Improving occupational health and safety in a petrochemical environment through culture change

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ABSTRACT

In spite of the vast technological progress and improvement in the standard of management systems within hazardous industries around the world, occupational health and safety incidents and fatalities continue to devastate thousands of lives each year.

Throughout the last decade, significant improvement has been achieved in the reduction of health and safety incident rates across the South African petrochemical environment. However, a persistent roller-coaster fatality rate still prevails. Recent studies have shown that in order to conquer the relentless battle in realizing sustainable world-class health and safety performance, an organisation has to move beyond the traditional compliance orientated safety focus towards an interdependent safety culture in which safety is ubiquitous and embedded in the hearts of all employees.

The root causes of more and more occupational health and safety incidents are no longer as a result of mechanical or systems failure, but instead originate from the attitude, values and beliefs of management and employees with regard to the significance of safety, also known as the safety culture. This has ignited a rising interest in the concept of safety culture among organisations because of the positive impact on occupational health and safety in reducing the potential for fatalities, injuries and workplace incidents.

Hence the primary objective of this study is to determine the maturity of the current safety culture in the South African petrochemical environment by identifying particular culture shortfalls which could lead to hesitant progress towards the desired interdependent state. In order to reach this objective, three secondary objectives have also been set. Firstly, an understanding of the concept of organisational culture and safety culture is crucial. In simple terms, organisational culture can be described as the shared values, assumptions and beliefs in an organisation that ultimately direct employee behaviour. Organisational culture is characterised by three layers known as artefacts, espoused values and basic assumptions. These layers

represent the manifestation of the organisational culture and vary in terms of outward visibility and resistance to change. Understanding and analysing these layers provide the reasons why employees behave in certain ways. Safety culture is a sub-set of organisational culture; in other words, it is the manifestation of the organisation's attitude, values and commitment in regard to the importance of health and safety. Companies which have developed effective safety cultures have demonstrated unequivocal results in closing the elusive health and safety performance gap.

Secondly, the fundamental components conducive of an effective safety culture were explored. These components include management and employee commitment to health and safety, accountability and involvement, communication and trust, risk awareness and compliance, competency and learning and finally recognition. Most of the components can be assigned to the artefact level or a combination of the level of artefacts and espoused values with only a small number more appropriately associated with the level of basic assumptions. The effectiveness within each of these areas ultimately dictates the nature of the safety culture and the success in preventing health and safety incidents.

The focus of the last secondary objective was to determine the development stages leading to an effective safety culture known as an interdependent safety culture. Each of these stages represents the degree of maturity of the attitudes and commitment of management and employees in relation to the ongoing health and safety improvement in the organisation. The DuPont model suggests that in a reactive safety culture, safety is merely a natural instinct with no real perceived value for the individual or organisation. Moving towards a dependent safety culture, employees start to value safety but only so they do not get caught. The next stage called an independent safety culture is characterised by self preservation. In this stage, the mindset of employees changed towards an attitude of "I do things safe so I do not get hurt". In the final stage known as interdependent safety culture, employees embrace safety as a personal virtue not only for their own safety but also in contribution to the safety of their peers. In such a culture it is employees' desire to do things safely so that no-one gets hurt.

An empirical study was conducted through a quantitative research approach in the form of a safety climate questionnaire. The target population consisted of first-line managers and non-managerial personnel within the production; maintenance; laboratory; technical, and the safety, health and environment departments in a petrochemical organisation.

In light of the results emanating from the empirical study it can be concluded that an overall positive perception was observed towards the selected safety culture components indicative through the mean response scores above the neutral scale of 3. Older and more experienced employees demonstrated a more positive response to the safety compared to younger employees. However, several distinctive safety culture shortcomings were also identified. In the current safety culture, health and safety is sometimes overlooked due to productivity or cost implications. Employees tend to withhold safety related information to themselves as a culture of guilt prevails and mere compliance to safety standards is considered adequate. Solutions to health and safety problems are most of a short-term nature and do not address the root cause.

It therefore provides evidence that the organisation under evaluation has not yet reached the desired safety culture maturity stage of interdependence. Although the study population is limited to a single organisation, the shortfalls identified could relate to the larger petrochemical environment and thus could explain the recent fluctuating health and safety performance. This assumption, however, can only be validated through further research within a much greater sample size inclusive of more than one organisation in the petrochemical environment.

It is thus clear that the existing safety culture within the petrochemical organisation could lead to potential health and safety incidents if the shortcomings are not appropriately addressed.

Keywords: Occupational health and safety, organisational culture, safety culture, safety climate, petrochemical environment

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“Safety is without a doubt, the most crucial investment any organisation can make and the question is not what it costs but what it saves”

— Robert E. McKee —

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FTA	Fault Tree Analysis
GDP	Gross Domestic Product
HAZOP	Hazard and Operability Study
ILO	International Labour Organisation
INSAG	International Nuclear Safety Advisory Group
IAEA	International Atomic Energy Agency
IOSH	Institute of Occupational Health and Safety
LOPA	Layers of Protection Analysis
NOHS	National Occupational Health and Safety Policy
OECD	Organisation for Economic Co-operation and Development
OHS	Occupational Health and Safety
OHSAS	Occupational Health and Safety Assessment Series
RCR	Recordable Case Rate
SD	Standard deviation
SHE	Safety health and environment
SPSS	Statistical Package for Social Sciences

CHAPTER 1
NATURE AND SCOPE OF THE STUDY

1.1. INTRODUCTION

The distinct trend in today's business world of reducing cost and saving time is driven by rapid globalisation and decreasing earning capacity. This drive is inherently enhanced by the natural incline to minimise effort which can easily create conditions in which the level of risk awareness fades away (Knegtering & Pasman, 2009:164).

Recent decades have seen major technological advance in the workplace, which, together with fierce competition, have transformed work for many throughout the world (ILO, 2010:1). The effects of such changes on occupational health and safety (OHS) have also been significant. In some cases, more traditional hazards and risks have been reduced or eliminated; for example, through plant automation, but new technologies have also created new risks (ILO, 2010:1). In spite of the vast improvement in the standard of risk and safety management in hazardous occupational environments around the globe, accidents, injuries and fatalities still continue to shake the society and corporate stage especially in the chemical industry (Venkataraman, 2006:63).

European organisations share some of the world's best records for occupational health and safety (Fitzgerald, 2005:324). Nevertheless, between 2008 and 2009, there were 180 fatal injuries and 246 000 recordable injuries to workers of which 32 fatalities occurred in the manufacturing industry alone (HSE, 2009:4). This figure might not seem overly disturbing; however, the average fatality rate since 2002 has reached a plateau, suggesting no significant overall improvement (Fitzgerald, 2005:324). Safety performance in the U.S. chemical industry reveals a similar picture with the average recordable incident rate from 2002 until 2007 remaining unchanged (ACC, 2008:1).

This stagnation in safety performance is not an unusual phenomenon as it is indicative of the latter and most challenging stage in the safety performance improvement process. Organisations usually engage in improving safety performance by firstly implementing engineering controls driven largely by standards, recognised good practice and legislation requirements. Secondly, organisations would establish a safety management system to provide a framework in which safety can be managed and finally, organisations would engage in safety improvement through people (Fitzgerald, 2005:325).

The reality is that only the minority of accidents occur as a result of unsafe mechanical or physical conditions. Many on-the-job accidents and injuries result from single employees' unsafe behaviour; however, the true cause of these incidents can be traced to end-events in a series of interacting factors on several levels within the organisation (Vredenburgh, 2002:260; Knegtering & Pasman, 2009:164).

The most frequent method for managing occupational health and safety has been through a control-oriented approach to human resources, one that assumes workers are motivated to exert only as much effort as is necessary for task completion. As such, it is management's responsibility to use its legitimate authority to control employee behaviour. This control-oriented approach emphasizes the use of rules to enforce behaviours and the use of punishment to increase rule compliance (Zacharatos, Barling & Iverson, 2005:77).

In contrast, developing an effective safety culture by moving beyond the compliance mindset and control-orientated approach enables the shift out of the seemingly stagnant safety performance improvement to the illusive zero injury target desired by every organisation. This is achieved by embracing an interdependent safety culture where all employees are responsible for safety and everyone's safety is equally important (DuPont, 2009:3).

The safest companies have recognised that such an organisational safety culture can be the difference between business prosperity and failure or even life and death. For these companies the concept of safety is ubiquitous and embedded in the heart

of the organisation's culture and values. Such organisations perceive safety as a personal issue rather than a corporate concern and form part of every employee's way of life, both on and off the job (Troxell, 2009:8).

1.2. PROBLEM STATEMENT

Most organisations consider themselves to have good technical controls and management systems and are seeking to achieve the engagement and involvement of their people in bringing about further improvement beyond the stagnant low or roller-coaster occupational incident rate trend (Fitzgerald, 2005:325).

This is also the case in the petrochemical environment of South Africa. Throughout the last decade the overall trend in safety performance in the South African petrochemical industry has improved substantially, evident in a significant decrease in the recordable injury and incident rate reported by some of the major players including Sasol Limited, Engen Petroleum Limited and Royal Dutch Shell. This improvement has been achieved mainly through the incessant focus on safety management systems and implementation of behavioural based safety initiatives. Although a remarkable improvement has been shown in the recordable injury rate compared to previous years, a persistent roller-coaster trend in employee and service provider fatality rate has been observed (Sasol, 2009:34; Engen, 2009:42; Shell, 2009:35). This distressing matter has brought about the evaluation of the occupational health and safety management in the South African petrochemical environment through the execution of an external safety review.

The safety review report revealed that clear, noticeable signs have been observed in the mind-set change of employees concerning the true meaning of safety although continuous improvement efforts are critical to achieve world-class safety performance. The report findings were indicative of hesitant progress towards the development of a mature, interdependent safety culture (DuPont, 2005:13).

1.3. OBJECTIVES OF THE STUDY

1.3.1. Primary research objective

It is therefore the primary research objective of this study to assess the current maturity of the safety culture in the South African petrochemical environment by identifying potential cultural shortfalls preventing further improvement in occupational health and safety performance hence resulting in hesitant progress towards the development of a mature, interdependent safety culture.

1.3.2. Secondary research objectives

The primary research objective will be realized by meeting the following secondary research objectives:

- Create an understanding of the concept of organisational culture and safety culture;
- Identify the different components or characteristics conducive in the development of an effective safety culture; and
- Determine the stages of maturity towards an effective safety culture.

1.4. SCOPE AND STUDY LIMITATIONS

This study focused on the safety culture within the South African petrochemical environment. The target population consists of first-line managerial personnel as well as lower-level employees responsible for production, technical support, maintenance, and OHS activities. Due to the time constraint in the execution of this study and logistical challenges in reaching these lower-level employees, a convenience sample method had to be applied within a single petrochemical organisation only. As a result, statistical inference to the study population should be considered with caution.

Literature sources utilized in order to meet the secondary objectives are limited to those readily available in online academic databases as well as publications available in libraries within the boundaries of South Africa until 31 October 2010.

1.5. RESEARCH METHODODOLOGY

The research methodology applied in this paper is through the application of a comparative literature review as well as through a qualitative approach in the form of a safety climate questionnaire.

1.5.1. Literature review

In order to establish a sound theoretical background in reference to the problem as formulated above, an in-depth literature analysis was conducted with specific reference to the following aspects:

- The significance of occupational health and safety for the organization;
- The concept of organisational culture and culture change;
- The concept of safety culture;
- The components of a safety culture;
- The concept of a safety climate; and
- The different improvement stages of an organisational safety culture.

1.5.2. Empirical investigation

Six fundamental components of a safety culture were identified through academic review. The attitude or perception with respect to each of these components were measured based on typical characteristics describing the maturity of the safety culture using a safety climate questionnaire. The questionnaires were distributed and gathered by the first-line managers of the selected departments in the study population, with the intention to ensure a high return rate. All questionnaires and collected information were treated confidentially. The results emanating from the empirical investigation were analysed with the assistance of the North-West

University statistical department through the use of statistical software packages including Statistical Package for Social Sciences (SPSS, 2009), Statistical Analysis System (SAS, 2003) and Statistica (Statsoft, 2009).

1.6. CHAPTER PREVIEW

This dissertation is divided into four chapters, which will be presented as follows:

- **Chapter 1 – Nature and scope of the study**
  This chapter contains an introduction to the study, the problem statement, study objectives, research methodology and study limitations.

- **Chapter 2 – Literature review**
  This chapter presents a concise literature review regarding the importance of occupational health and safety in the organisation, the concept of safety culture and the evolution of safety culture. The fundamentals of organisational culture are also discussed in order to create a platform in understanding the essence of a safety culture. The literature review concludes with the description of the key components conducive of a safety culture and the development stages towards an effective safety culture.

- **Chapter 3 – Empirical study**
  This chapter deals with the empirical research approach applied in the study including the development of the safety climate questionnaire for the evaluation of the current safety culture in the petrochemical organisation. It furthermore presents the target population, sample strategy and statistical methods used in the analysis of the sample. The information gathered from the empirical study is then discussed and interpreted based on the results obtained from statistical analysis.

- **Chapter 4 – Conclusions and recommendations**
  In this final chapter, conclusions and recommendations were made relating to the objectives of the study based on the literature information and key findings from the empirical investigation. This is followed by an evaluation confirming that the study objectives have been addressed. Finally, recommendations for future research are provided.

1.7. CHAPTER SUMMARY

Since 2002, the health and safety statistics in the petrochemical industry has shown significant improvement through the implementation of behavioural based safety programs and continuous focus on health and safety management systems. An independent safety review commended the progress achieved in the reduction of health and safety incidents which revealed a positive shift in the attitude and commitment of management and employees in regard to occupational health and safety.

Although the overall incident figures have dropped well below historical rates, recent safety statistics in the petrochemical environment suggests a roller-coaster trend in workplace fatalities. This study aims to determine the current maturity of the safety culture in a petrochemical environment by identifying particular culture shortfalls preventing further progress in health and safety performance. It hopes to achieve this by utilizing a safety climate questionnaire and employing statistical analyses. From this study, management practices can be aided in determining problem areas and implementing appropriate interventions.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

The concept of safety can be defined as the smallest possible or acceptable risk, whereas risk is the product of possible damages and the probability of their occurrence (Grote, 2007:638). Organisations that manage their risks best not only create a safer workplace but also an environment to reap the most profit. Those organisations that fall short are either perceived as dangerous or require making drastic changes such as scaling down their operations in order to achieve acceptable levels of safety performance (Hudson, 2000:1).

Over the past two decades a fundamental need has grown for change in the level of "acceptable" occupational health and safety (OHS) performance, especially in the petrochemical industry. Traditionally, the focus exists on safety management systems and risk identification through techniques such as hazard and operability studies (HAZOP), fault tree analysis (FTA), layers of protection analysis (LOPA) and the installation of appropriate monitoring equipment. However, these regulating systems and technical methods are far from superior as its focus is generally limited to analysing the physical and chemical aspects and not human behaviour (Knegtering & Pasman, 2009:162).

The root cause of many major worldwide accidents including the Chernobyl catastrophe has been attributed to failures arising from the culture of the organisation rather than mechanical failure (Hudson, 2007:698; Knegtering & Pasman, 2009:162). Other well known incidents occurring as a result of organisational culture shortfalls include the loss of the space shuttle Columbia (NASA, 2003:184) and railway disasters such as Clapham Junction (Hidden, 1989:117), Ladbroke Grove (Cullen, 2001:4) and the Waterfall disaster (McInerney, 2005:215). In South Africa, two of the

biggest occupational incidents include the Kinross gold mine disaster in 1986 and the St Helena mining incident in 1987 (Dixon, 2001:1).

