: 4). This study employed a cross-sectional time horizon, within a specific point in time, as it was more cost-effective and efficient for

data collection (Maier, Thatcher, Grover & Dwivedi, 2023: 6). Cross-sectional time horizon entails gathering data at a single point in time about a specific situation or phenomenon (Lackstrom, Kettle, Haywood, & Dow, 2014: 238). This cross-sectional approach gave an in-depth view of a qualitative approach, and interviews were conducted within a specific period of time in the automotive industry (Nkhoma, Ebenso, Akeju, Adejoh, Bennett, Chirenje, Dandadzi, Nabirye, Namukwaya, Namisango, & Okunade, 2021: 3).

3.7 DATA COLLECTION

The primary data for the study was obtained through semi-structured interviews using open-ended questions. A semi-structured interviews combine a set of questions, allowing the interviewer to delve deeper into specific themes (Denis & Nys, 2018: 6). The benefit of using this technique is that it offers valuable information from the context of participants knowledge and skill and permits innovative concepts to be explored during the interview (Denis & Nys, 2018: 6).

Before data collection, a gatekeeper letter was requested from the automotive organisation within Durban. Participants were interviewed face-to-face in designated areas. The language of communication was English, being one of the official languages and the most spoken language in South Africa. Each participant was given an information brochure explaining the aim of the study and a consent form (Annexure B) to review and sign prior to commencing with data collection. Participation was voluntary, and participants had the right to withdraw from the study at any time prior to data analysis.

The interviews were recorded, and the interviewer requested permission to record the conversation before starting to record. A dictaphone was used to capture the interview for ease of referral and recapping during data analysis. The collected data was stored on the researcher’s laptop, which is password-secured. All documented and handwritten notes were kept in a lockable cupboard in the researcher’s office.

Secondary data refers to information gathered from pertinent organisations that assist with the research (Sinta, Zuriani & Ilham, 2022: 536). However, secondary data is information that has been properly processed by primary data collectors or other parties (Nasution, 2022: 3). Analysis of secondary data is not without disadvantages. One of the many significant aspects of a study that a researcher gives up control over when applying secondary data analysis to data collected by someone else is the specific research questions that can be addressed (Weston, Ritchier, Rohrer & Przybylski, 2019: 217). Researchers engaged in secondary data analysis frequently examine data from the same dataset several times throughout their careers. Preconceived notions about the results, however, raise the possibility of bias because they may lead researchers to pursue particular questions or analyses. The worst-case scenario for a researcher would be to carry out several preliminary analyses and only pursue data that produce significant findings (Baldwin, Pingault, Schoeler, Sallis, & Munafò, 2022: 3).

This study used secondary to properly understand the research topic and collect relevant data. The secondary data was gathered from reliable sources, including books, scholarly articles, and peer-reviewed journals (Sharma, Chakravarthi, Shaikh, Ahmed, Jaiswal, & Naved, 2023: 3807; El Khatib, Hamidi, Al Ameeri, Al Zaabi, & Al Marqab, 2022: 569).

3.7.1 Pre-testing the research instrument

The pre-testing was used to test the pre-developed interview guide with the supervisor and data analyst to identify and remove any uncertain and superfluous questions. Pre-testing is a practice conducted in a research study on a small representative sample, meaning it is a small-scale study carried out prior to embarking on the actual research. Arowojolu (2021: 2) states that a pre-testing study can be referred to as the possibility of a study, pre-testing, or trying out a specific research tool. Pre-testing is significant for the development of excellence and proficiency of the research instrument to be used in the main study (Korea, 2017: 601). Any research needs a pre-test study as it is an important part of a successful study design.

A pre-test study was conducted on five employees who were not interviewed during the actual data collection. This was used to test the pre-developed interview guide with the

supervisor and the data analyst to identify and eliminate any uncertain or unnecessary questions. The purpose of the pre-test was to determine the correctness and effectiveness of the interview guide prior to conducting the data collection. There were no changes made during the pre-test because the results were positive, as all participants correctly answered all questions

3.7.2 Data preparation

The process of converting data from its original format into a representation that is more suited for analysis is known as data preparation (Konstantinou & Paton, 2020: 1). The primary goal of data preparation is to gather information from many sources and transform them into useful input (Firas, 2023: 13). Data preparation is convenient for validation (Hidayat, Mahardiko & Rosyad, 2023: 26).

For analysis purposes, the data must be restructured and formatted as part of the data preparation process (Clancy, Sulliva & Bruton, 2023: 59). The data preparation process contains three steps:

- *Data cleaning*: This is a vital activity for producing high-quality data analytics (Hosseinzadeh, Azhir, Ahmed, Ghafour, Ahmed, Rahmani, & Vo, 2023: 3). Cleaning approach was employed to eliminate the redundant data and remove all unnecessary and repeated information during the process of data cleansing (Maharana, Mondal & Nemade, 2022: 98). Data cleansing assisted the researcher to rectify mistakes in words or text (Murshed, Mallappa, Ghaleb & Al-ariki, 2021: 100).

- *Database sampling*: The researcher ensured that data base sampling is determined by understanding a foundation for sampling strategy. The researcher clarified the sampling strategy and sample linked to the methodology, research questions, analysis, and outcomes. The sampling strategy was grounded in deliberate, considered and purposive choice. Lastly, keeping in mind that sampling in qualitative research is adaptable, reactive, and iterative (Staller, 2021: 7; Tsui, Chen, Jiang, Yang, & Kan, 2023: 6). The researcher concentrated on selecting a

specific group of people who have experienced and who knowledgeable about the human error incidents within the automotive organisation (Klem, Bunzli, Smith & Shields, 2022: 8).

- *Database reduction and transformation*: Database reduction and transformation involve condensing and converting large, raw datasets into a more manageable and analysable form while preserving the integrity and meaning of the data (Tsui, et al., 2023: 6). Reduction is the process of minimising the volume of data by removing irrelevant or redundant information that does not contribute to answering the research questions, while transformation involves converting data into standardised formats to allow for easier interpretation and comparison (Borrohou, Fissoune & Badir, 2024: 108).

The researcher systematically reduced the qualitative data by identifying and extracting only the most pertinent responses linked to the study's objectives and research questions. This was achieved by grouping similar responses, summarising lengthy narratives, and eliminating repetition. Through transformation, textual responses were categorised and coded, facilitating thematic analysis and allowing the researcher to draw meaningful patterns and trends from the data (Özden, 2024: 72). Data transformation also ensured that all entries conformed to a consistent structure for easier use in Atlas.ti, Version 24 aiding in accurate code assignment and content generation. This stage was essential in converting raw input into a logical structure that allowed the researcher to conduct meaningful analysis while maintaining the richness and contextual relevance of the participants' narratives.

3.7.3. Population and sample size

A population is a set of units to which the research findings are applied (Shukla, 2020: 2). The study population consisted of employees from an automotive manufacturing facility located in Durban, KwaZulu-Natal. The paint shop plant employed 465 total employees who operated within the facility. The research used a qualitative case study method to study a single organizational environment. The research aims to develop

detailed understanding of the plant operations while it does not aim to create statistical results that represent the entire South African automotive manufacturing industry.

Sampling is the process of selecting or researching the situation and surroundings and participants are chosen who can bring rich data to the study on the phenomenon of interest (Moser & Korstiens, 2018: 10). Sample size is a portion of the larger population that will be interviewed and provide data (Islam & Aldaihani, 2022: 4). Twenty participants were selected to participate in this study, a non-probability sampling technique called convenience sampling was applied, as it was affordable, effective, and easy to use (Jager, Putnick & Bornstein, 2017: 3).

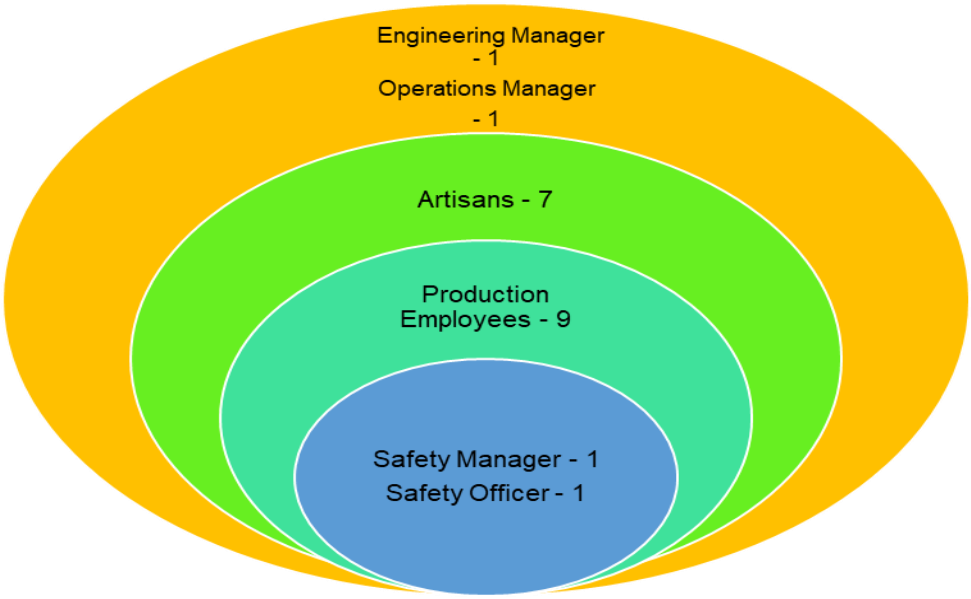
In a non-probability convenience sampling method, a sample of 20 participants within an automotive manufacturing industry in South Africa was selected at the convenience of the researcher and participants, making this method more accessible for data collection (Nanjundeswaraswamy, 2021: 26). A convenience sampling method is inexpensive (Singh, Vadakedath & Kandi, 2023: 9).

A non-probability purposive sampling method was used to choose participants who had essential knowledge about human error incidents and workplace accidents. The following inclusion criteria for selecting participants was developed:

- Minimum of two years' work experience within the organisation.
- Direct exposure to operational processes where human error incidents may occur.
- Participants who met the required age of 18 years or older.

Participants were selected from various plant positions which included machine operators, supervisors, maintenance personnel and safety representatives to achieve perspective diversity. Twenty employees were initially approached. The data saturation was used after conducting thirteen interviews because they found no new themes. The final sample therefore consisted of thirteen participants. The Figure 3.2 below indicates the research's selected sample.

Figure 3.2: Selected study sample



Source: Researcher's own compilation

3.7.4 Thematic data analysis

Data analysis is a process of analysis to simplifying words, so they are easier to read and understand (Heriyanto, Mulyanto & Darusman, 2022: 32). Thematic analysis involves various analytical techniques, each with separate goals, philosophies, and methodologies (Ayre & McCaffery, 2022: 77). Thematic analysis is a very unpretentious way to find patterns in qualitative data and come up with themes that give a description of them (Lochmiller, 2021: 2043). Therefore, to categorise patterns and create themes, thematic analysis assists researchers in investigative a wide range of data sets (Jnanathapaswi, 2021: 2). This includes recognising themes, ideas, and patterns in the pertinent information and goals of the study (Balieiro, 2024: 28). There are six steps in thematic data analysis that is explained in detail in Chapter 4 Section 4.11.1. The following steps were used to perform the thematic analysis (Islam & Aldaihani, 2022: 7):

- Step 1: Familiarisation of data
- Step 2: Generation of initial coding

- Step 3: Search for themes based on initial coding
- Step 4: Review of themes
- Step 5: Theme definition and labelling
- Step 6: Report writing

The researcher employed Atlas.ti, Version 24 to help locate quotes that are relevant to a particular code when composing the scope review (Smit & Scherman, 2021: 3). This tool assists in creating simpler codes, organising, and classifying new designs in-depth interviews. The Atlas.ti, Version 24 software allows researchers to store all relevant information digitally in one place, providing greater data management security and eliminating manual tasks.

The researcher separated the themes and codes to analyse the collected data with the support of a data analyst. The Atlas.ti, Version 24 software application assisted the researcher in finding differences or relationships between the variables and frequencies. Those fundamental capabilities of Atlas.ti, Version 24 provided the researcher with more features, which included word clouds, model construction, data retrieval and phrase-based automated coding possible (Yıldız & Tam, 2023: 52).

The primary codes were established by first submitting the data to open coding, followed by axial coding, which was then employed to govern the connections amongst the codes. Lastly, to combine and expand the comprehensive categories, selective coding was employed (Aeini, Moosavand, Heidari & Sabbar, 2023: 1273).

3.7.5 Data saturation

Data saturation is defined as ‘information redundancy or the point at which no new themes or codes "emerge" from the data (Braun & Clarke, 2021: 1; Renjith, Yesodharan, Noronha, Ladd, & George, 2021: 1). However, determining the point of correction researcher's saturation requires informed interpretive judgement as researchers are limited by the data obtained during the study (Tran, Porcher, Tran & Ravaud, 2017: 1). Saturation is a crucial concept that qualitative research theorists use to confirm the

validity and rigour of a study (Daher, 2023: 1). However, Aguboshim (2021: 180) argue that the connection between sample size and data saturation is practically weak as there is always new data to be discovered Lim (2025: 1) agree that data saturation is a major factor in deciding whether the sample size in a qualitative case study is sufficient. Therefore, it is crucial for qualitative researchers to consider all the variables that affect data adequacy in qualitative studies because reaching data saturation saves time, money, and resources (Mwita, 2022: 418).

For this study, once the researcher receives the same information from the interviewee, it will mean that data saturation has been reached, and interview can be concluded. Saturation was confirmed through these indicators:

- Thematic elements which had been discovered before were restated by participants.
- Thematic categories showed no changes.
- The participants provided duplicate accounts about how their organisations operated.

This study reached data saturation after interviewing thirteen participants. The next section examines the population and sample size.

3.8 DATA ANALYSIS

Data analysis in a qualitative study is about simplifying words, so they are easier to read and understand. It is the process of analysis (Heriyanto et al., 2022: 32). Coding, categorising, and theme development are the fundamental stages of data analysis in most qualitative methods, regardless of variations in data analysis between methods (Ravindran, 2019: 45). In addition, data analysis should be readable and thoroughly documented at the code level. Parameters, code, and software stack components must be able to be tracked through all relevant steps at the result level (Mölder, Jablonski, Letcher, Hall, Tomkins-Tinch, Sochat, Forster, Lee, Twardziok, Kanitz, & Wilm, 2021: 3).

Data analysis takes a lot of time because the researcher needs to analyse with the texts closely to uncover hidden meanings (Ravindran, 2019: 45). Moreover, data analysis

descriptions should be detailed enough so that someone applying the same analysis to the same set of raw data will produce identical results (Michel, Murphy & Motulsky, 2020: 139).

The qualitative study applied data analysis methods to process data through systematic procedures which included organisation and coding and the interpretation of participant views to develop insights about human error incidents that occurred in an automotive manufacturing industry. The researcher conducted the first analysis phase by using Atlas.ti. Version 24 to organise and code all transcribed interview data. Open coding was first conducted to identify significant statements, patterns, and recurring ideas across the transcripts. The researcher used axial coding to create broader categories that contained the initial codes which allowed them to study how different codes connected with one another. The researcher used selective coding to develop research themes which matched the study's objectives by connecting different research categories into unified thematic structures.

The study used coding to discover data patterns, but the research needed to follow its interpretivist structure because data analysis should extend beyond basic pattern recognition. The researcher built meaning through thorough research with participants who shared their personal experiences and professional work environment and during the study development stage which involved testing existing theories. The researcher used interpretation to assess three different elements of data which included participant interpretation of human error, their underlying safety assumptions, and their organisational practices, and their extreme safety organisational practices.

The study used analysis to discover recurring patterns and developed interpretation to explain those patterns across both the organisation and its theoretical frameworks. The study used reflexive analysis throughout the research process as the researcher checked transcripts and matched new themes with research consultant assessments to verify analytical work. The researcher used iterative data assessment to prove that recurring themes of the data showed real thematic significance within the study's conceptual framework.

3.8.1 Trustworthiness and dependability of data

Trustworthiness is a fundamental component of qualitative research. It is strengthened by four specific aspects namely: credibility, transferability, dependability, and conformability. The term "trustworthy" refers to the research design's systematic objectivity, the researcher's reputation, the plausibility of the research findings, and the practicality of the research techniques. (Nguyen, Ahn, Belgrave, Lee, Cawelti, Kim, & Villavicencio 2021: 47). This allows the reader to assume that the outcome of the research can be generalised or can be the same as their format (Rose & Johnson, 2020: 3).

The study applied four criteria of trustworthiness from qualitative research because this method ensures methodological correctness. The research process used methods to evaluate the criteria instead of using conceptual evaluation methods. Credibility can be defined as a sense of trust in a person, source, or message and it measures whether an audience perceives something as worthy believing (Abrar, Khan, Khan, Ali, & Shah, 2023: 1). Credibility can be established by demonstrating the researcher’s experimental presentation and meaning of the phenomenon so that the findings are credible to the audience (Dyar, 2022:198). To establish credibility for this study, the researcher utilised techniques like member checks of one's interpretations with participants, triangulation among multiple researchers and data sources, and ongoing comparisons of emerging patterns and data. The researcher achieved credibility through the extended data analysis which involved multiple coding iterations. In this study, each interview recorded in complete text and performed multiple rounds of analysis to verify that the researcher correctly captured what participants said.
In addition, the researcher used member checking during interviews by summarising participant answers back to the participants for verification which helped verify the understanding. The researcher shared the developing codes and themes with the research consultant to confirm the findings while minimising personal bias.

Dependability refers to the trustworthiness and consistency of a system (Gonzalez, Nencioni, Kamisiriski, Helvik, & Heegaard, 2018: 3). In this study, dependability is elaborated on the research methods used in qualitative research, applying open-ended

questions to better understand the research (Caayaman, 2023: 688). The dependability of research work depends on the ability to always produce trustworthy results. The researcher created an audit trail which documented all research activities through documentation of interview schedules, transcription procedures, coding framework creation and theme development decisions. The research team used Atlas.ti Version 24 software to create a structured data system which tracked all coding processes while enabling coding review. The researcher assessed the coding structure components with the research consultant to maintain uniformity in analytical procedures. The researcher established research procedures which could be followed throughout the study while documenting all steps.

Transferability is an abstraction process that applies data from specific contexts, settings, and eras to others that have not been directly studied (Drisko, 2025: 102). Transferability refers to providing sufficient descriptive detail for readers to determine how the findings might apply to other situations or groups. This entails a detailed portrayal of the research context, the characteristics of the participants, and the interactions that occurred during the study (Lim, 2025: 223). Transferability signifies that the study scenario has been described in adequate detail for a reader to determine whether the findings are applicable to their population (Phillips, Tichavakunda & Sedaghat, 2024: 31). The research study presented thick description throughout the dissertation even though it does not establish statistical generalisability. The research included a detailed description of the organisational setting through a clear explanation of participant roles and inclusion criteria and contextual explanation of operational processes within the paint shop plant. The detailed contextual information enables readers to assess whether the research findings apply to different automotive manufacturing organisations or hazardous industrial environments.

Confirmity refers to the process of altering one's behaviour to accommodate other people's reactions (Salomons, der Linden, Sebo & Scassellati, 2018: 187). The researcher used private conformity in this study, which is the act of aligning behaviour with the group because one believes one's own group to be correct. In this private conformity, the members adhere to the group's beliefs about appropriate behaviour in

addition to adopting the group's way of thinking (Rini, Matulessy & Sofiah, 2018: 29). The researcher achieved confirmability through reflexive practice which required to reflect on the researchers' own biases while constructing the findings on direct quotes from study participants. The audit trail was maintained which included coded transcripts and analytic memos and theme development documentation. Chapter four includes direct quotes from participants which show that themes developed from participants' stories and not from researcher conclusions. The study used these methods to establish that its findings arose from data analysis which the researcher explained through clear data presentation.

3.9 DELIMITATIONS AND LIMITATIONS

Delimitations refer to the purposeful limitations that researchers place on their research plan, with an awareness of what those limitations may mean for the outcomes they report (Alexander, 2020: 130). Study objectives, research questions, study sample, variables under investigation, and theoretical background are the primary areas of concern for delimitations (Theofanidis & Fountouki, 2018: 157). Delimitations could signify an intentional systematic bias that the researcher placed into the research design or research instrument (Ross & Zaidi, 2019: 262). Delimitations are not the reason "I acted in this way", rather they are the reason "I did not act in this way" (Theofandis & Fountouki, 2019: 157).

The following delimitations were noted for this study.

- The study was confined to a single automotive manufacturing plant located in Durban, KwaZulu-Natal.
- Only employees working within the paint shop division were included.
- Participants were required to have a minimum of two years' experience within the organisation to ensure adequate exposure to operational processes.
- The study interviewed employees who were over the age of 18 years and under the age of 60 years.

These delimitations were necessary to enable an in-depth qualitative exploration within a manageable and context-specific setting. The study was therefore designed as a single-site qualitative case study rather than a national survey of the South African automotive industry.

Limitations refer to the highlighting of the research shortcomings that could impact the findings and the conclusion of the study (Ross & Zaidi, 2019: 261). The limitation is generally found and determined throughout the study (Akanle, Shittu & Ademuson, 2020: 106). The available literature on the subject is mostly designed for mechanical applications and is found to be insufficient to explain the accident causalities in automotive organisation (Reyes, et al., 2015: 6499). The study has multiple limitations which it acknowledges. The research examined one plant which operated in one province. The findings of the study do not need to demonstrate statistical representativeness because they focus on a specific South African automotive manufacturing organisation. The study delivers specific information about human error incidents which occur in a specific work environment. The qualitative design of the study focused on achieving deep understanding of the subject matter. The research gathered detailed participant accounts which provided rich information, but these results do not support statistical generalisation. The organisation needed a longitudinal design to understand how safety culture and operational practices change over time. The study included participants from various positions, but the research focused on one manufacturing environment. The study used qualitative research methods to analyse specific cases which will help organisations in high-risk industrial environments that have similar operational conditions to those in the study.

The primary limitations of this study are:

- The lack of previous studies that are conducted in the South African automotive industry based on human error incidents and accidents.
- The qualitative methodology employed provided rich, detailed insights but limits the ability to generalise statistically across larger populations.

- The study's cross-sectional design captures a snapshot in time and therefore does not provide longitudinal data on evolving safety patterns or the sustainability of interventions.
- The study focused on the automotive sector as such; its conclusions may require adaptation when applied to other high-risk industries.
- The study's geographic focus on South African automotive manufacturing limits the generalisability of findings to other regions that may have different regulatory frameworks, cultural influences, or economic conditions.

3.10 ETHICAL CONSIDERATIONS

Ethics is seen as being true to the moral regulations or rational principles of behaviour - as such, it refers to any rational procedure that regulates what the individual ought to do was done correctly (Sidgwick, 2017: 1). The study followed Unisa's research ethics policy and ethical values and principles of respect, integrity, accountability, and transparency. Ethical approval was obtained on 12 November 2024 from the University of South Africa's (UNISA) Research Ethics Committee - Ethics reference number: 2324 (Annexure C).

Participants were informed about the consideration of the Protection of Personal Information Act (POPIA) No. 4 of 2013 and University of South Africa's (UNISA's) code of ethics and conduct (Lockhat, 2021: 69). The right of privacy is constitutionally protected in South Africa by virtue of the South African Constitution, Bill of Rights, Section 14 (Staunton, Adams, Anderson, Croxton, Kamuya, Munene, & Swanepoel, 2020: 1). To ensure the right of privacy in this study, participants name, addresses, and the organisation's name remained confidential (Czarnota-Bojarska, 2021: 56). Anonymity became a core principle of research ethics, protecting participants' confidentiality and preventing harm (Edwards, 2020: 1).

The collected information was protected by utilising a personal laptop with a secure password that only the researcher knows. When it comes to confidentiality the researcher upheld the identity of participants when communicating with them by not mentioning their names and ensuring that they were willing to participate in the study

and that their identities were safeguarded by participating anonymously while at the same time keeping their dignity. Voluntary participation was confirmed with all participants, and no one was forced to participate. If a participant wanted to withdraw, they were able to do so prior to data analysis.

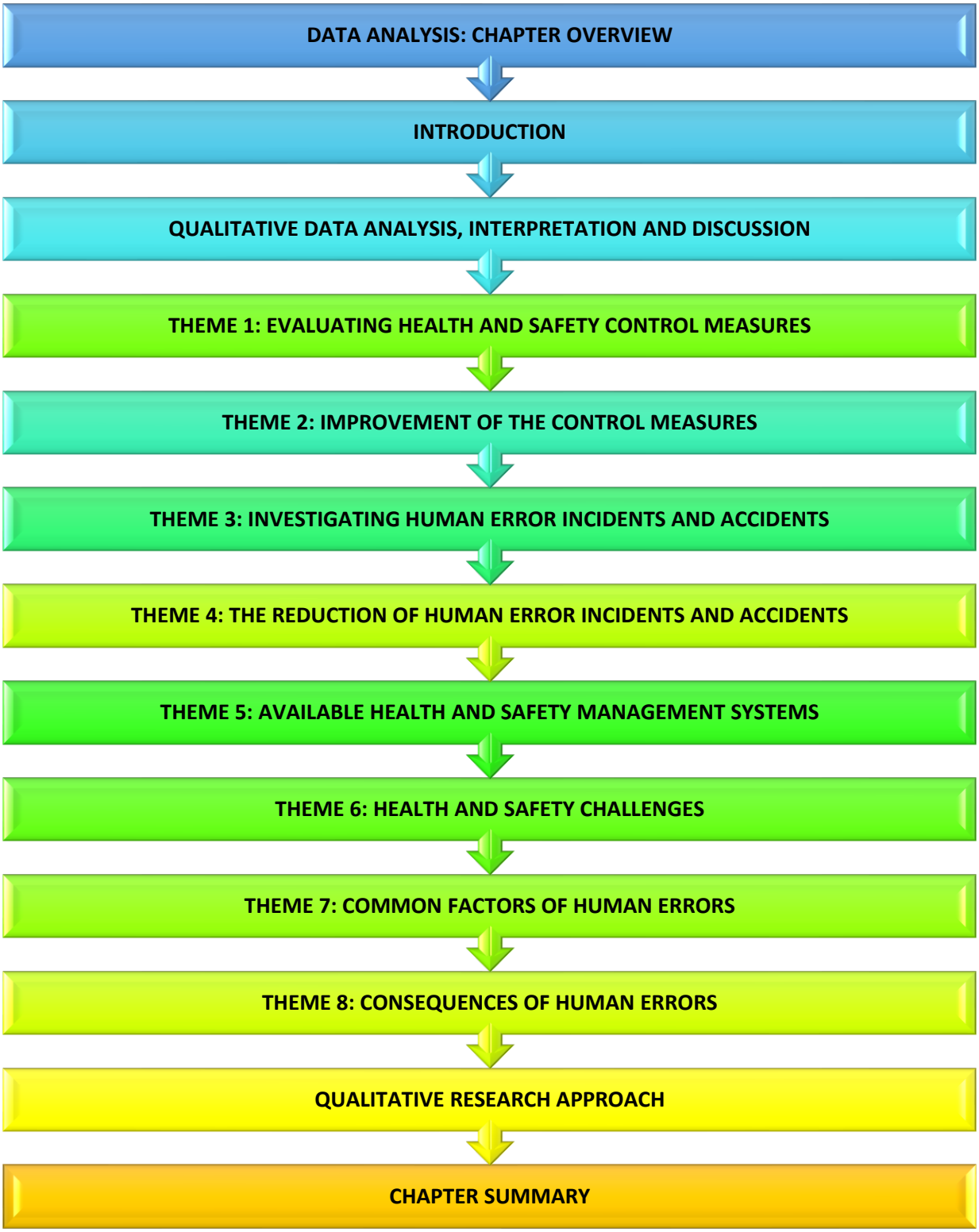
3.11 CHAPTER SUMMARY

This chapter discussed the research design and related methodological considerations. It provides a detailed account of how the research was planned and how the qualitative research method was applied in this study. This includes details and considerations taken on the research philosophy, research design, research approach, research strategy and procedures for data collection and analysis guided by Saunders research onion (Saunders, Lewis, & Thornhill 2019:129-130).

This qualitative study was anchored on the interpretivism philosophy and used the inductive approach to get insights from purposively selected participants who participated in the study via semi-structured interviews.

This chapter also discusses issues and the strategies taken to address the challenges of integrity, quality and trustworthiness of the research. The delimitation and limitations of the study are also presented. Lastly, the ethical considerations are discussed, and the ethics clearance issued by the UNISA's Research Ethics Committee was declared.
The next chapter examines the data collected and interprets and discuss the findings.

CHAPTER 4: DATA ANALYSIS



4.1 INTRODUCTION

This research investigates challenges faced by the South African occupational-related automotive industry regarding the prevention of occupational-related incidents that are caused by human errors. This chapter analyses the data that was collected from the participants. The key research questions raised in the first chapter guided the analysis and presentation of data. The thirteen (13) participants showed interesting knowledge about the topic. The researcher conducted face-to-face semi-structured interviews. The analysis is guided by the key research questions outlined in Chapter One and structured using a thematic analysis approach. The data were systematically coded and organised into eight main themes, each presented in a separate section of the chapter.

Each theme presents participant responses that are analysed, interpreted, and supported by the participants' direct quotations. The findings are then critically discussed in relation to the existing literature reviewed in Chapter Two, highlighting areas of agreement, disagreement, and new insights specific to the South African automotive manufacturing industry. The first theme investigates health and safety control measures, emphasising current strategies for preventing human error and the criteria for selecting suitable control mechanisms. The second theme examines the enhancement of existing control measures, specifically employee recruitment practices and compliance with applicable employment regulations.

The third theme examines the investigation of human error incidents and accidents. This included the fairness/unfairness of prompt incident investigation and the importance of truthful responses during incident investigation. The fourth theme considers strategies aiming to reduce human error incidents and accidents, particularly through the implementation and enforcement of Safe Operating Procedures (SOPs) and Safe Working Procedures (SWPs). The fifth theme examines the available health and safety management systems. This sub-section was subdivided into two categories: (a) the organisational culture and (b) the evaluation of health and safety management systems. The sixth theme examined the Health and Safety Challenges, which included two categories, namely the evaluation of health and safety management systems and long working hours. The seventh theme examined common factors of human error, namely,

the root causes of human errors and the working environment and conditions. The last theme examined the consequences of the identified human errors, which are the impact on productivity and psychosocial factors. Throughout the chapter, findings are interpreted within the context of relevant occupational health and safety theories and prior studies. This approach ensures the analysis goes beyond merely describing participant responses, placing them within broader scholarly debates on human error prevention and safety management systems. The chapter concludes with a summary of key findings in relation to the research questions. The next section examines data analysis, interpretations, and discussions.

4.2 QUALITATIVE DATA ANALYSIS, INTERPRETATION AND DISCUSSION

This section outlines the data analysis of interviews and focusing on presenting and illuminating the viewpoints of the study participants. These responses are congruent with the primary and secondary research objectives outlined in Section 1.5. It is thus important to recall the central objective of this study. That was to investigate the causation of occupational work-related human error incidents and accidents and the methods that are used to prevent the re-occurrence of these human-error incidents/accidents in South African automotive industry.

This study mainly sought to assess what control measures are in place to prevent incidents and accidents resulting from human error. The secondary objectives explored the current implemented controls, the effectiveness of preventive measures to minimise incidents and accidents in the future, and to set a platform for sustainable incident accident-free health and safety management practices. The final objective sought to develop a framework for the prevention of future occupation-related human error incidents and accidents within the automotive industry. The next section examines the identified themes from the data analysis, starting with the first theme: evaluation of the health and safety control measures.

4.3 THEME 1: EVALUATING HEALTH AND SAFETY CONTROL MEASURES

The first secondary objective of this study was to examine the types and effectiveness of control measures used in the automotive manufacturing industry to prevent incidents

and accidents resulting from human error. This theme emerged from participants' responses to question nine (9) of the interview guide (Annexure A), which asked them to describe the control measures employed at their respective workplaces. All thirteen participants described a range of controls, including engineering solutions, personal protective equipment (PPE), training, policy implementation, supervision, and routine inspections. While these controls align with recognised industry standards such as ISO 45001, the responses reveal a wide variation in how consistently and comprehensively they are implemented across departments and shifts.

Participant one stated that: ''*We have key performance indicators such as step-by-step work procedures, machinery safety operating procedures, toolbox talks and safety posters*.''

Participant two mentioned that: "*… the provision of training and fatigue management, as employees cannot think accurately when they are tired".*

Participant three elaborated that: "… *implementation of SOPs, availability of risk assessment, in-house training, induction, inspections to identify hazards, formulation of health and safety committees, and appointment of legal appointments, for example, 16.2 for manager, 17.1 for health and safety representative".*

Participant four mentioned that: *"It is a risk assessment, regular inspection, ongoing training, correct PPE, and physical assessment of the moving equipment."*

Participant five stated that: "control *measures that we have in place are engineering controls whereby the machines have guards, the machines have warning alarms, the machines have troubleshooting options, the machines have light curtains. That prevents accidental touching. The other controls that we have are the checklist, registers, which help to check equipment prior to the use of machines. Training is also a control measure that we have, so that before we give or before an employee goes into a process, they are trained enough. and then continuous things like your risk assessments, your machine checklist, and having an occupational health and safety system in the*

workplace that makes sure that you audit that, make sure that the machines and equipment are serviced and properly maintained. Annual checks and collaboration are done on the machine, so those are the things that we have as control measures."

Participant six stated: *''In our company, we select control measures according to a Hierarchy of controls that emphasise engineering solutions firstly, it is engineering control measures, then followed by safety work practices and administrative control and finally PPE of employees."*

Participant seven stated that: "*We have a training programme, we have risk assessment to manage risk, risk management whereby you will have a risk assessment categorised in terms of baseline issue based and whatever risk assessment that are required and then we have the checklist or analogue sheets for pre-task, prior the equipment use. We also have a communication procedure which is clear. Regular audits and inspection to make sure what's whatever that is put in place is it followed accordingly, and then we have an occurrence reporting system in place in our organisation*."

Participant eight mentioned that: *''Procedures as they specify the way of carrying out activities. It is the employee's duty to ensure that they follow them and ask when they are not sure. Should an employee cause an incident due to not following these procedures, the employer has a right to take disciplinary measures. This is done to protect employees themselves as well as the employer's equipment. Safety talks in the industry also make a huge impact as they remind the employees to exercise safety daily to prevent incidents and accidents*.''

Participant nine: ''Regular renewing and updating of policies and procedures, ongoing training for employees, regular servicing of equipment and machinery, regular inspections of machinery, implementation and control measures, supervision of employees, and after employee health and safety program for employees.''

Participant ten said that: *''The control measures are chosen by management and supervisors and not employees. They sit down together as a unit to identify which control*

measures are applicable for specific tasks. The decision is made by management. Supervisors and employees must be able to identify the correct control measures. They should be able to choose just like the way risk assessment safety procedures are conducted.''

Participant eleven stated that: *''Competencies, always make sure that the person who conducts the task is fully trained and tested on the task. Then you won't have an issue of human error in that regard. If you have like robust pre-task assessments, not just for the conditions in the area but for the teams. When you get a person coming into your work area, they have a one-on-one with the supervisors. They can tell when someone is not well, or they are suffering with some emotional disturbance. If there is that screening at work, then you won't [will not] have a person that is there. Other human errors can come about by substance abuse. The use of illegal substances so the breathalyser at the gates, quick drug testing before a person operates or comes in into the critical process to ensure that everyone has been checked. The removal of destruction in the working area like cell phones, it helps to reduce human error-based incidents."*

Participant twelve mentioned that: ''*Conduct site audits, give employees proper training from time to time also give refresher courses to employees so that they're always informed. Enforced health and safety policies, conduct risk assessments, provide proper time off you. When employees are fatigued, they can cause human error human errors which will result in incidents, so it is very important or critical to ensure that employees get proper time off to rest."*

Participant thirteen mentioned that*: ''All competent individuals or employees are legally appointed according to their competencies or skills. For example, 16.1 for CEO, 16.2 for Manager, 8.2(i) for Supervisor, 17.1 for Share Rep. There is also risk assessment in place, internal and external trainings and inspections."*

To minimise or eliminate exposure to risks, control measures may embrace administrative controls, engineering controls, and PPE (Adekanmbi, Ninduwezuor-

Ehiobu, Izuka, Abatan, Ani, & Obaigbena, 2024: 1140). Long-term evaluation has revealed consistent improvements and a reduction in risks. The most effective approach involves mixing various types of interventions, including engineering controls, administrative measures, PPE, and behavioural approaches, which collectively enhance health, safety, and environmental outcomes (Benson, et al., 2024: 1). Near miss incidents and accidents within the automotive industry show possible safety risks, and efficiently handling these situations is considered crucial for prevention of workplace accidents. However, the effect of organisation's approach to near misses on the regularity of future accidents is still not well understood (Inagaki, Nagata, Odagami, Adi, & Mori, 2024: 1).

As can be noted from the responses, participants are aware of risk assessments being conducted, the use of PPE, training and policies as control measures. This diversity of responses illustrates a critical insight: while control measures are formally in place, their impact is often limited by weak enforcement, infrequent updates, or poor alignment with real-time risk assessments. This concern is echoed in extant literature on this area of study, which suggests that knowledge of risks does not necessarily translate to safe behaviour, especially in high-risk environments like automotive manufacturing (Zakaria, Che Hassan, Hamid & Sukadarin 2024: 1). Moreover, despite the presence of regulatory standards and safe working procedures, employees often revert to shortcuts or unsafe workarounds due to pressure to meet production targets or equipment inefficiencies. Abdulla (2024: 1) stresses that, although PPE and policy are essential, organisations must also address safety culture and behavioural reinforcement to ensure sustainable compliance.

This theme directly relates to the Control System Layer of the Human Error Incidents Prevention Framework developed in this study. According to Reason's Swiss Cheese Model, control measures must be layered and actively monitored, with each layer representing a defence against error propagation (Reason, 1997). When these controls are weak, outdated, or not properly enforced, as highlighted by multiple participants, they fail to prevent incidents, despite being formally present.

In conclusion, the evaluation of control measures reveals that although most employees are aware of their existence and intended purpose, implementation quality and operational consistency remain significant challenges. The study thus highlights the need for not only strengthening control systems but also embedding them within a resilient safety culture, supported by training, supervision, and leadership engagement.

Even though governmental regulations and the adherence to safe working procedures, employees continue to engage in risky behaviour while accomplishing their tasks (Zakaria, et al., 2024: 1). The automotive sector presents an inherent high-risk environment, making the utilisation of PPE crucial for ensuring the safety of employees (Abdulla, 2024: 1). Even though employees possess substantial knowledge about hazards, they express concern for occupational health and essential safety measures to reduce workplace injuries, which confirms previous findings from similar studies (Quaigrain, Owusu-Manu, Edwards, Hammond, Hammond, & Martek, 2024: 809). During the analysis this theme formulated two categories which is human error prevention measures and the selection of the control measures.

4.3.1 Category one: Human Error Prevention Measures

Human error prevention measures are crucial to ensuring workplace safety, especially in high-risk industries, such as the automotive sector. Question three, as outlined in Annexure A, enquires about the importance of preventing human error incidents/accidents in the workplace. Participants identified various strategies that organisations have adopted to prevent human error and thereby enhance safety results.

Participant one mentioned that: ‘’*By preventing human errors, the organisation will be able to improve the quality of its products and processes and maintain its reputation. This can also keep employees safe and free from workplace hazards*.”

Participant two shared that: *‘’It is important because we don't want to have unnecessary downtime whereby machines fail or make mistakes. This affects the production time and results in human errors.”* The results of this research validate existing studies on occupational safety, which show that organisations must implement human error

prevention programs to establish stronger safety systems that protect their employees. The research by Dyreborg, Lipscomb, Nielsen, Törner, Rasmussen, Frydendall, Bay, Gensby, Bengtsen, Guldenmund, and Kines, (2022: 7) shows that human error functions as a warning sign which indicates more serious workplace problems.

Participant three shared that: *‘’Because it can bring about more productivity, less absenteeism, and a healthy and safe work environment*.’’

Participant four stated that: *‘’Each and every human being lives at home in the morning to do work, not to be injured. The organisation wants to achieve its target at zero injuries; therefore, it is important that the organisation rich the milestone to achieve a zero-injury rate. It is important to prevent human errors.’’*

Participant five stated that: *”It is important because human error can lead to a lot of near misses, which can eventually lead to fatal incidents. I think when you try to focus on human error and the things that disturb people on the line. For instance, talking too much on the cell phone. Then you can get better safety conditions, encourage employees to become more careful, and work more safely than when they have a lot of destruction.’’*

Participant six mentioned that: *’’It is because some of the incidents can be prevented by doing away with human errors*.

Participant seven mentioned that: *”It is important because if we don't prevent them, we will be sitting with a huge number of accidents, including injuries that can even lead to fatal incidents. So, we must control the mistakes that are happening as this will assist in creating a safer environment for the workers as well as our customers and the organisation at large.’’*

Participant eight elaborated that: *”It protects the life of employees as well as the company equipment. Human error normally leads to loss in production or loss of human life.’’*

Participant nine mentioned that: "*To prevent fatalities, to prevent job loss due to incompetence, claims for competition with minimal business or production, not to be affected in financial loss.''*

Participant ten mentioned that: *"Employees getting distracted, some of them are new in the workplace and not familiar with the rules; These are some of the issues that cause human error incidents or accidents in the workplace."*

Participant stated that eleven: *"It is quite important for an organisation to aim for zero safety incidents. Less to zero quality incidents, the ones that are in relation to the process itself. There will be quite a lot of production efficiencies. When there is more production, the customers get satisfied. That will give a good reputation for the organisation, and it increases the organisation's revenue, so it will be quite a good benefit*."

Participant twelve mentioned that: *"It is important because it is the result of the employees being productive. The company cuts costs because there is no lost time due to injuries in the workplace. There will be more production, so it is very important to prevent human errors in the workplace.''*

Participant thirteen stated that*: "It helps the organisation to increase production to prevent absenteeism caused by LTI, which is the lost time injury free rate whereby an employee was involved in an IOD.''*

Participants one, two, three, eight, and twelve explained clearly that preventing human error incidents helps the organisation to maintain and improve productivity.
These measures included structured training programs, technology, and behavioural-based safety (BBS) programs as reflected in participant responses.

Participant three stressed the importance of ongoing training: "*Providing employees with frequent safety training helps reinforce knowledge and ensures that safety procedures become second nature. Many incidents occur due to a lack of refresher training*."

This is not to say that safety training is not significant; rather, it is more ineffective than other efforts (Dyreborg, Lipscomb, Nielsen, Törner, Rasmussen, Frydendall, Bay, Gensby, Bengtsen, Guldenmund, & Kines 2022: 5). Regular training helps ensure employees are kept abreast of safety regimens and allows for the fostering of a culture of risk awareness. Technology also plays a pivotal role in diminishing human error through the implementation of automated safety mechanisms.
Participant eight: "*Automated systems such as machine guarding, sensors, and AI-driven monitoring help identify risks in real-time and prevent incidents before they occu*r."
Participant six: *"BBS programs ensure that employees are actively involved in identifying risky behaviours and taking corrective actions before they lead to incidents."*

BBS programs have been adopted by some organisations to encourage proactive safety engagement. Research has shown that workplaces that implement BBS strategies experience an improvement in safety compliance and a reduction in risky behaviours (Neal & Griffin, 2023: 45). Encouraging employees to observe and report unsafe actions fosters accountability and enhances workplace safety. Participant six noted that BBS ensures employees are "actively involved in identifying risky behaviours and taking corrective actions." However, critical perspectives caution that BBS programmes may become ineffective if they focus excessively on individual behaviour without addressing organisational pressures such as workload, fatigue, or inadequate staffing (Sinha & Muduli, 2025: 2310). Therefore, BBS should be integrated within a broader safety culture that prioritises both behavioural accountability and management responsibility.
Overall, the findings demonstrate that participants view human error prevention as a shared organisational responsibility, requiring continuous training, technological support, and proactive safety participation. Importantly, the integration of these measures reflects the need for a systems-based approach to occupational safety, where human error prevention is embedded in organisational culture, operational controls, and continuous improvement practices.

The South African automotive industry should focus on preventive structures such as training, supervision, and engineering controls, rather than relying solely on employee vigilance. Several participants, including Participants three, eight, and twelve, linked

prevention directly to improved productivity, reduced absenteeism, and safer working environments. Participant three stated that preventing errors leads to “more productivity, less absenteeism, and a healthy and safe work environment.” This reflects the interconnected relationship between safety and performance, where effective prevention strategies reduce lost time injuries and associated organisational costs. However, while participants strongly endorsed safety training as a key preventive measure, the literature presents a more nuanced view. Participant three stressed the importance of ongoing refresher training, noting that many incidents occur due to “a lack of refresher training.” Although training remains an essential component of safety management, Dyreborg et al. (2022: 5) caution that training alone is often insufficient if it is not supported by broader organisational controls. In other words, training may raise awareness, but without adequate resources, enforcement, and hazard elimination, its effectiveness becomes limited. This highlights the need for a multi-layered prevention approach that combines competence development with systemic safeguards.

Participants also emphasised the growing role of technology in reducing human error. Participant eight explained that automated systems such as machine guarding, sensors, and AI-driven monitoring can identify risks “in real-time and prevent incidents before they occur.” This supports contemporary safety models that view automation as an important barrier against predictable human limitations, especially in fast-paced production environments. Nevertheless, technological interventions must be carefully implemented, as over-reliance on automation can sometimes introduce new risks, including reduced situational awareness among employees.

4.3.2 The Selection of the Control Measures

This section investigates how control measures are selected and prioritised within the automotive industry. Question ten (10) enquired about choosing the correct control measures (Annexure A). In this regard, the analysis is guided by risk management theory, which holds that risks must be assessed and prioritised based on their severity and likelihood, leading to the selection of appropriate control measures (Yazdi, Zarei, Adumene & Beheshti, 2024: 1). Additionally, the Hierarchy of Controls model provides a framework for determining the most effective methods of risk control.

Participants express different experiences regarding how control measures are selected some report structured processes based on risk assessments, while others perceive them as reactive and inconsistent.

Participant one explained: ”They *are chosen based on the identified risk, for example, applying the correct method, utilising the correct equipment and tools for their job. We also have training and skills development, risk identification and mitigation.”*

Participant two shares: *”I would say after the implementation, or I mean after looking at previous incidents and accidents or proactively looking at the work processes to see where the control measures are in place. They need to prevent incidents and accidents.’’*

Participant three stated that: *“By conducting a risk assessment or HIRA, frequent inspections, and formulation of checklists and registers.”*
Participant four emphasises compliance: *“We normally select control according to a hierarchy that is emphasise engineering solution, it's including elimination or substitution. So, we first follow by safety work practises, administration control and finally PPE. We also avoid select and control that may introduce new hazards.”*

Participant five mentioned that: *“Control measures are chosen by first, doing your baseline risk assessment so you identify what you are producing and the required equipment, and then what control measures must be put in place so your risk assessment will tell you about your equipment, any material that you are using, any substances that you are using and then you able to rate your risks from your highest to your lowest and you are able to put control measures in place.”*

Participant six highlighted: *“In our company we select control measures according to a Hierarchy of controls that emphasise engineering solutions firstly, it is engineering control measures, then followed by safety work practises and administrative control and a finally PPE for employees.”*

Participant seven stated that: "*The control measures are chosen based on the risks involved. I will say it starts from the top whereby in the board of directors for the organisation they will put policies and procedures like the safety, health environmental procedures and policies. Then they will make sure they check through those outlines that are required especially in risk assessment. The conduction of internal risk assessment assist to get suggestion in terms of the potential control measures that will work for the organisation. Ensure that's the chosen measures are aligning with the relevant health and safety regulation that is a governing or the standard that the organisation is compliant with. All continuous improvement in general for everything that has been done in the organisation."*

Participant eight adds: *"They are chosen according to the job specification and the exposed hazards and risks."*

Participant nine mentioned that: *"They are chosen according to the risk assessment.''*

Participant ten explained: *"The control measures are chosen by management and supervisors to assist the employees. They sit down together as a unit to identify which control measures are applicable for specific tasks. It is not a one-person choosing what to do, they should be able to choose just like the way risk assessment safety procedures are conducted. It is not a single person's responsible, but the management, supervisors and employees must be able to identify them correctly as a team."*

Participant eleven stated that, "*The selection depends on hazards Identification."*

Participant twelve stated that, *"They are chosen based on the scope of work. Every scope of work that needs a control measure for example if it's a dismantling of a car there needs to be a specific control measures for that task so if assembling the car, the parts of the car there should be a certain control measure for that.*

Participant thirteen mentioned that, *“They are chosen according to risk assessment which uses the hierarchy control measures which are elimination, substitution, engineering, administration and PPE.”*

Participants indicated that the control measures are chosen based on the risk assessment. These responses highlight the connection between the Hierarchy of Control measures. ISO 45001 encourages the use of participatory processes and proactive risk assessment to guide control selection (ISO, 2018: 15). The findings show that control selection is often reactive, budget-driven, or influenced by compliance pressure rather than strategic planning.

The effective risk treatment must include stakeholder input, cost-benefit analysis, and prioritisation based on exposure levels (Luo, Jiang, Zhang, Ren & Hou, 2021: 33). However, the participants’ input suggests that risk controls are frequently selected without employee’s engagement, undermining both their suitability and effectiveness.

To improve the selection of control measures, organisations need to adopt structured risk assessment procedures, involve employees in control design, and align decision-making with both ISO standards and the Hierarchy of Controls.”

This approach aligns with the widely recognised Hierarchy of Control measures, which includes

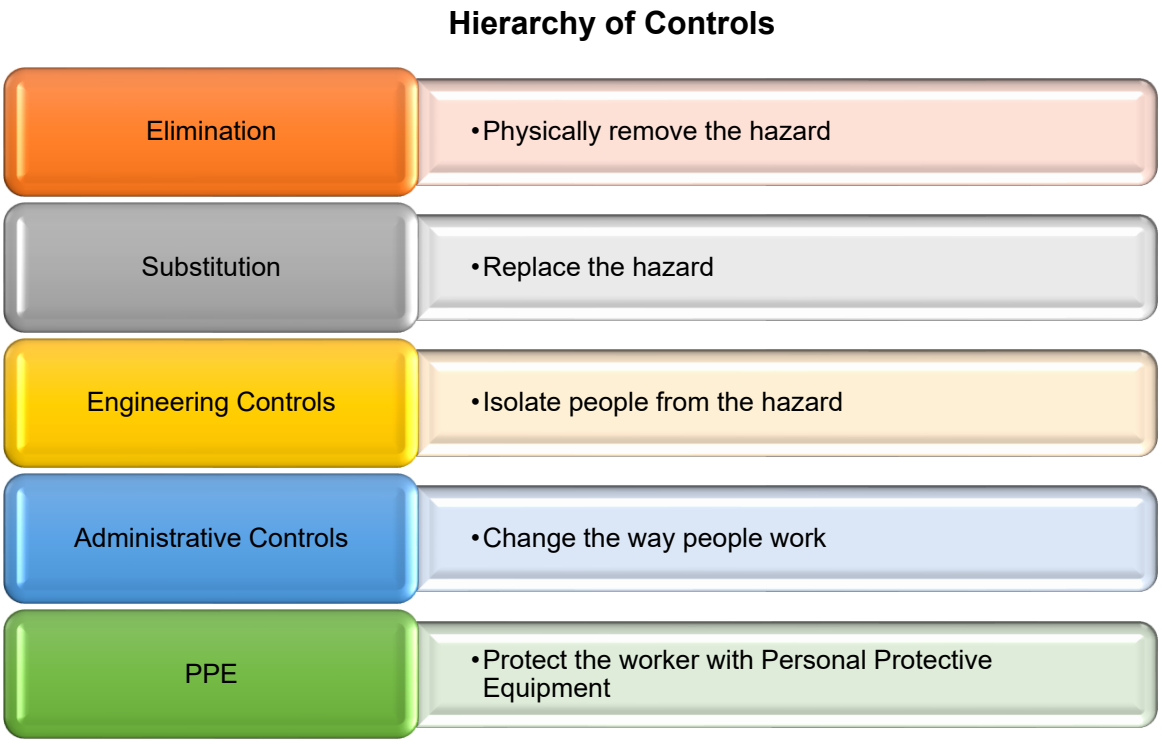


Figure 4.1. Hierarchy of controls

Source: Henny, Budi, Andriyansyah, Rozzak, Baru and Masek (2025: 276).

Automotive manufacturing workplaces prioritise elimination and engineering controls over PPE and administrative measures report better long-term safety outcomes (Dyreborg, Lipscomb, Nielsen, Törner, Rasmussen, Frydendall, Bay, ensby, Bengtsen, Guldenmund & Kines, 2022: 20). Organisations must, therefore, ensure that control measures are not just compliant with legislation but are also proactive in mitigating risks at the source.

4.4 THEME 2: IMPROVEMENT OF CONTROL MEASURES

This theme builds on the first objective of the study, which explored the effectiveness of control measures used to reduce human error and prevent incidents and accidents in the automotive manufacturing sector. While the previous section focused on the presence of control mechanisms, this theme centres on opportunities to strengthen and enhance those controls. The findings indicate that employees recognise existing safety strategies but are equally aware of their limitations and the areas requiring improvement. The analysis of Question eleven from the interview guide (Annexure A) enquired about

what can be done to improve the available control measures in the automotive industry. Two categories that were developed in this regard: (1) recruitment of employees, and (2) enforcement of employment regulations. The participants' perspectives reflect a strong understanding of how workplace processes and personnel decisions can influence safety outcomes. A key insight from the data is that improvement is not limited to tools and policies, it must also address the human element, including behavioural competency, leadership engagement, and system responsiveness.

Participant one stated that: *"Regular monitoring of control measures by conducting audits, reviewing of control measures if they are still relevant, enforcing compliance, hiring of well-skilled personnel, regular reviewing of policies and procedures, conducting plant and machinery inspection, and conducting daily safety talks."*

Participant two mentioned that: "C*ontrol measures must be embedded into the safety culture of the organisation.*''

Participant three stated that: "*By reviewal of SOPs, conducting regular audits, having open forums for employee suggestions, and review of IOD training*."

Participant four introduced the "*concept of Kaizen, or continuous improvement, stating, Daily assessment allows for incremental safety improvements. We add new measures when we find gaps in existing procedures*." Kaizen is a Japanese term meaning "continuous improvement" is a philosophy that emphasises incremental changes to enhance processes and efficiency in organizations. It involves everyone in the organisation, from top management to frontline employees, in identifying and implementing small, incremental improvements. By fostering a culture of ongoing enhancement and problem-solving, Kaizen aims to increase productivity, reduce waste, and improve quality
(Biswas & Das, 2023: 52).

Participant five elaborated that, *"I think we can focus more on engineering controls and ensure that we rely on the machine to safeguard the employees. Installation of automatic*

closing guards can be a solution. Installation of lights that detect the speed. sensors of foreign objects can also make a difference. Also focus more on awareness and teaching employees that whatever you do should not be a tick box exercise, you should do the proper machine inspection, test the actual machines, and not take the results from what was done previously."

Participant six mentioned that: "*Employ competent employees, provide training, provide correct PPE, and then also do supervision to employees*."

Participant seven mentioned that, "*It is by an ongoing training and updating and refreshing the employee knowledge. When you are having the new employees, you need to review your procedures and the technology that you are using to align with what is happening at that point in time because things are changing, so you also must keep up with those changes that are in place. Update the policies that will reflect the current practises and regulation you do the stats analysis which will be including your near misses because once you eliminate from the near misses then your number of incidents will lower and then also identify the weaknesses that are existing in your controls and puts the unnecessary adjustment to make sure that you are on par. The benchmarking as well or assist if you have the industries that have the best practices that you can apply to the organisation and then the ongoing engagement with your employees and we also include the committees, which make sure that safety committees meet, and the discussed findings are shared with all the employees."*

Participant eight mentioned that: "*When employees execute non-routine jobs, there should be a safety discussion which highlights the risks associated with the job. For routine jobs, employees tend to ignore some safety rules as they have been doing these jobs for a long time without any incidents. There should be a discussion for routine work to remind employees of risks associated with such jobs or tasks."*

Participant nine stated that: "By conducting a risk assessment to identify all risks and hazards.''

Participant ten mentioned that: *"The control measures are chosen by management and supervisors. They sit down together as a unit to identify which control measures are applicable for specific tasks. It is not a one-person choosing what to do, they should be able to choose just like the way risk assessment safety procedures are conducted. The entire management is responsible for the decision. Supervisors and employees must be able to identify them correctly."*

Participant eleven presented a more comprehensive approach by identifying various improvement opportunities: "*pre-task assessments, emotional readiness screening, and drug and alcohol abuse testing, and removing environmental distractions like mobile phones*". These suggestions reinforce the understanding that human error is multi-dimensional, often arising from physical, cognitive, and emotional disruptions (Mutmainah, Pramudya & Rufa'i, 2024: 1). Participant eleven further stated that: *"Competencies, always make sure that the person who conducts the task is fully trained and tested on the task so then you won't have an issue of a human error in that regard. If you have like robust pre-task assessments not just for the conditions in the area but for the teams. When you get a person coming into your work area, they have one one-on-one with the supervisors. They can tell when someone is not well, or they are suffering some emotional disturbance. Other human errors can be caused substance abuse. The use of illegal substances alcohol and drugs abuse. There is a breathalyse at the gates specifically for quick drug testing. Before a person operates or comes in into the critical process it ensures that everyone is in check. The removal of destruction in the working area like cell phones, it helps to reduce human error-based incidents."*

Participant twelve mentioned that: *"My understanding is that it helps to improve communication between employer and employee. They assist with the relevant training to employees. They improve the efficiency and consistent and consistence of the work processes so the safe work procedures they assist with executing the work properly and safely in terms of health and safety.''*

Participant thirteen stated that: ”Formulation and review of policies. Provide training to employees, defect identification and reporting. Conduct inspection and testing processes. Proper maintenance of equipment, machinery and properties.”

Participant three recommended: *”Improving systems through continuous SOP review, regular safety audits, and participatory forums where employees can voice safety concerns and suggestions”.*

This study has revealed that the control measures can be improved if the organisation can focus on training the employees and hiring competent employees. The Swiss Cheese Model (SSM) suggests that layers of organisational defence such as training, supervision, and procedural reviews, can only prevent errors if each layer is intact and responsive (Reason, 1997). When these defences are neglected or bypassed, the probability of failure increases. Literature supports this by noting that organisations that embed continuous improvement into their safety culture experience significantly fewer incidents.

Amirah, Him, Rashid, Rasheed, Zaliha, & Afthanorhan, (2024: 108) argue that automotive workplaces still have substantial room for growth in strengthening their safety management systems, particularly in how control measures are evaluated, adapted, and enforced over time. This theme aligns closely with the System Enhancement Layer of the Human Error Incidents Prevention Framework. Improvements must be institutionalised through structured mechanisms such as employee screening, policy revisions, and a culture of openness to feedback. Only through deliberate, participatory, and evidence-based modifications can safety controls evolve from static documents to dynamic processes. The next sections will further analyse the two sub-categories: (1) recruitment of employees and (2) employment regulations.

4.4.1 Category one: Employee Recruitment and Training

Question nine in the interview guide (Annexure A) asked the participants to indicate the existing control measures for preventing human error incidents and accidents. Participants recognised the role of employee recruitment in improving control measures,

hiring qualified personnel with relevant industry experience, and providing continuous training as a critical control measure.