There are a number of ways of achieving high levels of OHS performance although not all methods will lead to sustainable performance. These range from having a systematic and highly controlled prescription of all activities in order to manage potential hazards, to creating a safety culture in which everyone is personally involved in ensuring the safety of all concerned (Hudson, 2000:1). Companies which have developed effective safety cultures understand the psychology of why employees behave a certain way and ultimately how to get employees to actively care about safe behaviour (Troxell, 2009:12).

Research has demonstrated that the relationship between a positive safety culture and world-class safety performance is unequivocal (Gardner, 1999:26; Gregory, Harris, Armenakis & Shook, 2009:678, Olive, O'Connor & Mannan, 2006:139). The reality however is that many organisations vary in their understanding of the concept of safety culture and the steps necessary to influence it in a positive way (IAEA, 2002:16).

It is therefore the main objective of this chapter to explore the concept surrounding organisational safety culture and the key elements influencing the creation of an effective safety culture. In achieving this objective the literature review covers the following aspects:

- Implications of health and safety performance for the organisation;
- The need to change the approach to enable further improvement in OHS;
- The concept of organisational culture and culture change;
- The concept of safety culture and safety climate;
- Key components in safety culture; and
- Stages of safety culture development.

The literature research and empirical application in this study is limited to the surface level of safety culture known as the safety climate and therefore the deeper

psychological motivation behind employee behaviour with regard to occupation health and safety is not explored.

2.2 SIGNIFICANCE OF OHS FOR THE ORGANISATION

2.2.1 Legal and moral obligation

"*Safety is without a doubt, the most crucial investment any organisation can make and the question is not what it costs but what it saves*" (Bates, 2001:27). In South Africa, an annual total of 122 889 employees fall victim to accidents or sickness as a direct result of their work, with almost 1% of these being fatal. The number of man-days lost annually due to injuries and sickness is estimated at more than 12 million, excluding further losses due to labour unrest (Sieberhagen, Rothman & Pienaar, 2009:1).

Although the general belief is that people are any company's most important asset, this notion is certainly not always a true reflection of the reality when it comes to workplace safety. Employers, particularly those employing lower skilled workforces, tend to view expenditure on OHS as a cost to be avoided if at all possible. This immoral approach normally results in an even greater financial expense (NOHS, 2003:4).

Occupational accidents are becoming more and more expensive in modern society. Thus apart from being the right thing to do, preventing occupational accidents makes good economic sense for society as well as organisations (Dorman, 2000:1). Workplace accidents cost organisations and national economies billions of Rands annually, disabling and injuring millions of employees (ILO, 2003:23). A large portion of these costs is associated with legal fees such as workers' compensation cost and costs for medical treatment. Costs to employers include repair cost to damaged equipment, investigation time, lost production and often the loss of the employability of the worker. Costs to workers and their families include permanent disabling injuries, loss of employment and loss of breadwinners. In South Africa, the annual

cost due to occupational health and safety incidents is an estimated 3.5% of the national Gross Domestic Product (NOHS, 2003:4).

It is therefore the purpose of litigation to encourage the employer to improve and sustain acceptable occupational safety performance for no other reason than to reduce workplace safety accidents by providing safe working environments (South Africa, 1993:1). The common thread running through the International Labour Organisation (ILO) convention 155 on occupational health and safety, the Mine Health and Safety Act 29 of 1996 (South Africa, 1996:1), the Occupational Health and Safety Act 85 of 1993 (South Africa, 1993:1), the Occupational Health and Safety Assessment Series (OHSAS) 18001 and the South African national constitution is that all employers have an obligation to ensure that their employees are protected from health and safety risks in the work environment as far as reasonably practical.

Failure to comply with the above regulations could have significant repercussions for the employer as well as the employee. When any activity performed in the work environment is deemed potentially unsafe, an employer could be prohibited to commence with the associated activity which often result in production losses with consequential financial implications. In the case where an employee is injured and it is found that the employer failed to comply with the necessary regulations, the employer could be convicted of culpable homicide irrespective of whether or not the injury could have resulted in the death of the employee. Such a conviction could result in a heavy financial penalty and possible imprisonment (South Africa, 1993:27).

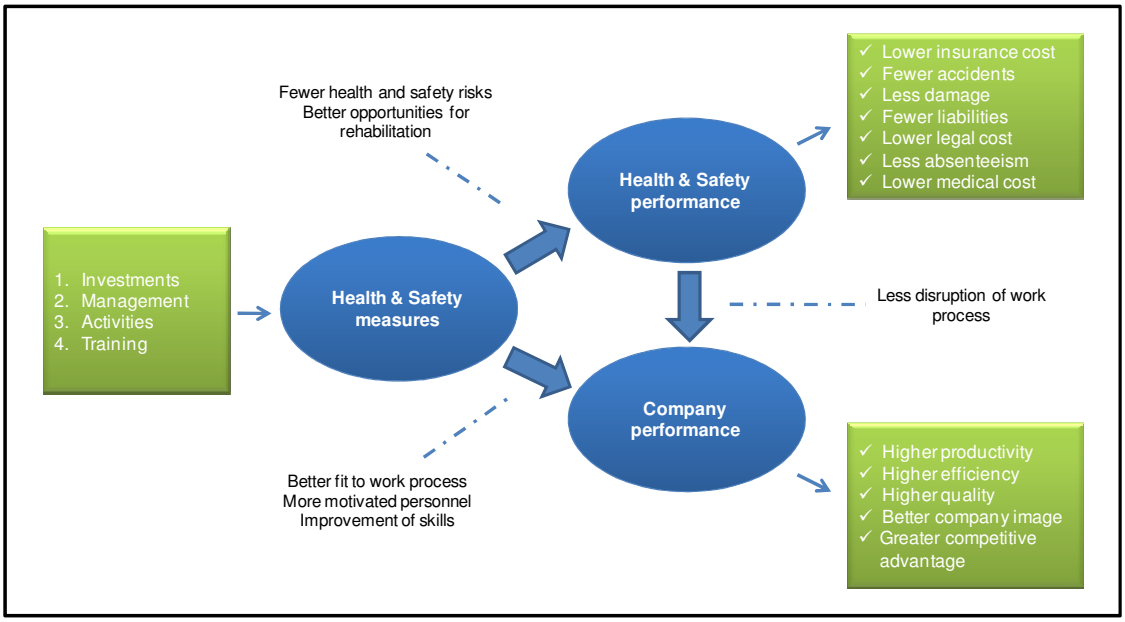
Although the adherence to OHS standards and regulations may be regarded as an important catalyst to guide the employer in providing a safer work place, it should not be seen as the alpha and omega (Yu & Hunt, 2004:211).

2.2.2 Safety performance is good business performance

Failure to comply with occupational safety legislation clearly has its consequences but so thus the endeavour to strive towards good safety performance. Creating a safe working environment presents no obstacles to being competitive and successful. In fact, no country and no company in the long run has been able to grow to a high level of productivity without making sure that the work environment is safe (Heymann, 2003:289).

Safety performance has become synonymous with good business performance. For many manufacturing organisations, safety performance forms part of their key business indicators which encourages employees' behaviour to prevent workplace accidents (Fernández-Muñiz, Montes-Peón & Vázques-Ordás, 2009:980). How an organisation deals with the safety of its employees, suppliers, customers and its community stakeholders can speak volumes about how well the organisation is managed, how much earning potential it has and whether or not it makes a good partner over the long run (I2A, 2010:1).

Figure 2.1: From safety performance to business performance



Source: Fernández-Muñiz *et al.* (2009:982)

Figure 2.1 illustrates the economic effects of occupational safety from a business perspective. Occupational incidents interrupt the production process, generating both financial and opportunity costs and decreasing the quantity and quality of production achieved, ultimately leading to a drop in the firm's productivity (Fernández-Muñiz *et al*., 2009:982).

Unsafe working conditions undermine workers' morale and motivation and could potentially affect employee turnover rates and result in the loss of valuable knowledge and critical skills. Moreover, increasing and repetitive accidents can adversely affect the firm's image and reputation, provoking a severe deterioration in its public relations as well as customer loyalty (Smallman & John, 2001:237).

All this can damage the organisation's value creation and lead to a decline in the firm's competitiveness with a consequent loss of market position. Therefore, preventing occupational risks and incidents is an essential element in business management with important strategic implications for the organisation (Fernández-Muñiz *et al*., 2009:982).

2.3 A NEED FOR CHANGE

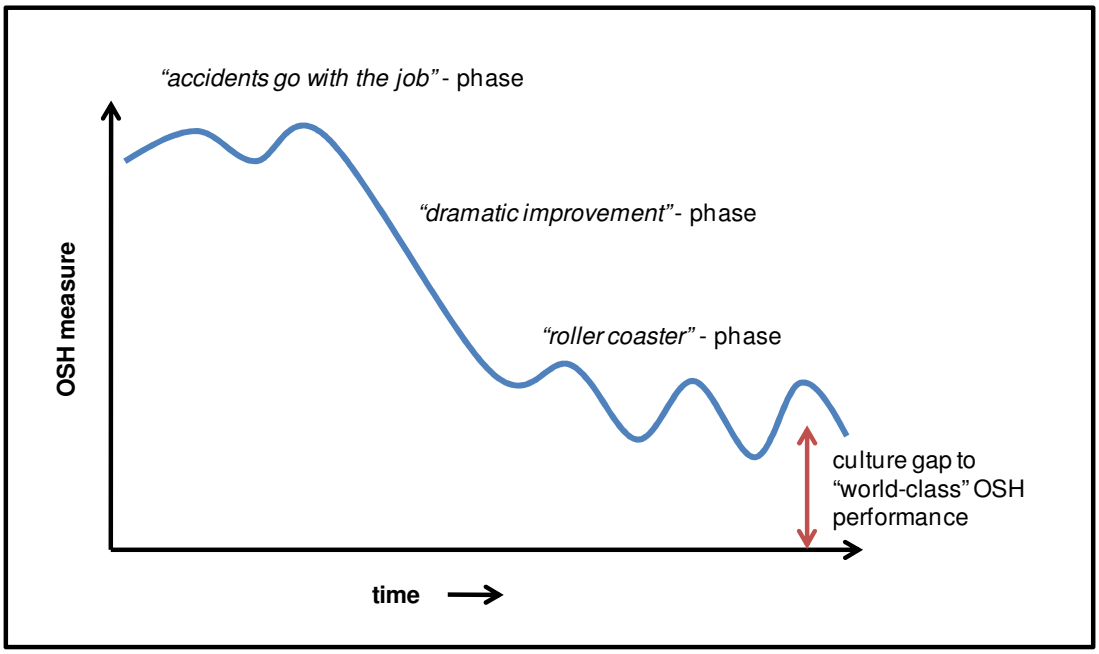
The transformation in organisational safety performance is often characterised by a cyclical effect with three distinct phases as illustrated in Figure 2.2.

- Accidents go with the job;
- Dramatic improvement; and
- Roller-coaster phase.

These phases reflect a transition from an attitude of "do not really care about OHS" through a period of focused improvement on well-defined initiatives to a plateau of lower but non-zero accident rate levels often characterized by a persistent roller-coaster trend in OHS performance. Each stage presents cultural challenges. To enable the transition from the phase where the belief is that accidents are an

inevitably part of the job, the challenge is to change the organisational mindset to realise the benefit in taking control of OHS performance and help the organisation see that safe working is achievable, thereby enabling all members to drive rapid improvement. At the other end, the challenge is to break out of the roller-coaster zone of fluctuating safety performance (Fitzgerald, 2005:325).

Figure 2.2: Improvement phases of health and safety performance



Source: Adapted from Taylor (2002:23)

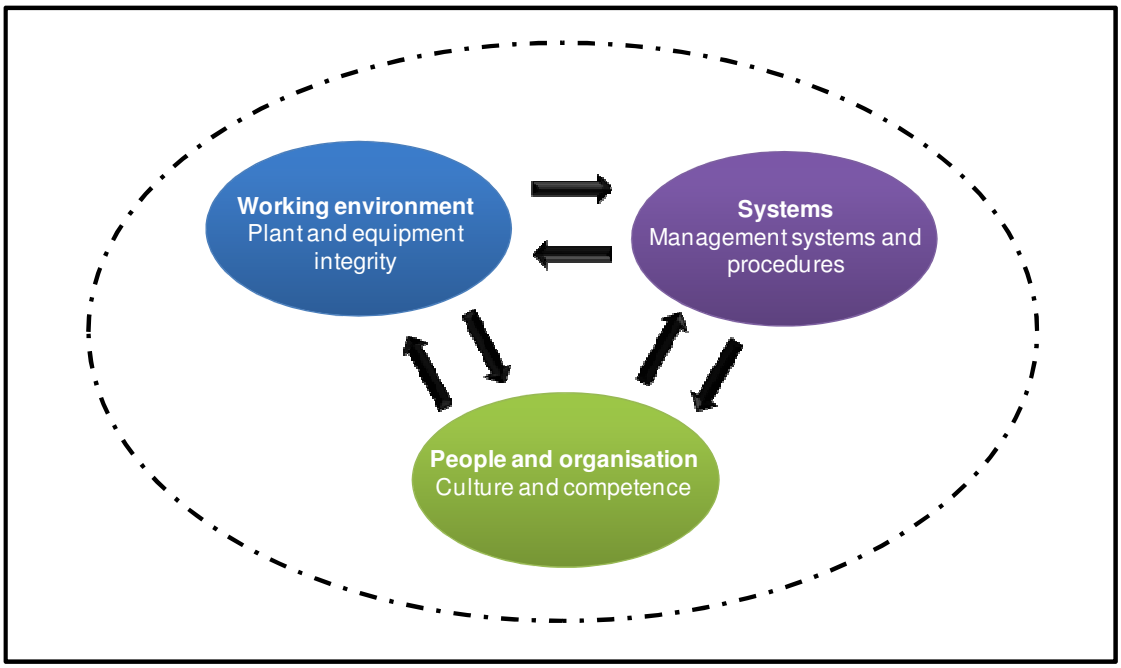
Organisations that find themselves at the roller-coaster phase are not yet in full control of their safety performance. The residual safety performance gap is indicative of a safety culture deficiency which represents the most challenging step in striving towards world-class OHS performance (Taylor, 2002:23).

In most organisations, safety performance is strictly compliance-oriented. Consequently, requirements mandated by regulations and industry standards are too narrowly focused and lack the momentum to break out of the roller-coaster phase. Solutions for individual safety problems are often short-term, merely addressing symptoms rather than root causes. In the absence of an integrated safety

management philosophy and a strong safety culture, any improvements will likewise be short-term (Yu & Hunt, 2004:211).

Since the International Atomic Energy Agency (IAEA) reported on the Chernobyl disaster, high-risk industries across the world have been showing a rising interest in the concept of safety culture as a means of reducing the potential for large-scale disasters and safety incidents (Clarke, 2003:41; Cooper, 2000:111, Hudson, 2003:i7; Mearns, Rundmo, Gordon & Fleming, 2004:545; Sorensen, 2002:189; Vredenburgh, 2002:259). Studies have shown that engineering controls and safety management systems are essential in reducing OHS incidents but in isolation of a strong safety culture the residual performance gap is almost impossible to overcome (IOSH, 2004:6).

Figure 2.3: Interactions in occupational health and safety management



Source: IOSH (2004:6)

Figure 2.3 illustrates that health and safety management has to consider the interaction between the physical plant and equipment, management systems and procedures and finally people or particularly human behaviour. Poorly designed

equipment, poor working conditions and poor management systems can all encourage unsafe behaviour; however, unsafe behaviours are not inevitable. An organisation's attitudes and values regarding safety have a significant influence on the approach and execution of work and ultimately the degree of organisational safety performance. In essence, it is insufficient to provide safe equipment, systems and procedures if the organisational culture is not conducive to healthy and safe working (IOSH, 2004:7).

These attitudes and values regarding safety originate from the safety culture of the organisation which is a sub-facet of organisational culture (Cooper, 2000:111). It is therefore necessary to explore the concept of organisational culture as the review of safety culture may not be complete without it.