Key aspects include recruitment and selection processes tailored to identify candidates with a strong safety mindset, ongoing training programs to enhance competencies and awareness, and the establishment of a safety-centric organisational culture (Oyewole, Okoye, Ofodile, Odeyemi, Adeoye, Addy, Özden, 2024: 623). Only participants three and 13 provided information.

Participant three stated that: "*Implementation of SOPs, availability of risk assessment, in-house training, induction, inspections to identify hazards, formulation of health and safety committees, and appointment of legal appointments, for example, 16.2 for manager, 17.1 for health and safety representative."*
Participant thirteen mentioned that: "*All competent employees are legally appointed according to their skills, such as 16.1 for CEO, 16.2 for Managers, and 17.1 for Health and Safety Representatives*."

Ensuring that employees understand safety regulations and protocols contributes significantly to workplace safety. Literature supports this perspective, emphasising that organisations prioritising safety training see a reduction in workplace accidents and higher employee retention rates (Hussain & Mackie, 2024: 4). Studies also highlighted that onboarding processes should include general safety aspects, safety briefings, and competency assessments to ensure new employees fully understand workplace hazards (Waldan & Ruci, 2025: 6).

Employees must get ongoing professional development to stay current on new safety technologies and changing risks. Human error incidents are reduced in organisations that use mentorship programs and refresher training (Neal & Griffin, 2023: 22). This section explores how recruitment practices influence the effectiveness of occupational health and safety (OHS) control measures. The analysis is informed by the Person-Organisation Fit Theory, which suggests that selecting candidates whose values align with organisational goals, including safety culture, enhances job performance and

commitment (Mubintaj, Bangera & Ravi, 2024: 167). Additionally, Safety Climate Theory underlines the importance of hiring individuals who demonstrate safety-conscious behaviours from the onset (Zohar, 2021: 132).

Literature supports this perspective, emphasising that organisations prioritising safety training see a reduction in workplace accidents and higher employee retention rates (Hussain & Mackie, 2024: 4). Continuous professional development is necessary to keep employees updated on evolving risks and new safety technologies. Organisations that integrate refresher training and mentorship programs experience lower human error incidents (Neal & Griffin, 2023: 22). These responses highlight the absence of safety-specific recruitment criteria, which weakens the implementation of control measures once workers are onboarded. According to Neal and Griffin (2023: 49), pre-employment screening for safety attitudes and competencies is a key predictor of safe work behaviour. Furthermore, ISO 45001 emphasises competence and awareness as essential requirements for all persons working under an organisation's control (ISO, 2018: 20).

Failure to recruit safety-aware employees can lead to increased training costs, longer adaptation periods, and elevated incident rates. Therefore, aligning recruitment with OHS objectives ensures that employees come in with a basic understanding of hazard recognition, PPE usage, and safe work practices. Integrating safety into job descriptions, interviews, and induction phases is not just a compliance requirement. It is a foundational step toward building a proactive safety culture.

4.4.2 Category Two: The Employed Regulations

This category focuses on how existing workplace regulations are applied and enforced, and their role in strengthening health and safety control measures. The analysis is guided by Systems Theory, which views organisations as complex systems where regulations serve as control mechanisms to align individual behaviours with institutional safety goals (Leveson, 2020: 14). Additionally, enforcement and reinforcement of rules are essential in promoting safety behaviours and reducing violations (Mosarwana &

Mogaka, 2025: 4). Legislative compliance plays a pivotal role in improving safety control measures in the workplace.

Question seven in the interview guide (Annexure A), enquired about the benefits of the OHSA No. 85 of 1993, COIDA No. 130 of 1996, NEMA No. 107 of 1998, and Labour Laws of South Africa. Participants acknowledged the importance of adhering to national and industry-specific legislation to minimise risks. Participants expressed a range of views regarding the enforcement and adequacy of safety regulations. While most workplaces have safety regulations, participants reported gaps in consistency, supervision, and application.

Participant one said that: *"The benefits of the OHS Act are that it caters safety and health of persons at work regarding the use of plant and machinery, and the employer should provide employees with a safe working environment. The COIDA provides the right for the employee to be compensated for loss of income in case of permanent disability due to workplace injury or disease.''* In this case, these safety rules or regulations are not followed strictly. Some people get away with ignoring them.

Participant two mentioned that: *"The advantage is to regulate the working conditions and then give guidance as to what must be followed to create a safe working condition. Other thing is it will obligate both employees and employers to accept. However, we only hear about regulations when something bad happens or when an inspection is due."*

Participant three explained: *"The Occupational Health and Safety Act give [provide] guidelines that aims to protect the health and safety of employees in the workplace. For COIDA, it gives direction on how to manage incidents and accidents that take place in the workplace. "… even if we know the regulations, no one enforces them daily. They only become important during audits."*

Participant four added: "*Regulations are available, but they are not visible on the floor. People don't really engage with them."*

Participant five stated: *"Supervisors apply rules differently. Some are strict, others let things slide. That confuses the employees."* The investigation showed that leadership acts as the main factor which drives safety while supervisory practices create a key safety issue.

Participant six mentioned: "*Sometimes, shortcuts are allowed to meet targets, even if it break safety rules."* This shows how production demands take precedence over safety requirements. The organisation faces an internal problem because its employees must choose between two conflicting objectives when making operational choices. The implementation of unsafe work methods becomes normal practice in workplaces which prioritise operational needs over protecting employees, which results in decreased effectiveness of safety regulations and heightened risk of human errors.

Participant nine explained: *"Policies are in the file, but there's no training to make sure we understand them."* This shows that the organization has failed to create a system that enables employees to learn and participate in their work.

Participant ten said: *"If enforcement were consistent, we'd all take safety more seriously."*

Participant eleven states: "Sometimes, management ignores violations when the person is productive or senior."

Participant twelve shared: *"People know the rules exist, but they feel they are not enforced fairly."*

Participant thirteen remarked: *"There are too many rules, but not enough communication about what they mean."*

These responses reveal a disconnect between regulatory frameworks and day-to-day practice. While safety regulations may exist in formal documentation, their effectiveness is undermined by weak enforcement, inconsistent supervision, and limited worker

engagement. According to ISO 45001, regulatory compliance must be embedded into organisational processes, and leadership is required to ensure implementation and worker participation (ISO, 2018:11–13). The lack of clear, consistent enforcement contradicts this requirement and reflects a gap in safety governance.

Furthermore, Leveson (2020: 18) argues that safety systems fail not due to the absence of rules, but because of failure in enforcement and feedback mechanisms. The participants' accounts confirm that rules without accountability contribute to a safety culture where violations are normalised. The participants' experiences demonstrate that the system-based approach is correct because the organisation has existing regulations which the system fails to uphold through its training methods and its systems of monitoring and communication and its procedures for corrective action. To strengthen regulatory effectiveness, organisations must:

- Train employees on the rationale behind each rule,
- Monitor and enforce regulations uniformly,
- Establish feedback mechanisms that ensure continuous improvement,
- An automotive manufacturing industry should hold their leaders responsible for demonstrating safety standards and ensuring their implementation.

A system-based approach to regulation enforcement ensures that compliance is not a reactive or audit-driven process but an everyday part of operational culture.

Participant one stated: *“To improve our safety through regulation and identify workplace hazards, the employees are protected in terms of occupational diseases. This helps to ensure that employees are protected regarding occupational diseases and injuries. It also promotes the employee's total well-being because the acts force your Occupational Health and Safety Act forces them. The employers must ensure that employees undergo medical surveillance to verify if they are fit for their jobs. Organisation’s compliance assists in adhering to regulations and in risk management. In terms of regulations, NEMA or environmental management. They also assist in protecting and minimising environmental impacts. Ensuring we would say in my workplace environment. The right*

for employees and I must take hold of it, and in general, it helps in improving and sorting the continuous improvement of the organisation."

Participant seven mentioned that: *"These regulations promote worker protection, enforce medical surveillance, and encourage continuous safety improvements."*
Participant eight elaborated that: *"Employees should be actively involved in reviewing safety policies, ensuring they align with real workplace risks."*
While regulations provide the framework for workplace safety, enforcement remains a challenge. Some organisations only adhere to compliance when facing inspections rather than embedding safety into daily operations. Dasgupta and Islam (2024: 36), argues that legal compliance alone is insufficient in preventing workplace incidents; instead, organisations must foster a proactive safety culture beyond minimum legal requirements.

Organisations can strengthen compliance by implementing routine safety audits, integrating compliance checklists into daily operations, and encouraging employee involvement in policy review processes.

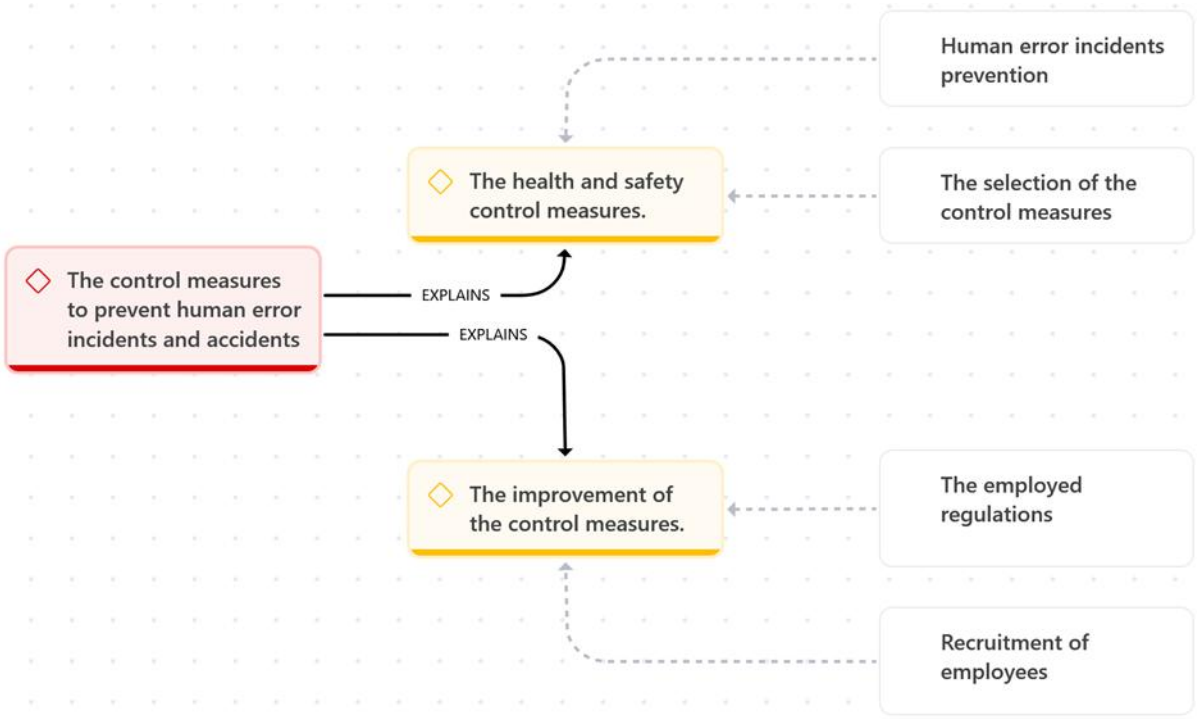
Technology also plays a role in improving compliance monitoring. Digital reporting systems and real-time safety dashboards can track compliance metrics, reduce administrative delays and enhance responsiveness to potential hazards (Wang, Gihleb, Giuntella, & Stella, 2023: 7).

The different safety practices which organisations follow for their operations show that current safety regulations do not match their actual safety activities. The existence of safety regulations in formal documents does not create actual safety protection because their enforcement lacks strength and their supervision does not maintain consistency while employees show limited participation. The safety system of the organisation experiences its most severe decline through these challenges which begin as individual compliance breaches.

The OHSA and COIDA regulations create essential workplace protection laws, yet the primary challenge according to participants lies in the organisational system responsible for implementation. Inconsistent enforcement, weak leadership commitment, and limited employee engagement undermine the intended impact of regulatory control measures. Thus, the effectiveness of workplace regulations depends not only on compliance structures, but also on the safety culture and organisational systems through which these regulations are enacted.

Theme two addressed the first secondary objective related to the improvement of control measures to prevent human error incidents and accidents. Figure 4.2 illustrates the aggregated themes and categories identified during data analysis for theme two.

Figure 4.2: Control measures to prevent human error incidents/accidents



Source: Researcher's development from Atlas.ti, Version 24

Table 4.1 illustrates the aggregated themes, themes, categories and codes.

Table 4.1: Aggregated themes, themes, categories and codes for human error control measures

Aggregated themes	Themes	Categories	Codes
The control measures to prevent human error incidents and accident.	**Theme 1:** The health and safety control measures	Human error incidents prevention	Proper Communication, Good company reputation, Compliance, Continuous improvements, Defect identification and reporting, Incentives. Prevention of financial losses, Property and assets damage prevention, Safety awareness, The health and safety control measures, Training.
		The selection of the control measures	Gaps identification, Hazard identification, Incidents investigation, Provision of PPE, Risk identification and mitigation. Scope of work, The health and safety control measures, The health and safety control measures. The review of control measures.
		The employed regulations	Health and safety regulations,

Aggregated themes	Themes	Categories	Codes
	Theme 2: The improvement of the control measures		Improves health and safety performance, International Organisation for Standardization for (ISO), Key performance indicators, Machinery regulation Protection of employees The improvement of the control measures.
		The recruitment of employees	Appointment of functional health and safety committee, Legal appointment of competent staff, Production increase, Reduce incident costs, Skills, The improvement of the control measures, The improvement of the control measures.

Source: Researcher's own compilation

The next section reflects on theme three (3), examining the investigation of human error incidents and accidents.

4.5 THEME 3: INVESTIGATING HUMAN ERROR INCIDENTS AND ACCIDENTS

The second objective of this study sought to examine the effectiveness of the 'as is' preventative measures to prevent future incidents and accidents. In pursuit of this

objective two themes emerged both centred on understanding the root causes of incidents and accidents at work proactive action to learn from the events. When such incidents occur, a root cause analysis is conducted to determine the underlying cause of the disruption (Chen et al., 2024: 676). Despite having preventive measures and standard operating procedures (SOPs), the effectiveness of incident investigations determines whether future errors are mitigated or repeated. As such, the data analysed followed two categories: (1) The promptness of incident investigations, and (2) The importance of truthful reporting. Literature highlights that root cause investigations play a critical role in identifying systemic weaknesses and ensuring that similar incidents do not recur. Question thirteen of the interview guide (Annexure A) enquired about the fairness/unfairness for employees to be investigated immediately after the incident. Participants responded as follows:

Participant five stated that: *"An investigator needs to find the real root cause of the incident to prevent the recurrence of the same incident."*

Participant eight mentioned that: "*To determine the incidents. root cause, the incident must be investigated immediately, so that evidence is preserved for case sharing to improve the course by developing a preventative measure. This will assist in preventing the recurrence of the same incident.*

It is therefore important to ensure that all incidents are investigated immediately to find the root cause. This assists in preventing future incidents and the recurrence of the same incidents.

A well-executed investigation that goes beyond surface-level causes can uncover latent organisational flaws contributing to unsafe behaviours (Butmee, Jitjamnong, & Sangaroon, 2024: 1). Similarly, Chen et al. (2024: 676) state that root cause analysis helps prevent future occurrences by addressing human, environmental, and procedural failures. In terms of procedural compliance, international safety standards such as ISO 45001: 2018 and organisational SOPs require that incident investigations be timely, impartial, and corrective in nature. Regulation nine of the General Administrative

Regulations (GMR 9) in the Occupational Health and Safety Act 85 of 1993 (OHSA 85 of 1993) mandates that investigations must begin as soon as reasonably practicable after the incident, to preserve evidence and avoid memory degradation.

The process of strengthening regulatory compliance needs more than creating laws because organizations must develop a safety culture which ensures leadership backing for ongoing regulation enforcement and proper regulation dissemination to their workforce. Organisations need to enhance their regulations through these actions:

- Employees need to understand why each regulation exists through training.
- All organisational levels need to implement monitoring and enforcement of regulations through standardised methods.
- Organisations need to create feedback systems which enable ongoing organisational development.
- Organisations should hold their leaders responsible for demonstrating safety standards and ensuring their implementation.

Organisations need to implement a system-based approach for regulating enforcement which enables all staff members to maintain compliance as part of their daily duties and their organizational governance functions.

The OHSA and COIDA regulations create essential workplace protection laws, yet the primary challenge according to participants lies in the organisational system responsible for implementation. Inconsistent enforcement, weak leadership commitment, and limited employee engagement undermine the intended impact of regulatory control measures. Thus, the effectiveness of workplace regulations depends not only on compliance structures, but also on the safety culture and organisational systems through which these regulations are enacted.

4.5.1 Category One: The Prompt Incident Investigation

This section explores how promptly and effectively organisations respond to incidents and accidents. The importance of swift and consistent responses to unexpected events in high-risk environments (Renner, Cvetković & Lieftenegger, 2025: 25). In addition, Organisational learning theory supports the idea that incident investigations must be conducted promptly to enable reflection, feedback, and system improvement (Mehrizi, Nicolini & Modol, 2022: 25).

Question thirteen of the interview guide (Annexure A), enquired about the fairness/unfairness for employees to be investigated immediately after the incident occurrence. In this case, participants stressed the importance of prompt incident investigations to prevent recurring hazards and improve workplace safety. Delayed investigations can result in the loss of crucial evidence, inaccurate reports, and a failure to implement corrective actions in a timely manner. However, some participants pointed out that immediate investigations might put employees under stress, making them reluctant to provide truthful statements. The investigation might cause feelings of injustice and post-traumatic embitterment disorder (Brennan & Cole, 2024: 303). Participants express concern that investigations are often delayed, incomplete, or used to apportion blame rather than for learning.

Participant one stated that: *‘’Yes, it is important to do investigation immediately as the employee who is involved in the incident will be able to re-call the sequence of events before the incident happened’’.*

Participant two mentioned that: ‘’*Yes, because we don't want the incident to be tampered with and it would provide the actual investigation results.”*

Participant three stated that: *‘’Yes, it can be identified if incidents were caused by human error or if there is a gap in the SOPs and procedures followed.’’*

Participant four mentioned that: “*No, it’s not fair as per my opinion because an employee might still be traumatised at that moment. So, he or she cannot be able to give an accurate information.”*

Participant six stated that: *“Investigating incidents immediately ensures that all relevant details are captured while they are still fresh. Waiting too long can lead to inaccurate statements from employees and lost evidence.”*

Participant seven mentioned that: "*This one for me. It's always on two folds. In a sense that if you get that the information soon it can provide more accurate information from the involved both parties and the witnesses. On the other hand, sometimes you find it when the incident or accident has occurred, the person that is directly involved is still in shock and traumatised. Therefore, that person will give an inaccurate information that has gaps in between. We basically need to get a clear rate of what's happen, while the memory is still fresh. This will reduce a risk of forgetting the critical details. However, on the other hand, you also you also need to take into consideration that you don't have to push a person too much because we don't take the stresses at the same level. My understanding when the incident is investigated its helps in identifying hazard that needs to be mitigated immediately*."

Participant nine stated that: *"Yes, to obtain information and root causes that can assist the employee in mitigating the risk urgently."*

Participant ten mentioned that: *"While immediate investigations are important, employees involved in incidents may still be in shock. It is crucial to balance urgency with employee well-being."*

Participant eleven elaborated that: "*Yes, it is quite important to get an undiluted account of the sequence of events before the incident happened. If you get that account immediately from the person, there is very little time for people to try and doctor the information. You get this raw information. Still influenced by the feelings as well. Then you get how they feel about this process. I will say a person who just came out of the incident situation. They are quite truthful about the accounts of what just happened. If you use that time to do the investigation, a full thorough investigation, then you may not benefit. That's they can be questioned, questioning about the accounts, yes, but a fully-fledged investigation immediately after, then you know."*

Participant twelve mentioned that: "*Yes, it is fair, to determine the root cause and it's very imperative that we investigate immediately so that evidence is preserved for case sharing to improve the course of by developing a preventative measure.so that when we*

announce the case or when we educate, or we do them case sharing. Others are informed and they will prevent. or they will avoid repeating the same incident.''

Participant thirteen mentioned that*: ''Yes, it is easy to get accurate information if the investigation has been conducted immediately. The chances of cheating or changing statement will be very limited if investigation has been conducted immediately*.''

In summary, most of the participants elaborated that it is crucial to investigate the incidents immediately to get the root cause immediately and prevent it from re-occurring. They also clarified that if an investigation is conducted immediately, the chances of changing the statement will be eliminated. Therefore, the investigator can get accurate information regarding the scene.

To address this, organisations can implement structured investigation protocols that allow for both immediate hazard control and supportive post-incident interviews to ensure accuracy and fairness. Incident response lacks consistency and urgency, which diminishes opportunities for system-level improvement and increases the risk of recurrence. ISO 45001: 2018 mandates immediate response and proper documentation of all workplace incidents, regardless of severity, to promote learning and continuous safety enhancement (ISO, 2018: 21). According to Roberts (2020: 95), high-reliability organisations conduct rapid assessments to uncover root causes while facts are still fresh. Delays, as reported by participants, result in loss of information, distorted accounts, and missed preventive actions.

Moreover, Mauri and Neiva de Figueiredo (2025: 31) note that timely investigation contributes to double loop learning, where organisations not only correct the specific issue but also improve underlying processes and systems. Failure to act promptly reflects a compliance-driven culture rather than a learning-oriented one. To improve promptness in incident investigations, organisations must:

- Assign dedicated response teams;
- Define clear investigation timelines in policy; and

- Automate initial reporting to trigger faster response.

Emphasise that every incident, regardless of scale, is a learning opportunity.
Prompt investigations are a marker of a proactive safety culture and are essential for reducing both direct and indirect risks in the workplace. The next section examines the importance of truthful responses.

4.5.2 Category Two: The Importance of Truthful Responses

Question fourteen in the interview guide (Annexure A) enquired about the importance of responding truthfully during an incident/accident investigation. Honest reporting of incidents is essential for organisations to implement effective corrective actions. However, some participants noted that employees sometimes withhold information out of fear of punishment.

Furthermore, this section explores the role of honesty and transparency during workplace incident investigations. It is underpinned by psychological safety theory, which posits that individuals are more likely to speak honestly when they feel safe from retaliation or blame (McHugh, Louch, Ludwin, Sheard, O'Hara, 2024: 1; Edmondson, 2019: 113). It is also informed by the Just culture framework, which encourages balanced accountability while fostering open communication about safety incidents (Glarcher & Vaismoradi, 2025: 10).
Participants emphasise that investigations are often undermined by fear, blame, and lack of trust, leading to incomplete or inaccurate reporting.

Participant one explained: *"In order to determine the cause of the incident and the root cause, the organisation will be able to prevent the re-occurrence of the same incident and to implement the correct control measures.*

Participant two said that: *"The corrective measures will be provided accurately to stop re-occurrence of the incident or accident. We would need to ensure that if there are corrective measures to be taken, they should be taken immediately before the incident*

repeats itself. So, point number one is for learning and preventive measures to be taken. Point number two is for corrective measures to be taken in time before a real case.''

Participant three mentioned that: "*It can be determined if there is a need for SOPs and policies to be reviewed.*''

Participant four shares: *"If you made the mistake, you just keep quiet. Admitting it means punishment, even if the system caused it."*

Participant five remarks: *"Honest answers are rare. People tell the version that protects them, especially if the supervisor is involved."*

Participant seven explained: *"It is important to do so based on the task of the organisation and as an individual if they are not being honest in their response. It can prove an employee's dishonest, and that employee cannot be trusted in the organisation. It will assist in terms of making sure that we get to the right cause of the accident, if we are given the correct information, and the preventative measures will be the correct ones that you put in place. It builds trust between the employee and the management or the employer, which creates a safer environment for everyone in the organisation. It promotes a safety culture."*

Participant eight noted that: *"So that the gaps can be closed, or issues can also be addressed to prevent the re-occurrence of incidents in the future.*

Participant nine stated: *"To ensure that the employer complies with action plans, compiles action plans accordingly and improves safe working systems to determine whether safe procedures need to be reviewed."*

Participant ten reflected: *"Employees need to respond truthfully during the instant investigation because we need to get the correct information, and that correct information will assist in avoiding incident re-occurrence. Employees need to respond*

truthfully because if we get the truthful information, gaps within the organisation can be identified and can be established right away."

Participant eleven added: *"If they are being truthful, it gives the investigating team a clear picture of what happened, and therefore it assists the business in identifying areas of concern and the open gaps within the organisation. It will lead to corrective remedial actions to be applied and to correct and close those gaps."*

Participant twelve explained: *"It is crucial because if they don't respond truthfully, it defeats the purpose of the incident investigation. Therefore, employees need to be truthful so that we can determine the root cause and do a continuous risk assessment to improve. The risk assessment so that we prevent the same incident from occurring again."*

Participant thirteen commented: *"When employees respond truthfully, it is easier for an investigator to find the root cause of the incident. That will assist in preventing the re-occurrence of the same incident.''*

These responses demonstrate that a culture of fear and punishment discourages transparency, which undermines the integrity of the investigation process. According to Edmondson (2019: 115), psychological safety is necessary for individuals to report mistakes, offer feedback, and contribute to organisational learning. Furthermore, the Just Culture model promoted by Quillivan (2020: 40) argues that safety investigations must distinguish between human error, at-risk behaviour, and negligence. When organisations treat all errors as misconduct, employees conceal the truth, and opportunities to improve systems are lost.

ISO 45001:2018 emphasises that employees must be encouraged and empowered to report incidents truthfully and without fear of blame (ISO, 2018: 19). Transparency during investigations is not only about ethical practice it is a strategic mechanism for error correction, hazard prevention, and continuous improvement. To encourage truthful responses, organisations should:

- Establish anonymous or protected reporting mechanisms.
- Train investigators on neutrality and fairness.
- Promote a culture that focuses on system improvement rather than personal fault.
- Reinforce that the goal of investigations is learning, not punishment.

A trustworthy investigation environment enables accurate diagnosis of root causes and promotes a mature safety culture, where employees and management share responsibility for improvement. The next theme examines the reduction of human error incidents and accidents.

4.6 THEME 4: THE REDUCTION OF HUMAN ERROR INCIDENTS AND ACCIDENTS

Another theme that emerged frequently from the data was the contribution of human error as one of the primary causes of accidents in the workplace. Question one in the interview guide (Annexure A), enquired from participants if they considered human error to be the root cause of incidents or accidents.

Participant one said that: "*Some causes of human error can be stress, fatigue, long working hours, improper equipment and machinery operation, negligence, shortcuts, miscommunication, time pressure, poor design, and equipment failures."*

Participant two mentioned that: "*Yes, they can cause incidents and accidents because when humans operate machinery, they are bound to make mistakes when operating the machine. This can result in a human error incident/accident*."

Participant three mentioned that: *"No, it's not always because of human errors that cause incidents. It could be due to unclear, unidentified work procedures and SOPs that can lead to incidents and accidents."*

Participant four mentioned that*: "I would say yes because most of the time we work with the moving machines, so any moving machinery can cause accident are operated by human. So, in most cases there is a human behind who did not follow all the safety procedures."*

Participant five said that: *''I would say yes because most of the time we work in with the moving machines, so any moving machinery that is caused accident, it's been operated by human. So, in most cases there is a human behind who did not follow all the safety procedures.''*

Participant six stated that: *"Yes, I do. Some incidents or accidents are caused by negligence of the employees. Incompetent employees also contribute to many human errors."*

Participant seven stated: "*Yes, I do. Because in most accident investigations, there is a huge percentage that points to incidents that are caused by human errors. By looking at things like safe operating procedures and the IT that is not followed. People are taking shortcuts, or even the misunderstanding from the people as well, or sometimes they are distracted by other things while they are in operation. The huge number in terms of the outcome of the investigation points that the incident was caused by human errors.''*

Participant eight mentioned that: "*Yes, when the machine is programmed to do a task, they follow that and normally do not make mistakes. When humans operate the machines, they sometimes mistakenly press the buttons, resulting in incidents or accidents*."

Participant nine mentioned that: *"Yes, employees failing to follow safe working procedures while handling machinery equipment.*"

Participant ten elaborated that*: "No, human error indicates the underlying factors to do with management, involvement in training, or empowering employees. So, I believe that human error cannot be the root cause of the incidents.''*

Participant eleven mentioned that: "*Yes, I do consider human errors to be the root cause of many incidents. However, some errors arise from maintenance practices that are not implemented correctly, and other system-based causes or operational-based causes. That has gaps because of human interference. Poor processes and documentation can also lead to human errors."*

Participant twelve mentioned that: "*Yes, the reason for my response, I believe that human errors are the most contributing factor because people are stressed, you know, people are overwhelmed at work, people are distracted. So that it can result in human errors.''*

Participant thirteen mentioned that: "*It helps the organisation to increase production to prevent absenteeism caused by lost time injury-free rate (LTI), whereby an employee was involved in an Injury on Duty (IOD)."*

Despite advancements in workplace technology and safety in the automotive industry, the human factor remains critical in determining workplace accidents. The data analysed showed that human error is caused by stress, fatigue, long working hours, improper equipment, and negligence in machine operation. Quizzed further on what the automotive industry can do to reduce human error that increases accidents, participants indicated that constant equipment assessment can reduce the incidence of human error. Employee appointment, absenteeism, and morale all rise when employees feel that their health and safety are a real priority. Each element increases productivity and efficiency (Orikpete & Ewim, 2024: 12).

The Health and Safety Executive (HSE) describes human factors as people's perceptual, mental, and physical capabilities, interactions of individuals with their job and work environment, and the influence of equipment design and system design on human

performance. It also notes the characteristics of the organisation that influence safety-related behaviour at work. Identifying and studying human error is exciting to the safety field as these factors are involved in human errors (Morais, Yung, Johnson, Moura, Beer, & Patelli, 2022: 1).

Human error is a complex construct that has received constant attention among researchers on human factors causing workplace accidents. It has consistently contributed to many incidents in complex and dynamic systems. The dominant definition of human error is a generic term that encompasses all those occasions in which a sequence of physical or mental activities. It fails to achieve its desired result, and when these failures cannot be attributed to the intervention of change.

A manufacturing process can be conceptualised as a sequence of physical actions and information processing activities that transform raw materials into customers' specified products. The goal of this process is to create profits and sustain industry growth. This process is expected to be robust through carefully designed safety mechanisms to preserve the firmly coupled activities that remain connected under the interferences of occupational stresses, such as human errors. Even though modern technology is incorporated during the process design and installation stages, the inconsistent performance of human behaviours and unstable hardware quality often creates problems that result in accidents in the workplace. Unexpected human errors and hardware failures disturb the system activities and initiate fluctuation. Once the magnitude of the fluctuation exceeds the limits of the system safety capacity, the manufacturing process is interrupted, and industrial accidents occur. Investigators have shown that human errors have been generally recognised as the major cause of industrial accidents. This problem is aggravated by the increasing mental workload of humans in the modern manufacturing environment and insufficient company resources spent due to the lack of understanding of the losses of human errors (Hilmi, Hamid & Ibrahim, 2024: 48).

To prevent and/or reduce the occurrence of accidents and incidents, organisations must work towards reducing human error or making the work system more error tolerant.

Managing human error accidents involves prevention, recovery from errors, and containment of the consequences of their occurrence. The first step in this process is error identification, which may allow appropriate prevention and mitigation strategies to be developed. The causes of occupational accidents from the human factor's perspective have received little attention in scientific research. Actions should be taken to control the resulting impacts when human errors occur (Luo, Liu & Qiu, 2022: 2; Aksoy, 2024: 96).

The lack of equipment maintenance increases the chances of human error and plays a crucial role in reducing the chances of accidents in the automobile industry by ensuring that machinery, tools, and vehicles function properly and safely. Proper maintenance ensures machines and tools operate as designed, reducing the likelihood of unexpected breakdowns that can lead to errors in production or assembly. Employees rely on equipment to perform their tasks accurately. Regular maintenance builds trust in the equipment, reducing stress and enabling employees to focus on their tasks rather than compensating for faulty tools. Faulty or worn-out equipment can create hazardous situations, leading to accidents or distractions that increase human error. Routine maintenance ensures safety features, such as emergency stops and alarms, are functional, creating a safer environment for employees to perform their duties (Murugan & Sathiya, 2024: 64; Kakolu & Faheem, 2023: 571).

Maintenance significantly improves safety and accident prevention in the rapidly evolving automotive industry (Mandala & Kommisetty, 2022: 7). The automotive industry relies on maintenance for smooth operation. Maintenance identifies potential breakdowns and enables proactive corrective measures (Patil, Rane & Paramesha, 2024: 185). Therefore, machines and equipment should be properly maintained. These should be appropriately greased and frequently inspected by the personnel of the engineering department to reduce human error (Ranganathan, 2022: 16). However, as noted by participant responses maintenance should not be overdone as this can increase the risk of operational errors among employees (Mentes, Mollaahmetoğlu & Akyildiz, 2024: 17).

This analysis highlights various elements utilised in the comprehensive loss control strategy, including hazard identification, risk assessment, safety audits and inspections, safety communication, safety education and training, safe design, accident investigation, accident reporting, and the implementation of the hierarchy of controls (Shabani, Jerie & Shabani, 2023a/b/c: 93). Health and safety risks can be successfully managed through a five-step process: identifying hazards, assessing risks, implementing risk controls, documenting the findings, and reviewing the controls (Fayshal, Ullah, Adnan, Rahman & Siddique, 2023: 30).

Maintenance is important in achieving production targets and ensuring the workplace is safe. For example, electromechanical equipment and facility infrastructure within automotive manufacturing industries are expected to perform optimally during the operational phase of production (Ramerea & Laseinde, 2021: 229). According to automotive manufacturing industry statistics, a significant problem in the automotive production plan is associated with unexpected downtime, primarily linked to aging equipment (Ramere & Laseinde, 2021: 229). During production downtime, much time is lost to fault-finding, repairs, and replacement of faulty components within production lines. This transforms into low throughput in production, and performance gradually declines during the operational life cycle of the equipment. The condition-based performance level prediction is designed to help formulate maintenance schedules and strategies that eliminate human error incidents/accidents. Automotive manufacturing industries face challenges that pressure them to deal with serious accidents caused by human error, which hamper industrial systems' operations. The myriads of challenges associated with human error have been linked with factors such as aging infrastructure, poor system reliability, uncertainties, and changes in the regulatory requirements of the automotive sector.

The ageing infrastructure in the automotive manufacturing industry results in a high incidence of accidents caused by human error. This results in high operational costs and negatively influences the production output. System maintenance, though costly, guarantees the reliability of manufacturing machinery and limits the incidence of human error that causes accidents. Accidents that result from human error have contributed to huge costs as the automobile industry tries to reduce these errors. In Europe,

approximately 150 billion Euros are spent annually on industrial maintenance to avoid human error. In other industries, approximately one-third of the maintenance budget is lost to unnecessary, unplanned maintenance activities due to improper maintenance plans.

Faults, natural breakdowns, and external factors such as human error interrupt manufacturing machinery and systems. Factors contributing to system downtime are equipment or hardware failures, vandalism, natural events, operating errors, third-party collisions, and other unsubstantiated causes. The manufacturing system is a combination of different equipment and hardware interdependent on one another to achieve line system objectives. Equipment failure occurs when any part or component of the system malfunctions or fails, which results in a stoppage and, sometimes, accidents. The significant problems that lead to equipment failure are sub-standardised equipment, improper installation, aged equipment, and any other system part that exceeds its life span. The causes of equipment failure can be visually identified or require technological diagnostic instruments. Engineering department employees should regularly inspect and lubricate machines and equipment to ensure appropriate maintenance (Ranganathan, 2022: 16). The first category identification in theme four looks at the implementation and formulation of SOPS and SWPs.

4.6.1 Category One: The Implementation and Formulation of SOPs & SWPs

The automotive manufacturing industry should provide SOPs and SWPs (Abanga, et al., 2023: 11). However, the compliance department of an automotive manufacturing company faces a significant challenge due to the repetition of documentation within their SOP/SWP (Delgado Santos, 2023: 1). Implementation and processing of SOPs and SWPs might be the most crucial aspect of reducing human errors while promoting workplace safety. SOPs guide employees in a structured manner as to how tasks might be performed safely and efficiently, while SWPs provide specific safety measures regarding workplace risk. Question twelve of the interview guide in Annexure A, asked the participants about the importance of SOPs and SWPs, with response as follows:

Participant one mentioned that: *“Safe work procedure is about identifying the risk within the workplace and thereafter identify the correct personnel protective equipment that is relevant to the risk to protect employees from hazards. Safety operating procedure is whereby employees are provided with a step-by-step guide to perform the task and how to operate machinery or equipment.”*

Participant two stated that*: “They provide guidance to the work activities that need to be performed.”*

Participant three explained that: *“They outline and give guidance on health and safety procedures to be followed. They guide activities carried out within the automotive industry.”*

Participant four stated that: *“They refer to the operational documents that are created locally that describe the safest and most efficient way to perform a certain task or to carry out an operation or operate a machine or a tool.*”
Participant five mentioned that: *‘’Safe work procedures and safe operating procedures are similar. It depends on the format that the company has chosen. So basically, what they're saying is, when you are creating a procedure, you need to ensure that it is specific to the task or the process. Some work areas will have safe operating procedures whereby they only talk about a certain process but are not specific to the tasks or the process, and then some work areas will have safe working procedures that are specific to a process and to a task as an individual.”*

Participant six stated that: *‘’Safe Work Procedure directions on how to work is to be carried out safely and are required for all hazard tasks performed in the workplace.”*

Participant seven mentioned that: *My understanding would say it indicates the specific task that should be performed, ensuring the consistency and safety in the operation, particularly in equipment and machines that are used. Safe Work procedures are documented in the form of a process flow, and they are very detailed in giving the instructions on how to perform a specific task while minimising the risk at the same time.”*

Participant eight stated that: "*SOPs and SWPs form the basis for creating a structured process for employees to follow, which reduces the chance of errors caused by miscommunication or uncertainty*."

Participant nine stated that: *“The involvement of employees and make them understand the risks involved due to human errors.’’*

Participant ten stated that: "*When employees are trained on SOPs and SWPs regularly, they become more aware of potential hazards and how to manage them effectively*."

Participant eleven elaborated that*: “The safe operating procedure refers to a standardised procedure that provides a certain way of doing things. It prevents ambiguity and provides steps to perform a task. Safe operating procedures are mostly used for the machinery and the equipment.”*

Participant twelve mentioned that: “*My understanding is that it helps improve communication between employer and employee. They assist with the relevant training to employees. They improve the efficiency and consistent and consistence of the work processes so the safe work procedures they assist with executing the work properly and safely in terms of health and safety.”*

Participant thirteen stated that: *“Safe work procedures are standardised processes that outline how work should be done safely. Steps taken when implementing safe work procedures are risk assessment, evaluate hazards, establishing PPE, and documenting steps. SOP gives the instruction of how to operate a machine or equipment.”*

The researcher noted that the implementation and formulation of SWP and SOP is crucial in the automotive industry to prevent the human error incidents and accidents. Participants confirmed that SOPs and SWPs are comprehensive written guidelines intended to ensure consistency in the way particular tasks are performed. These protocols specify the actions required to complete jobs in a safe manner while

guaranteeing adherence to health and safety laws. Protecting employees, from potential risks at work is the main goal of health and safety SOPs and SWP. To enhance the prospect of SOPs and SWPs fulfilling their purpose, organisations should:

- Update procedures regularly in keeping with the advancement of technology and changes in regulations;
- Train the employees consistently to reinforce their knowledge and adherence to safety parameters; and
- Conduct audits that will look at compliance status and possible improvement.

With a clear definition, regular review, and effective communication of SOPs and SWPs, the organisation will be able to significantly reduce workplace injuries and create a safe working environment. The next category examines compliance enforcement.

4.6.2 Category Two: Compliance Enforcement

The employer must play a supplementary active role in law enforcement and safety education programs (Kineber, Antwi-Afari, Elghaish, Zamil, Alhusban, & Qaralleh, 2023: 29). Regarding this, governments and regulatory bodies should establish and enforce standards for the manufacturing and automotive industries to protect the environment as well as employee safety (Adekanmbi., et al., 2024: 228). Question eight in the interview guide (Annexure A), enquired about the necessity for employers to enforce health and safety compliance. The following responses were analysed:

Participant one stated that: *“It is significant for the prevention of adverse health issues and injuries from occurring due to working conditions and the working environment, and to keep a safe workplace and prevent incidents and accidents”.*

Participant two mentioned that: “*To ensure that the people work safely and to comply with the requirements of safety regulations of South Africa. The laws obligate the company or the employer to enforce laws so that the laws will guide people to accept”.*

Participant three stated that*: "For promotion of health and safety in the workplace, for increased productivity, minimisation of incidents and accidents, decrease lost Time Injury Free Rate, and to promote good company reputation".*

Participant four stated that: *"It is very important because without compliance, it can result in a legal penalties or financial loss, or sometimes a reputational damage of the industry.''*

Participant five mentioned that*: "It is necessary for enforcement because if we don't have rules and regulations, it becomes difficult to control what is happening on the line. So, when you enforce, you ensure that the machines are checked, you ensure that the employees are trained, you ensure that people use their protective clothing, and you ensure that everyone follows their rules in a standard way and that whoever is not following is also taken disciplinary action in the same way, so it also reduces bias in the workplace."*

Participant six mentioned that: *"Non-compliance can result in legal penalties, financial losses, and reputational damage to the company."*

Participant seven mentioned that: "*Because they are also forced by it in terms of legal obligations, they are required by law to make sure that they comply and because it puts a mass certain penalty whereby, they are not complying and it also helps to protect our employees from injuries and that it will be paying off for my employees and it assists in reducing the accident in the workplace. It improves productivity because you will have fewer accidents on the basis that you follow all the protocols that are required in terms of identifying risks, eliminating hazards, and putting a massive operating procedure in place."*

Participant eight stated that: *"It is the employer's duty to protect their employees as per OHS Act to enforce the health and safety compliance. On the other hand, the employees are obligated to comply with the rules and regulations."*

Participant nine mentioned that*: "To reduce or prevent incidents, illnesses and fatalities. If workplace health and safety is well implemented, it guarantees reduced incidents and accidents, prevention, less stress, and an increase in productivity."*

Participant ten mentioned that: *"Safety compliance is a very important part of an organisation because to minimise injury to employees, you need to enforce safety compliance. To reduce maintenance costs, you also need to enforce health and safety compliance. Machine damage, our need to make sure that you are an employee enforcing OHS compliance and Safety, health, and safety compliance is important in that it creates a good reputation and discipline among employees, especially if it is properly adhered to."*

Participant eleven noted that: *"They can be fined for not complying. So, it is important for the employee's benefit. Health and safety compliance does not only entail the prevention of incidents, but it ensures efficiencies in quality services to be provided so it's quite important to enforce and ensure everyone abides. It also ensures that there is no ambiguity in the processes everyone works the same way everyone understands the same thing and therefore everyone complies with the minimum legislative requirements. It's quite important to have the laws enforced."*

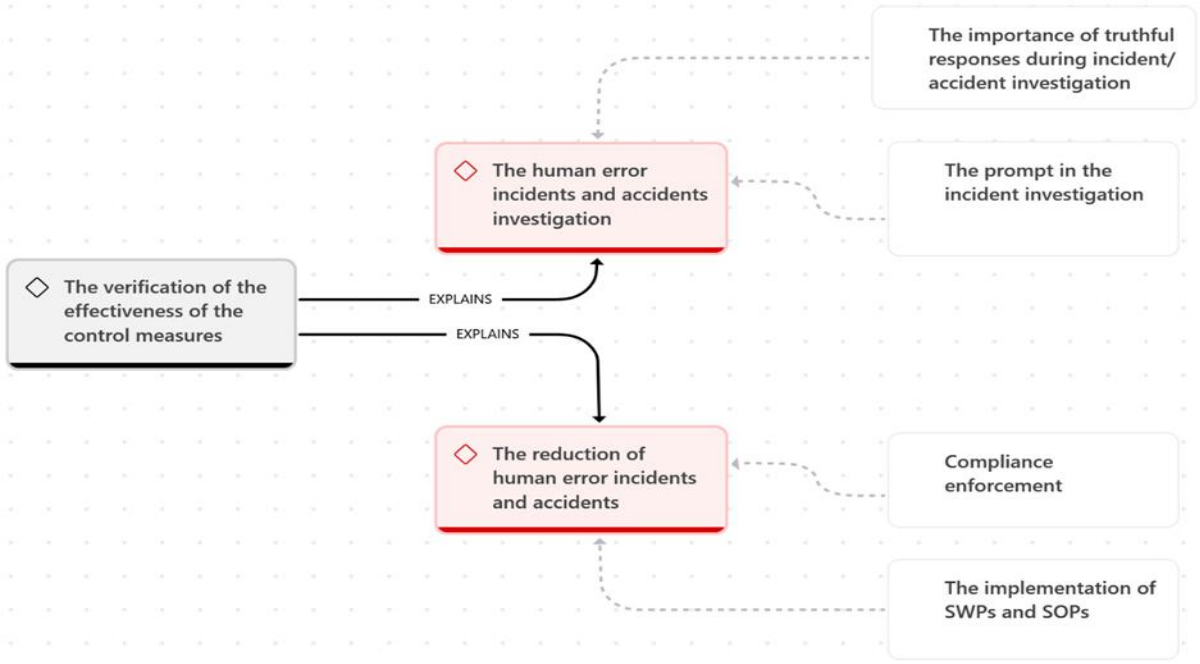
Participant twelve mentioned that: *"To prevent loss and damages to the company assets. If there is no enforcing of the health and safety complaints, there will be legal issues. The employer needs to protect its employees anyone entering the premises like visitors. They need to be protected against injuries, diseases, death. To also ensure that everyone in the workplace complies with the health and safety requirements."*

Participant twelve mentioned: *"Enforcement of health and safety compliance helps the employer to ensure that employee returns home safe and healthy. It reduces absenteeism, creates more productivity, and protects the employer from paying fines".*

Literature in OHS suggests that a lack of employer compliance with health and safety programs has a negative impact on employee production and organisational

performance (Shabani, Jerie, & Shabani, 2023c: 296). Figure 4.3 below illustrates the verification of the effectiveness of the control measures.

Figure 4.3: The verification of the effectiveness of the control measures



Source: Researcher's development from Atlas.ti, Version 24

Theme five examines the available health and safety management systems. Table 4.2 below illustrates aggregated themes, themes, categories and codes. The table below illustrates aggregated themes, themes, categories and codes.

Table 4.2: **Aggregated themes, themes, categories and codes for checking the effectiveness of Health and Safety controls.**

Aggregated themes	Themes	Categories	Codes
The evaluation of the effective health and safety	**Theme 3:** The human error incidents and accidents Investigations	The importance of truthful responses during incident/accident investigation.	Determine the incident root cause, Incident reduction Learning from previous incidents, Minimise the chances of cheating or changing statements, root cause analysis The human error incidents and accidents investigation
		The prompt in the incident's investigation	Accurate instructions, Incident mitigation, the human error incidents and accidents investigation, the review of the previous incidents, to obtain proper information
Control measures	**Theme 4:** The reduction of human error incidents and accidents	Compliance enforcement	Injury on duty, Loss Time Injury Free rate, Productive employees, Profitability, Safety protocols. The reduction of human error incidents and accidents
		The implementation of SWPs and SOPs	Guidelines, Job specification, Outlines the steps to do a task, Review of SOPs, Safe work procedures The reduction of human error incidents and accidents

Source: Researcher's own compilation

Theme five examines the available health and safety management systems.

4.7 THEME 5: AVAILABLE HEALTH AND SAFETY MANAGEMENT SYSTEMS

This theme is related to objective three of this study, which sought to examine the functionality and effectiveness of Health and Safety Management Systems (HSMS) currently in use in the automotive manufacturing sector. The data analysis generated two main sub-themes: (1) organisational safety culture and (2) evaluation of safety systems, both of which are discussed further in this chapter. A systems-thinking approach has become central to effective safety management in modern industries. ISO 45001:2018 represents a globally recognised framework that integrates safety performance into an organisation's business processes, leadership, and continuous improvement structures (Karanikas, Weber, Bruschi, & Brown, 2022: 3). The standard focuses on proactive hazard identification, risk assessment, and the implementation of dynamic controls that are supported by an engaged workforce and top management commitment. To assess how these principles are operationalised in practice, question fifteen in the interview guide (Annexure A) asked participants to describe the risk management systems currently in use in their organisations. The responses indicated that participants were aware of various legislative, procedural, and analytical tools applied to manage occupational health and safety.

Participant one explained that: "*the company uses job hazard analysis, human factor management such as medical surveillance, ISO standards, policies, and regulations*".

Participant three stated: "*It is the International Standards for Organisations (ISO), it's the Occupational Health and Safety Act 85 of 1993, it's COIDA, Labour Relations, and NEMA."*

Participant six added: *"We follow internal audit checklists and performance review procedures based on our ISO compliance."*

Participant seven noted: "*There is a safety manual, and monthly audits are conducted." Participant eight shared that their company has incident monitoring software and weekly toolbox talks, integrated with the HSMS".*

Participant nine highlighted more detailed methodologies: *"We have process mapping, flow charts, hazard operating procedures, fault tree analysis, and the 4S system, which means Sort, Set in Order, Shine, and Standardise".*

The 4S system, referenced by participant nine, is a simplified adaptation of the widely known 5S methodology originally developed in Japan as part of lean manufacturing principles. While the traditional 5S system includes Sort, Set in Order, Shine, Standardise, and Sustain, some organisations streamline this to 4S for operational simplicity. These principles focus on maintaining a clean, orderly, and standardised work environment, which reduces workplace hazards and improves human performance reliability (Singh & Pathak, 2023: 112).

From these responses, it is evident that most automotive manufacturing organisations have implemented structured health and safety systems that draw on a combination of legal regulations, international standards, and internal auditing tools. However, the depth of integration and consistency of application vary significantly between organisations. For instance, while some participants referenced proactive methods such as job hazard analysis and incident monitoring, others pointed to passive compliance with legal documents that may not always translate into action.

The variation in responses is reflective of broader trends in industry, where safety systems exist on paper but may not always be integrated into operational behaviour. The effectiveness of a safety management system depends not only on its design but also on its adoption by both leadership and employees. ISO 45001:2018 emphasises that the true value of an HSMS lies in its ability to trigger action and foster a learning culture, not just its documentation (Benson, et al., 2024: 11).

In the context of the Human Error Incidents Prevention Framework developed in this study, health and safety systems fall within the Systemic Prevention Layer, which includes planning, execution, review, and learning mechanisms. Systems that are dynamic, inclusive, and adaptive allow for faster feedback loops, which help organisations respond to near misses, evolving hazards, and employee concerns in real-time.

In summary, most participants demonstrate awareness of formal safety systems including ISO 45001:2018, OHSA 85 of 1993, and internal audits. As such there is a clear need for improved integration, particularly in aligning system design with practical behaviour. A strong HSMS must not only meet compliance obligations but must also support real-time communication, performance feedback, and continuous safety improvements at all levels of the organisation.

Objective three of this study sought to examine health and safety management systems. Pursuant to this objective, the data analysis resulted in the generation of two themes: (a) organisational safety culture and (b) evaluation of health and safety systems. Each theme contains two categories.

Systems thinking has become an essential methodology for effective management, particularly in the realm of occupational health and safety. This is underscored by the recent release of the international standard known as ISO 45001:2018, which focuses on occupational health and safety management systems (Karanikas, Weber, Bruschi, & Brown, 2022: 3). Question fifteen in the interview guide (Annexure A) required the participants to indicate the risk management systems that are utilised in the automotive industry.

Participant one stated: *"We have job hazard analysis, human factor management such as medical surveillance, ISO standards, policies, and regulations"*.

Participant three mentioned: *"It's the International Standards for Organisations (ISO), it's the Occupational Health and Safety Act 85 of 93, it's the COIDA, Labor Relations, and NEMA".*

Participant nine stated that: *"We have process mapping, flow charts, hazard operating procedures, fault tree analysis, and the 4S system, which means sort, set in order, shine, and standardise".* The next section examines the organisational culture.

4.7.1 Category one: The Organisational Culture

Establishing a safety culture in the organisation promotes shared values and an environment of accountability where everyone considers safety in their daily activities. Evidence suggests that companies with good safety culture report fewer accidents and safety violations (Zohar, 2021: 132). The participants mentioned that leadership commitment is one of the core drivers. This section explores how organisational culture influences health and safety behaviours, decision-making, and the implementation of safety controls. It draws on safety culture theory, which views culture as a shared set of values, beliefs, and practices that shape how safety is perceived, prioritised, and practiced (Bisbey, Kilcullen, Thomas, Ottosen, Tsao & Salas, 2021: 88). It is also informed by Transformational Leadership Theory, which emphasises the role of leaders in shaping and sustaining a safety-oriented culture through inspiration, support, and role modelling (Bass & Riggio, 2019: 66). Participants provide diverse insights into how culture affects compliance, accountability, and safety ownership. While some describe proactive and supportive cultures, others report indifference, blame, or fear-driven environments.

Participant six mentioned that: "*If leadership is not actively involved in promoting safety, employees are less likely to adhere to safety protocols*".

Therefore, to strengthen the organisational culture, companies should promote safety leadership, encourage open communication, and include safety performance measures in the overall business objectives. The next section explores the evaluation of health and safety management systems.

4.7.2 Category two: The Evaluation of Health and Safety Management Systems

Organisations monitor compliance with safety risk management controls and requirements to prevent risk incidents. The automotive industry conducts proactive monitoring activities such as safety audits and behavioural observations (Aderamo, Olisakwe, Adebayo & Esiri, 2024: 72). Question sixteen in the interview guide (Annexure A), asked participants to indicate things that are done to verify the functionality of the current health and safety management practices within the automotive industry.

Participant one mentioned that: *“It can be verified by conducting equipment expansion inspections, by checking safety targets and objectives for employees are met, doing follow-ups to determine whether health and safety culture is adhered to, by interviewing employees about safety resources that are available to them, for example, safety signs, emergency plans and safety data sheets’’.*

Participant two explained that: “*You need to measure the strategies if they are met. If not, then you have to find out why and where are the shortfalls and correct them if necessary’’.*
*Participant three mentioned that: ’’*E*xternal auditing, regular inspections, ensuring compliance with current and updated regulations”.*

Participant four stated that: ‘’Ongoing training, audits, and inspections”.

Risk management plays a key role in uncertain times, preventing organisations from acting rashly and incorrectly, allowing them to become flexible and resilient (Settembre-Blundo, González-Sánchez, Medina-Salgado & García-Muiña, 2021: 107). However, regular assessment of safety systems was reported as necessary for continuous improvement. Studies suggest that frequent audits enhance safety compliance by 35% (Injurysafetyfacts.nsc.org, 2021). Safety audits, incident reviews, and employee feedback mechanisms allow organisations to identify gaps in safety programs and implement necessary improvements.

4.8 THEME 6: HEALTH AND SAFETY CHALLENGES

This theme addresses one of the central challenges emerging from this study. That is the persistent barriers that undermine the effectiveness of workplace health and safety practices in the automotive manufacturing environment. These challenges directly influence the occurrence of human error and contribute to a breakdown in safety systems. The sixth theme (theme 6) supports the broader objective of understanding how current systems can be improved to reduce incidents and promote a safer working environment. Thematic analysis generated three interrelated categories, which is long

working hours, fatigue management and shift optimisation, and assessment of health and safety systems. Question five in the interview guide (Annexure A), requested the participants to indicate what can be done to ensure that workplace challenges and failures are resolved to prevent the occurrence of incidents and accidents. Participants responded as follows.

Participant one mentioned that: *“By conducting proper and regular inspections, management should ensure that faults are fixed immediately, and employees should be provided with refresher training”.*

Participant two stated that: *“At the workplace, there must be zero tolerance to drug abuse. There should be proper screening at the gate to stop employees who are intoxicated from entering the workplace. That's the zero-tolerance approach on alcohol and drugs. Number two is to provide the adequate training. Number three is to make sure instructions are simple and are well communicated”.*

Participant three mentioned that: *“Investigation of all incidents, appointment of functional health and safety committee, and co-ordinate with the automotive industry”.*

Participant four explained that: *“I will say, when a member is operating a machine, you must do a daily safety check on the machine. On the surroundings, they must do a proper 4S, which is set in order, shine, sorting, and standardise to puts everything in its place. That can reduce the accident if maybe we can follow those rules. There must be a daily safety training and the refresher training safety work, walkways and as well as the safety signs safety rules, all those things it must be put in place to prevent an accident”.*

Participant five mentioned: *”Ongoing training on safe working procedures, daily safety talks, safety awareness, supervision by a competent individual”.*

Participant six elaborated that*: ‘’That could be training safety awareness and ensuring that all employees who are entering workplaces are sober-minded. You can use a*

breathalyser test to ensure that they are sober-minded when they enter get into the workplace".'

Participant seven explained that: *''By conducting regular training, safety awareness and ensure that employees are up to date with the best practices and procedures. Employees should be well skilled whereby you conduct things like daily and pre-task talks whereby you align with them and make them aware so that you make sure that these are eliminated. It must promote a clear communication and encourage employees to share their concerns and ask questions when necessary or where they are not clear about giving task or the things that are happening within the organisation and allow them to give feedback based on what they look at, the environment or scenario. That's if I raise such a concern. I'm putting my job on the line. When you develop or when you communicate your SOPs, make sure that your SOPs and your risk assessment are clear when you communicate with employees and most importantly you also must engage your employees in problem-solving or decision-making because r they are the ones who are directly involved in all the operation that is taking place."*
Participant eight mentioned that: *"It could be the poor communication amongst employees, poor working environment, ergonomic effects and horse play".*

Participant nine stated that: *"'Miscommunication between employees and supervisors, machinery malfunctions, poor servicing, inadequate training, refresher training, adopting to new systems of work and poor supervision".*

Participant ten elaborated that: *"Yes, would be the hiring of unskilled labour to perform the work of trained people. Employers are unwilling to equip employees with relevant training but still expect quality results from the same employees who have fewer skills. Poor communication regarding OHS rules and values can also be one of the reasons and challenges of failures in the workplace and the last one could be. Management withdrawal in supporting OHS initiatives at the workplace can also. This would be one of the workplace challenges and failures that can lead to a high rate of human error".*

Participant eleven mentioned that: *"I think that we need a committed leadership committed to management and not just senior management. We need committed leaders and supervisors who understand what being a supervisor entails. We need leadership that is given the power to manage. In other areas, you find that a supervisor is just to oversee the job, but the decision-making powers are taken from them. So, if we can have if we can empower the leaders, empower the supervisors, empower the team leaders in our operation, make sure they fully understand the importance of managing the systems safely that are there, we won't have people that are only operationally driven. If the employees themselves. They are taught. Through competent training, continuous awareness and taught, and the rules are enforced. There's no letting off on it then you can have quite a good safety culture, and everyone will be quite aware of what is happening around them what not to do and what to do. When something when there's a name is for example, and everything is resolved prior then we there won't be human error-based accidents because we can spot the incident the potential of having an incident even before it happened and then it can be resolved".*

Participant twelve mentioned that: *"Lack of management support in the workplace. A lack of support from management in terms of enforcing health and safety. Employees not addressing to the health and safety rules and regulations. Top management not providing support to employees in terms of health and safety queries".*

Participant thirteen mentioned that: "This could be improper housekeeping, some employees fail to follow 4S rules which is sought, shine, standardize, and sustain. Insufficient synergies within the plant, other synergies are failing, and you cannot see or read what is written on it".