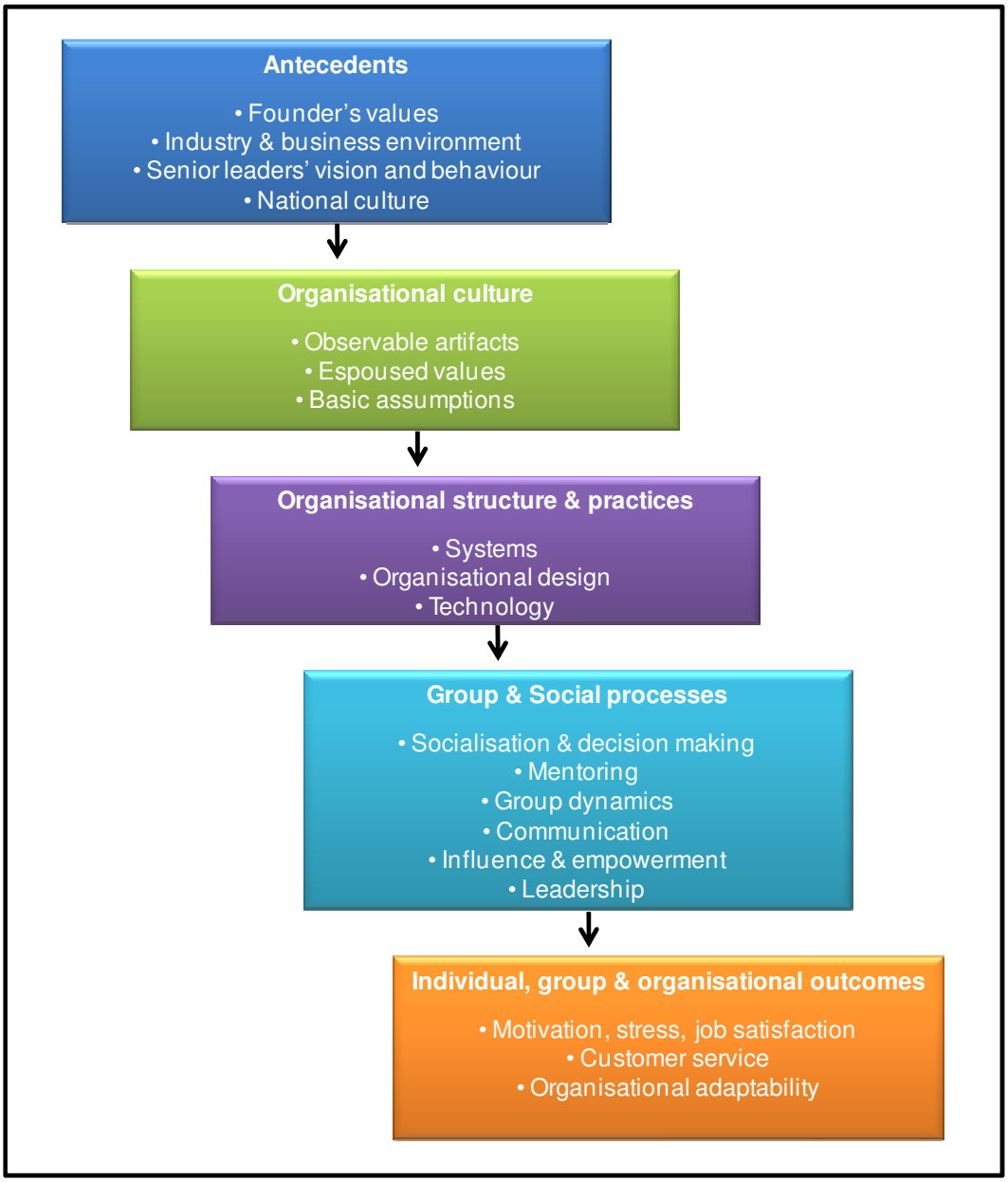
2.4 ORGANISATIONAL CULTURE

2.4.1. Concept defined

The notorious concept of organisational culture has grown throughout the years as one of the most academically researched and controversial subjects in management research and practice (Asif, 2010:1-2). This interest grew from the acknowledgement that an organisational culture is a key driver of employee attitudes and behaviour which ultimately influences organisational effectiveness and performance (Balthazard, Cooke & Potter, 2006:727; Kreitner & Kinicki, 2007:85).

One of the pioneers of organisational psychology, Edward Schein, defined organisational culture as a set of shared, taken for granted, implicit assumptions that a group holds and that determines how it perceives, thinks about and react to various environments. In simple terms, it is also referred to as "the way we do things around here" (Schein, 2009:27). It contains the written and unwritten prescriptions and norms within the internal environment of the organisation and not only does it provide guidance but also influences behaviour (Kreitner & Kinicki, 2007:76). Figure 2.4 provides a conceptual framework for understanding organisational culture.

Figure 2.4: Understanding organisational culture



Source: Ostroff, Kinicki and Tamkins (2003:566)

Organisational culture is primarily shaped by the founding fathers and its subsequent senior leaders and could eventually become so entrenched that it is difficult, if not impossible to change (Millman, 2007:44). The surrounding national culture with its diverse subcultures including social cultures, religious cultures and geographical cultures plays an important role in the development of organisational culture.

Personal values and beliefs formed from childhood are brought into the organisation which influences individual behaviour. As these individuals express their own values they contribute to the ongoing process of shaping and reshaping assumptions, beliefs and values in the organisation (Sagiv & Schwartz, 2000:434).

In turn, the organisational culture influences the structure adopted by the organisation and the various systems, policies and procedures utilised in pursuit of the corporate objectives. These organisational practices then set the scene in which social processes and leadership capacity ultimately shape employee behaviour and attitude leading to individual, group and organisational performance (Kreitner & Kinicki, 2007:77).

It is therefore imperative that a clear understanding of the organisational culture is necessary as it has a direct impact on the organisation's performance and effectiveness.

2.4.2. Levels of organisational culture

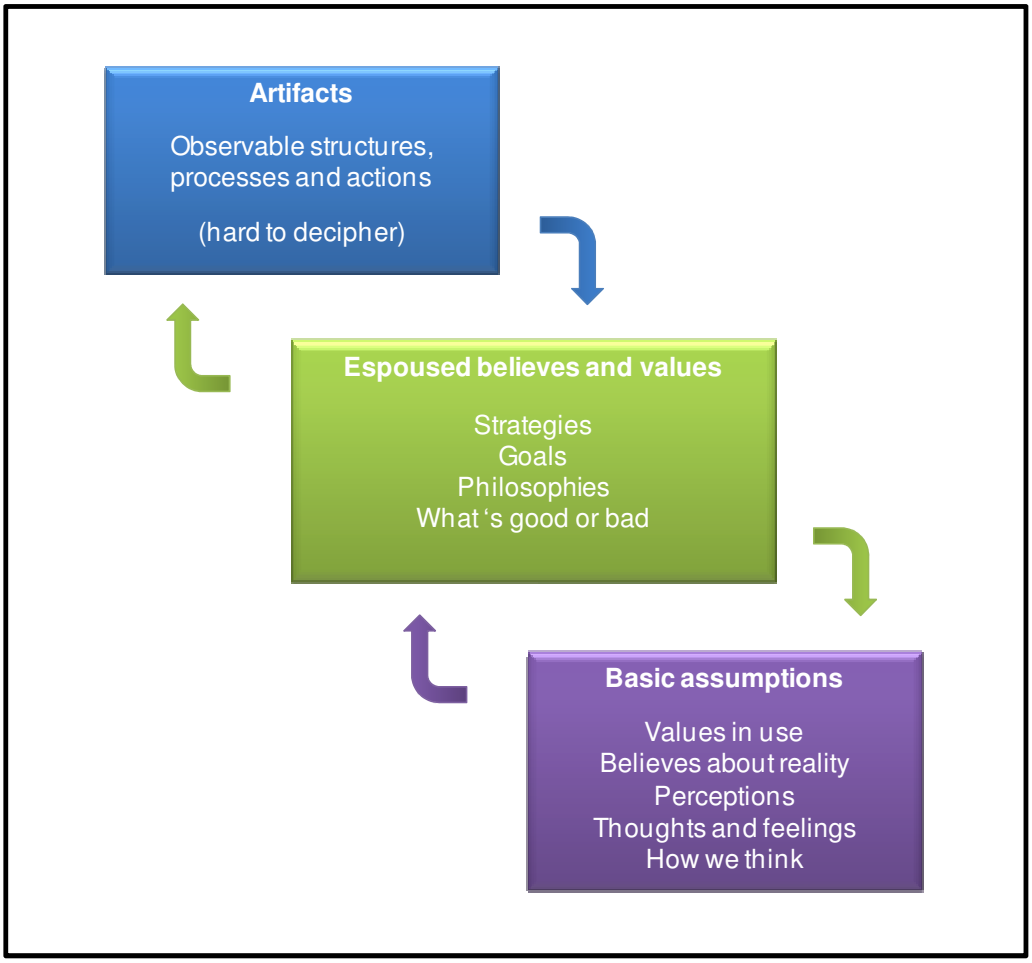
Organisational culture is passed on to new employees through the process of socialization and commonly manifests itself on three fundamental levels: observable artefacts, espoused values and basic assumptions (Schein, 2004:25). These different levels as shown in Figure 2.5 vary in terms of outward visibility and resistance to change (Kreitner & Kinicki, 2007:77).

At the surface level of organisational culture is the level of artefacts. This layer represents the physical manifestation of an organisation's culture and includes those visible features of a group such as language, appearance, emotional displays and observable rituals (Kreitner & Kinicki, 2007:77).

Closer to the organisation, artefacts also refer to organisational processes and structural elements which influence the behaviour of its members. This level of the organisational culture is easy to notice though very difficult to comprehend.

Observers can without difficulties describe what they see and feel but cannot reconstruct based on their observation alone what these things means to the observed group or whether it reflects any basic underlying assumptions. Only those that have been educated in the organisation's culture will understand the larger meaning behind the artefact. In order to accelerate this level of understanding one can analyse the espoused values and beliefs which provide the day-to-day principles by which members direct their behaviour (Schein, 2004:27).

Figure 2.5: Levels of organisational culture



Source: Schein (2004:26)

Espoused values are those explicitly stated values and norms that are preferred by the organisation and most often established by top management. In other words, they represent the aspirations of the organisation in the hope of influencing

employee behaviour. However, these values do not always align with the actual values and norms exhibited by employees as individuals, called enacted values, and therefore creates a gap which most often leaves large areas of behaviour unexplained (Schein, 2004:30) and can significantly influence employee attitude and organisational performance (Kreitner & Kinicki, 2007:78). To predict behaviour more accurately one has to understand the next level of organisational culture which consists of basic assumptions (Schein, 2004:30).

The level of basic assumptions represents the core of organisational culture and consequently reserves the highest resistance to change. These basic assumptions manifest themselves through perceptions, thoughts, emotions and behaviours of the members of the organisation. They become so taken for granted that members would find behaviour based on any other premise inconceivable (Kreitner & Kinicki, 2007:79).

Any group or organisational culture can be studied at these three levels. If one does not decipher the pattern of basic assumptions operating in the group, one will not know how to interpret the artefacts correctly or how much credence to give to the articulated values. In other words, the essence of a culture lies in the pattern of basic assumptions, and once understanding these one can understand the origin of the surface levels of culture and deal appropriately with them (IAEA, 2002:5).

2.4.3. Types of organisational culture

Considerable research has been done in the attempt to identify and measure various types of organisational cultures and their relationship on organisational effectiveness (Kreitner & Kinicki, 2007:84). For the purpose of this study the following three general clusters of organisational culture will briefly be discussed:

- constructive culture;
- passive-defensive culture; and
- aggressive-defensive.

Each of these culture types is associated with a set of normative beliefs which represents the thoughts and beliefs concerning the expected behaviour of its members (Kreitner & Kinicki, 2007:84).

Constructive culture – A constructive culture is one where employees are encouraged to interact with their peers in such a way that will assist them in satisfying their needs to grow and develop. This culture endorses normative beliefs associated with achievement, self-actualising, humanistic-encouraging and affiliation (Kreitner & Kinicki, 2007:84).

The achievement norm reveals an organisational culture that values and encourages members to set their own goals and completing tasks well. The self-actualising norm reflects an emphasis on creativity and quality. The humanistic-encouraging norm characterises a people-centred culture that promotes employee participation in decision-making. The affiliative norm reflects a culture that places a high priority on constructive interpersonal relationships among employees (Kwantes, Arbour & Boglarsky, 2007:102).

Passive-defensive culture – On the other side of the coin, a passive-defensive culture is characterised by the belief that employees must interact with their peers in ways that do not threaten their own job security (Cooke & Szumal, 1993:1302). The prevailing normative beliefs within a passive-defensive culture are characterized by approval, dependent, conventional and avoidance.

Employees' part of a passive-defensive culture is expected to agree with or gain the approval of their peers thus ensuring conflict-free interpersonal relations. The dependent nature of this culture type resembles organisations that are hierarchically controlled and limits the input from employees. Organisations exhibiting a passive-defensive type culture are most often characterised by bureaucratic control and emphasises conservatism and traditionalism (Kwantes *et al*., 2007:102). Employees are expected to conform and make a good impression and will often shift responsibilities to others in order to avoid the possibility of blame (Cooke & Szumal, 2000:149).

Aggressive-defensive culture – Organisations with aggressive-defensive cultures encourage their employees to approach their tasks in a forceful manner in order to protect their status and job security. This type of culture is characteristic of normative beliefs associated with oppositional, power, competitive and perfectionist (Cooke & Szumal, 1993:1302).

The oppositional trait reveals patterns of behaviour associated with negativity and confrontation (Kwantes *et al*., 2007:102). Organisations in which the power style exists expect their employees to take charge by controlling their subordinates and yielding to the demands of superiors. An aggressive-defensive culture expects its employees to operate in a "win-lose" environment with the intention of creating internal competition on the belief that to do well they must win at the expense of their peers. Hard work, persistence and perfectionism are valued and employees are expected to avoid mistakes, stay on track of everything and work long hours to attain narrowly defined objectives (Cooke & Szumal, 2000:149).

It is important to note that no organisational culture exists on its own. Every organisation will display a dominant culture but will also contain fragments of other cultures usually in the form of subcultures varying from geographical subcultures to social subcultures (Hofstede, 1998:1). The interaction between these subcultures could have a significant effect on the overall organisation's performance (Kreitner & Kinicki, 2007:84). Understanding the different subcultures within any organisation can explain the reason why some organisations exhibit dysfunctional behaviours that are counter to their espoused values which often hinder organisational efficiency and effectiveness. Employees may not behave in ways that promote efficiency and effectiveness if doing so is inconsistent with their reference prevailing culture (Balthazard *et al*., 2006:727).

These different subcultures are also found in the safety culture of the organisation in the form of improvement stages and therefore explain the reason for different perceptions and behaviours when it comes to health and safety which also affects the organisation's overall OHS performance (Hudson, 2003:i9). This is explained in more detail in the latter part of the literature review.

2.4.4. Changing organisational culture

Throughout the years, considerable debate has been entertained over whether changing something as embedded as organisational culture is possible. Those advocating culture change generally focus on the more superficial elements of culture such as norms and artefacts. These elements are more tangible and easier to change compared to the deeper elements of values and basic assumptions. Some might argue that unless the deeper values and assumptions are changed, organisations have not really changed its culture. Cultural change is an extremely complex and long-term process and many of the expected financial and organisational benefits are only visible long after its implementation (Cummings & Worley, 2005:489).

Kurt Lewin, a distinguished social psychologist, suggested a three-stage change model of how to initiate, manage and stabilise the change process. The three stages are known as unfreezing, changing and refreezing (Kreitner & Kinicki, 2007:584).