The researcher noted that most participants collectively reflect the organisational and operational constraints faced by both employees and safety managers in high-risk environments. Many of the responses focused on procedural gaps, lack of refresher training, drugs and alcohol abuse (intoxication), insufficient team communication, and

weak supervision, all of which can contribute to the conditions in which human error occurs. The next section examines the long working hours.

4.8.1 Category one: Long Working Hours

This section examines how extended working hours impact workplace safety and contributes to human error. The discussion is informed by Fatigue Risk Management Theory, which emphasises that physical and cognitive fatigue from long working hours impairs concentration, decision-making, and reaction time (Sprajcer & Vincent, Dawson, 2025: 24). Additionally, Human Factors Theory recognises fatigue as a critical risk factor in error-prone environments, particularly in shift-based and high-demand industries.

Question four in Annexure A enquired about the main causes of the human error incidents/incidents within the automotive industry. Participants linked long working hours to fatigue-related human errors and inefficiencies as the cause of incidents/accidents. Participants mentioned the different causes of human error incidents, including long working hours as a main cause.

Participant one stated that: *"Some of the causes of human error can be stress, fatigue, long working hours, improper equipment and machinery operation, negligence, shortcuts, miscommunication, time pressure, poor design, and equipment failures"*.

Participant four mentioned that: *"The main factor or cause is when a member is not following the safety operational rules of the machinery, and sometimes the member uses shortcuts to arrange the target. Normally leads to an accident or if you are using a shortcut sometimes, so you're not following all the safety procedures. That is in line with the operation. Poor supervision, lack of experience, and working long hours also cause human error incidents".*

Participant seven elaborated that: "Physical and mental fatigue are considered the main causes of human error incidents. When an employee is fatiguing, the level of concentration gets poor, and that results in poor decision-making. The second point is the ignorance of SOPs, whereby you find employees are taking shortcuts when they are

performing their tasks. They fail to follow the safety steps. Environmental factors such as poor lighting and uncomfortable workplace conditions also contribute to human error incidents. The lack of support in general from your leadership or your management. It's also contributing, or a lack of resources as well, and mostly a lack of training to employees".

The literature suggests that increased working hours place employees at a higher risk, raising incidents/accidents statistics by about 40% higher (Black & Taylor, 2023: 45). Fatigue-related human errors have emerged as leading risk factors in high-risk industries, resulting in poor decision-making and delayed reaction times. Indications are that structured shift patterns and mandatory rest periods will significantly mitigate fatigue-related risks (Yue, Ye, Liu, Yang, Xiang & Luo 2024: 1).The implementation of a workload management system complemented with flexible scheduling can further optimize the effectiveness of employees to keep alert and productive. Actions to alleviate these risks include:

- Adopting a shift rotation policy to protect employees from burnout;
- Ensuring availability of rest breaks; and
- Monitoring workload to ensure that no individual employee accrues excessive hours.

4.8.1.1 Fatigue Management and Shifts Optimisation

In every aspect of life especially in the automotive manufacturing sector, fatigue is a frequent cause of human error incidents/accidents (Dabkowski, Porter, Smith, Fernando, Seaward, Simic, 2025: 1). It is noted that the automotive manufacturing industry continues to occupy tasks that require significant human labour, characterised by numerous repetitive actions which in combination with various other factors lead to employees' fatigue or exhaustion (Lambay, Liu, Morgan & Ji, 2021: 1). Furthermore, fatigue negatively affects cognitive and automotive performance, leading to decreased productivity and a heightened risk of injury (Martins, Annaheim, Spengler & Rossi, 2021: 1).

Fatigue is a major contributor to errors at work, especially in fields demanding high concentration and attention. Fatigue is said to be a leading cause of workplace accidents, contributing to increased errors, reduced alertness, and higher accident rates. Studies show that organisations with these safety measures report fewer fatigue-related accidents while improving the overall welfare of their employees (Neal & Griffin, 2023: 110). Fatigue impacts the risk of human error incidents/accidents. Excessive workload leads to a failure in work strength, endurance, and productivity, which raises the risk of human error accidents at work (Gidiagba, Leonard, Olurin, Ehiaguina, Ndiwe, Ayodeji, & Banso, 2024: 39). A multifaceted approach should be followed when managing fatigue, including optimising shifts. Question four enquired about the main causes of human error incidents/incidents within the automotive industry (Annexure A).

Participant two stated that: *"The use of drugs in a working environment, poor training, lack of concentration due to fatigue. Alcohol abuse might be one of the causes. Alcohol and drug abuse are all classified as causes of human error incidents".*

Participant three mentioned that: *"Intervention training, poor work procedures, poor supervision and lack of management support".*

Participant five mentioned that: *"Stress caused by working under pressure, trying to reach targets, and socialising or lots of conversations while working. The anxiety leads employees to make mistakes".*

Participant six explained that: *""Human errors are caused by incompetence, lack of awareness of taking drugs, and drinking alcohol in workplaces".*

Participant eight noted that: "*By not following the equipment isolation procedure, which could lead to spillages, major equipment damage, fires or fatalities".*
Participant nine elaborated that: "Stress which can affect an employee psychologically, fatigue, reduced ability to process information and memory lapse, multiple tasking which can increase the risk of making mistakes, and financial issues".

Participant thirteen: “*We implemented mandatory rest breaks and shift rotations to ensure that employees remain alert and productive throughout their shifts”*.

Introducing technology-based fatigue detection systems will assist in identifying fatigue before it starts to affect job performance and enhancing risk surveillance to help mitigate fatigue induced errors at work, which could be detected through effective health and safety management systems.

4.8.2 Category two: The Assessment of Health and Safety Management Systems

Assessing a HSMS requires an effective evaluation and legislative compliance. Such an assessment includes evaluating the system's structure, implementation, and performance through various methods like risk assessments, audits, and performance monitoring. Question six (Annexure A) asked participants to give a few examples of the workplace challenges and failures that lead to high rates of human error incidents and incidents in the automotive industry.

Participants noted that resource limitations pose a significant challenge to the effective evaluation of health and safety management systems. Among other resource-related challenges, this finding suggests that limitations on budgets often hinder the implementation of safety training.

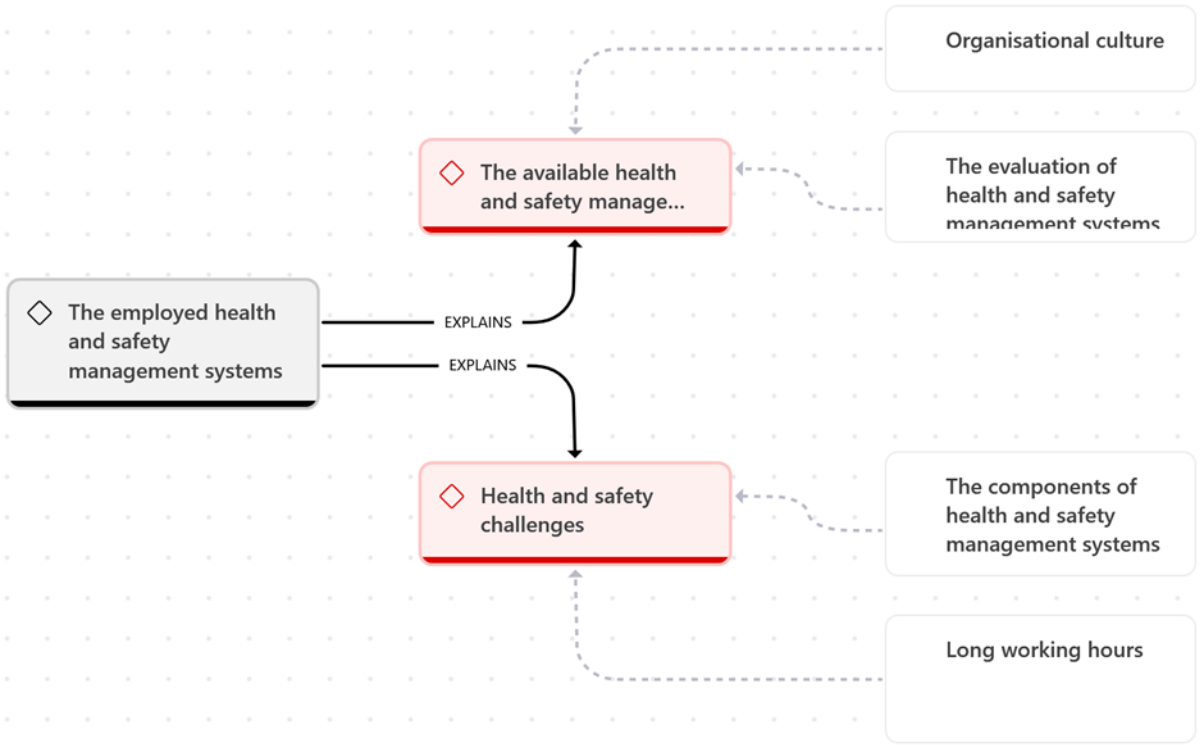
Participant ten mentioned that: “*The inadequacy of funding results in obsolete safety programs, absence of refresher training, and little or no remediation of hazards”.*
Participant twelve elaborated that: "*Without proper investment in safety assessments, the organisations risk not being compliant, and a greater danger in the workplace”*.

Regular safety checks empower compliance of workplace regulations and highlight the need for improvement. Suárez-Albanchez, Blazquez-Resino, Gutierrez-Broncano and Jimenez-Estevez (2021: 9), state that organisations intending to work on health and safety evaluations exhibit a significant decrease in incidence rates within the workplace. To enhance the functioning of the health and safety system assessment, organisations should:

- Be willing to fund safety audits and risk assessments adequately;
- Introduce technology-aided evaluation instruments, such as digital safety dashboards and Artificial Intelligence (AI)-based risk analysis; and
- Stimulate employee participation in safety policy reviews and hazard identification programs.

The implementation of these strategies would position organisations to be legally compliant while continually improving their safety systems, thus reducing human-error hazards (Smith, Brown & Jones, 2023: 88). Figure 4.4 shows the factors contributing to human error incidents/accidents.

Figure 4.4: Factors resulting in human error incidents/accidents



Source: Researcher's own illustration generated from Atlas.ti Version 24

Table 4.3 on the next page illustrates aggregated themes, themes, categories and codes mapped by the research in pustule of the study objectives.

Table 4.3: **Aggregated themes, themes, categories and codes for causes of human error incidents/accidents**

Aggregated themes	Themes	Categories	Codes
The developed framework that identifies factors that result in human error incidents/ accidents.	**Theme 5:** The common factors of human errors	The working conditions and environment	Conflict amongst employees. Health and safety working conditions. Safe working environment. The common factors of human errors.
		Root cause of human error	Application of 4S system, Distraction. Equipment failure. Horse play, Housekeeping, Improper maintenance Lack of experience, Management support, Mechanical designs, Negligence, Non-compliance with rules Shortcuts. The common factors of human errors
	Theme 6: The consequences of human errors	The impact on productivity	Breakdowns, Increase absenteeism, Insufficient profit. Legal penalties, Losses, Poor quality. The consequences of human error.
		The psychosocial factors	Alcohol and drug abuse, Financial and psychosocial well-being, Personal problems, Stress, Emotional abuse, and Underlying factors

Source: Researcher's own compilation

Human errors are a significant factor contributing to automotive incidents/accidents where common factors include lack of attention, fatigue, and poor judgment. The next section explores these common human-error factors.

4.9. THEME 7: COMMON FACTORS OF HUMAN ERRORS

The objective of this study was to examine the factors that resulted in human error incidents and accidents. The data analysis formulated three themes, each containing two categories, where question six asked participants to list a few examples of workplace challenges that leads to human error incidents/accidents. Table 4.4 below illustrates the types of hazards, participants who mentioned them, frequency, and their priority rank.

Table 4.4: Types of hazards and the study ranking

Hazard/Factor	Participants Who Mentioned the Hazard	Frequency (No. of Mentions)	Priority Rank
Fatigue due to long hours	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P12, P13	12	1
Poor lighting/visibility	P3, P4, P6, P8, P9, P10, P11	7	2
Inadequate training	P1, P2, P5, P6, P7, P12	6	3
Unsafe machinery/equipment	P2, P3, P4, P7, P10	5	4
Lack of supervision	P5, P6, P9, P11	4	5
Poor communication	P2, P7, P8	3	6
Time pressure/ production targets	P1, P6, P13	3	6
Distractions in work environment	P4, P9	2	7
Peer pressure/ workplace norms	P11, P13	2	7
Lack of SOPs or unclear procedures	P3, P12	2	7

Source: Researcher's development from Atlas.ti Version 24

4.9.1 Category one: Root Causes of Human Errors

Human errors in the workplace originate from several root causes, ranging from individual to organisational and environmental factors. Question one asked the participants to explain what they consider human errors to be the root cause of incidents/accidents (Annexure A). Participants cited what they consider to be primary contributors, such as inadequate training, lack of supervision, poor communication, and systemic inefficiencies.

Participant five mentioned that: "*Supervisors are key to maintaining safety, but when there is no supervision, the employees are likely to take shortcuts or ignore protocols"*.

Participant seven stated that: "*Employees making critical safety errors when not properly supervised and trained"*.

Participant nine mentioned that: "*Often, misunderstandings between employees and management regarding safety procedures cause mistakes"*.

Insufficient training remains a significant cause of human errors, as employees who have not been properly trained in SOP and SWP are very likely to breach these procedures. A further major source of human error is the lack of supervision. Supervision should ensure that employees follow safety protocols, take responsibility, and provide guidance during high-risk activities. A study by Smith and Jones (2021: 88) shows that organisations that support supervision have a lower incidence rate and greater compliance. Inadequate communication in workplaces was also considered as one of the main causes of human error.

As such, addressing root causes is vital to reducing workplace incidents and accidents and promoting an overall safety culture. By tackling these root causes, such as training gaps, supervision gaps, failures in communication, and systemic inefficiencies, organizations can safeguard their operations through an active approach to minimising potential workplace incidents/accidents and effective communication strategies.

4.9.1.1 Poor Communication

Another example given by participants in question six was communication. Poor communication impacts safety and result in human error incidents/accidents (Viswanthan & Nisa, 2024: 68). In many cases, these accidents occur due to a lack of proper training or understanding of company policies (Bandari, 2023: 6). However, the research has revealed a dual impact of mechanisation, offering opportunities for enhanced operational efficiency and safety while also posing challenges related to workforce displacement and the need for extensive re-skilling (Popoola, Akinsanya, Nzeako, Chukwurah & Okeke, 2024: 1467). Question six of the interview guide (Annexure A) asked participants to give a few examples of the workplace challenges and failures that lead to a high rate of human error incidents and incidents in the automotive industry.

Participant seven stated that: "*If you have inadequate training on equipment in operation that will lead to improper use of equipment, a poor communication or giving instruction that are not clear, then that will contribute to human error incidents. The safety procedures give clear, clear guideline when they are communicated. Long working longer hours or working without adequate rest will also contribute. Insufficient resources they will also contribute because if the resources are insufficient people would do things in a short cut way so that they meet these targets at the end of the day. Resistance to change like for example if there is a new technology system that is being used. Whereas people are used to working manually, then it takes time and then that will be contributing. If maybe I will say as an employer, you are unable to explain and sell your technology to employees for them to understand it. This is going to assist them to execute their work in a quicker way".*

Participant eight mentioned that: *"It could be the poor communication amongst employees, poor working environment, ergonomic effects and horse play".*

Participant nine elaborated that: *"Miscommunication between employees and supervisors, machinery malfunctions, poor servicing, inadequate training, refresher training, adopting to new systems of work and poor supervision".*

Participant ten explained that: *"Yes, would be the hiring of unskilled labour to perform the work of trained employee. Employers are unwilling to equip employees with relevant training but still expect quality results from the same employees who have insufficient skills. Poor communication regarding OHS rules and values can also be one of the reasons and challenges of failures in the workplace and the last one could be. Management withdrawal in supporting OHS initiatives at the workplace can also. This would be one of the workplace challenges and failures that can lead to a high rate of human error".*

Communication is vital as it allows employees to speak freely about health and safety issues. As such, employees must learn communication skills that will enable them to feel comfortable doing so (Siewert, Brook, Swedeen, Eisenberg & Hochman, 2019: 261). Miscommunications between employees and their supervisors can lead to misconceptions, resulting in errors or mishaps (Orikpete, & Ewim, 2024: 5). Working with a lack of information and communication could lead to inconsistent decisions made between teams and a misunderstanding of what the aims of the system are (Wiggins, 2024: 12). There is a need for managers and policymakers to develop improved methods of communication around OHS policy (Lestari, Sunindijo, Loosemore, Kusminanti, & Widanarko, 2020: 15).

4.9.2 Category two: The Working Conditions and Environment

These factors affect employees' concentration, decision-making capability, and safety. The participants commented on a substandard working environment, which they argued increases the probability of accidents at work. Question eight of the interview guide in Annexure A asked participants about the benefits of employee regulations such as OHSA 85 of 1993, COIDA, NEMA, and Labour law. This research revealed that through the application of laws, the employer gains the benefits of stability and the prevention of disputes. The benefits to employees include working in a safe environment.

Participant one: *“It is significant for the prevention of adverse health issues and injuries from occurring as a result of working conditions and the working environment, and to keep a safe workplace and prevent incidents and accidents”.*

Participant two explained that: *”The advantage is to regulate the working conditions and then give guidance as to what must be followed to create a safe working condition. The other thing is it will obligate both employees and employers to accept”.*

Participant thirteen mentioned that: *“Protects employees in the workplace and forces the employer to protect employees against unhealthy and unsafe conditions. Compensation of Injuries and Diseases Act protects the incident reporting and the compensation of injuries and illnesses sustained by employees during work or at work. NEMA promotes the protection of the environment against spills and other pollution such as air pollution. Labour law protects employees from any dispute.”*

Extant literature in this area of study backs this assertion that poor lighting diminishes the ability to see properly and reduces reaction time, thus driving a plus 30% increase in workplace incidents (Neal & Griffin, 2023: 142). South African National Standards (SANS) 10400 Regulation 3 of the Environmental Regulations for Workplaces states that a workplace must have adequate lighting that meets the minimum levels required for each task, which are listed in the Regulations' Schedule. SANS 10400, Regulation 3.3 stated that a workplace average illumination must be at least one-fifth of the task's average illumination at any floor level in the workplace that is five meters away from it. It is paramount to have the correct illumination for reducing human error and guaranteeing safety for personnel, especially in places where high risks exist.

Ventilation and air performance were also mentioned as environmental issues. Various studies claim that employees in poorly ventilated workplaces suffer from headaches, drowsiness, and concentration loss, all of which contribute to errors and accidents at work (Brown, Green & White, 2022: 98). An organisation can therefore improve the air quality by installing ventilation systems, ensuring regular air filtration, and minimising the use of hazardous substances.

Participant six stated that: “*Poor air circulation and exposure to harmful fumes lead to worker fatigue and reduced cognitive function, making errors more likely”*.

Another major factor was high noise levels, to the extent that employees cannot hear each other. Exposure to extreme temperatures can lead to dehydration, fatigue, and slower reaction times, which negatively impact workplace safety. Implementing climate control measures, providing hydration stations, and adjusting work schedules during extreme weather conditions can help mitigate these risks.

Participant nine mentioned: ”*In such noisy environments, it becomes very hard for them to communicate with each other, leading to misunderstandings and errors, especially in high-risk environments”*.

4.10 THEME 8: CONSEQUENCES OF HUMAN ERRORS

Due to human nature's biological and psychological possessions, human errors cannot be excluded (Groysman, 2024: 10). As such, the consequences of human errors range from minor incidents to catastrophic and fatal incidents/ accidents (Orikpete & Ewim, 2024: 4). Human errors not only pose risks to the health and safety of employees, but it also directly impacts the organisations productivity and operational costs. Gaunt (2024, n.d.) refers to human errors as a human action that deviates from what was intended, resulting in an undesirable outcome. Question two in the interview guide enquired about what participants considered to be a negative impact of human errors on employees or teams in the automotive industry (Annexure A).

Participant one stated that: *“Employees can experience physical harm such as injuries, fatalities, and financial losses due to medical expenses”.*

Participant four stated: “*Accidents can cause loss of lives or injuries. If human errors can result in an accident, there will be a loss of production and income eventually”.*

Participant ten elaborated that: *“This would be fatal accidents, job losses or financial losses”.*

It follows that there was consensus among participants that human error incidents and accidents can result into fatalities, injuries, production and profit loss. The data analysis resulted in two themes that will be elaborated in the next sections.

4.10.1 Category one: The Impact on Productivity

Question two in the Annexure A asked about what is considered to be the negative impact of human errors on employees or team of employees. Participants emphasised how human errors lead to decreased productivity and increased operational costs. Employees' safety, health, and productivity depend on the timely identification and remediation of potential risk factors (Patel, Chesmore, Legner, & Pandey, 2022: 1). Manual gathering processes are susceptible to human errors, which can reduce the quality of the final product (Torres, Nadeau & Landau, 2021: 1).

Participant two responded that: *“Accidents can cause loss of lives or injuries. If human errors can result in an accident, there will be loss of production and income eventually”.*

Participant three: *“Even minor errors can cause major disruptions, delay projects and increase operational expenses”.*

To prevent these losses, organisations should implement continuous improvement strategies, such as error-proofing of work processes and introducing automated safety mechanisms.

4.10.2 Category two: The Psychosocial Factors

Human errors incidents/accidents are significantly influenced by psychosocial factors. This includes aspects of employee perception of their work environment. Leading psychosocial factors are stress, mental health issues, and human error mistakes that contribute to incidents/accidents (Dodoo & Al-Samarraie, 2023: 12).

Question four of the interview guide (Annexure A) enquired about the root causes of human error incidents/accidents. Participants discussed the emotional and psychological consequences of human error on employees and teams. According to research these workplace incidents/accidents are due to stress, job dissatisfaction, and mental health issues among other causes. Research by Dyreborg, et al. (2022: 29) state that organisations that consider the well-being of their employees' report about 30% reduction in safety incidents/accidents.

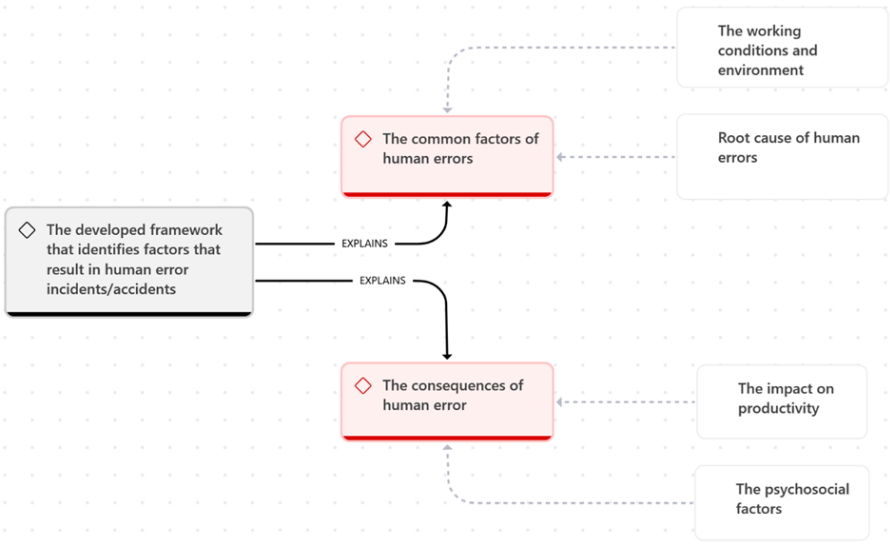
Participant five stated that*: "I think stress cause by working under pressure trying to reach targets. Also, lots of conversations disturb the next person. The anxiety of trying to avoid mistakes ends up to people creating mistakes".*

Participant nine mentioned that: *"Stress which can affect an employee psychologically, fatigue, reduced ability to process information and memory lapse, multiple tasking which can increase the risk of making intake and financial issues".*

Participant eleven mentioned that: *"It should be behaviour-based perhaps what we normally call negligence. A person knows what they are supposed to do and then choosing not to do it. It would be a person's behaviour. Inadequate supervision, poor job training. It would be a person who's not familiar with the task or who does not perform the task regularly. So then when they do it after some time there will be those gaps and errors that can happen so if it's quite a host of things sometimes it could be some personal mental health issues or psychological issues at home that distract a person. Is quite dangerous in a working environment in an inner production environment because they are distracted, so their mind is not at work while working, it is somewhere else".*

Offering mental health programs, improving communication channels, and keeping workloads manageable will help reduce stress-related errors, thereby creating a conducive working environment.

Figure 4.5: Factors resulting in human error incidents/accidents.



Source: Researcher's own illustration as extracted from Atlas. ti Version 24

Human errors are a significant factor contributing to automotive incidents/accidents where common factors include lack of attention, fatigue, and poor judgment. The next section explores the qualitative research approach.

Table 4.5 illustrates aggregated themes, themes, categories and codes.

Table 4.5: Aggregated themes, themes, categories and codes on Health and Safety Management Systems

Aggregated themes	Themes	Categories	Codes
The employed health and safety	**Theme 7:** The available health and safety management systems	Organisational culture	Health and safety programmes, Safety culture. The available health and safety management systems.
		The evaluation of health and safety management systems	Emergency preparedness. Inspection. Monitoring. Risk assessments. The available health and safety management systems.
Management systems	**Theme 8:** The health and Safety challenges	The components of health and safety management systems	Audits, Checklists and registers, Fault tree analyses. Flow charts, Formulation and review of policies. Health and safety challenges, Health and safety plan. Incentives, PESTEL analysis, planned task observations. Respond to safety concerns, Surveys.
		Long working hours	Fatigue Health and safety challenges. Time management. Working long hours

Source: **Researcher's own compilation**

4.11. QUALITATIVE RESEARCH APPROACH

This study adopts a qualitative approach, underpinned by an interpretivist paradigm, which focuses on exploring and understanding the lived experiences and perspectives of individuals working in high-risk automotive environments. This approach allows for

rich, detailed descriptions of safety practices, human error causes, and organisational systems, enabling the researcher to derive insights that are both context-specific and theoretically grounded.

4.11.1 Thematic analysis

The interview data were analysed using thematic analysis supported by Atlas.ti (Version 24). The detailed procedures for coding and theme development were fully presented in Chapter Three. Therefore, this section provides only a summary of how the method was applied in the current chapter. The researchers conducted a transcription process for semi-structured interviews with thirteen participants, which resulted in data that they then transferred to Atlas.ti for their inductive and deductive coding work. The research team used inductive coding to derive themes from participant responses while using deductive coding to verify study objectives and theoretical frameworks which included Management Theory and Safety Culture Theory. The process enabled researchers to identify main patterns which led to the creation of advanced themes that included Health and Safety Control Measures Human Error Investigation and the Consequences of Human Errors.

In this study, transcribed interviews from thirteen participants were imported into the Atlasti, Version 24, where the researcher conducted both inductive and deductive coding. Initial codes emerged inductively from the raw data without predetermined categories, capturing key statements, phrases, and concepts shared by participants. This inductive stage allowed participant voices to shape the direction of the analysis. This was also applied using themes aligned with the study objectives and supported by existing theories such as Management Theory, and Safety Culture Theory. The thematic analysis process enabled the researcher to:

- Identify frequently mentioned safety concerns (e.g., fatigue, inadequate supervision, poor communication);
- Organise codes into families based on conceptual similarities.
- Visualise code co-occurrence and frequency; and
- Develop higher-level themes such as Health and Safety Control Measures, Human Error Investigation, and Consequences of Human Errors.

The following steps were used to perform the thematic analysis (Islam & Aldaihani, 2022: 7):

Step 1: Familiarisation of data

The process of thematic analysis begins with this step. It entails transcribing data and becoming acquainted with it. Scholars go deeply into the material to identify key passages and emerging ideas. After that, they choose quotations that vividly depict the facts and suitably reflect a range of perspectives and trends relevant to the study's goals (Naeem, Ozuem, Howell & Ranfagni, 2023: 2-3). In this step, the research read the interview transcription repeatedly to be more familiar with the data.

Step 2: Generation of initial coding

Create codes by closely reading and emphasising important ideas and themes (Humble & Mozelius, 2022: 91). In this stage, the researcher coded each line and created quotations at the same time.

Table 4.6 below highlights the codes that were generated from the initial coding and the related frequencies.