The main focus in the first stage of unfreezing is to create a motivation to change. The general experience is that some kind of dissatisfaction or threat has to be present in a mature organisation before it is willing to embark on change (IAEA, 2002:60). Therefore, management needs to disconfirm the usefulness or appropriateness of employees' current behaviours and attitudes such that employees become dissatisfied with the current way of doing things. The second stage involves the learning of new concepts and new meanings for old concepts either through imitating a role model or re-inventing one's own solutions until satisfied. The final step of refreezing entails the stabilisation of the change process through helping employees integrate the changed behaviours or attitudes into their normal way of doing things followed by continuous positive reinforcement (Kreitner & Kinicki, 2007:585).

Most change models are based on focusing on the problems faced and how they can be resolved to allow better performance, therefore primarily deficit based. An alternative approach entails the emphasis on what the organisation is doing right and leveraging those strengths. This model is known as appreciative enquiry (AI). AI deliberately infuses a positive value orientation focusing on the organisational issues which has the most energy to address. These best practices within the organisation are then used to collectively envision a preferred future state of "what should be" through exciting and provocative possibilities. AI encourages employee involvement in creating a shared vision about the organisation positive potential which provided a powerful drive to what the organisation could be (Cummings & Worley, 2009:28).

In the following section the concept of safety culture will be discussed, highlighting the key characteristics of safety culture as well as the safety culture change process.

2.5 SAFETY CULTURE

2.5.1. Concept defined

The concept of an organisational safety culture is certainly not a new phenomenon making its first appearance in 1987 in the OECD Nuclear Agency report in the aftermath of the 1986 Chernobyl disaster (INSAG, 1999:2). Since then, a rising interest in this concept was ignited because of the positive impact on occupational health and safety in reducing the potential for fatalities, injuries and workplace incidents (Choudhry, Fang, & Mohamed, 2006:1009).

As with the concept of organisational culture, there is a range of definitions cited by public enquiries and research bodies as seen in Table 2.1. The commonalities among these definitions bring about the following fundamental description shaping the essence of safety culture:

> The product of individual and group values, attitudes, competencies and patterns of behaviour that determine the commitment towards the reduction

of employees' exposure to occupational hazards and the prevention of accidents.

In other words, safety culture is the part of the organisational culture which concerns employees' attitudes and behaviours concerning health and safety in the workplace (Cooper, 2000:111).

Table 2.1: Safety culture definitions

The attitudes, beliefs and perceptions shared by natural groups which determine how they act and react in relation to risks and risk control systems (Hale, 2000:7)
Those aspects of the organisational culture which have an impact on attitudes and behaviour related to increasing or decreasing risk (Guldenmund, 2000:251).
Safety culture is a sub-facet of organisational culture which influences members' attitudes and behaviour in relation to ongoing health and safety performance (Cooper, 2000:111).
A sub-facet of organisational culture, which affects workers' attitudes and behaviour in relation to an organisation's on-going safety performance (Mohamed, 2003:81).
Shared and learned meanings, experiences and interpretations of work and safety which guide people's actions towards risk, accidents and prevention (Richter & Koch, 2004:705)
A set of prevailing indicators, beliefs and values that the organisation owns in safety (Choudhry *et al.*, 2006:1009).
An arrangement of values, perceptions, attitudes and behaviours towards safety across the organisation together with an integrated system of policies, practices and procedures governing the reduction of employees' exposure to occupational hazards and the prevention of accidents (Fernández-Muñiz *et al.*, 2007:628).

In terms of its application to the issue of accident reduction in high-risk industry, the safety culture approach emphasises the role played by social forces within an organisation that act upon its members with respect to safety. It has been suggested that the one universally accepted feature of culture is that its influence extends across the entire organisation exerting a consistent effect whether good or detrimental. For this reason its improvement is more effective than increased supervision or more rigorous procedures or systems in enhancing safety performance (Parker, Lawrie & Hudson, 2006:552).

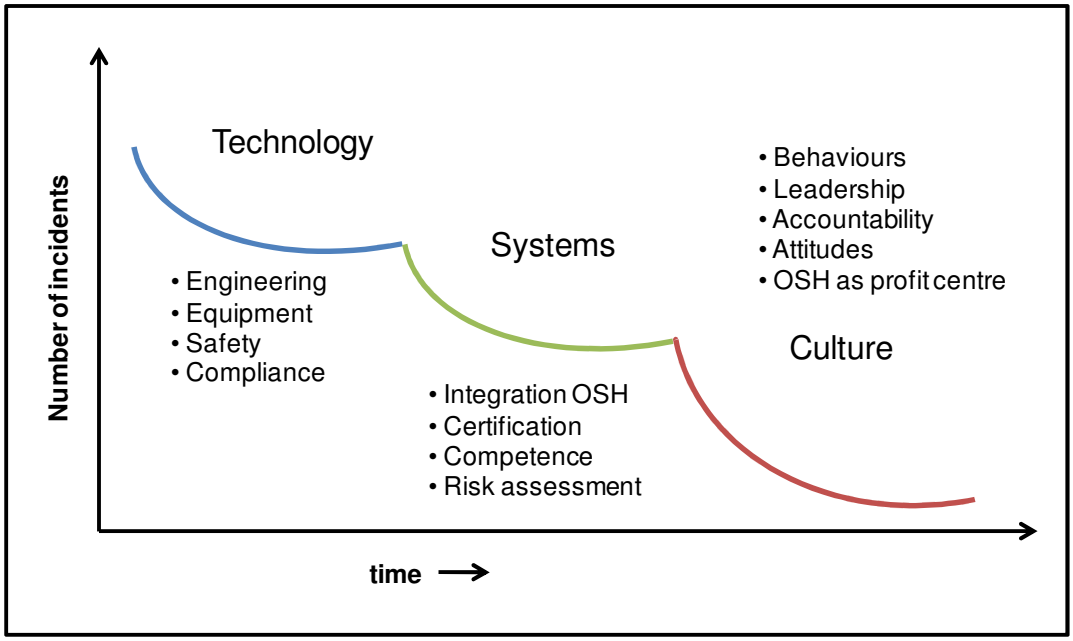
2.5.2. Evolution of health and safety performance

An organisation's safety culture takes on a profound significance at the point where accident rates reach a plateau; that is, where outcome data bottom out at some asymptotic value (Reason, 2000:5). In order to go beyond this seemingly unassailable plateau and to continue progress in safety performance, it is necessary to address the hearts and minds of the management and workers (Hudson, 2007:717). This plateau is often reached after the successful implementation of safety "hardware and software", that is mechanical safe design and safety management systems (Parker *et al.*, 2006:552).

Figure 2.6 shows, schematically, how the technology and the systems approaches each reach a plateau, in terms of incident rates and the next step necessary to enable further improvement. By the late 1990s it became clear that such a plateau was about to be reached after the implementation of the systems approach and that 'more of the same' would no longer be sufficient to achieve the improvements in performance that had become to be perceived as desirable.

The mechanical application of safety management systems was never going to achieve the levels of performance organisations had become to expect. As those very systems had produced such significant improvements in performance compared to the late 1980s, so did the expectations about what could and should be achieved become more stringent (Hudson, 2007:699).

Figure 2.6: Evolution of safety performance



Source: Hudson (2007:700)

2.5.3. Components of safety culture

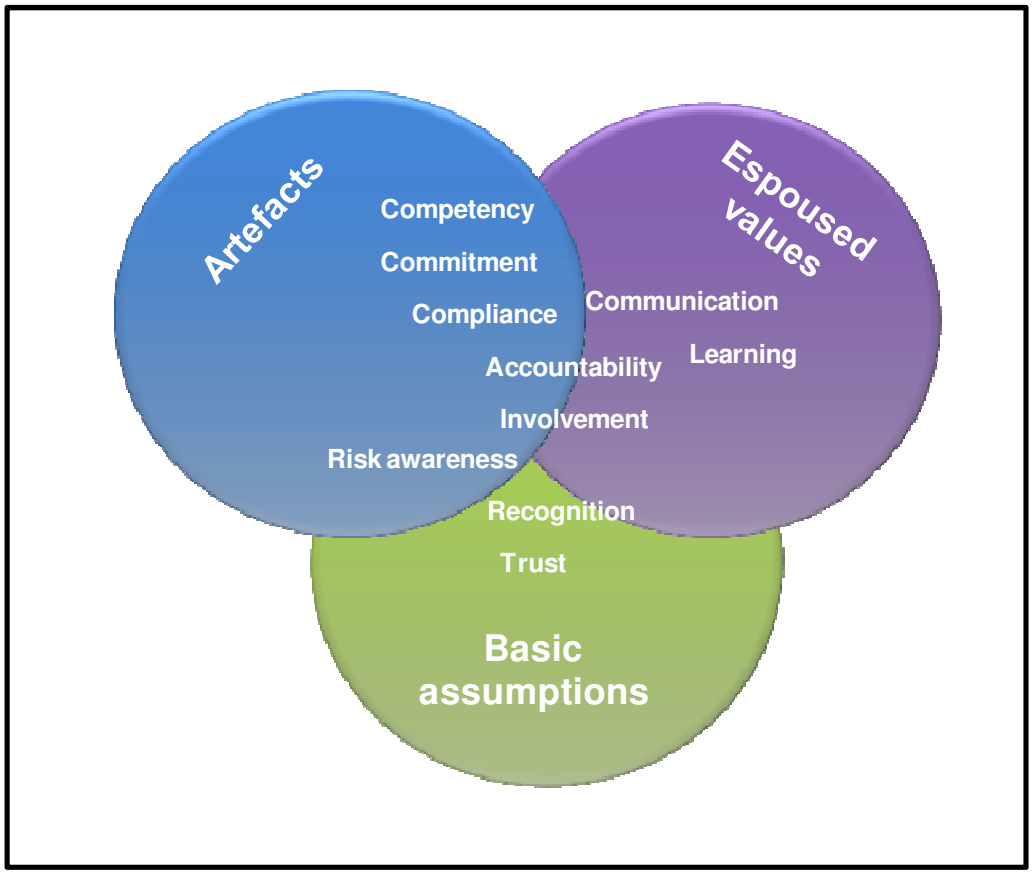
Similar to organisational culture, safety culture can also be examined based on the three levels of culture, observable artefacts, espoused values and basic assumptions. Artefacts are the easiest to observe but are the most difficult to interpret. Knowledge of espoused values will assist in understanding where these artefacts originate from, but it is only when the basic assumptions are understood that the true meaning of the components at the artefact level will become apparent (IAEA, 2002:10).

Whilst there are somewhat differing perspectives within the classification of safety culture there appears to be a general agreement when it comes to extracting culture into its sub components. Figure 2.7 shows ten of the most influential components in an organisational safety culture (Fleming, 2001:3).

Most of the components can be assigned to the artefact level or a combination of the level of artefacts and espoused values with only a small number more appropriately

associated with the level of basic assumptions as illustrated in Figure 2.7 (IAEA, 2002:10).

Figure 2.7: Components of a safety culture



Source: Adapted from Fleming (2001:3)

These safety culture components are described below under the appropriate level, artefact and/or espoused value and basic assumption. The characteristics are not listed in any order of importance.

Components at the artefact and/or espoused value level:

- **Commitment** – A growing number of safety climate studies show that employees' perception regarding the organisation's commitment to safety is a core ingredient in shaping a positive safety culture (Flin, Mearns, O'Connor & Bryden, 2000:178; Parker, Axtell & Turner, 2001:212). In general, employees

will want to conform to the culture of the organisation or “the way things are done”. Truthful commitment means more than policy statements hanging in the corridors stating that health and safety is important; there needs to be coherence between words and reality (DeJoy *et al*., 2004:87; Olive *et al*., 2006:134). It is essential that top managers demonstrate their commitment to safety through their behaviour, attitude and in the allocation of resources, including the time spent on safety issues particularly in the time spent on efforts to improve safety (IAEA, 2002:10). Management that fails to visibly demonstrate their commitment to safety will send ambiguous massages to the workforce if they attempt to introduce safety measures which they themselves do not comply with (Furness & Muckett, 2007:73).

An integral part of management portraying their commitment to safety is to ensure that it remains priority. This is often challenging as pressure on production can often result in managers sacrificing safety in the fear of losing vital output (Furness & Muckett, 2007:74). Employees should under no circumstance improvise without risk assessment in order to save time or achieve a production target (IAEA, 2002:11).

- **Involvement** – One of the most important indications of a good safety foundation in an organisation is the extent to which employees are actively involved in safety on a daily basis. Low levels of involvement, with safety solely dependent on managers and safety officers, will not win people over to the safety effort. Conversely, when safety issues are identified and acted on by employees at all levels as part of their normal working routine, the attempt to win over people's hearts and minds to the safety cause is realistic (IAEA, 2002:9).

  The degree of formal and informal involvement and decision-making that employees have in the workplace can significantly influence safety performance. In a constructive organisational culture a workforce that reflects management’s positive commitment to safety will be motivated and empowered to influence day-to-day decisions regarding safety. In contrast,

employees who feel disconnected with management will perceive their views as of little value and can easily adopt a passive-defensive organisational culture resulting in a clinical approach to safety which could be detrimental to the overall safety performance (Furness & Muckett, 2007:74).

- **Competence** – Competence is a significant although fundamental requirement to ensure safety operations. Safety competence is a combination of knowledge, experience and skills that ensure the safe completion of jobs in the face of certain hazards and the risk control measures necessary to achieve the required levels of safety (Furness & Muckett, 2007:67).

- **Compliance –** This is of obvious importance for safety. Failure to comply with procedures or safety precautions, that is, wearing of correct personal protective equipment (PPE), should not be negotiable. There should be no room for discretion or turning a blind eye to a safety requirement violation (Taylor, 2002:25). Violation of regulations and procedures is a clear sign that safety culture is weak (IAEA, 2002:1). A culture in which all actions are immune from punishment would lack credibility in the eyes of the workforce. It is thus imperative that management does not tolerate lack of discipline when it comes to compliance to safety rules and regulations.

  Management should, however, be aware of hiding behind compliance as a means of protecting the employer. Some organisations demand compliance to mass amounts of rules and procedures which are irrelevant to the workforce, which may lead to resentment and ultimately result in employees taking shortcuts. These organisations typically exhibit a passive-defensive culture. It is thus vital that compliance goes hand in hand with ownership, by allowing the workforce to develop these safety rules and procedures to ensure relevance and buy-in (Taylor, 2002:26).

- **Accountability** – Staff need to be aware of their responsibility for their own safety and that of their colleagues, not only in the way they perform tasks but

also in identifying potential safety problems or improvements in their area of work (Barraclough & Carnino**,** 1998:29). Clear safety objectives and targets must be specified and progress evaluated in agreement of the consequences for achievement as well as non-achievement (IAEA, 2002:12).

Components at the espoused value level:

- **Communication** – Organisations with effective safety cultures can be characterised by a good safety communication system both from top to bottom as well as bi-directional communication. Formal and informal communication between line management and operations staff is vital to disseminate important safety information. Ideally, an organisation should have a structure and atmosphere such that its employees feel free from intimidation or retribution in raising issues, and in which they are encouraged to ask questions. Additionally, face-to-face communication helps cultivate trust. This trust, coupled with an open door policy, helps ensure that a good reporting culture will develop. If employees feel strongly about an issue and need to convey its importance to higher authority, it is imperative to the overall safety improvement effort that they feel comfortable doing so (Olive *et al*., 2006:135).

- **Learning** – Another key element is the extent to which every employee receives high quality integrated job and safety training. Exposing people to infrequent safety lectures in classrooms is insufficient. Evidence suggests that a planned integrated series of safety training events relevant to the participants should be conducted on a rolling basis for all employees (IAEA, 2002:9). Organisations with effective safety cultures have the willingness to learn from others and also share experiences beyond their boundaries. The learning organisation continually re-evaluates the environment and adapts in anticipation of environmental changes. Commitment to organisational learning is crucial in learning from safety problems and identifying their true root causes (IAEA, 2002:13).