Table 4.6: Code groups and frequencies from initial coding

Code	Frequencies
○ Accurate instructions	4
○ Alcohol and drug abuse	4
○ Application of 4S system	1
○ Appointment of a functional health and safety committee	1
○ Audits	8
○ Checklist and registers	1
○ Communication	3
○ Company reputation	2
○ Competency	6
○ Compliance	13
○ Conflict amongst employees	1
○ Continuous improvements	2
○ Defect identification and report	1
○ Determine the incident root cause	8
○ Distraction	2

Code	Frequencies
○ Emergency preparedness	1
○ Equipment failure.	1
○ Improper use of equipment	1
○ Fatigue	5
○ Fault tree analyses	1
○ Financial and psychosocial well being	4
○ Flow charts	1
○ Formulation and review of policies	2
○ Gaps identification	2
○ Guidelines	8
○ Hazard identification	11
○ Health and safety plan	2
○ Health and safety regulations	2
○ Health and safety working condition	7
○ Horse play	2
○ House keeping	1
○ Improper maintenance	7
○ Improves health and safety performance	2
○ Incentives	1
○ Incentives.	2
○ Incidents investigation	4
○ Incidents mitigation	2
○ Incidents reduction	4
○ Increase absenteeism	3
○ Injury on duty	7
○ Inspection	7
○ Insufficient profit	1
○ Insufficient resources	1
○ International standards for organisation (ISO)	3
○ Job specification	1
○ Key performance indicators	1
○ Lack of experience	1
○ Lack of safety programmes	1
○ Leal appointment letters	2
○ Learning from previous incidents	1
○ Legal penalties	1
○ Loss Time Injury Free rate	2
○ Losses	7
○ Machinery regulation	4
○ Management support	5
○ Mechanical designs	1
○ Minimises the chances of cheating of changing statement	1

Code	Frequencies
○ Monitoring	2
○ Negligence	4
○ Non-compliance with rules	1
○ Outlines the steps to do a task	1
○ PESTEL analysis	3
○ Planned task observations	1
○ Poor quality	4
○ Prevention of financial losses	2
○ Production increase	5
○ Productive employees	1
○ Profitability	1
○ Property and assets damage prevention	1
○ Protect the employees	7
○ Provision of PPE	2
○ Reduce incidents costs	1
○ Respond to safety concerns	1
○ Reviewal of SOPs	2
○ Risk assessments	10
○ Risk identification and mitigation.	2
○ Root cause analysis	8
○ Safe work procedures	9
○ Safe working environment	2
○ Safety awareness	5
○ Safety culture	3
○ Safety protocols	1
○ Scope of work	1
○ Shortcuts	7
○ Skills	2
○ Stress	6
○ Surveys	1
○ The reviewal of control measures	8
○ The reviewal of the previous incidents	3
○ Time management	5
○ To obtain proper information	3
○ Trainings	16
○ Underlying factors	3

Source: Researcher's own work as extracted from Atlas.ti, Version 24

Step 3: Search for themes based on initial coding

Mark preliminary codes from first impression notes that represent several important ideas that are derived straight from the data (Humble & Mozelius, 2022: 1). The code

groups and code lists were generated from Atlas.ti, Version 24 using data collected from participants. Coding is defined as the degree to which codes accurately capture and represent the text data's meaning (Han, Tavasi, Lee, Luzuriaga, Suresh, Oppenheim, Battaglia & Terlecky, 2025: 11). The selection of words is arranged by frequency and rare words are removed (Sharonova, Kyrychenko, Gruzdo & Tereshchenko, 2022: 8). Coding of meaningful themes, identifying patterns, categorising common codes and themes, conceptualising the inner meaning, generation of the underlying theory and reporting the same is brought out through the analysis (Christou, 2022: 79). Table 4.7 below indicates the code groups and code lists as derived from Step 3, explained above.

Table 4.7: Illustration of the groups and codes after initial coding

Document Group	Specific Code
Human error incident prevention	Proper Communication Good company reputation Compliance Continuous improvements Defect identification and report Incentives. Prevention of financial losses Property and assets damage prevention Safety awareness The health and safety control measures Trainings
The selection of the control measures	Gaps identification Hazard identification Incidents investigation Provision of PPE Risk identification and mitigation Scope of work The health and safety control measures The reviewal of control measures
Recruitment of employees	Appointment of functional health and safety committee Legal appointment of competent staff Production increase Reduce incidents costs Skills The improvement of the control measures

Document Group	Specific Code
The employed regulations	Health and safety regulations Improves health and safety performance International standards for organisation (ISO) Key performance indicators Machinery regulation Protection of employees The improvement of the control measures
The prompt in the incident investigation	Accurate instructions Incidents mitigations The human error incidents and accidents investigation The review of the previous incidents To obtain proper information
The importance of truthful responses during incident/accident investigation	Determine the incident root cause Incidents reduction Learning from previous incidents Minimises the chances of cheating or changing statements Root cause analysis The human error incidents and accidents investigation
Compliance enforcement	Injury on duty Loss Time Injury Free rate Productive employees Profitability Safety protocols The reduction of human error incidents and accidents
The components of health and safety management systems	Audits Checklist and registers Fault tree analyses Flow charts Formulation and review of policies Health and safety plan Incentives PESTEL analysis Planned task observations Respond to safety concerns Surveys

Document Group	Specific Code
The implementation of SWPs and SOPs	Guidelines Job specification Outlines the steps to do a task Review of SOPs Safe work procedures The reduction of human error incidents and accidents
Long working hours	Fatigue Health and safety challenges Time management Working long hours
Organisational culture	Lack of safety programmes Safety culture The available health and safety management systems
Root cause of human errors	Poor application of 4S system Distraction Equipment failure Horse play House keeping Improper maintenance Lack of experience Insufficient management support Poor mechanical designs Negligence Non-compliance with rules Shortcuts Excessive workload
The evaluation of health and safety management systems	Emergency preparedness Inspection Monitoring Risk assessments The available health and safety management systems
The working conditions and environment	Conflict amongst employees Health and safety working conditions Safe working environment Poor working environment

Document Group	Specific Code
The impact on productivity	Breakdowns Increase absenteeism Insufficient profit Legal penalties Losses Poor quality The consequences of human error
The psychosocial factors	Alcohol and drug abuse Financial and psychosocial well-being Personal problems Emotional abuse Stress Anxiety

Source: Researcher's own development in Atlas.ti, Version 24

Step 4: Review of themes

In this step, the themes are modified and developed. It may be necessary to collapse themes together, split them further, or discard ones that are not central to the study agenda. The researcher checked whether the themes work (in relation to the data and the other themes) and tries to tell a convincing story that answers the research questions (Finlay, 2021: 107). The researcher reviewed the themes and codes to identify the missing information and ensure sufficient information to back up the themes.

Step 5: Theme definition and labelling

This is a more artful stage where themes are refined and crafted to reveal their essence. The researcher writes a detailed analysis of each theme, looking to tell a story about the theme and the data overall. This is also the time to find a concise and informative – and ideally punchy and interesting title for each theme (Finlay, 2021: 107). During this phase, the researcher named and defined the themes through value responses to the research questions.

Step 6: Report writing

In this phase, the researcher writes the themes into the wider report (including literature review and discussion (Finlay, 2021: 107). Table 4.8 below shows the final code groups and their related frequencies.

Table 4.8: Outline of the final codes and related frequencies

Document Group	Codes Frequencies
Root cause of human errors	13
Human error incident prevention	12
The components of health and safety management systems	12
The selection of the control measures	9
Recruitment of employees	9
The employed regulations	8
The impact on productivity	7
The importance of truthful responses during incident/accident investigation	6
Compliance enforcement	6
The implementation of SWPs and SOPs	6
The psychosocial factors	6
The prompt in the incident investigation	5
The evaluation of health and safety management systems	5
Long working hours	4
The working conditions and environment	4
Organisational culture	3

Source: Researcher's own development in Atlas.ti, Version 24

4.11.1 Memoing in Atlas.ti, Version 24

Memoing is an essential part of the data analysis process in qualitative research. In this study, memoing was conducted using Atlas.ti, Version 24, a qualitative data analysis software that facilitated the systematic management of codes, categories, and themes. Memos are used to record analytical reflections, coding decisions, and theme development insights throughout the research process. During the Thematic analysis, analytical memos were created to capture initial impressions about participant responses, emerging patterns, and links between codes and theoretical frameworks. For instance, a memo was developed when several participants reported fatigue as a recurring issue; this helped conceptualize the overarching theme of ‘Human Error Causes’ and link it to Fatigue Risk Management Theory.

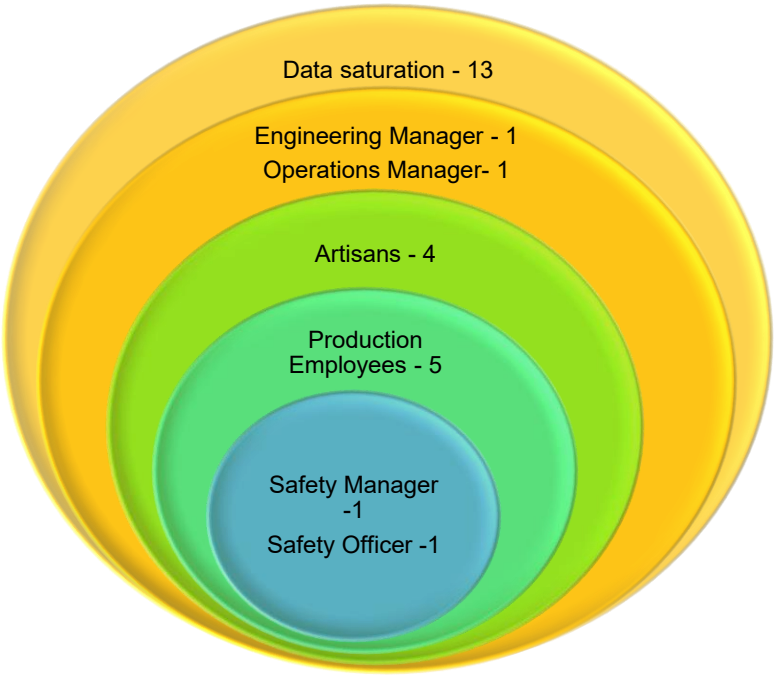
Additionally, memos were written to track shifts in understanding as new codes emerged, especially in complex areas such as incident investigation delays and

psychosocial stress. These memos guided the refinement of code groups and ensured that the researcher's interpretive process was transparent and traceable. ATLAS.ti allowed memos to be linked directly to quotes, codes, and documents, which enhanced analytic depth and coherence. The use of memoing helped bridge raw participant data with higher-order themes and maintained reflexivity in interpretation. This process supported the rigorous development of the themes presented in this Chapter.

4.11.2 Data saturation

Data saturation refers to the point in qualitative research where no new themes, insights, or codes emerge from the data (Braun & Clarke, 2021: 1; Sharma & Raju, 2024: 134). In this study, saturation was used as a guiding principle to determine the adequacy and completeness of the interview data. Saturation was assessed during the process of thematic analysis. By the time the eleventh interview was coded, the major themes such as fatigue, poor supervision, communication breakdown, and inadequate training had consistently appeared. Interviewees twelve and thirteen did not reveal any substantially new codes or patterns but rather reinforced the categories that had already been developed. Using Atlas.ti, Version 24, the researcher observed a decline in new code frequency after coding the 10th transcript, indicating a convergence in participant perspectives. Code repetition, thematic analysis overlap, and the depth of participant quotations confirmed that conceptual saturation had been achieved. Figure 4.6 below illustrates the data saturation sample.

Figure 4.6: Data saturation sample diagram

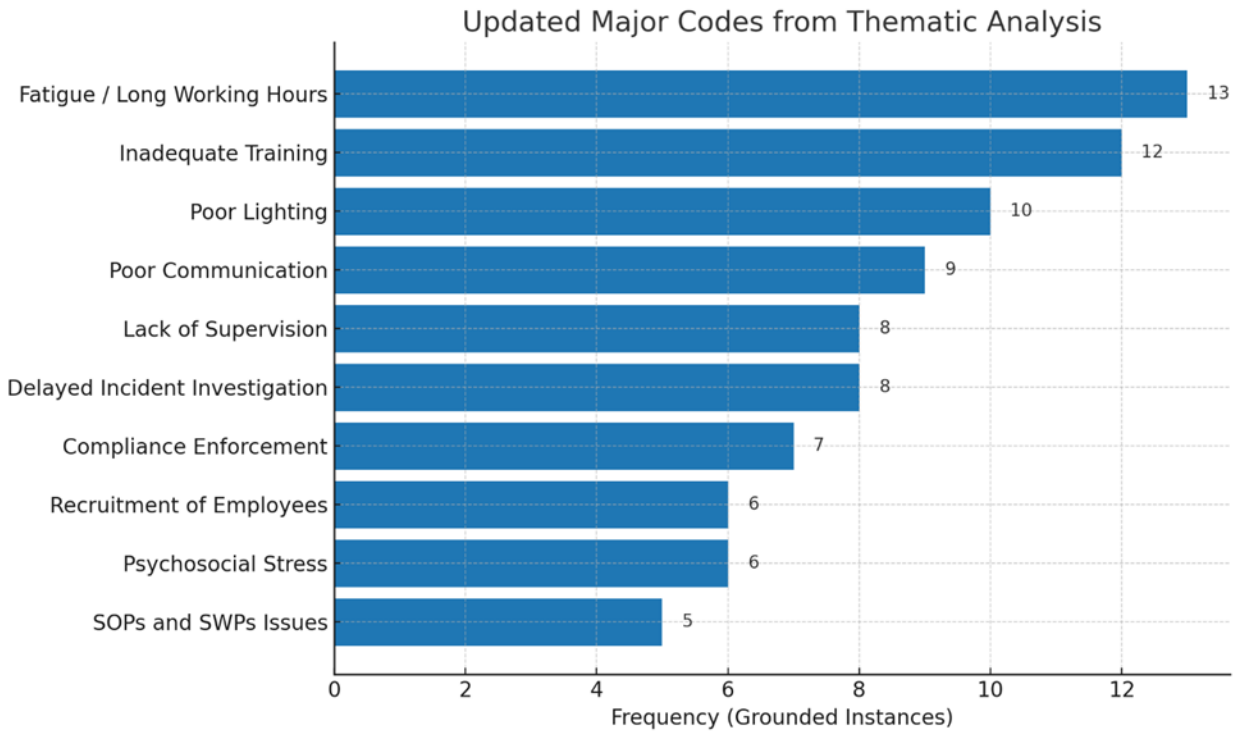


Source: Researcher's own compilation

4.11.3 Code groups and codes

This section presents the major codes identified through thematic analysis. Codes with a frequency of five or more are selected for in-depth discussion, as they represent the most prominent patterns and recurring ideas across participant responses. These codes are grouped into their respective code families, based on conceptual relationships, and aligned with the study's themes and objectives. Each code presented in Figure 4,7 discussed below emerged from participants' lived experiences and was repeatedly referenced across multiple interviews, signifying core issues in workplace safety and human error dynamics.

Figure 4.7: Analysis of the major codes from the thematic analysis



Source: Researcher's own compilation

4.11.4 Word Cloud

For improved visualisation, Word Cloud creates random words of different sizes for the data set. Not every word is displayed in the cloud, but terms with higher frequency are recognised and displayed as a word, where larger words represent higher frequency and smaller words indicate less frequently used words (Sofyan & Abdullah, 2022: 49: Kausar, Soosaimanickam, & Nasar, 2021: 4).

To generate the right codes, this begins by examining the frequency of words used by participants. These are converted into codes that are linked to the various open-ended questions (García-Tudela, Prendes-Espinosa & Solano-Fernández, 2021: 7). The most common terms that participants contributed from the open-ended question are shown in the word clouds (Rhee, Bayer, Lee, & Kuru, 2021: 9).

The Word Cloud shown in Figure 4.8, was developed using Atlas.ti, Version 24 to indicate words that were used frequently by participants during the interviews. As show

below, the most frequent words were employees, incidents, human, safety, error, health and risk, work, cause, and safe.

Figure 4.8: Word Cloud

Source: Researcher's development from Atlas.ti, Version 24

4.12 CHAPTER SUMMARY

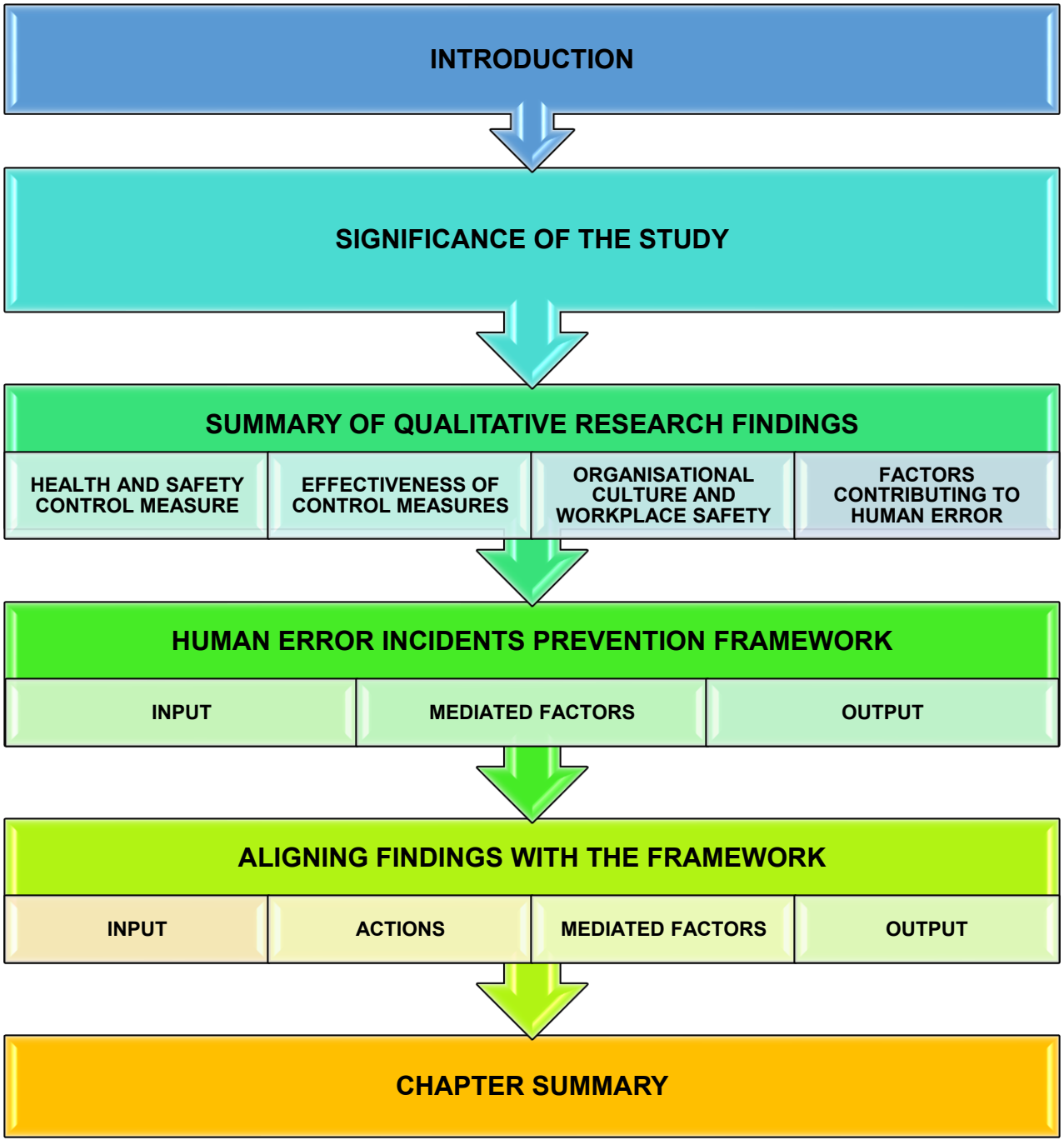
This chapter was based on the data collected and highlighted the difficulties in reducing human error accidents in the automotive industry. The main purpose of this chapter was to examine, cleanse, transform, and model data to determine the useful information, draw conclusions, and provide decision-making. It involved applying various methods and tools to extract expressive insights from raw data, assisting in the identification of thoughtful patterns, trends, and the correlation within a dataset.

This analysis showed that while there are safety control measures in place, their effectiveness is compromised because of inconsistent enforcement and noncompliance from employees, along with external environmental considerations. The finding shows that organisations need to go well beyond minimal regulatory compliance and develop a proactive safety culture that emphasizes risk assessment, ongoing training, and employee involvement in safety initiatives.

The key insight that emerged from this study is the psychological impact of workplace incidents. Human errors have implications beyond financial and productivity losses; they result in employee stress, anxiety, and diminished confidence. Organisations can deal with these issues by putting in place mental health support programs, establishing non-punitive reporting mechanisms, and fostering open conversations about workplace safety concerns. One other salient finding to emerge from this study is the necessity to improve the investigative process for the purposes of workplace safety. By carrying out prompt and fair investigations into incidents, organisations can learn from the past, amend control measures, and prevent similar incidents in the future. In this regard, honest reporting and protection of the employees from being victimised are key to building trust and cultivating a safety culture that is open to scrutiny. Further to the above, this chapter discussed the evaluation of health and safety control measures, the improvement of control measures, investigating the human error incidents and accidents, the reduction of human error incidents and accidents. The available health and safety management systems, the health and safety challenges, and the consequences of human errors.

The next chapter (Chapter 5 of this report) reflects the proposed Human Error Incidents Prevention Framework (HEIPF) to address occupational health and safety challenges in the automotive manufacturing industry.

CHAPTER 5: THE PROPOSED HUMAN ERROR INCIDENTS PREVENTION FRAMEWORK (HEIPF)



5.1 INTRODUCTION

The automotive manufacturing organisation which operates in KwaZulu-Natal works under conditions which require specialised safety measures, and which demand intensive labour, yet human error still leads to safety issues. Workplace safety remains a critical concern in high-risk industries such as automotive manufacturing, where human errors can result in severe consequences, including injuries, fatalities, financial losses, and operational disruptions. Understanding the root causes of human error and implementing targeted interventions is an essential step toward fostering safer and more productive workplaces.

The analysis in Chapter 4 demonstrated that human errors are influenced by a combination of factors, including workplace distractions, fatigue, inadequate training, weak leadership, poor organisational culture, and insufficient technical controls. The final objective of this study was to develop a framework that integrates technical interventions, organisational systems, behavioural strategies, and decision-making enhancements to minimise errors and strengthen workplace safety. Building on the findings presented in Chapter 4, this Chapter introduces the HEIPF, a structured, evidence-based approach to addressing workplace safety challenges identified in the South African automotive manufacturing industry.

The study results show that workplace accidents continue to happen because of systemic problems and organizational defects and human behaviour issues despite the presence of occupational health and safety regulations. The research provides site-specific empirical data which shows the reasons behind human error according to participants from 1 to 13 and through thematic analysis. The study shows that workplace safety management needs three elements which include technical controls and organisational systems and behavioural strategies to create a strong safety management framework. The study shows that leadership involvement and open communication together with employee engagement and ongoing assessment create a safety culture which protects employees from hazards.

By aligning the study findings with best practices in occupational health and safety, the framework offers the automotive industry a comprehensive and practical strategy to reduce incidents caused by human errors and foster a resilient safety culture. The HEIPF promotes proactive risk management, continuous employee training, leadership involvement, real-time hazard reporting, and consistent monitoring of workplace conditions. This chapter reflects on the significance of the study, summarises the key qualitative findings, and presents the HEIPF, demonstrating its alignment with the empirical evidence and its potential to reduce workplace incidents effectively. The HEIPF development represents a systematic evidence-based solution which addresses the specific challenges faced by the selected plant. The framework based itself on qualitative research results and existing occupational health and safety principles needs external empirical testing which has not occurred outside this study environment. Its main contribution provides the participating plant with a practical operational guide which meets its specific requirements.

5.2 SIGNIFICANCE OF THE STUDY

The automotive manufacturing industry is both safety-critical and labour-intensive. Despite the existence of occupational health and safety regulations, the industry continues to experience high rates of workplace incidents attributable to human error. This research provides empirical evidence on the underlying causes of these errors and proposes a practical framework to guide organisations in implementing effective preventive measures. By identifying gaps in existing control measures and uncovering the factors that contribute to unsafe behaviours such as fatigue, inadequate supervision, poor communication, and insufficient technical controls, the study offers actionable insights for improving workplace safety. Furthermore, the study's findings reinforce the importance of integrating technical, organisational, and behavioural interventions to create a holistic safety management system. It highlights the critical role of leadership engagement, transparent communication, employee involvement, and ongoing evaluation in building a proactive safety culture.

By developing and validating the HEIPF, this study equips automotive manufacturers with a structured tool to reduce incidents, enhance employee well-being, improve

compliance with occupational safety regulations, and increase operational efficiency. The contribution of this study is not only for the automotive industry but also for other high-risk sectors seeking to strengthen their safety systems and minimise the impact of human error.

5.3 SUMMARY OF QUALITATIVE RESEARCH FINDINGS

This research identified multiple factors influencing workplace safety, particularly concerning human-error incidents/accidents within the automotive industry. This section summarises the key qualitative findings from the study and how they relate to workplace safety and control measures. The HEIPF shows the correlation between incident prevention and incident mitigation through health and safety control measures.

5.3.1 Health and Safety Control Measures

The first secondary objective of this study, as outlined in Section 1.5.2, was to examine the existing control measures implemented to prevent workplace accidents caused by human error. The findings in Section 4.3 revealed that while safety management systems were in place, they were often inconsistently applied and insufficiently monitored. Participant three in Section 4.3 highlighted the need for robust safety management systems, particularly in the machine-intensive automotive sector, where accidents can have fatal consequences. Regular audits, employee engagement in safety forums, and adherence to the hierarchy of controls were identified as critical components of an effective system. Section 4.3, participant four noted that risk assessments should categorise hazards, evaluate the adequacy of existing controls, and implement improvements based on previous assessments.

On theme one, participant two emphasised the importance of regular training on risk assessment techniques to ensure employees understood and applied these principles effectively. The hierarchy of controls elimination, substitution, engineering controls, administrative controls, and PPE was emphasised as a guiding principle during risk assessments (Iqbal, Isaac, Al Rajawy, Khuthbuddin, & Ameen, 2021: 1; Söner & Kandemir, 2022: 86). Risk assessments were reported to be more effective when they categorised hazards, evaluated the adequacy of existing controls, and implemented

improvements based on previous assessments (Karadinovic & Engman, 2023: 35). Among the hierarchy of controls, elimination was regarded as the most effective strategy, while PPE was seen as the least effective (Othman, 2022: 81). Participants also noted the need for regular training on risk assessment techniques to ensure employees understood and applied these principles effectively (Pouyakian, Khatabakhsh, Yazdi, & Zarei, 2022: 55).

5.3.2 Effectiveness of Control Measures

The second secondary objective assessed the effectiveness of existing control measures in mitigating human error within the selected automotive manufacturing plant. The implementation of safety strategies in Chapter 4 required multiple implementation methods to achieve their full effectiveness because employees did not show sufficient dedication to their work. The study demonstrated that human error reduction results from applying structured training programs and legal requirements and technological methods and Behaviour-Based Safety initiatives. The program achieves its goals through dedicated effort from the entire organisation and through leaders who take responsibility and through employees who actively engage.

Legal compliance, particularly adherence to the Occupational Health and Safety Act (OHS Act No. 85 of 1993) and associated regulations, was identified as a key control measure. Workplaces that rigorously applied legal requirements reported fewer incidents and better risk management (Papulová, Gažová, & Šufliarský, 2022: 1488). Technological interventions, such as automation and AI-based monitoring, were highlighted by participants as particularly effective in minimising human involvement in high-risk tasks. AI-driven monitoring systems improve hazard detection, support predictive analytics, and reduce cognitive burdens on workers (Ozobu, Adikwu, Cynthia, Onyeke, & Nwulu, 2025: 156); Ajiga, Okeleke, Folorunsho, & Ezeigweneme, 2024: 30). Automated systems also enhance consistency and allow for immediate corrective action, significantly improving safety performance (Karwowski & Zhang, 2021: 29). Finally, Behaviour-Based Safety (BBS) programmes contributed significantly to safety outcomes by encouraging proactive reporting, peer observation, and corrective feedback. Participants indicated that BBS programmes helped establish accountability, reduced

unsafe behaviours, and improved hazard awareness (Li, Guo, Skitmore, Chan, Chen, & Wong, 2021: 542). The Behaviour-Based Safety (BBS) programs create a positive impact on safety results because they motivate employees to watch their coworkers and report safety issues while providing feedback about safety problems. The programs establish accountability through their requirements for employees to observe each other and report safety violations while giving feedback about safety problems.

5.3.3 Organisational Culture and Workplace Safety

The third secondary objective was to examine the role of health and safety management systems in fostering a positive organisational culture conducive to workplace safety. Section 4.7 and 4.7.1 showed that leadership commitment, transparent communication, and a supportive reporting environment were central to effective safety management. Leadership commitment was repeatedly stressed by participant six in Section 4.7.1 as the strongest predictor of employee compliance. This can be taken to imply that when management actively participated in safety initiatives, employees are more likely to follow procedures. This can also be read to imply that poor relationships with supervisor's lead to neglect of safety rules. Transparent and non-punitive reporting mechanisms encourage employees to report hazards without fear of retaliation, allowing the organisation to identify and correct risks more effectively. Regular audits and inspections were also seen as essential by participants three and four in Section 4.7.2 for maintaining high standards of workplace safety.

Transparent and non-punitive reporting mechanisms also encouraged employees to report hazards and near-misses. Participants indicated that fear of retaliation or punishment often discouraged hazard reporting, creating blind spots in safety management. Implementing a just and open culture improved the organisation's ability to identify risks early and implement corrective measures (Stemn, Bofinger, Cliff, & Hassall, 2023: 219).

Regular safety audits and inspections were also mentioned as essential for maintaining high safety standards. Frequent evaluations of workplace conditions, employee

compliance, and equipment integrity ensured that emerging risks were identified and addressed promptly (Bayram & Durdyev, 2021: 86).

5.3.4 Factors Contributing to Human Error

The final objective examined the factors contributing to human error in the automotive workplace. Findings revealed that multiple interacting elements, spanning from personal to organisational and environmental, contributed to lapses in attention and unsafe behaviours. These include poor communication and misunderstanding as reported by participants seven, eight, and nine as the main contributors to discouraged employees and leading them to poor morale (Section 4.9.1). As presented in Section 4.10.1, participants two and three noted the impact on production, which results in loss of production, loss of income, and loss of profit. Although there has long been a connection between workplace accidents and poor communication, this study adds to that knowledge by demonstrating how poor communication reduces morale, which in turn raises the possibility of mistakes. In this regard, the results are consistent with those of Basahel, Alsaedi, and Young (2022: 117), who found that poor communication and high levels of workplace distraction reduce job efficiency and increase error rates. However, this study reveals that the issue is not only cognitive but also emotional, as morale and motivation mediate the effects.