Components at the basic assumption level:

- **Trust** – It is essential that an organisation safety culture is a culture of 'no blame' where an atmosphere of trust is present and people are encouraged or even rewarded for providing essential safety-related information. This is a challenging task and often very difficult to decipher the issue underlying the resistance to trust as it is intertwined with most of the other safety culture components (Hudson, 2000:12).

- **Risk awareness** – Human beings are creatures of habit. At best, our cognitive capacity allows us to focus consciously on only a few things at the same time. The rest of our actions happen on a subconscious level. This is an important issue when it comes to health and safety risks. It implies that there are physical and mental limits to people's ability to constantly, actively be aware of potential safety risks. On the positive side, it means that safety-minded companies can make good use of people's natural habit-forming abilities by building effective learning practices into their safety programs (Trybuss, 2008:54).

- **Recognition** – People are motivated to behave in ways that lead to desired consequences. They will modify their behaviour to conform to a cultural norm if it is perceived that compliance will lead to a desirable outcome (Kreitner & Kinicki, 2007:271). Positive reinforcement through recognition is a powerful tool in changing the safety culture (IAEA, 2002:61).

The above components play an essential role in establishing a good foundation for safety culture in an organisation. Although it is difficult to understand the dynamics behind some of these components within an organisational culture, all of the components can be observed and measured to a certain degree, therefore creating a better understanding of the safety culture maturity (IAEA, 2002:9).

2.5.4. Safety climate

The term safety climate is used to describe shared employee perceptions of how safety management is being practised in the workplace at a particular moment in time (Cooper & Philips, 2004:497). It is therefore an articulation of safety culture (Walker, 2009:333). These descriptive perceptions provide an indication of the true priority of safety in an organisation with regard to other priorities such as production or quality. Guldenmund (2000:220) formalises this by proposing that culture should be reserved for Schein's level of basic assumptions, whilst climate should be used for his espoused values and the artefacts they give rise to.

Safety climate is regarded as a manifestation of safety culture in the behaviour and expressed attitude of employees and is most often used to determine the level of safety culture maturity of an organisation by means of empirical survey analysis (Mearns, Whitaker & Flin, 2003:642).

When a significant incident took place it is the climate of an organisation rather than the culture that will undergo immediate modification. However, if the underlying culture is not sufficiently and accordingly altered further incidents are inevitable (Olive *et al.*, 2006:133).

In light of the preceding discussions it appears reasonable to conclude that safety climate is a distinct dimension of safety culture that lends itself to measurement of health and safety perceptions within the organisation. It is also important to note that the safety climate of an organisation has a profound influence on its overall safety culture. If employees' own values, attitudes and perceptions are not supportive or comply with safety rules or regulations, the safety culture will be negatively impacted (Furness & Muckett, 2007:60).

2.5.5. Safety culture maturity models

The development of safety culture in the organisation has been described by numerous research attempts over the years. One of the well-known proposed models include the work of Westrum, which suggested that one way to distinguish between organisational safety cultures was according to the sophistication of the way that safety related information was handled across the organisation. He developed a typology of cultures, each reflecting a characteristic way of handling information flow and representing increasing levels of advancement. The three types of safety cultures were labelled pathological, bureaucratic and generative (Westrum, 1993:22).

Two additional levels of safety culture development were later added to this model namely, reactive and proactive, with the intention to allow for more subtle classification and increasing the familiarity to industry employees by including terms they would be familiar with (Reason, 1997:219).

The International Atomic Energy Agency (IAEA) suggested that the stages of development in safety culture can be condensed to three basic stages:

- Safety is based on rules and regulations;
- Safety is considered a organisational goal; and
- Safety can always be improved.

DuPont, an organisation recognised for its world-class safety solutions, has suggested a slightly extended version of the IAEA safety culture model. This model explains the change in safety culture with reference to the degree of importance of safety to the individual employee (DuPont, 2009:10).

For the purpose of this study the two most recent models as suggested by IAEA and DuPont will be discussed in more detail in the following section. Each model reflects the multidimensional nature of safety culture by providing descriptions of an organisation with respect to a range of fundamental components of safety culture as discussed in section 2.5.2, within the different stages of safety culture maturity.

2.5.4.1. IAEA safety culture model

According to the International Atomic Energy Agency (IAEA, 2002:17), three stages of development of safety culture seem to occur in organisations. Each stage involves a different level of awareness of the influence on health and safety through employee behaviour and attitudes. The characteristics of each stage are described below. They may be used by an organisation to diagnose which stage reflects its current state most accurately.

At the first stage an organisation perceives safety as an external requirement and not as an aspect of moral obligation or conduct that will allow it to succeed. The external requirements include those of government and the regulatory bodies. At this stage there exists little awareness of the behavioural and attitudinal aspects of safety which is seen as a mere technical issue to be achieved through compliance (IAEA, 2002:17).

The typical characteristics indicative of IAEA's first safety culture stage are:

- Reactive approach to problems;
- Poor communications between departments and functions;
- Collaboration and shared decision-making are limited;
- Indicative of a "blame" culture;
- The role of management is seen as enforcing the rules;
- Limited learning inside or outside the organisation, which generally adopts a defensive position when criticised;
- People are viewed as components of the system;
- Adversarial relationship between managers and other employees; and
- Employees are rewarded for obedience and results.

An organisation at stage two considers safety to be an important organisational goal even in the absence of external requirements. Although there is growing awareness of behavioural issues, this aspect is largely missing from safety management which generally concentrates on technical and procedural solutions. Safety is managed

through the setting of targets or goals with clear accountabilities. Organisations which exhibit such a safety culture soon discovers that after a period of improvement, health and safety performance reaches a plateau with no further progress (IAEA, 2002:18).

Characteristics describing the second safety culture stage include:

- There is growing awareness of the impact of cultural issues in the workplace with respect to safety improvements;
- Management encourages communication;
- Management's response to mistakes is to introduce more controls and procedures with the focus on retraining;
- The role of management is to ensure objectives are clear and safety goals are achieved;
- A growing willingness to learn from others;
- Recognition is given for exceeding goals;
- The degree of team work increases; and
- The organisation remains primarily reactive in relation to problems although consideration is given to potential through planning.

In the final safety culture stage an organisation starts to apply the concept of continuous improvement to health and safety. There is a strong emphasis on communication, training, management style and improving efficiency and effectiveness. The majority of employees share an understanding of the impact of cultural issues on safety (IAEA, 2002:18).

The characteristics describing the third and final safety culture stage are:

- Problems are anticipated and dealt with proactively;
- Effective interdepartmental collaboration exists;
- There is no priority conflict between safety and production;
- Mistakes are investigated with the aim in learning rather than blaming;
- Management's role is seen as coaching people to improve performance;

- Learning from others both inside and outside the organisation is valued;
- Employees are valued for their contribution;
- Mutually supportive relationship between management and employees exists;
- The impact of cultural issues is considered in decision-making;
- Recognition is given for improving processes as well as results; and
- Employee wellness is considered to be an important part of organisational systems with attention and not just to achieve technical efficiency.

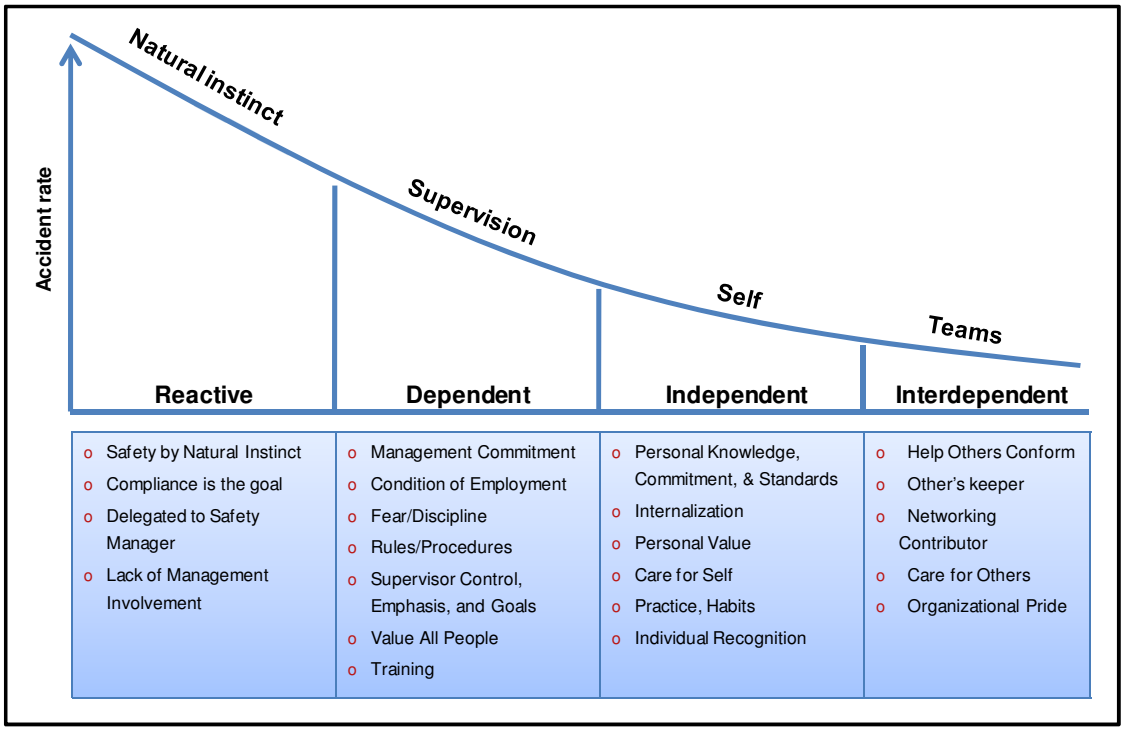
2.5.4.2. DuPont safety culture model

The DuPont model explains the change in safety culture with reference to the degree of importance of safety to the individual employee (DuPont, 2009:10). In the ideal stage known as an interdependent safety culture, the overarching perception from the entire organisation is that all employees are responsible for safety and everyone's safety is equally important (DuPont, 2009:3).

The first stage in DuPont's safety culture model as shown Figure 2.8 is very similar to the initial stage suggested by the IAEA, which is characteristic of a reactive culture, whereby safety is merely a natural instinct with no real perceived value for the individual or organisation. Safety is delegated to management which is primarily concerned with compliance to regulation and standards (IAEA, 2002:17).

In the second stage, known as a dependent culture, the emphasis is on management control with the extensive use of discipline to enforce safety measures with high reliance on written safety rules and procedures. Safety performance is therefore dependent on the level of management commitment in enforcing these rules and procedures. Safety performance will reach a plateau as no matter how committed management is, it is not possible to oversee all behaviours and actions (Van Sonsbeek, 2006:5).

Figure 2.8: DuPont safety culture model



Source: DuPont (2009:14)

If an organisation desires to move beyond its current safety performance it needs to develop an independent safety culture. Creating an independent safety culture presents some difficulty of which cost and time are often the most important restrictions experienced. The more the organisation needs to change the more expensive the change interventions will be and the longer it will take to establish the new organisational culture. In this third stage of safety culture improvement, the predominant focus is on personal commitment and responsibility. This involves all employees developing their own personal safety standards and demonstrating their commitment by adhering to these standards. While safety rules and procedure are still present, employees in an independent culture look after their own safety and make active choices in keeping themselves safe. Safety improvement is limited by the degree of homogeneity of the safety standards of all employees and the absence of people looking out for other people's safety (Van Sonsbeek, 2006:7).

The fourth and final stage in DuPont's model of safety culture development is known as an interdependent safety culture. This type of culture is manifested by employees having a sense of responsibility for safety beyond their own work through the caring for the safety of others (Van Sonsbeek, 2006:7). Employees share a common belief in the importance of safety. The movement to an interdependent culture requires over and above personal commitment, shared perceptions, attitudes and beliefs. Employees must be willing to assist others to adapt to this belief, not by sanction but by persuasion. Achieving an interdependent safety culture requires prevention through observation and through practices and personal commitment that instil organisational pride and individual accountability (Van Sonsbeek, 2006:7).

Although the IAEA and DuPont model describes the safety culture improvement process in distinct stages, it is likely that different parts of the organisation find itself at different levels at any one time exhibiting characteristics associated with several or all of the stages. It is therefore vital that an organisation firstly assesses its current maturity stage prior to attempting to improve the safety culture (Betitchi *et al.,* 2004:28).

2.5.6. Safety culture change

Changing an organisation's safety culture is a slow and challenging affair. A culture change intervention is also unlikely to succeed unless there is commitment to change and leadership at the highest management levels.

A first step in developing a positive safety culture is to create a "reporting culture" together with a culture of "fair blame". In a "fair blame" culture it should be clear what the expectations and standards are, yet employees should be allowed to report all but the most reckless health and safety incidents without fear of retribution (IOSH, 2004:7). Reference is often made to a "no blame" culture, yet it has been proven neither feasible nor desirable (Reason, 1998:296). The small number of incidents originating from wilful unsafe acts deserves severe sanction and failure to recognise this would undermine the credibility of the organisation's culture. The development of such a "fair blame" culture is directly related to the organisation's understanding of

the risks that need to be managed and the distinction between accidental unsafe acts and deliberate contraventions (IOSH, 2004:7).

In order to identify where an organisation's safety culture gaps are, a safety climate assessment can be conducted by evaluating factors such as:

- The degree of commitment to health and safety performance demonstrated by senior management;
- The level of employee communication, education and training in health and safety;
- The extent of involvement of different levels of the workforce in the improvement process;
- The responsibly which employees show for their own as well as others' safety;
- The degree of tolerance of risk taking behaviour;
- How well the health and safety performance is measured and enforced; and
- The arrangements for periodic review of the safety culture for the implementation of improvement plans.

It is therefore possible to create an understanding of where the shortfalls are which are causing an obstruction in further health and safety performance (IOSH, 2004:7).

2.6 CONCLUSION

Occupational health and safety performance is not only a legal and moral obligation but also steers an organisation's financial success and reputation in the eyes of its stakeholders. Organisations with poor health and safety records are perceived as irresponsible and most often have to close their doors or make substantial changes in structure or hardware which depreciates overall company value.

In light of the literature review it can be deduced that an organisation's safety culture has a profound significance in the pursuit to improve its occupational health and safety performance. Mere reliance on engineering controls and safety management

systems only has a limited affect which ultimately leaves a residual performance gap. This gap can only be closed through the collaboration of management and employees' efforts and behaviours towards health and safety by embracing a safety culture in which everyone's attitude is directed to ensure not only the safety of oneself but also the safety of others. Such a culture is created through value driven leadership from the corner office right down to the plant floor.

It is however clear that in order to develop a mature safety culture and ultimately improve the health and safety performance, the realisation of certain components within an organisation is crucial. Ineffectiveness within one of these components is evident of hesitant progress towards a state of interdependence. Failing to address these culture shortfalls will result in an immature safety culture and thus increase the risk for health and safety incidents.

2.7 CHAPTER SUMMARY

The first section of this chapter dealt with the significance of occupational health and safety in the organisation. Research has revealed that good safety performance leads to good business performance. Occupational health and safety accidents cost organisations and the economy billions of rands annually, disabling and injuring millions of employees. The effort in reducing these incidents through government regulation, safety management systems and technological controls has realised only limited improvement leaving a residual gap in the endeavour towards world-class OHS performance. A rising interest in the concept of safety culture has since developed in the attempt to close this performance gap.

The concept of organisational and safety culture was subsequently explored. In simple terms, organisational culture can be described as the shared values, assumptions and beliefs in an organisation that ultimately direct employee behaviour. Organisational culture is characterised by three layers known as artefacts, espoused values and basic assumptions. These layers represent the manifestation of the organisational culture and vary in terms of outward visibility and resistance to change. Understanding and analysing these layers provide the reasons why

employees behave in certain ways. Safety culture is a sub-set of organisational culture; in other words, it's the manifestation of the organisation's attitude, values and commitment in regard to the importance of health and safety. Companies which have developed effective safety cultures have demonstrated unequivocal results in closing the elusive performance gap.

The different components of a safety culture were then discussed. The effectiveness within each of these areas ultimately dictates the nature of the safety culture and the success in preventing health and safety incidents. The degree of maturity of the safety culture can be determined through the assessment of the safety climate in the organisation.

Finally the different stages of a safety culture were explored. Safety culture can be classified into distinct development stages. Each of these stages represents the degree of maturity of the attitudes and commitment of management and employees in relation to the ongoing health and safety improvement in the organisation. In a reactive safety culture, safety is merely a natural instinct with no real perceived value for the individual or organisation. Moving towards a dependent safety culture, employees start to value safety but only so they do not get caught. The next stage called an independent safety culture is characterised by self preservation. In this stage the mindset of employees changed towards an attitude of "I do things safe so I do not get hurt". In the final stage known as interdependent safety culture, employees embrace safety as a personal virtue not only for their own safety but also in contribution to the safety of their peers. In such a culture it is employees' desire to do things safely so that no one gets hurt.

The next chapter deals with the empirical research conducted in the evaluation of the current safety culture in the petrochemical environment in South Africa. It will furthermore present the statistical analysis of the empirical data and interpret and discuss these results.

CHAPTER 3
RESEARCH FINDINGS & DISCUSSION

3.1 INTRODUCTION

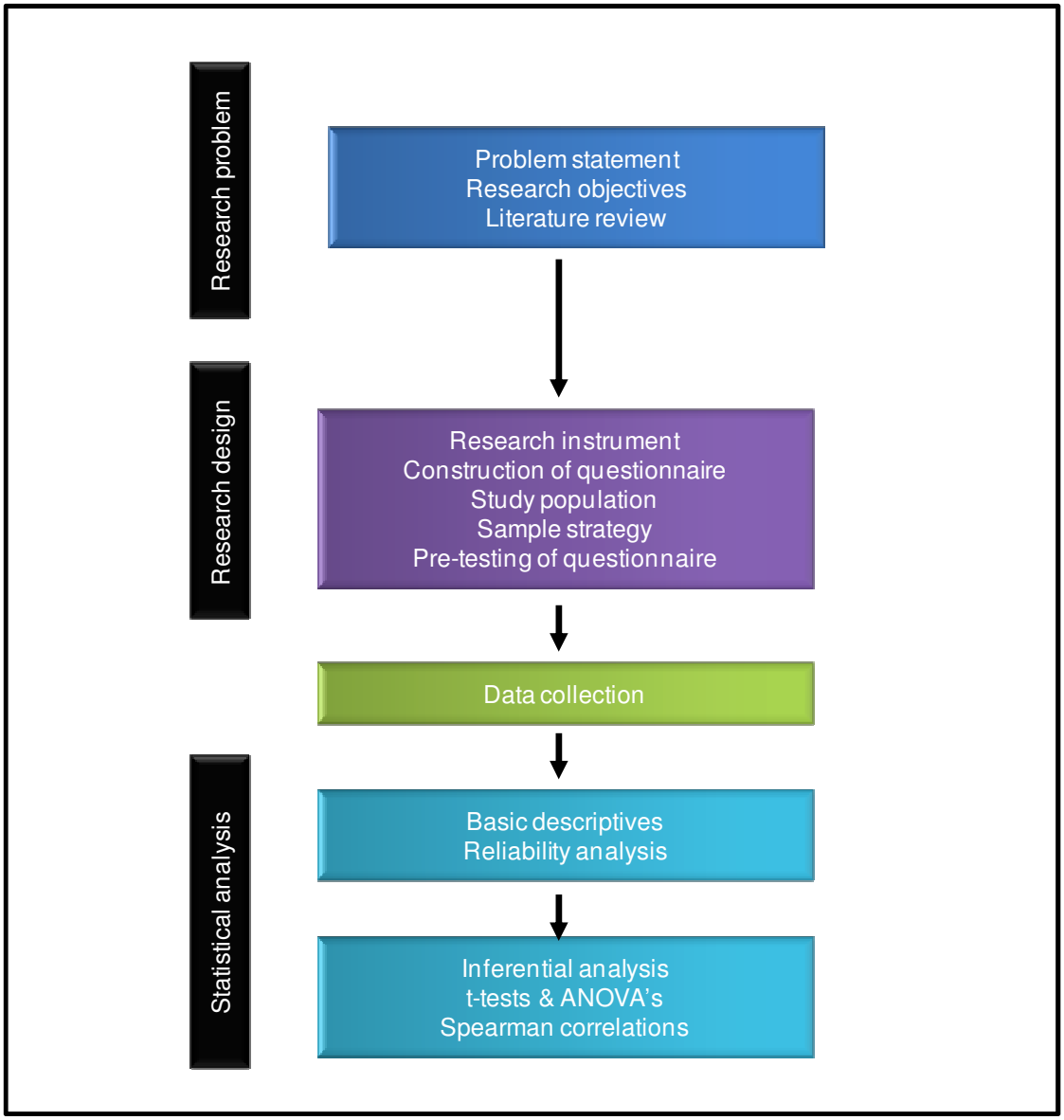
Recent focus on safety management systems and the implementation of behavioural based safety initiatives have seen the petrochemical industry in South Africa produce considerable success in the improvement of occupational health and safety (OHS) performance. However, an evident roller-coaster injury and fatality rate has been the Achilles' heel in sustaining target OHS performance. Such a roller-coaster trend in safety statistics is really an indication that OHS performance is not entirely under control and that a new approach is needed to bring about improvement (Taylor, 2002:23). This residual safety performance gap can only be closed by understanding the hearts and minds of the management and workers when it comes to OHS which is known as the safety culture (Parker *et al.*, 2006:552; Hudson, 2007:717).

In the previous chapter a review of the literature concerning the concept of organisational safety culture was provided and its significance in the pursuit of further improvement in OHS performance. The fundamental components influencing the safety culture were highlighted and the maturity stages in the development of an effective safety culture were discussed.

3.2 RESEARCH PROCESS

Figure 3.1 illustrates the research process followed in this study starting with the problem identification of the residual occupational health and safety performance gap experienced in the petrochemical industry as specified in chapter 1. The next step of determining the reason behind the inability to achieve sustainable OHS performance lead to the establishment of research objectives as listed in chapter 1. In order to understand the obstacles preventing performance improvement, a literature study was conducted as discussed in chapter 2.

Figure 3.1: Research process



This chapter explains the research approach and methodology used in the empirical study to identify the shortfalls within the safety culture in the South African petrochemical environment. This includes the selection of an appropriate research instrument, questionnaire design, target population, sample strategy and statistical methods used in the analysis of the sample. The information gathered from the empirical study will then be discussed and interpreted based on the results obtained from statistical analysis.

3.3 RESEARCH DESIGN

3.3.1 Research methodology

Empirical research is generally applied through two commonly recognised methods, known as the quantitative or qualitative research approach. The difference between these two methods is based on different research paradigms. The quantitative research paradigm is based on positivism, therefore measuring social constructs objectively with the aim of testing certain research objectives based on the statistical analyses of a set of theoretical variables. In contrast, the qualitative approach is holistic in nature and aims at understanding the deeper meaning that people attach to everyday life. This approach is subjective and makes use of inductive reasoning (Schurink & Schurink, 2001:4).

In safety culture research, quantitative measurement of organisational culture has been the predominant assessment approach (Guldenmund, 2007:724). This approach however is limited to the observable and measurable manifestations of culture known as the organisational safety climate. These shallower layers of culture are more explicit and can be appropriately studied using a structured and quantitative approach generally explored through a questionnaire survey (Ashkanasy, Wilderom & Peterson, 2000:132). The quantitative data generated from a climate assessment provide a useful indication of where an organisation's strengths and weaknesses may lie (Fitzgerald, 2005:325).

Although the exclusive use of quantitative assessment of organisational culture has been criticised in the past, it is generally agreed that surveys or questionnaires represent an efficient and standardised means of tapping the shallower levels of Schein's typology. The deeper level of culture, on the other hand, is more accurately investigated by means of a qualitative research approach through more intensive observation, focused interviews and the involvement of organisational members in self-analysis (Ashkanasy *et al.,* 2000:133).

For the purpose of this study the use of a quantitative research approach by means of a self-complete safety climate questionnaire was deemed acceptable.

3.3.2 Construction of questionnaire

The self-complete questionnaire used in this study was designed to access the perceived maturity level of the safety culture within the South African petrochemical industry based on the key components of a safety culture as discussed in the literature review in chapter 2 (see section 2.5.2). The questionnaire consists of two parts:

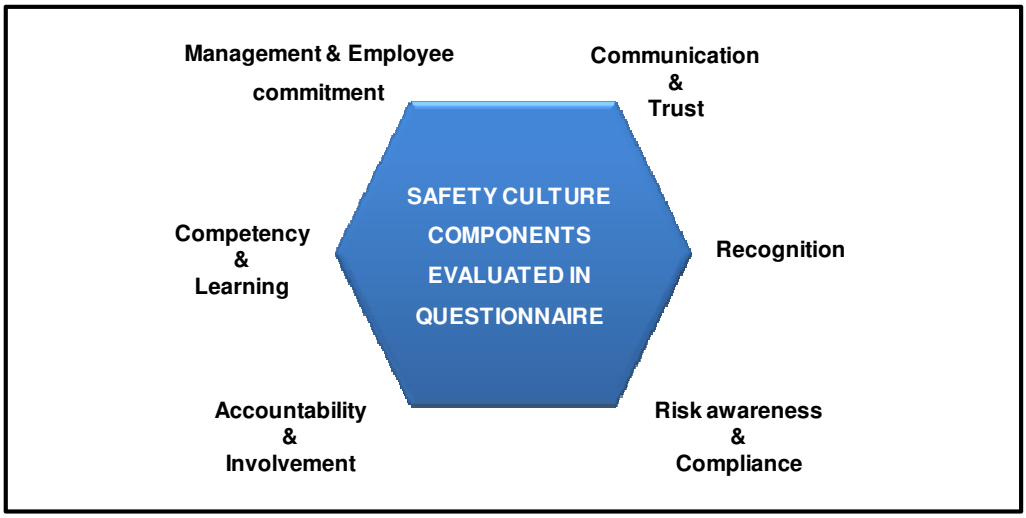
Part 1: Demographical information

Respondents had to indicate their gender, age group, department, tenure and management level.

Part 2: Assessment of the safety culture

This section of the questionnaire was designed to assess each of the key aspects conducive of an effective safety culture as listed in Figure 3.2, in the form of statements which capture the essence of each component. A total of 50 statements referring to the six selected components were randomly listed and a five-point Likert scale (1 = highly disagree, 2 = disagree, 3 = not sure, 4 = agree, 5 = highly agree) were used in order to evaluate the subject's agreement with each statement. The complete questionnaire is shown in Annexure A.

Figure 3.2: Safety culture components used in questionnaire



Source: Adapted from Choudhry *et al.* (2007:1004); Fleming (2001:3), Fitzgerald (2005:325); Hudson (2000:7)

The safety culture components evaluated in the questionnaire were selected based on the agreement to relating academic research (Choudhry *et al*., 2007:1004; Fleming, 2001:3; Fitzgerald, 2005:325; Hudson, 2000:7) as well as relevance to the petrochemical environment. Some of the selected components have been grouped together due to integrated similarities and to simplify analyses.

3.3.3 Study population

The study population for the empirical study consisted of first-line managers and non-managerial personnel within the production, maintenance, laboratory, technical and safety, health and environment departments. The particular departments in the study population were selected based on their day-to-day exposure to occupational safety risks. Management levels higher than first-line management were excluded from the study and should be considered in potential future studies.

Considering that the size of the petrochemical industry in South Africa exceeds 120 000 people (Labour SA, 2008:107), this study will focus its efforts on the population within the above mentioned five departments in a single petrochemical organisation. These five departments of interest consist of 358 employees (N) which form the study population.

3.3.4 Sample strategy

Sampling refers to the process of indentifying a relatively small number of elements from a larger defined group of elements known as a population so that the information gathered from the smaller groups allows the researcher to make judgements about the larger population (Levine, Stephan, Krehbiel & Berenson, 2008:252). Sample analysis is less time consuming, less costly and less cumbersome compared to the analysis of the entire population.

Different sampling methods exist and can be used depending on the scale and complexity of the investigation. For this type of sampling, inferences about the study population should be made with caution. In particular, a sample of 200 employees

was taken from the study population based on the operations department employee database. This sample consisted of 90 production employees, 75 maintenance employees, 10 laboratory employees, 5 safety officers and 20 employees from the technical department. These proportions roughly represent the department size proportions in the study population. Respondents in each department were selected on the basis of easy accessibility.

The questionnaires were distributed and collected by the leaders or first-line management of each of the different departments of interest. More convenient distributing channels such as email or internet could not be utilized as most of the participants only have limited access to computers. From the 200 questionnaires distributed, 93 (n) fully completed questionnaires were returned before the cut-off date which constitutes a 47% response rate. The reason for the relatively low response rate is due to the fact that a high number of participants are shift-workers and therefore not always on duty depending on their work schedule and overtime limitations. Another reason could be due to high work loading especially in the maintenance department resulting in some participants only returning partially completed and even blank questionnaires. Note that the high non-response rate can cause bias in the sample and therefore inferences to the population should be handled with caution.

Participant anonymity was maintained throughout the questionnaire. At no time during the research were the respondents required to divulge any kind of information whereby they could be identified by the researcher. The anonymity was intended to enhance the honesty of the response given.

3.3.5 Pre-testing of questionnaire

The purpose of pre-testing a questionnaire is considered a good practice in ensuring the development of a good quality questionnaire (Boyce, 2002:534).

Through pre-testing the researcher can determine whether:

- The instructions of the questionnaire are clear and easy to follow;
- Every statement is fully understood by the respondent;
- The statement sequence is logical; and
- The language and wording are understandable and non-contradictive.

The questionnaire was tested on six employees in the production department. Based on face validity, careful consideration was given to the language, logic and sensitivity of the statements. After adjustments were made no further changes were deemed necessary.

In the following section the results of the demographical information collected from the questionnaire feedback are discussed.

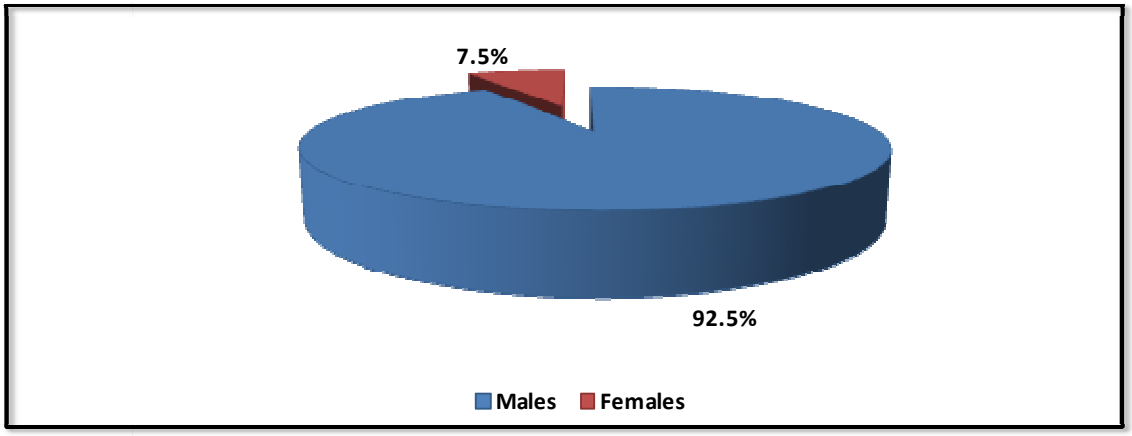
3.4 RESULTS OF DEMOGRAPHICAL INFORMATION

The demographical analysis of the sample (n = 93) is discussed in this section. The variables examined consist of the gender, age, department, tenure and management level distribution of the total sample.