Fatigue and long working hours were highlighted in Section 4.8.1 by participants one and four as major contributors to diminished cognitive functioning and slower reaction times. Further to this, participants five and nine noted that some of the employees are suffering from stress, anxiety, and other psychological issues (Section 4.10.2). These experiences align with the findings of Folkard and Lombardi (2021: 93), who argue that fatigue significantly increases accident risk and reduces productivity. However, this study further highlights how production pressures may normalise long working hours, thereby embedding fatigue into daily operational culture rather than treating it as an exception.

Participants noted that employees who lacked proper safety training were more prone to errors due to insufficient knowledge of procedures. Weak supervision further

exacerbated these risks by allowing unsafe behaviours to persist. These findings align with Zhou, Goh, and Li (2022: 207), who argue that insufficient training and ineffective supervisory practices significantly increase the likelihood of workplace accidents. Furthermore, in Section 4.8.1, poor workplace conditions, including inadequate lighting, poor ventilation, and extreme temperatures, were cited as undermining employee focus and increasing the probability of errors. This is consistent with Lu, Wu, Zhang, and Wang (2021: 462), who found that adverse physical environments significantly impair employee concentration and safety performance. Similarly, Basahel et al. (2022: 117) emphasise the relationship between distraction and increased error rates. However, this study reveals how environmental discomfort interacts with fatigue and stress, amplifying their collective impact rather than operating independently.

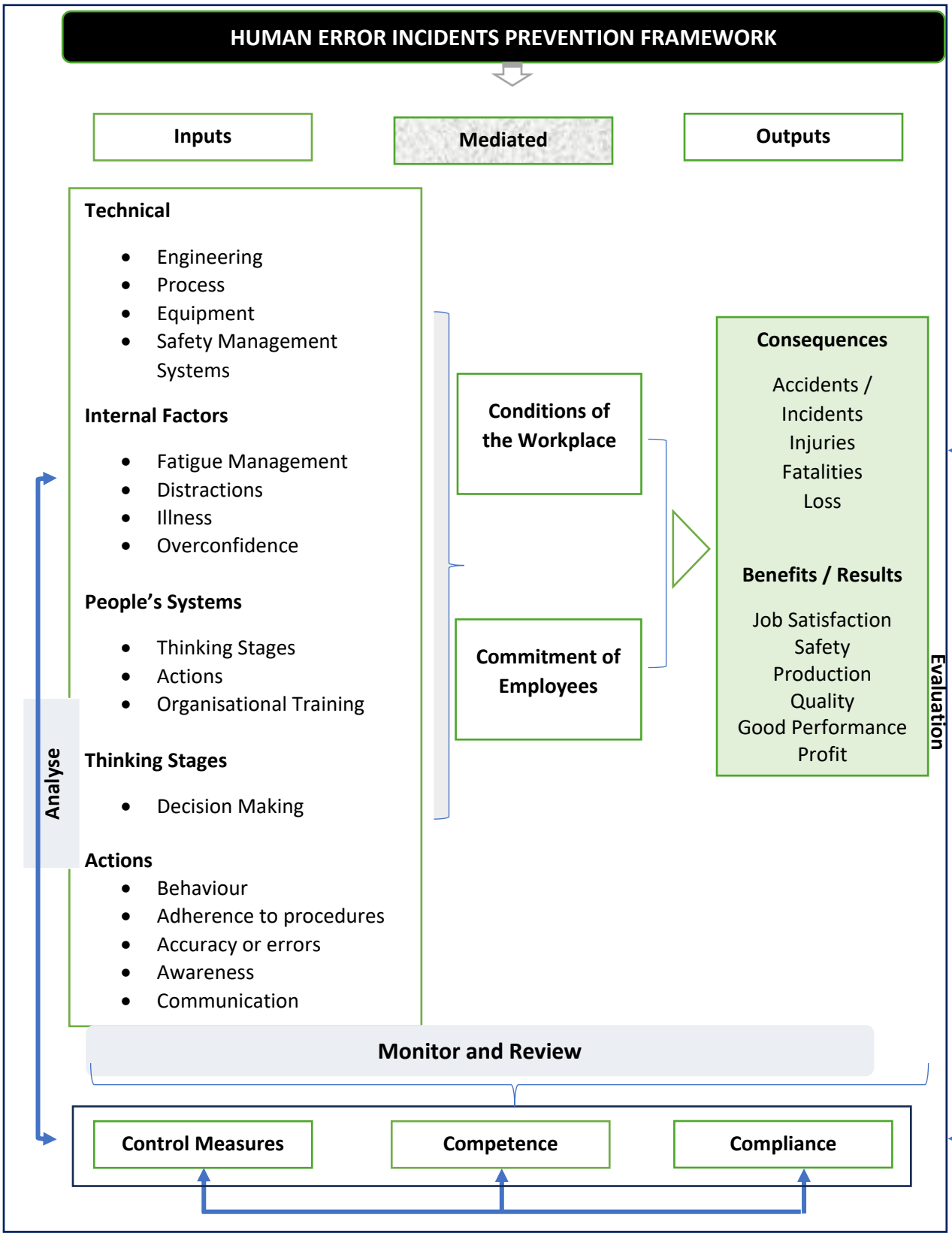
Psychological factors such as stress, anxiety, and burnout were also identified as underlying contributors to human error (Section 4.10.2). Participants observed that emotionally strained employees struggled with concentration and decision-making. This finding supports Samanta and Gochhayat's (2023: 5) assertion that psychological distress weakens cognitive control and increases susceptibility to unsafe behaviours. Importantly, the present study illustrates that stress is often not an individual weakness but a response to organisational demands, supervision styles, and workplace climate. Thus, psychological well-being must be understood within its structural context.

These insights informed the development of the Human Error Incidents Prevention Framework. Grounded in a human-centred and integrated perspective, the framework recognises that effective prevention requires simultaneous attention to communication practices, workload management, psychological wellbeing, environmental conditions, training adequacy, and supervisory effectiveness. Addressing these factors in isolation would be insufficient. Instead, a coordinated and holistic approach is necessary to reduce errors sustainably, enhance employee wellbeing, and improve organisational performance within the automotive industry

5.4 HUMAN ERROR INCIDENTS PREVENTION FRAMEWORK

The final secondary objective of this study was to develop a framework for the prevention of future human-error incidents and accidents within the South African automotive manufacturing industry. This resulted in the HEIPF, shown in Figure 5.1. The framework is grounded in the study findings, particularly the eight themes identified in Chapter 4. It presents a structured, integrated approach to minimising human error by addressing technical, organisational, and behavioural factors, as well as cognitive and decision-making processes. The HEIPF comprises three core components: Inputs, Mediated Factors, and Outputs. Each of these components is further divided into interrelated elements that were observed as contributing to or mitigating human error incidents within the study participants' workplaces. This section describes each component of the framework, explaining how it responds to the specific challenges identified in Chapter 4.

Figure 5.1: The Human Error Incidents Prevention Framework



Source: Researcher's own compilation

5.4.1 Input

All facts or information that is supplied or fed into a computer, equipment, system, or procedure for additional processing, interpretation, or analysis are referred to as input. The input process for this study encompasses technical factors, internal factors, people's systems, the thinking stage, and actions.

5.4.1.1 Technical Factors

As captured in theme four in Chapter 4 of this report, participant eleven highlighted several technical challenges, such as poor equipment maintenance, inadequate engineering controls, and inconsistent application of SOPs. To address these challenges, the HEIPF includes technical interventions at the input stage, which focus on engineering, processes, equipment, and safety management systems. For example, automated systems and AI-based monitoring can reduce reliance on human judgment in repetitive or high-risk tasks, as recommended by Kaassis, Badri & Elkamel, (2021: 312).

Furthermore, participant five (Section 4.3), noted the critical role of well-maintained machines, safety alarms, and guarding systems, reinforcing the need for robust engineering controls and workplace ergonomics (Yazdi & Adumene, 2025: 659; Odebiyi, & Okafor, 2023: 9). The technical factors of the HEIPF encompass four interconnected elements: engineering, processes, equipment, and safety management systems (SMS**)**. These components address the technical deficiencies identified in theme four as presented in chapter 4. Participants four and five noted the challenge of inadequate machine maintenance, outdated procedures, and insufficient engineering controls in the automotive industry. Strengthening these technical aspects is essential to minimise risks at their source and reduce human dependency in hazardous operations.

- **Engineering**

The automotive industry employs engineering control measures to designing and implement physical safeguards that eliminate or isolate hazards. In this regard, the closed-off equipment reduces injury rates and less interaction with moving parts (Jogie, Rampersad, Bharrath-Singh, Joseph, Clarke, & La Rosa, 2025: 35). Participants four

and six (Section 4.3.2) emphasised the importance of well-maintained machines, effective guarding, and alarms to prevent direct contact with dangerous equipment. Additionally, ergonomic workplace design optimising lighting, ventilation, noise levels, and workstation layout was highlighted as critical for improving concentration, reducing fatigue, and minimising human errors caused by discomfort (Odebiyi & Okafor,2023: 17).

- **Processes**

Processes refer to the standardisation and formalisation of work activities to ensure consistency and accuracy. Participants three, four, five, and six (Section 4.6) noted that outdated or ambiguous procedures contributed to mistakes. Developing and implementing clear Standard Operating Procedures (SOPs) and Safe Work Procedures (SWPs) helps prevent the human errors that arise from miscommunication or insufficient knowledge. Organisations with well-documented and enforced procedures experience higher compliance and operational efficiency (Hare, Kumar & Campbell, 2020: 53). The researcher's analysis highlights the multifaceted features of accidents, which may arise from lack of communication, exhaustion, negligence, insufficient training, and time constraints (Gidiagba, et al., 2024: 43).

By minimising human errors, the HEIPF enhances procedures, resulting in greater effectiveness, safety, and financial savings. This HEIPF involves taking practical steps to reduce the likelihood of human error incidents and accidents as opposed to merely responding to them after they have already occurred. This entails putting human error-tolerant mechanisms into place, figuring out the fundamental causes of human errors, and inspiring a culture of accountability and safety in the South African automotive industry.

- **Equipment**

Equipment involves the tools, machines, and technology used in production, which must be properly maintained and upgraded to ensure safe and reliable operation. Participants one, two, five and eleven (Section 4.6) highlighted frequent equipment breakdowns and lack of preventive maintenance as sources of incidents. Integrating automation and AI-

based monitoring within equipment enables real-time risk detection, predictive safety analytics, and consistent task execution with reduced human intervention. The use of the automated equipment, such as sensor-based machinery and robotic process automation, minimises the likelihood of human error in the automotive operational tasks while enhancing safety and productivity (Kaassis, Badri & Elkamel, 2021: 312).

- **Safety Management Systems (SMS)**

The automotive manufacturing industry employs the Appropriate SMS to prevent deaths and injuries in the workplace (Nallathambi, Savaram, Sengan, Alharbi, Alshathri, Bajaj, Aly, & El-Shafai, 2023: 2). SMS integrates the above elements into a cohesive organisational framework that ensures their effective implementation and continuous improvement. Participants one and ten positively responded to the more structured risk assessments, audits, and documentation of safety performance (Section 4.4). SMS includes regular inspections, training on hazard recognition and control strategies, and clear documentation of incidents and corrective actions. These practices foster accountability, facilitate learning from past mistakes, and sustain a proactive safety culture.

Strengthening engineering controls, formalising processes, maintaining and upgrading equipment, and embedding robust SMS, organisations can eliminate or reduce hazards at their source. This alignment between the HEIPF and the findings of Chapter 4 ensures that technical interventions directly address the gaps identified by participants and contribute to the prevention of future human-error incidents within the automotive manufacturing industry.

5.4.1.2 Internal Factors

The internal factors component of the HEIPF addresses individual vulnerabilities that reduce concentration and increase the likelihood of workplace incidents. Section 4.8 revealed that fatigue, distractions, illness, and overconfidence were significant contributors to human error. These factors impair cognitive performance, slow reaction times, and compromise judgment, especially in high-risk environments.

- **Fatigue Management**

Employees have been continuously reporting that they are working excessive hours within the automotive industry (Williams, 2021: 1). Extended working hours lead to fatigue simply due to the length of uninterrupted work. The impact is intensified when the work duration prolongs wakefulness, resulting in an increased accumulation of sleep pressure from the homeostatic progression, and/or shifts some work hours into the night, a time when the daily energy for restlessness is diminished (Gurubhagavatula, Barger, Barnes, Basner, Boivin, Dawson, Drake, Flynn-Evans, Mysliwiec, Patterson, & Reid, 2021: 2286).

Participant one (Sections 4.6. and 4.8.1) consistently reported that long working hours and inadequate rest periods led to fatigue, which in turn impaired attention and increased human error incident rates. Fatigue management involves regulating work schedules, ensuring adequate rest breaks, and monitoring workload distribution. As noted by Folkard and Lombardi (2021: 94–95), implementing structured work–rest cycles and limiting overtime effectively reduces fatigue-related errors and improves productivity.

- **Distractions**

Workplace distractions such as excessive noise, mobile phone use, and interruptions were cited by participant five (Section 4.3.1). The participant elaborated that distraction contributes to lapses in concentration and poor task performance. Mitigating distractions requires clear workplace policies on phone use, minimising unnecessary noise through engineering and administrative controls, and designing workflows that minimise interruptions. Distractions cause a reduction in focus and incorrect operations of machinery, which can lead to serious human error accidents in the automotive industry (Stapelbroek, Kilic, Yang Van Donk, 2024: 801).

- **Illness**

Physical and psychological health challenges, including chronic illness, stress, and burnout, negatively impacted employees' ability to perform tasks safely. Participants five

and nine (Section 4.2.10) highlighted that employees struggling with stress and other psychological health issues due to working under pressure and trying to reach targets are at risk. This leads them to be more likely to make mistakes and less likely to comply with procedures. Providing psychosocial support, access to medical services, and fostering a supportive work environment helps employees manage health issues effectively.

- **Overconfidence**

The researcher noted a common insight from the participants that experienced employees within the automotive industry tend to become overconfident. These experienced employees are the ones who bypass procedures and take shortcuts due to familiarity or complacency. Moreover, the researcher has revealed that there is a risk where employees are skipping steps and taking shortcuts and may lead to human error incidents and accidents (Sinsky, Jerzak & Hopkins, 2021: 431; Diman & Rahman, 2024: 234). This was also observed by participants one and seven (Section 4.6). This behaviour increases the risk of errors as it undermines adherence to safety protocols. Counteracting overconfidence requires reinforcing the importance of compliance through refresher training, regular supervision, and promoting a culture of vigilance. By systematically addressing fatigue, distractions, illness, and overconfidence, organisations can reduce internal vulnerabilities that lead to human error. These interventions, grounded in the study's findings, contribute to sustaining employee focus, improving judgment, and fostering a safer, more productive workplace.

5.4.1.3 People Systems

The people's systems component of the HEIPF addresses the organisational and social structures that influence employee behaviour and workplace safety. Participant six highlighted that leadership skills, teamwork, training, and organisational culture play a crucial role in reducing human error incidents and accidents within the automotive industry (Section 4.7.1). These elements shape how employees perceive and respond to hazards, reinforcing safe behaviours and discouraging unsafe practices.

- **Competency and Skills**

Competencies and skills were identified by participant thirteen as key factors concerning impacting safety in the workplace (Section 4.3). Competent employees need to be appointed according to their level of skill to ensure a positive safety culture. When appointed staff are competent on what they are doing, they are likely to model safe workplace behaviour and to comply with safety protocols. Participants also noted that absent or disengaged leaders led to complacency and increased incidents. Leaders have an essential role to play and need to be effectively supported in their role to create and maintain the critical factors that sustain healthy workplaces (Drew, Bartels & Herrington, 2023: 3). Strong leadership ensures that safety priorities are visible, valued, and consistently enforced. Senior leaders are involved in creating the direction for EHS initiatives, distributing resources, and showcasing responsibility (Adikwu, Ozobu, Odujobi, Onyekwe & Nwulu, 2023:372).

- **Training**

Participants one, three, four, seven, and eleven emphasised the importance of comprehensive and ongoing training in building competence and confidence (Section 4.3). Effective training equips employees with the knowledge and skills to recognise hazards, follow procedures, and respond appropriately to emergencies. Regular refresher training and on-the-job coaching help sustain these competencies and adapt to changes in processes or technology (Vinodkumar & Bhasi, 2020: 2083). Employees with insufficient training and experience may not be able to complete duties safely and effectively, which can lead to accidents (Gidiagba et al., 2024: 41).

- **Organisational Culture**

Section 4.7.1 highlighted the influence of organisational culture, the shared values, attitudes, and beliefs about safety on employee behaviour. A culture that prioritises safety encourages employees to report hazards, challenge unsafe practices, and contribute to improvement efforts without fear of reprisal. Conversely, a punitive or indifferent culture discourages reporting and undermines compliance. Establishing a just

and open culture enables early identification of risks and strengthens collective commitment to safety (Stemn, et al., 2023: 219).

5.4.1.4 Thinking Stages and Human Decision Making

The thinking stages and human decision-making component of the HEIPF address the cognitive processes that influence employees' ability to assess situations, make sound decisions, and maintain situational awareness. Participants one, three and six declared that failure to follow the ISO standards is a significant contributor to errors incidents and accidents within the automotive industry (Section 4.7).

5.4.1.4.1 Decision Making

Section 4.9.2 revealed that unclear decision-making processes and a lack of guidance during emergencies affect employees and lead to confusion and human errors. Providing employees with structured decision-support tools such as checklists, risk assessments, and predefined response plans improves consistency and helps employees make timely, appropriate decisions even in stressful situations (Van Ginkel & Biradar, 2021: 3).

- **Attention and Cognitive Load**

As shown in Section 4.9.2, participants noted that high workloads, multitasking, and environmental distractions overwhelmed their ability to concentrate, increasing the likelihood of errors. Human performance and decision-making depend heavily on perceptive workload management, especially under pressure or when people must multitask (Van Rooy, 2023: 6). Simplifying workflows, removing unnecessary tasks, and managing cognitive load enable employees to focus on critical safety tasks (Reite, 2025: 22). Implementing task rotation and pacing work to match employee capacity also mitigates mental fatigue and helps maintain attention.

- **Safety Awareness**

Safety awareness, the ability to perceive, comprehend, and anticipate what is happening in the work environment, was identified by participants five, six and seven in Section 4.8

as crucial for detecting and responding to hazards effectively. However, many participants admitted struggling to maintain awareness during busy or noisy operations. Safety awareness training, which teaches employees to observe their surroundings, recognise hazards, and predict potential developments, significantly improves their ability to respond proactively (Endsley & Jones, 2021: 156). Supporting decision-making, reducing cognitive load, and improving safety awareness, organisations can help employees maintain focus, anticipate risks, and make effective decisions. These interventions, aligned with the findings of this study, strengthen employees' cognitive capabilities and reduce the likelihood of errors during complex or high-pressure tasks.

5.4.1.5 Action-Oriented Prevention Strategies

The actions component of the HEIPF represents the observable behaviours employees exhibit while performing their tasks. These include adherence to procedures, vigilance, effective communication, and hazard awareness. As presented in Section 4.6, participants one and seven revealed that lapses in these areas such as bypassing procedures, failing to report hazards, and becoming complacent during routine tasks contributed significantly to human error incidents and incidents.

- **Behaviour**

The primary methods of reducing incidents due to unsafe behaviour among employees in the automotive industry involve adapting process equipment, skill-related incidents, ensuring compliance with operating procedures, increasing safety awareness, and augmenting safety knowledge (Wang, Cui, Zhang & Geng, 2024: 1). Participant five in Section 4.9.1 observed that employees sometimes engaged in unsafe behaviours, such as taking shortcuts or ignoring safety rules, especially under production pressure. Promoting a culture of accountability, peer observation, and corrective feedback helps reinforce safe behaviours and discourages risky practices. Behaviour-based safety (BBS) programmes, which include monitoring and reinforcing desired behaviours, have been shown to reduce unsafe actions and improve compliance (Li, et al., 2021: 543).

- **Adherence to Procedures**

In Section 4.8, participant thirteen noted that failure to consistently follow established procedures, such as good housekeeping and 4S rule (sought, shine, standardise, and sustain) leads to avoidable human error incidents. Regular training, visible supervision, and clear communication of expectations encourage employees to adhere strictly to SOPs and safe work practices. Simplifying procedures and involving employees in their development also increases ownership and compliance. Participants eight and ten encouraged the adherence to SOP to ensure the elimination of human error incidents and accidents within the automotive industry (Section 4.61).

- **Accuracy and Awareness**

Maintaining vigilance and situational awareness was highlighted in Section 4.8 by participants one and seven as critical for identifying hazards and preventing incidents. Employees reported that complacency, particularly during repetitive tasks, reduced their attentiveness and increased the likelihood of errors. Continuous awareness campaigns, such as toolbox talks and safety reminders, help sustain attention and reinforce the importance of remaining alert to changing conditions (Raju, Reddy, Sindhu, Abhinaya & Manoj, 2024:1).

- **Communication**

Effective communication and coordination within the automotive organisations are essential to prevent human error incidents. In Section 4.9.1.1, participants reiterated the notion that poor communication among team members, supervisors, and management often created misunderstandings and delayed hazard reporting. Encouraging open, two-way communication, including anonymous reporting options and regular feedback sessions, improves the flow of information and ensures that risks are addressed promptly. Fostering safe behaviour, ensuring adherence to procedures, maintaining vigilance, and improving communication, organisations can create an environment where employees act proactively to prevent incidents. These actions, supported by the findings of this study represent the ultimate manifestation of upstream interventions and reflect the success of the HEIPF in promoting workplace safety.

5.4.2 Mediated Factors

The mediated factors component of the HEIPF refers to the organisational and environmental conditions that influence how technical and behavioural inputs translate into safe outcomes. Section 4.9.1 revealed that inadequate supervision, inconsistent rule enforcement, and poor employee engagement weakened the effectiveness of existing control measures. Addressing these mediated factors ensures that upstream interventions are consistently implemented, monitored, and sustained over time.

5.4.2.1 Workplace Conditions

The employers in the South African automotive manufacturing industry pays less attention to the health and safety working conditions of their employees and this results into employees' injuries and fatalities due to poor work environment (Dodoo et al., 2024: 15). Thus, when the working environment is not supportive or is unpredictable, the likelihood of human errors increases, which endangers the safety of the employees (Kakemam, Chegini, Rouhi, Ahmadi & Majidi, 2021: 1980). In Section 4.8.1, participant seven highlighted that poor workplace conditions, such as cluttered workspaces, poor lighting, high noise levels, and uncomfortable temperatures, created distractions, increased fatigue, and impaired performance. Regular inspections and improvements to the physical work environment help minimise these risks and support employee concentration and well-being (Lu, et al., 2021: 463).

5.4.2.2 Employee Commitment

In Section 4.8, participant ten expressed concern over low levels of management commitment to OHS initiatives, which undermined the impact of technical and behavioural controls. Involving employees in decision-making, recognising their contributions, and providing opportunities for feedback fosters a sense of ownership and accountability. When employees feel valued and engaged, they are more likely to comply with procedures and report hazards promptly (Shabani, Jerie & Shabani 2023a: 13).

5.4.2.3 Monitoring and Evaluation

In Section 4.4, participants one, eight, and nine noted that inconsistent supervision and lack of follow-up on safety issues diminished the effectiveness of control measures. Regular monitoring, including audits, inspections, and performance reviews, ensures that safety systems remain functional and effective. Establishing clear metrics, providing timely feedback, and acting promptly on deficiencies identified during evaluations are essential for continuous improvement (Farooq, Abbey & Onukwulu, 2024: 435). By addressing workplace conditions, fostering employee commitment, and ensuring robust monitoring and evaluation, organisations strengthen the link between preventive measures and desired outcomes. These mediated factors reinforce the sustainability of the HEIPF and create a work environment in which safety systems can thrive and adapt to changing circumstances.

5.4.3 Outputs

The outputs component of the HEIPF represents the desired outcomes of implementing effective safety interventions. Section 4.10 revealed that when organisations strengthened control measures and addressed the underlying causes of human error, they experienced improved employee well-being, higher productivity, better compliance with regulations, and reduced costs associated with incidents. Conversely, neglecting these factors led to injuries, fatalities, reputational damage, and financial losses.

- **Enhanced Job Satisfaction and Well-Being**

In Section 4.6.2, participants two, five, ten, and eleven reported that health and safety compliance is enforced within their working environments. In this regard, workplaces with strong safety systems foster greater job satisfaction and improved employee morale. When employees feel that their safety and health are prioritised, they are more motivated, engaged, and less likely to experience stress or burnout (Samanta & Gochhayat, 2023: 6).

- **Improved Safety Outcomes**

In Section 4.6, participant thirteen observed significant reductions in the frequency and severity of incidents when safety programmes were consistently applied. Enhanced training, supervision, and monitoring led to fewer injuries and near misses, contributing to a safer and more stable work environment (Morais et al., 2022: 2).

- **Increased Productivity and Quality**

Section 4.6 noted that implementing comprehensive safety measures also improved operational efficiency and product quality. Reduced downtime due to fewer accidents, lower error rates, and a more focused workforce translated into higher productivity and fewer defects in production processes (Karwowski & Zhang, 2021: 30).

- **Financial and Reputational Benefits**

Section 4.6 highlighted that effective safety systems reduced costs associated with compensation claims, medical expenses, and equipment damage. They also noted that organisations with strong safety records enjoyed better reputations, which helped attract and retain skilled workers and maintain client trust (Morais et al., 2022: 3). By achieving these positive outputs, the HEIPF demonstrates the value of a comprehensive, proactive approach to safety. These outcomes affirm the findings of this study and underscore the importance of sustaining investments in safety systems for long-term organisational resilience and success.

5.5 ALIGNING FINDINGS WITH THE FRAMEWORK

The HEIPF was designed to directly respond to the gaps, risks, and opportunities identified in chapter 4 of this study and in extant literature. The framework incorporates targeted interventions that address the root causes of human error with the aim of strengthening the resilience of the workplace safety systems. This section provides a detailed explanation of how each component of the framework inputs, mediated factors, and outputs corresponds to the findings of the research and supports the prevention of workplace incidents and accidents.

5.5.1 Inputs

Section 4.3.1 highlighted the importance of using computerised machines to prevent human error incidents. Participant eight emphasised the significance of automated systems or machines, such as AI-driven systems, in predicting failures before they occur. Section 4.9.2 revealed that employees in the automotive industry are exposed to hazardous conditions, such as extreme temperatures, toxic chemicals, heavy lifting, and high-risk equipment. Participant six pointed out that high temperatures, poor air circulation, and exposure to harmful fumes lead to fatigue and reduced cognitive function, increasing the likelihood of errors. The findings suggest that adopting computerised systems for hazardous or safety-critical tasks can significantly improve safety performance by reducing employees' direct exposure to potential risks.

5.5.1.1 Technical Factors

In Section 4.6 it was revealed that insufficient maintenance of machines, poorly designed workplace environments, and inconsistent application of engineering controls were significant contributors to human error. Participants described examples such as machine guards' safety alarms and sensors as a preventative measure for human error incidents. Maintenance schedules need to be updated and to decrease the likelihood of incidents. The HEIPF addresses these technical gaps by advocating for:

- Automation and AI-based monitoring to detect hazards in real-time and reduce human dependency in high-risk tasks (Kaassis, Badri & Elkamel, 2021: 312);
- Standardised SOPs and SWPs, which are clear, regularly updated, and properly communicated; and
- Ergonomic workplace design, ensuring that noise, lighting, and equipment layout support concentration and reduce strain (Yadav, 2023: 4).

Strengthening technical systems at the input stage, organisations can eliminate or minimise hazards at the source, aligning with participants' recommendations for regular maintenance, modernised equipment, and rigorous SOP enforcement.

5.5.1.2 Internal Factors

Section 4.8.1 showed that fatigue, mental distress, and distractions severely impaired employee performance and decision-making. Participants two and five described long

shifts without adequate rest and limited support for managing stress. Such conditions were linked to decreased vigilance and increased mistakes. The framework mitigates these risks through:

- Fatigue management programs, including regulated working hours, rest breaks, and workload balancing;
- Mental health and psychosocial support, offering counselling and stress management resources to employees; and
- Skill development and ongoing training, ensuring that employees remain confident and competent.

These measures echo the literature suggesting that employee well-being is fundamental to preventing incidents and sustaining productivity (Folkard & Lombardi, 2021: 94–95).

5.5.1.3 People's Systems

Section 4.6.2 highlighted the critical influence of the outcome compliance informants within the automotive industry. Participant three indicated the benefits of health and safety rules enforcement such as, zero injuries, increase in productivity, increase in profit and maintenance of a good reputation. Section 4.9.2 highlighted the critical influence of leadership, teamwork, and organisational culture on safety outcomes. Lack of Supervision support and poor communication across departments were considered as barriers to effective safety management. The HEIPF addresses these issues by promoting:

- Visible supervision involvement, where managers actively participate in and champion safety initiatives (Michael, 2025: 1);
- Behaviour-based safety (BBS) programs, encouraging employees to observe and correct unsafe behaviours in real-time; and
- Incentive and recognition programs, rewarding adherence to safety practices to reinforce positive behaviours.

Embedding safety into the organisational culture and fostering shared responsibility, these elements counteract the gaps in supervision, motivation, and engagement noted in the findings.

5.5.1.4 Thinking Stages and Human Decision Making

Section 4.9 identified that employees often operated under cognitive overload, lacked situational awareness, and made suboptimal decisions, especially during high-pressure situations. Participants described different types of hazards as identified in Table 4.3. The framework supports employees' cognitive performance by:

- Decreasing cognitive load during decision-making improves user experience by reducing mistakes and speeding up task completion (Timileyin, 2024: 8);
- Decision-support tools, such as checklists and automated reminders, to guide employees in real-time; and
- Safety awareness training, helping employees anticipate and respond effectively to dynamic workplace hazards (Endsley & Jones, 2021: 156).

These interventions ensure that employees remain focused, attentive, and capable of making sound decisions even in stressful environments.