3.4.1 Gender distribution

Figure 3.3 shows the gender distribution of respondents who participated in the study. The majority of respondents were male, which were not an unexpected outcome as the male workforce currently dominates more than 80% of positions in the chemical industry (Labour SA, 2008:107).

Figure 3.3: Gender distribution

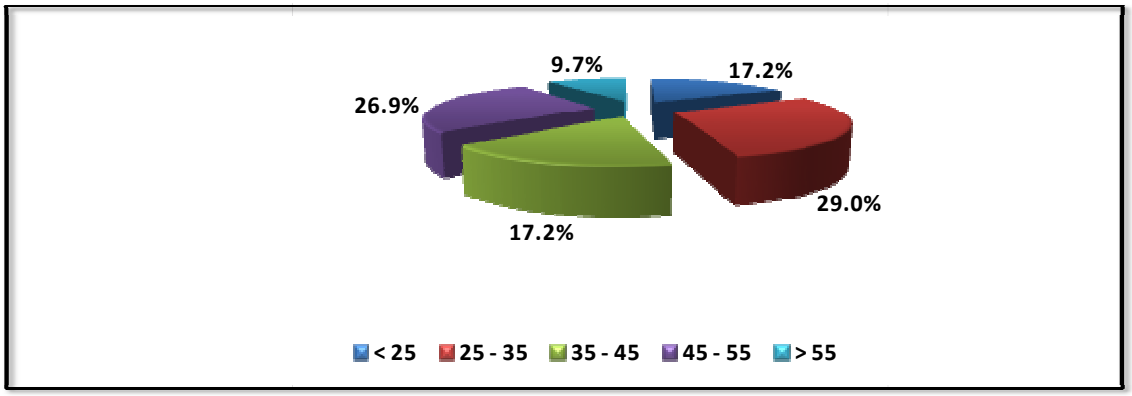


Source: Safety climate questionnaire, Annexure A, Part 1

3.4.2 Age distribution

Figure 3.4 reveals the age distribution of respondents which indicates a fairly equal spread with the highest percentage of respondents being between the ages of 25 and 35 (29%) and between 45 and 55 (27%).

Figure 3.4: Age distribution

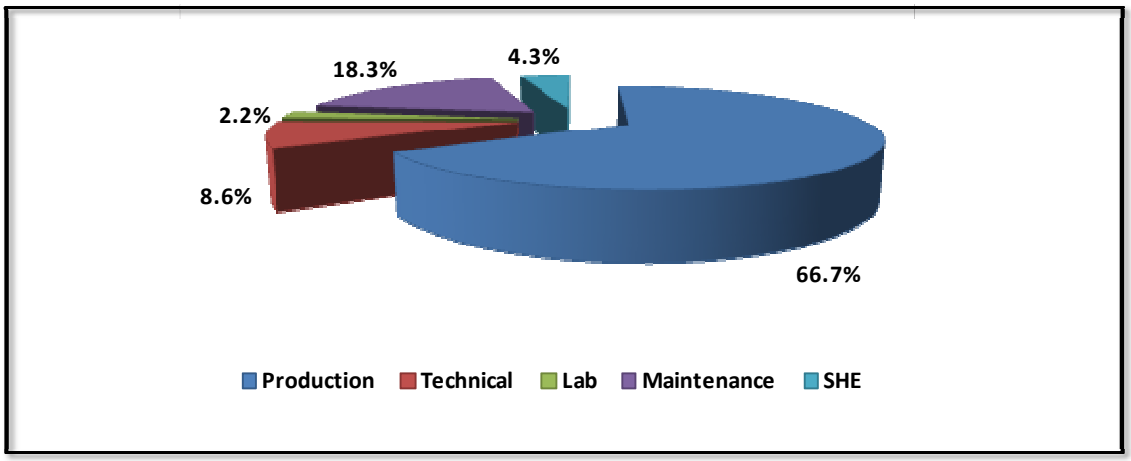


Source: Safety climate questionnaire, Annexure A, Part 1

3.4.3 Department distribution

From Figure 3.5 it is clear that two thirds of the respondents represented the production department and 18% were from the maintenance division.

Figure 3.5: Department distribution



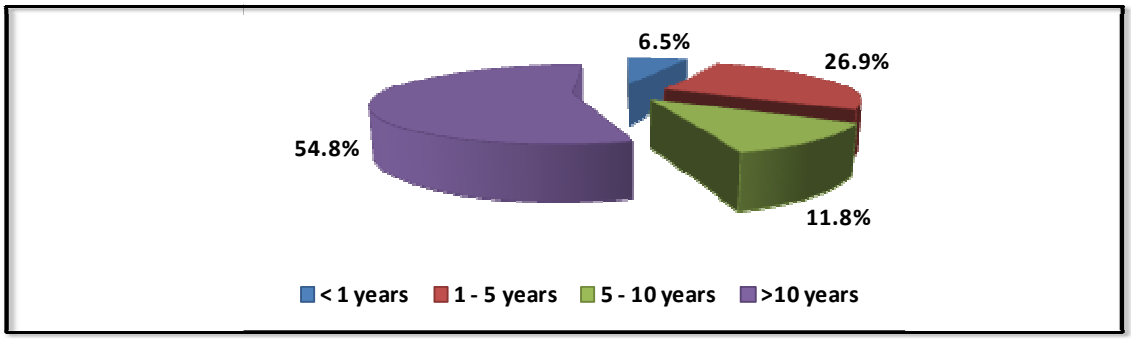
Source: Safety climate questionnaire, Annexure A, Part 1

The remaining portion was made up of 8.6% in the technical group, 4.3% from the safety health and environment team and 2.2% representing the laboratory or analytical section.

3.4.4 Tenure distribution

Figure 3.6 clearly illustrates the vast majority of participants have more than 10 years of experience. It is interesting to note the difference in distribution between 1 to 5 years experience and 5 to 10 years of experience.

Figure 3.6: Tenure distribution



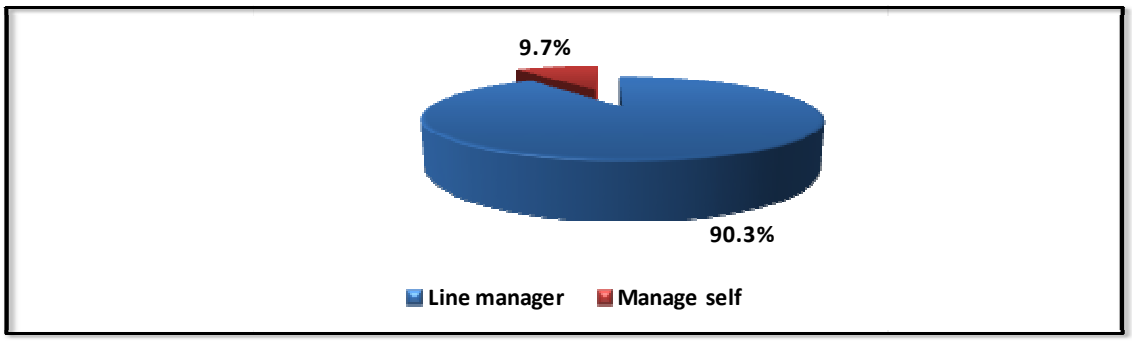
Source: Safety climate questionnaire, Annexure A, Part 1

A similar trend was observed in the age distribution with a much lower portion of the participants between the age of 35 and 45 compared to the distribution between 25 and 35 as well as 45 and 55.

3.4.5 Management level distribution

Figure 3.7 illustrates that the majority of respondents were non-managerial employees with approximately 10% of participants in a first-line management position.

Figure 3.7: Management level distribution



Source: Safety climate questionnaire, Annexure A, Part 1

3.5 STATISTICAL ANALYSIS

The data collected were analysed, using statistical software packages including Statistical Package for Social Sciences (SPSS, 2009) and Statistica (Statsoft, 2009). The statistical analysis consisted of two phases. Firstly, descriptive statistics were explored for each of the statements. The reliability or internal consistency of the six components of the questionnaire was assessed by calculating Cronbach alpha coefficients with the main focus to provide evidence that the components form reliable constructs for the purpose of this study.

The second phase of analysis describes the inferential section of the study. Statistical and practical significant relationships between the different demographical variables were explored by means of independent samples t-tests, analysis of variance

(ANOVA) tests and Spearman rank correlations, based on the data collected from the safety climate questionnaire.

3.5.1 Basic descriptives

The following descriptive statistics were use in the analysis:

- The most common measure describing the central tendency of the data (the extent to which all the data values group around a central value) is the mean which is calculated by summing the values of a variable for all observations and then dividing by the number of observations (Levine *et al*., 2008:97).
- The variance is calculated by finding the squared difference between an observation and the mean, summing for all cases and then dividing by the number of observations minus one. It describes the average scatter of values around the mean therefore indicating the dispersion of the data (Levine *et al*., 2008:106).
- The standard deviation (SD) is calculated as the square root of the variance and also describes the dispersion of data around the mean (Levine *et al*., 2008:107). Since the standard deviation is a direct form of variance, it will be used instead of the latter when reporting in this study.

3.5.2 Questionnaire reliability

The popular technique used to determine the reliability of a subsection of a questionnaire is known as the Cronbach alpha or coefficient alpha (α). Reliability analysis is conducted to determine the internal consistency between the statements relating to each safety culture component. It represents the extent to which the statements are measuring the same underlying concept. Interrelated items may be summed to obtain an overall mean score for each safety culture component. Cronbach's coefficient alpha estimates the reliability of this type of scale by determining the internal consistency of the test or the average correlation of items within the test (Field, 2009:674). The greater the resulting Cronbach alpha coefficient, the more reliable is the scale. In essence, it means that if similar individual responses

are observed for a set of statements it could be concluded that the statements are measuring the same construct. For items to be considered reliable a general accepted value greater than 0.7 is required (Nunnally & Bernstein, 1994:265). It is however also noted that when dealing with psychological constructs, values below even 0.7, can realistically be expected because of the diversity of the constructs being measured (Field, 2009:675).

If the alpha value of a group of statements describing a safety culture component is low then it suggests that some statements included in the component do not relate to it. These statements must be considered to be removed. The criterion used to determine whether a statement needs to be dropped out or not, is the "item-to-total correlation'. If the "item-to-total correlation" is low, one should consider removing the item. Such a removal will increase the alpha coefficient value of the overall component. The Cronbach alpha coefficient will thus be calculated for each of the six components of which each is described by a set of statements. If the alpha value is in the region of 0.7 or higher, the group of statements referring to the particular safety culture component can be considered as reliable and therefore descriptive statistics can be calculated for the overall component (Field, 2009:675).

3.5.3 Statistical inference

In this study, independent samples t-test and analysis of variance (ANOVA) were conducted between the mean values to examine the relationship between the extracted factors, including the age group, gender classification, department classification, tenure and management level of respondents. In simple terms these analyses aim to determine if there exists a statistical and practical significant difference between the evaluations based on the mean score; for instance, male and female respondents with regard to a specific safety culture component (Field, 2009:328).

The independent samples t-test, also known as the two-sample t-test, compares the mean values of one variable for two groups of cases. This test is commonly used for comparisons between groups of only two categories such as gender. The ANOVA test is an extension of the independent samples t-test and produces a one-way

analysis of variance for a quantitative dependent variable by a single categorical independent variable consisting of more than two categories. Analysis of variance is used to test the hypothesis that several means are equal. If the means are found not to be equal by the ANOVA-test, post hoc tests are conducted to pairwise determine which of the groups' means differ. If the *p*-value in either the t-test or ANOVA is found to be less than 0.05, then the independent variable in question has a statistical significant relationship with the factor at hand (SPSS, 2009).

A result that is statistically significant at conventional levels may not be practically significant as judged by the magnitude of the effect or the opposite, a result that may be perceived as insignificant may have practical importance. Interpreting empirical data purely on the basis of statistical significant tests, may lead to misrepresentation of the research findings. Especially since this sample is a convenience sample and not a random sample from the population, statistical significance (p-values) should be considered with caution. Rather, practical significance is important (Ellis & Steyn, 2003:51). Hence this calls for the use of effect sizes, which gives an indication of practical significance. In particular, the effect size that will be used in this analysis is Cohen's d-value. Cohen's d-value is independent of the sample size and will therefore also be calculated to determine the practical significant difference between the independent variables, in this case the biographical variables, based on the questionnaire response (Field, 2009:32; Ellis & Steyn, 2003:51; Thompson, 2001:80). Cohen's d-value is interpreted, according to Cohen's (1988:25) guidelines, as follows:

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

3.5.4 Correlations

The final statistical method applied was correlation analysis which measures the degree to which changes in one variable are associated with changes in another, thus indicating the relation between two or more variables (Levine *et al*., 2008:131). Correlation coefficients can range from -1, presenting a perfect negative correlation, to +1, representing a perfect positive correlation. In this study, Spearman rank correlations coefficients were calculated to assess how well the relationship between the different safety culture components can be described. This type of correlation coefficient is nonparametric in the sense that it does not rely on assumptions such as normality of the data (Field, 2009:179). Correlation coefficient values of ±0.1 indicate a small correlation with values of ±0.3 implying moderate correlation and values greater than ±0.5 represents substantial correlation between two variables (Field, 2009:170).

Although correlation analysis indicates the relation between two variables, it does not imply a causation effect (Levine *et al*., 2008:131). This causality is based on two reasons:

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

3.6 DESCRIPTIVE STATISTICS

The results of the first phase of statistical analysis are discussed in this section. Each statement referring to its associated component is listed with the percentage response frequency distribution based on the five-point Likert scale as selected by the participants. The mean and standard deviation scores for each statement are also shown.

It is important to note that the scoring for some of the statements had to be reversed due to the fact these statements were stated negatively. In other words, disagreeing with the statement indicates a positive rather than negative perception. Reversing the response in this case is also essential in order to successfully determine the internal consistency (Cronbach's alpha coefficient) between the groups of statements. The statements of which the response had to be reversed are indicated with an underscore "_r".

3.6.1 Management and employee commitment

The descriptive statistics in response to the statements forming part of the component, "management and employee commitment" are listed in Table 3.1.

It can be noted that although only three out of the twelve statements have a response greater than four implying an inclination towards strong positive agreement with the associated statements, the majority of statements scored a mean value greater than the neutral response of 3.00 indicating an inclination towards positive agreement. Item A1 stating that "*sufficient time and effort is committed to safety in my organisation*" scored the highest with a mean value of 4.28 with the lowest standard deviation of 0.70, whilst item A23_r stating that "*although safety is regarded as top priority it is sometime overlooked due to productivity and cost implications*" scored the lowest with a mean value of 2.75 and the highest standard deviation of 1.21.