5.5.3 Mediated Factors

The mediated factors in the HEIPF represent the organisational environment that influences how inputs are transformed into outputs. Section 4.9.1, participants five, seven and nine revealed weaknesses in supervision, misunderstanding, and limited opportunities for employee feedback. Section 4.8.2, Participants ten and twelve reported the challenges they are facing in the automotive industry. This includes the inadequate investments for safety programmes such as training. This leads to feeling disengaged feeling as the rules were applied unevenly compared to other departments. To strengthen these mediating conditions, the framework recommends:

- Consistent supervision and monitoring, ensuring that policies are uniformly applied, and deviations are addressed promptly;
- Regular evaluation of workplace conditions, identifying emerging risks and areas for improvement; and
- Building employee commitment by involving them in decision-making and recognising their contributions.

According to Farooq, Abbey & Onukwulu (2024:435), these measures promote continuous improvement, foster trust between management and employees, and improve adherence to safety systems.

5.5.4 Outputs

Section 4.6.2 demonstrated that workplaces that enforces health and safety compliance experienced higher job satisfaction, improved production quality, and reduced costs due to fewer accidents. Conversely, weak controls led to injuries, fatalities, and reputational harm. Participants one, two and three noted that the employer enforces the health and safety compliance to prevent human error incidents, to avoid loss of profit and to prevent legal penalties. Enforcement is essential in the workplace in preventing human error and that improves both individual well-being and organisational performance.

The outputs of the HEIPF, including reduced incidents, increased job satisfaction, enhanced production quality, and profitability, reflect the benefits of investing in comprehensive, preventive measures. Research supports that integrated safety frameworks enhance organisational resilience and competitiveness (Morais et al., 2022: 1–3). In conclusion, the HEIPF aligns explicitly with the empirical findings of this study, offering a systematic and actionable approach to reducing human error. By addressing technical, internal, organisational, cognitive, and behavioural factors while strengthening mediation mechanisms the framework equips organisations with the tools needed to build a proactive, sustainable safety culture.

5.6 CHAPTER SUMMARY

The primary objective of this study was to identify the factors contributing to human error and develop an evidence-based framework to prevent its recurrence. The findings presented in Chapter 4 highlighted multiple interacting factors: technical, organisational, behavioural, and cognitive that increase the risk of workplace incidents.

The HEIPF, developed and discussed in this chapter, directly addresses the gaps and challenges identified in the study. The framework integrates five key input dimensions: technical factors, internal factors, people’s systems, thinking stages, and action

strategies. These inputs are supported by mediated organisational conditions such as workplace environment, employee commitment, and monitoring mechanisms, which influence how preventive measures are implemented and maintained. The findings of this study suggest these elements lead to positive outputs, including improved job satisfaction, enhanced safety outcomes, increased productivity, and reduced costs associated with incidents.

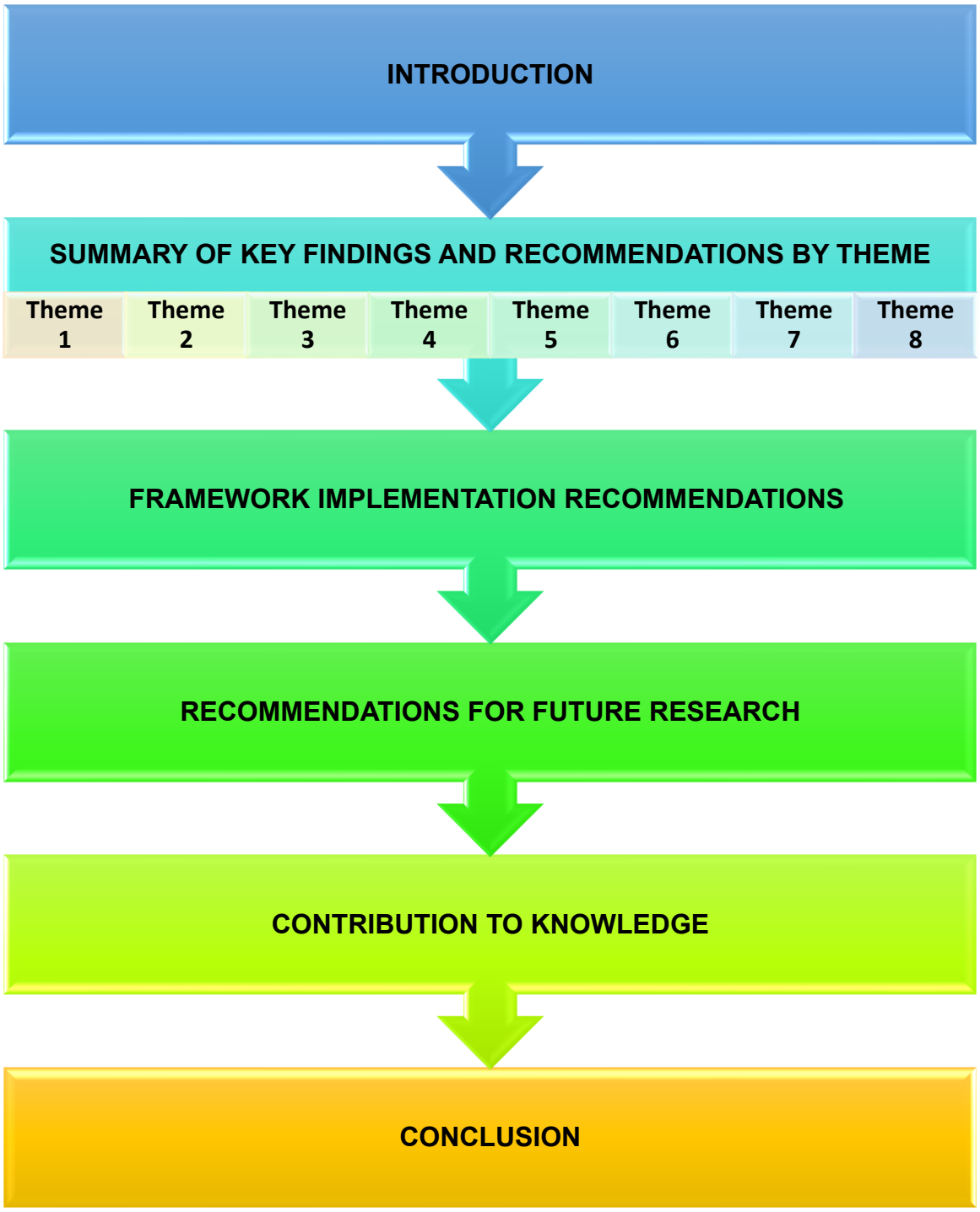
The HEIPF explicitly aligns with the empirical findings of the study where it responds to technical deficiencies (e.g., inadequate equipment maintenance and SOPs) through automation, ergonomic design, and regular audits. It mitigates internal vulnerabilities (e.g., fatigue, mental distress) by promoting worker well-being and regulated workloads, and addresses organisational culture and leadership gaps by strengthening people's systems and fostering accountability and engagement. in addition, it enhances cognitive and decision-making processes by providing situational awareness training, decision-support tools, and simplified workflows. In conclusion it promotes safe actions by embedding real-time hazard reporting, audits, and continuous reinforcement of correct behaviours.

In doing so, the framework offers a comprehensive, practical, and sustainable strategy for preventing human error incidents in the workplace. Further to this, it reinforces the notion that effective safety management requires not just compliance with procedures but an ongoing commitment to leadership, employee involvement, and system-wide vigilance. The study makes several contributions to both theory and practice. The HEIPF expands the understanding of human error prevention by integrating multiple dimensions and aligning them with real-world evidence. For practitioners, the framework provides a structured guide to developing interventions that are contextually relevant and empirically grounded.

In conclusion, achieving a safe and productive work environment in the automotive manufacturing industry demands deliberate and coordinated efforts across all levels of the organisation. By adopting the HEIPF, organisations can systematically reduce the likelihood of human error, improve safety outcomes, and enhance overall performance.

The findings of this study underscore the importance of embedding safety within organisational culture, continuously evaluating control measures, and prioritising employee well-being as essential steps toward fostering a resilient and proactive safety culture. The final chapter addresses the conclusion and recommendations.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS



6.1 INTRODUCTION

This chapter presents the conclusions and recommendations of this study that sought to understand the cause of human error incidents and accidents in the South African automotive manufacturing industry. Pursuant to the insights from the analysis phase of this study, the overall goal of this study was to develop a comprehensive framework for addressing workplace safety challenges. Building on the qualitative findings presented in Chapter 4 and the HEIPF developed in chapter 5, this Chapter concludes the study and provides practical recommendations for industry practitioners, policymakers, and researchers.

The recommendations are structured according to the eight major themes identified in the study, each linking directly to specific components of the HEIPF framework. These recommendations offer actionable strategies for automotive manufacturing organisations seeking to strengthen their safety management systems, reduce human error incidents, and foster a proactive safety culture. The chapter concludes with suggestions for future research and the study's contribution to the field of occupational health and safety.

6.2 SUMMARY OF KEY FINDINGS AND RECOMMENDATIONS BY THEME

The section discusses the findings and what needs to be done in the future to ensure that all human error incidents/accidents are significantly reduced. This involves the evaluation of health and safety control measures, the improvement of health and safety control measures, investigation of human error incidents and accidents, the reduction of human error incidents and accidents, the available health and safety management systems, health and safety challenges, common factors contributing to human errors, and factors contributing to human error.

5.5.2 Actions

Section 4.9.1 revealed that employees sometimes bypassed procedures, failed to report hazards, or grew complacent in routine tasks. This was often driven by production pressures, unclear responsibilities, or insufficient accountability. The HEIPF reinforces the importance of correct actions through:

- Real-time hazard reporting systems, enabling immediate and anonymous reporting of risks (Alruqi & Hallowell, 2022: 275);
- Regular safety audits and monitoring, ensuring compliance with rules and reinforcing correct behaviours; and
- Continuous awareness campaigns, reminding employees of the consequences of unsafe practices and the benefits of vigilance.

By fostering proactive and accurate actions, organisations can reduce incidents and build a resilient safety culture.

6.2.1 Theme 1: Evaluation of Health and Safety Control Measures

The study found that while automotive manufacturing organisations typically have control measures in place, the evaluation of these measures tends to be inconsistent and poorly structured. Properly conducted risk assessments, guided by the hierarchy of controls (elimination, substitution, engineering, administrative controls, and PPE), provide a robust framework to evaluate safety interventions. Participants stressed that elimination is the most effective control, whereas PPE is the least reliable. Organisations with systematic evaluation processes reported fewer safety incidents and improved overall safety performance. To enhance safety control evaluations, automotive manufacturers should standardise risk assessment protocols, conduct regular assessments, and develop risk matrices that prioritise hazards by severity and likelihood. Strengthening the technical elements of the HEIPF framework is also advised, prioritising elimination and substitution measures. Additionally, improved digital documentation, monitoring systems, and the establishment of key performance indicators are recommended to track control effectiveness and ensure consistency across organisational units.

6.2.2 Theme 2: Improvement of Health and Safety Control Measures

Improving safety controls hinges on comprehensive employee training, competency-based hiring, and the application of continuous improvement approaches such as kaizen. The research highlighted that employees lacking adequate safety training are more susceptible to errors, while organisations investing in ongoing, structured training

achieve better safety outcomes. It also showed the limitations of hiring based solely on technical skills without safety competencies. Recommendations include developing multi-tiered training programmes that embed human factors and organisational culture aspects from the HEIPF framework. Recruitment practices should evaluate both technical and safety competencies, incorporating pre-employment safety assessments and regular recertification to maintain up-to-date skills. Furthermore, continuous improvement methodologies should be integrated into safety management systems, encouraging employee participation through suggestion systems, regular SOP reviews, and cross-functional safety teams.

6.2.3 Theme 3: Investigating Human Error Incidents and Accidents

Incident investigations revealed significant shortcomings, especially regarding transparency and employee trust. Fear of blame inhibited honest reporting, leaving critical safety gaps. Investigations often targeted individuals rather than uncovering system-level causes. The study recommends establishing just culture practices where investigations focus on systemic failures rather than personal fault. Training investigation teams in human factors and root cause analysis methods, fostering anonymous reporting systems, and adopting structured investigation tools like the “5 Whys” and fishbone diagrams can improve findings. Furthermore, investigation results should be communicated transparently with clear timelines and feedback channels to employees. Maintaining a lessons-learned database and monitoring corrective actions are essential to closing the feedback loop in safety management.

6.2.4 Theme 4: The Reduction of Human Error Incidents and Accidents

Human error incidents in automotive manufacturing often trace back to poor maintenance practices and unclear equipment operation procedures. Organisations with systematic preventive maintenance schedules and SOPs experience fewer errors (Rosati, Romeo, Cecchini, Tonetto, Viti, Mancini & Frontoni, 2023: 107; Hardt, Kotyrba, Volna, & Jarusek, 2021: 5). Implementing condition-based monitoring with predictive technologies and maintaining detailed maintenance documentation are crucial to early detection of potential equipment failures. The study findings showed that training maintenance staff in technical and safety-specific competencies further reduces errors.

Strengthening protocols aligned with technical factors from HEIPF and integrating automation can enhance equipment reliability. Visual management and verification systems ensure adherence to SOPs while regular updates keep procedures relevant.

6.2.5 Theme 5: Available Health and Safety Management Systems

inconsistent implementation and poor integration across departments. The effectiveness of these systems strongly depends on leadership commitment, open communication, and active employee engagement. Recommendations include developing comprehensive SMS that cohesively integrate technical, organisational, and behavioural components per the HEIPF framework. Clarity in roles and communication protocols is vital. Leadership should visibly engage in safety activities and be held accountable through training and recognition programmes. Employees can be empowered through safety committees, suggestion schemes, peer observation, and open communication channels to ensure ongoing participation.

6.2.6 Theme 6: Health and Safety Challenges

Several challenges complicate effective safety management, including limited resources, the competing interests between production goals and safety priorities, regulatory enforcement gaps, and insufficient long-term commitment from organisations. Addressing these requires developing strong business cases that highlight the economic benefits of safety investments and incorporating safety metrics alongside production targets. Proactive compliance management systems and regular internal audits help ensure adherence to legislation such as the OHSA 85 of 1993. Building organisational resilience through change management, succession planning, and partnerships with academic and industry bodies fosters safety knowledge and benchmarking against industry leaders.

6.2.7 Theme 7: Common Factors of Human Errors

The research identified fatigue, distractions, poor training, communication failures, and workplace stress as frequent contributors to human error. These factors often interact to increase the risk of incidents /accidents. Organisations should target the internal factors of the HEIPF framework by implementing fatigue management, distraction reduction policies, and mental health support. Enhancing communication systems with structured

protocols, multiple channels, and language assistance helps overcome barriers. Cognitive support can be improved with decision aids, workflow design to reduce mental strain, and training in situational awareness to maintain focus during tasks.

6.2.8 Theme 8: Factors Contributing to Human Error

Human error incidents result from complex interactions among environmental, personal, and organisational factors. Poor workplace conditions, lack of supervision, insufficient technical controls, stress, and fatigue combine to elevate error rates. To address these, comprehensive workplace assessments should identify and mitigate environmental issues such as lighting and ventilation. Supervisor training should emphasise recognising and managing human factors risks. Support systems, mentoring, and clear supervision standards help employees manage stress and improve performance. Organisational systems must mediate workplace conditions, employee commitment, and monitoring consistently across shifts to foster a culture of safety and continuous risk management.

6.3 FRAMEWORK IMPLEMENTATION RECOMMENDATIONS

This HEIPF framework as presented in Figure 5.1, (Section 5.4) visually presents a comprehensive, phased roadmap for implementing the HEIPF safety management framework within automotive manufacturing environments. The top section outlines a step-by-step process beginning with foundational activities, advancing through core system development, and culminating in the integration and optimisation of safety systems. Interconnected success factors are shown as essential enablers to drive change effectively throughout the organisation. The bottom section illustrates the practical implications of the framework for manufacturers, safety professionals, and policymakers, emphasising risk assessment, targeted interventions, and continuous improvement of workplace safety.

Figure 5.1 (Section 5.4) represents the HEIPF component, which is the thinking stage. This stage plays a critical role in the risk assessment process, as it is linked to effective decision-making. This finding aligns with Section 4.3.1, which discussed human error prevention measures implemented within the automotive industry. Notably, participants

six, nine, and ten emphasise that incidents can be avoided by conducting a thorough risk assessment before commencing any task. Risk assessment is viewed as a formal approach to identifying potential risks, hazards, and their corresponding mitigation strategies. Furthermore, Section 6.2.1 encourages the application of the hierarchy of control measures to ensure employee safety and to proactively prevent incidents and accidents related to human error. In light of this, the researcher recommends that the organisation should prioritise the elimination and substitution stages of the hierarchy of controls to enhance safety outcomes.

Additionally, participants in Section 4.4.2 highlighted that strict adherence to OHSA 85 of 1993 and other relevant regulations plays a crucial role in reducing workplace incidents within the automotive industry. Following standard procedures ensures tasks are performed systematically, reducing the likelihood of errors caused by negligence. The HEIPF in Figure 5.1 (Section 5.4) outlines the key actions required to ensure compliance, which include behaviour, adherence to procedures, accuracy or the prevention of errors, awareness, and effective communication. Therefore, the researcher recommends that the automotive industry reinforce procedural compliance through continuous training, supervision, and performance monitoring. Clear communication of safety protocols and regular audits should be maintained to identify and correct deviations promptly. Moreover, improving adherence to protocols can lower incident rates, improve operational discipline, and foster a proactive safety culture in the automotive sector.

6.5 RECOMMENDATIONS FOR FUTURE RESEARCH

Future investigations should prioritise the empirical validation and refinement of the HEIPF framework. Implementation studies that quantitatively measure the framework's effectiveness in reducing incident rates would provide strong evidence of practical value. Comparative research across diverse automotive manufacturing contexts could reveal how regional or organisational factors influence outcomes. Longitudinal studies tracking sustained impacts over time would offer insights into the durability of improvements. There is also a rich opportunity to explore the integration of emerging technologies such as artificial intelligence, Internet of Things (IoT), and virtual or augmented reality for

preventing human error. Developing predictive analytics and evaluating automated safety monitoring systems could transform compliance and risk management. On a broader level, adapting and testing the HEIPF framework in other high-risk industries would expand its applicability, especially through comparative analyses of human error factors and culturally sensitive implementation strategies. Economic impact studies investigating cost-benefit ratios, return on investment, and economic models for safety investments would also deepen understanding of the financial implications of prevention programmes.

6.6 CONTRIBUTION TO KNOWLEDGE

This research contributes significantly to occupational health and safety by developing an integrated framework that addresses technical, organisational, behavioural, and cognitive dimensions of human error prevention, specifically within automotive manufacturing. It extends existing theory by synthesising multiple perspectives into a cohesive, practical model. Practically, it provides evidence-based recommendations and a structured approach for organisations aiming to reduce human error incidents. The study also introduces tools and methodologies to assess the effectiveness of safety management systems. Methodologically, it demonstrates the value of comprehensive qualitative approaches for investigating complex safety phenomena and highlights systematic methods for translating research insights into actionable guidance.

6. 7 CONCLUSION

The study offers comprehensive insights into preventing human error incidents in South Africa's automotive sector. It highlights that human error as a multifactorial, arising from complex interactions among technical, organisational, behavioural, and cognitive factors rather than isolated causes. This amplifies the necessity of integrated prevention strategies that coordinate interventions across all contributing elements simultaneously. Leadership commitment and fostering a positive safety culture emerged as a vital foundation for effective prevention programmes.

Continuous evaluation and refinement of safety systems are crucial to maintaining effectiveness in dynamic work environments. Employee engagement further enhances

implementation success by ensuring broad ownership and sustained performance improvements.

The HEIPF presents automotive manufacturers with a practical tool to reduce error incidents and strengthen workplace safety by addressing inputs such as technical and internal factors, people systems, thinking stages, and actions mediated by workplace conditions, employee commitment, and monitoring efforts to achieve outputs including improved job satisfaction, safety outcomes, productivity, and financial benefits. Ultimately, preventing human error requires deliberate and sustained commitment, adequate resourcing, and systematic application of evidence-based interventions. Automotive organisations adopting the HEIPF and following the study's recommendations can anticipate meaningful improvements in safety and operational effectiveness, creating safer and more productive workplaces.

This research aims to inspire a future wherein human error-related incidents become increasingly rare through proactive and comprehensive prevention efforts, securing competitive advantages along the way.

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ANNEXURE A: INTERVIEW GUIDE

PREVENTION OF WORK-RELATED (OCCUPATIONAL) INCIDENTS AND ACCIDENTS CAUSED BY HUMAN ERROR IN THE SOUTH AFRICAN AUTOMOTIVE MANUFACTURING INDUSTRY

You are co-ordinally invited to participate in a semi-structured interview that will be conducted by Gabsile Mdletshe under the supervision of Dr Cheryl Rielander, a senior lecturer, in the Department of Operations Management towards a Master of Commerce in Business Management at the University of South Africa.

Human error is a formidable challenge in the automotive manufacturing industry, often leading to, incidents/accidents, and in severe cases, disasters. The consequences of these errors can be significant, impacting productivity, safety, and reputation. It is anticipated that the information gained from this research will help the researcher to identify incidents and accident control measures and prevention.

As a participant, you will comprehensively explore strategies to minimize human error and enhance overall performance. However, you will not benefit from your participation as an individual, but you be envisioned and find the understanding of the causes of human error incidents and accidents in the automotive industry.

By participating in this study, you will assist the researcher in developing control measures for the prevention of the re-occurrence of incidents to create a safer working environment. We do not foresee that you will experience any negative consequences by participating in the interview. The researcher(s) undertake to keep any information provided herein confidential, not to let it out of our possession, and to report on the findings from the perspective of the participating group and not from the perspective of an individual.

INTERVIEW GUIDE

1. Do you consider human errors to be the root cause of incidents/accidents and why?

_____

_____

_____

_____

2. What would you consider to be a negative impact of human errors on employees or teams of employees?

_____

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3. Why do you consider preventing human errors in a workplace important?

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4. Explain what you consider to be the cause of human error incidents and accidents?

_____

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5. What can be done to ensure that workplace challenges and failures are resolved to prevent the occurrence of incidents and accidents?

_____

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6. Give a few examples of what the workplace challenges and failures are that lead to a high rate of human error accidents and incidents in the automotive industry?

_____

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7. What are the benefits of the employed regulations such OHSA 85 of 1993, COIDA, NEMA, labour law, etc?

_____

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8. Why is it necessary for employers to enforce health and safety compliance?

_____

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9. Indicate what control measures are in place for preventing human error incidents and accidents.

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_____

10. How are the correct control measures chosen?

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11. In your opinion what can be done to improve these control measures that are in place?

_____
_____
_____
_____
_____

12. What is your understanding with regard to safe work procedures and safe operating procedures?

_____
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_____

13. Do you think that it is fair for employees to be investigated immediately after the incident has occurred? Why?

_____

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14. Why is it crucial for employees to respond truthfully during an incident/accident investigation?

_____

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15. Which risk management systems are in place within the automotive industry?

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16. What can be done to verify the functionality of the current health and safety management practices?

_____

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17. Would you like to add anything that has not been mentioned during the interview?

_____

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_____

Thank you for your participation

ANNEXURE B: PARTICIPANT INFORMATION SHEET AND CONSENT FORM

THE PREVENTION OF WORK-RELATED (OCCUPATIONAL) INCIDENTS AND ACCIDENTS CAUSED BY HUMAN ERROR IN THE SOUTH AFRICAN AUTOMOTIVE INDUSTRY

Dear Participant,

My name is **Gabsile Mdletshe** a registered master's student at the University of South Africa (Unisa). I am currently studying a Master of Commerce in Business Management Studies (MCOM) degree, under the supervision of Dr. C.L. Rielander and co-supervised by Dr E. Esterhuyzen.

You have been invited to participate in a research study entitled:

> *"The Prevention of Work-related / Occupational Incidents and Accidents Caused by Human Error in the South African Automotive Industry".*

Purpose of the study

The purpose of the study is to explore the causation of human error incidents and accidents within automotive organisations and to identify methods that can be used to examine why human errors are causing incidents and accidents within automotive manufacturing organisations.

Why am I being invited to participate

You are invited to participate as the study focuses on preventing work-related occupational incidents and accidents caused by human error within the automotive industry. Participation is completely voluntary, and you can withdraw from the study at any time.

What is the nature of your presentation?

For this study, the researcher will conduct interviews with participants guided by several open-ended questions. The interview will take approximately 30 to 45 minutes.

Can I withdraw from the study?

Participation in the study is voluntary, as was previously stated, and you are free to leave the study at any time. However, withdrawal will no longer be an option once data analysis commences.

Are there benefits for participating in the research study?

The findings from the study will create an understanding of the causes of human error incidents and accidents in the automotive industry with generalisation to other organisations and will assist the researcher in developing control measures for the prevention of the re-occurrence of incidents to create a safer working environment. There is no monetary compensation for completing the interview guide.

Are there anticipated inconveniences of taking part in the study?

There is no anticipated inconvenience foreseen by the researcher for participating in the study. Should you feel negatively impacted or uncomfortable responding to the questions in the interview you may freely withdraw from the study.

What are the inclusion and exclusion criteria for the study?

Participants will be selected based on their experience and exposure. It would be required that participants should have at least two years of experience and above the age of 25 years. Participants who have been appointed for less than two years will be excluded from the study. Participants above the age of 60 years will be excluded from this study.

Confidentiality

All information received will be anonymised and will be stored following the Protection of Personal Information (POPI) Act No. 04 of 2013 (as enhanced). Information received may be used anonymously for purposes other than thesis research, such as articles or conference presentations.

An appointed statistician who has been given access to the interview guide data will review the data and be required to sign a confidentiality agreement. The supervisors,

members of the reviewing research ethics committee, and internal and external examiners are additional parties who will review the research thesis.

Ethical requirements

Ethics approval for the study has been obtained from the College of Economic Management Sciences (CEMS), research ethics review committee in line with Unisa's policy on research ethics. A copy of the approval letter can be requested from the researcher.

Should you have concerns about the way in which the research has been conducted, you may contact the Supervisors as follows:

Supervisor Dr. C.L. Rielander
Tel No. (012) 429 2947
Email on: rielacl@unisa.ac.za

Co-Supervisor- Ms E. Esterhuyzen
Tel No. (012) 429 3612
E-mail on: estere@unisa.ac.za

How will I be informed of the findings and recommendations?

Please contact the researcher if you need more information on any aspect of the research project by calling 078 008 9798 or sending an email to 41024885@mylife.unisa.ac.za. Please enter your contact information if you would like to be informed of the research's final conclusions or contact the researcher using the information provided above. After the study's conclusion, the results will be available for five years.

Thank you for completing the interview guide.
Your input is valuable to the research.

Please provide your email address if you would like to receive the research findings on completion of the research study _____

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understand the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time from the study prior to the data analysis phase.

I am aware that the findings of this study will be anonymously processed into a research thesis report, journal publications, and/or conference proceedings.

I am aware of the minimum of 25 years and a maximum of 60 years of age restriction in order to participate in this interview.

I agree to the recording of the interview.

I have received a signed copy of the informed consent agreement.

Participant name & surname…… (please print)

Participant signature…… Date……

Researcher's name & surname……..… (please print)

Researcher's signature…….. Date……

ANNEXURE C: ETHICAL CLEARANCE

College of Economic and Management Sciences_CRERC

Ref #: 2324
Name: Mrs Gabsile Ruth Mdletshe
Student #: 41024885

Date: 12/09/2024

Dear: Mrs Gabsile Ruth Mdletshe

Decision: Ethics Approval from 12 September 2024 to 11 September 2027

Researcher: Mrs Gabsile Ruth Mdletshe

480 Smith Street, Durdoc hospital

Durban

41024885@mylife.unisa.ac.za 078 008 9798

Supervisor: Dr Cheryl Rielander rielacl@unisa.ac.za

Co-Supervisor: Dr Elriza Esterhuyzen estere@unisa.ac.za

THE PREVENTION OF WORK-RELATED/OCCUPATIONAL INCIDENTS AND ACCIDENTS CAUSED BY HUMAN ERROR IN THE SOUTH AFRICAN AUTOMOTIVE MANUFACTURING INDUSTRY

Qualification: Master of Commerce in Business Management

Thank you for the application for research ethics clearance by the College of Economic and Management Sciences_CRERC for the above mentioned research study. Ethics approval is granted for three years.

The **low risk application** was **reviewed** by College of Economic and Management Sciences_CRERC on 10 June 2024 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the College of Economic and Management Sciences_CRERC.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.

ANNEXURE D: CERTIFICATE OF LANGUAGE EDITING

TARA

To: Whom it May Concern

cc: Gabsile Mdletshe <41024885>
MCOM Candidate | University of South Africa (UNISA)
Email: 41024885@mylife.unisa.ac.za

15 September 2025

Ref: **Masters degree - Final Report Proof-reading & Editing Confirmation Letter**

Further to the request to review the MCOM dissertation, this correspondence serves to confirm that I (Dr Thabani Mudavanhu) have proof-read and edited the manuscript for Ms. Gabsile Mdletshe – student number 41024885 titled:

The prevention of work-related/ occupational incidents/accidents caused by human error in South African automotive industry

This report was proof-read and edited from 26 Aug 2025 – 15 Sept 2025. The task included but was not limited to the following: highlighting language issues - grammar and sentence construction; academic writing issues (choice of words review and referencing) and formatting issues. Recommendations were also given on specific sections to enhance the overall report and to ensure document alignment as per the attached annotated copy.

All other minor academic writing issues were resolved. This correspondence summarises the review of this work as submitted and does not in any way imply the editor's material contribution to the study.

Should you need further information concerning this work or related matters, feel free to contact the undersigned consultant.

Yours Sincerely,

Thabani Mudavanhu
Principal Consultant
082 444 3244
thabani@africanresearchassist.com
www.africanresearchassist.com

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