Table 3.1: Descriptive statistics – Management and employee commitment

		Frequencies (%)					Descriptives	
Item	**Statement**	**1**	**2**	**3**	**4**	**5**	**Mean**	**SD***
A1	Sufficient time and effort is committed to safety in my organisation.	0	3.2	4.3	53.8	38.7	4.28	0.70
A2	Management attentively listens to safety ideas and concerns and take appropriate action.	0	8.6	15.1	53.8	22.6	3.90	0.85
A9_r	Management is involved in safety only after incidents have occurred.	7.5	19.4	11.8	45.2	16.1	3.43	1.19
A21	Employees would often help their fellow colleagues to comply with safety rules.	0	5.4	11.8	54.8	28.0	4.05	0.79
A23_r	Although safety is regarded as top priority it is sometimes overlooked due to productivity or cost implications.	17.2	31.2	16.1	30.1	5.4	2.75	1.21
A26	Management does not tolerate lack of discipline when it comes to safety compliance.	2.2	3.2	4.3	47.3	43.0	4.26	0.86
A33_r	Employees in this organisation are motivated to exert only as much effort as is necessary for task completion regardless of safety.	4.3	20.4	16.1	46.2	12.9	3.43	1.09
A34	Management cares about the safety and well being of their sub-ordinates.	2.2	5.4	10.8	71.0	10.8	3.83	0.77
A38_r	The reason for not achieving our safety targets is because everyone does not value safety as important.	6.5	28.0	18.3	37.6	9.7	3.16	1.14
A39	Management commitment to safety is visible through their actions ("walk the talk")	3.2	3.2	17.2	62.4	14.0	3.81	0.84
A43_r	Management talks a lot about safety in the midst of an accident but when everything goes well they tend to quiet down.	10.8	23.7	16.1	41.9	7.5	3.12	1.18
A45	Employees will rather spend more time on a task to ensure it is done safely than rushing to complete a job.	1.1	9.7	15.1	39.8	34.4	3.97	0.99

**SD = Standard deviation*

More than 92% of the participants believe that sufficient time and effort is devoted to safety with 76% of respondents acknowledging that management's commitment to safety is visible through their actions. This is a positive result and essential in the development of a strong safety culture as discussed in chapter 2 (Flin *et al.,* 2000:178; Parker *et al.,* 2001:212).

The majority of respondents (82%) also agreed that management cares about the safety and well-being of their sub-ordinates with 76% approving that management attentively listens to employees' safety suggestions and take appropriate action.

Although it is perceived that overall management commitment to safety is quite high, 35% of the respondents indicated that during periods when the incident rate tend to reach a stable plateau, management's voice tends to quiet down compared to periods in the midst of an accident. Close to 27% of participants also suggested that management is involved in safety only after incidents have occurred. Although less than a third of the respondents highlighted the loss in management commitment during stable periods together with the reactive culture displayed by management, this finding is of concern as it sends ambiguous messages to the workforce regarding management's true commitment and could potentially exacerbate employees' commitment to safety (Furness & Muckett, 2007:73)

The most negative response received as shown in Table 3.2, highlighted in red, is the perception that although safety is regarded as top priority it is sometimes overlooked or bypassed due to productivity and cost implications. More than 47% of respondents agreed with this statement with only 35% indicating the opposite, that safety is always favoured above profit. This finding is of significant importance as it not only contradicts management's commitment to safety but also diminishes the importance of the safety value communicated through management (Furness & Muckett, 2007:74).

The majority of respondents (83%) indicated that employees would often assist their fellow colleagues to comply with safety rules and 75% suggested that when completing a task, employees would often spend more time to ensure the safe completion of an activity rather than rushing the job. This is supported by the response (59%) that employees do not exert only the necessary effort required to complete a task regardless of possible safety implications. However, 34% of participants indicated that the reason why safety performance targets are not met is due to the fact that not every individual values safety as important. From the results discussed above it appears that a large segment of the workforce is probing within

the transition phase from an independent towards interdependent safety culture on basis of commitment to safety.

The results obtained from the iterative reliability analysis for the 12 statements forming part of the component, management and employee commitment, yielded a Cronbach alpha coefficient of 0.719, indicating an acceptable reliability.

From Table 3.2 it can be seen that the removal of any of the 12 statements will not significantly improve the already obtained alpha coefficient and therefore all statements will be considered for further assessment.

Table 3.2: Item reliability analysis – Management and employee commitment

Item	Item-Total Correlation	Cronbach's Alpha if item deleted
A1	.462	.693
A2	.532	.680
A_r	.331	.706
A21	.295	.709
A23_r	.233	.722
A26	.302	.708
A33_r	.298	.710
A34	.406	.697
A38_r	.205	.725
A39	.511	.683
A43_r	.552	.668
A45	.284	.711

Descriptive statistics for the overall component may therefore be calculated based on the analysis of the individual statements. This will be discussed in more detail in section 3.6.7.

3.6.2. Communication and trust

The descriptive statistics in response to the statements forming part of the component, “communication and trust”, are listed in Table 3.3.

As seen in Table 3.3, five out of the seven statements revealed a mean response greater than 3.00 indicating a positive agreement towards communication and trust. It is however observed that two statements revealed a response lower than 3.00 indicating a negative agreement towards communication and trust. Item B3 stating that “*relevant safety information is communicated to me on a regular basis*” scored the highest with a mean value of 4.16 with the lowest standard deviation of 0.81, whilst item B48 stating that “*our organisation has a culture of 'no blame*' with an atmosphere of trust” scored the lowest with a mean value of 2.75 and a standard deviation of 1.17.

Table 3.3: Descriptive statistics – Communication and trust

		Frequencies (%)					Descriptives	
Item	**Statement**	**1**	**2**	**3**	**4**	**5**	**Mean**	**SD**
B3	Relevant safety information is communicated to me on a regular basis.	2.2	3.2	3.2	59.1	32.3	4.16	0.81
B5	Management operates an open door policy on safety issues	4.3	8.6	10.8	53.8	22.6	3.82	1.02
B13	I feel comfortable when allowing others to carry out tasks in my area of responsibility.	3.2	7.5	14.0	55.9	19.4	3.81	0.95
B20_r	Employees would rather keep safety information such as near misses to themselves.	17.2	32.3	15.1	24.7	10.8	2.80	1.29
B25	My supervisor / manager shows complete trust in my ability to identify risks.	3.2	2.2	6.5	66.7	21.5	4.01	0.81
B28	We learn and share safety information with other departments and organisations.	2.2	3.2	6.5	60.2	28.0	4.09	0.82
B48	Our organisation has a culture of 'no blame' with an atmosphere of trust.	18.3	24.7	23.7	30.1	3.2	2.75	1.17

The bulk of respondents (91%) indicated a positive agreement to the statement that relevant safety information is regularly communicated with 76% agreeing that management practise an open door policy when it comes to safety issues. A high number of respondents (88%) revealed that safety information is shared with other

departments and organisations although approximately 50% indicated that employees tend to refrain in sharing information regarding near miss incidents.

The majority of respondents (88%) indicated an attribute of trust in the relationship with their supervisors or managers. Although 76% of participants indicated that they feel comfortable allowing others to perform activities in their areas of responsibility, close to 43% indicated that their organisation does not exhibit a culture of “no blame”. This result is in line with the observation discussed above that half of the participants believe that employees do not share safety information regarding near miss incidents.

The descriptive statistics prove to indicate that there appears to be an open communication channel between management and sub-ordinates which is a positive observation although it seems that an atmosphere indicative of intimidation or retribution prevails when raising issues such as near miss incidents or mistakes leading to half of the respondents agreeing that employees tend to withhold information. In the consequential absence of a “no blame” culture, the advancement in safety culture would prove sincerely challenging if not impossible (Hudson, 2000:12).

The results obtained from the iterative reliability analysis for the seven statements forming part of the safety culture component, communication and trust, yielded a Cronbach alpha coefficient of 0.724, indicating an acceptable reliability.

Table 3.4: Item reliability analysis – Communication and trust

Item	Item-Total Correlation	Cronbach's Alpha if item deleted
B3	.667	.647
B5	.611	.646
B13	.254	.732
B20_r	.372	.718
B25	.626	.655
B28	.424	.696
B48	.270	.739

From Table 3.4 it can be seen that the removal of any of the seven statements will not significantly improve the already obtained alpha coefficient and therefore all statements will be considered for assessment. Descriptive statistics for the overall component may therefore be calculated based on the analysis of the individual statements.

3.6.3. Accountability and involvement

The descriptive statistics in response to the statements forming part of the component, "accountability and involvement", are listed in Table 3.5.

As seen in Table 3.5, all nine statements revealed a mean response greater than 3.00, therefore suggesting a positive inclination towards accountability and involvement. Item C31 stating that, "*all employees are responsible for safety and everyone's safety is equally important*" scored the highest with a mean value of 4.49 with the lowest standard deviation of 0.65, whilst item C50_r, stating that "*safety is primarily driven by management rather than looked for by the workforce",* scored the lowest with a mean value of 3.09 and a standard deviation of 1.19.

Almost all respondents (96%) indicated that every individual is accountable for safety and everyone's safety is equally important. This perception was emphasised by the positive agreement (82%) that safety is part of the organisational culture, "*the way we do things around here*". This is a positive observation although somewhat opposing if compared to the previous finding that 34% of respondents indicated that the reason for not achieving safety targets is because not everyone values safety as important. It would appear that the employees hold themselves accountable for safety and that the general atmosphere speaks of safety as "*the way we do things around here*" although some individuals might not perceive safety as a personal objective.

Table 3.5: Descriptive statistics – Accountability and involvement

		Frequencies (%)					Descriptives	
Item	**Statement**	**1**	**2**	**3**	**4**	**5**	**Mean**	**SD**
C4	I am encouraged to make safety improvement suggestions.	4.3	3.2	17.2	49.5	25.8	3.89	0.97
C7	We often analyse routine and new tasks to look for ways of doing a job safer.	3.2	2.2	11.8	61.3	21.5	3.96	0.85
C8	Everyone is accountable for their own safety.	2.2	4.3	0	34.4	59.1	4.44	0.88
C11	Safety is how we do things around here.	2.2	3.2	12.9	61.3	20.4	3.95	0.81
C16	Co-workers often give tips to each other on how to work safely	1.1	3.2	11.8	60.2	23.7	4.02	0.77
C17	We have systems in place to manage all hazards.	3.2	8.6	11.8	54.8	21.5	3.83	0.97
C31	All employees are accountable for safety and everyone's safety is equally important.	0	2.2	2.2	39.8	55.9	4.49	0.65
C40	Employees at all levels are involved in decisions when it comes to safety.	10.8	16.1	10.8	44.1	18.3	3.43	1.26
C50_r	Safety is primarily driven by management rather than looked for by the workforce.	9.7	26.9	18.3	35.5	9.7	3.09	1.19

The majority of respondents (75%) indicated that they are encouraged to make safety improvement suggestions and 83% agreed that they often analyse tasks to develop ways to execute jobs in a safer way; however, only 46% disagreed with the statement that safety is primarily driven by management and not actively pursued by employees. When it comes to decisions relating to safety, 62% of respondents indicated that employees at all levels are involved in decision-making. These findings support the observation that the current safety culture still has some deep roots anchored into a dependent safety culture.

The results obtained from the iterative reliability analysis for the 12 statements forming part of the element, accountability and involvement, yielded a Cronbach alpha coefficient of 0.706, indicating an acceptable reliability.

Table 3.6: Item reliability analysis – Accountability and involvement

Item	Item-Total Correlation	Cronbach's Alpha if item deleted
C4	.350	.686
C7	.379	.681
C8	.342	.687
C11	.462	.668
C16	.351	.686
C17	.611	.633
C31	.256	.700
C40	.476	.661
C50_r	.253	.713

From Table 3.6 it can be seen that the removal of any of the nine statements will not significantly improve the already obtained alpha coefficient and therefore all statements will be considered for assessment. Descriptive statistics for the overall element may therefore be calculated based on the analysis of the individual statements.

3.6.4. Competency and learning

The descriptive statistics in response to the statements forming part of the component, "competency and learning", are listed in Table 3.7.

As seen in Table 3.7, five out of the seven statements revealed a mean response greater than 3.00 indicating a positive agreement towards competency and learning. It is however observed that two statements revealed a response lower than 3.00 indicating a negative agreement towards the component, competency and learning. Item D12 stating that "*the organisation learns from past mistakes and implements appropriate preventative measures*" scored the highest with a mean value of 4.15 with the lowest standard deviation of 0.82, whilst item D32_r stating that *"the majority of incidents are due to failures arising from the culture of the organisation rather than mechanical*" scored the lowest with a mean value of 2.74 and a standard deviation of 1.01.

Table 3.7: Descriptive statistics – Competency and learning

		Frequencies (%)					Descriptives	
Item	**Statement**	**1**	**2**	**3**	**4**	**5**	**Mean**	**SD**
D12	The organisation learns from past mistakes and implements appropriate preventative measures.	1.1	4.3	7.5	52.7	34.4	4.15	0.82
D14	Employees in this organisation undergo comprehensive and meaningful safety training.	2.2	7.5	9.7	50.5	30.1	3.99	0.95
D32_r	The majority of incidents are due to failures arising from the culture of the organisation rather than mechanical failure	8.6	37.6	28.0	22.6	3.2	2.74	1.01
D37_r	Solutions for safety problems are most often short-term and do not address the root cause.	7.5	31.2	22.6	32.3	6.5	2.99	1.10
D41	Employees in this organisation possess the necessary knowledge and skills to allow them to work safely.	2.2	4.3	6.5	61.3	25.8	4.04	0.83
D44	The way we conduct safety investigations is indicative of a world-class organisation.	1.1	14.0	16.1	50.5	18.3	3.71	0.96
D49_r	The organisation keeps on getting the same incidents over and over again.	3.2	20.4	18.3	41.9	16.1	3.47	1.09

The majority of respondents (87%) indicated that their organisation learns from part mistakes and takes appropriate action to prevent re-occurrences with only 24% indicating that the same incidents occur repetitively. However, a neutral response was obtained for the statement noting that solutions to safety problems are most often short term and do not address the root cause. It is interesting to note the 46% of respondents agreed that the majority of incidents occur due to a culture weakness rather than mechanical failure. This observation is in agreement with the literature stating that the dominant root cause for more and more incidents is due to failures arising from the culture of the organisation rather than due to technical failure (Hudson, 2007:698; Knegtering & Pasman, 2009:162).

A similar positive response (87%) suggested that the employees in this specific organisation possess the necessary knowledge and skills to enable them to work safely with 80% agreeing that they receive meaningful and comprehensive safety training. More than two thirds of participants (69%) felt that the manner in which safety investigations are conducted is reflective of a world-class organisation.

The results obtained from the iterative reliability analysis for the seven statements forming part of the element, competency and learning, yielded a Cronbach alpha coefficient of 0.571, indicating a low internal consistency between the underlying statements describing the element.

Table 3.8: Item reliability analysis – Competency and learning

Item	Item-Total Correlation	Cronbach's Alpha if item deleted
D12	.343	.518
D14	.301	.529
D32_r	.128	.594
D37_r	.254	.550
D41	.356	.513
D44	.374	.502
D49_r	.332	.517

From Table 3.8 it can be seen that by removing statement D32_r, the alpha coefficient will increase to 0.594 which is still lower than the desired value of close to 0.7. However, by further removing statements D37_r and D49_r, the Cronbach alpha increases to 0.666 which indicates an acceptable level of reliability. Therefore, the mean values of items D12, D14, D41 and D44 will be considered for the analysis of the overall component, competency and learning, for the remainder of the study.

3.6.5. Risk awareness and compliance

The descriptive statistics in response to the statements forming part of the component, “risk awareness and compliance”, are listed in Table 3.9.

As seen in Table 3.9, six out of the nine statements revealed a mean response greater than 3.00 indicating a positive agreement towards risk awareness and compliance. It is however observed that three statements revealed a response lower than 3.00 indicating a negative agreement towards the safety culture component, risk awareness and compliance. Item E27 stating that “*safety is seen as a condition of employment*” scored the highest with a mean value of 4.18 with a standard deviation

of 0.86, whilst item E47_r stating that "c*ompliance with rules and regulations is considered adequate*" scored the lowest with a mean value of 2.22 and a low standard deviation of 0.76.

Table 3.9: Descriptive statistics – Risk awareness and compliance

		Frequencies (%)					Descriptives	
Item	**Statement**	**1**	**2**	**3**	**4**	**5**	**Mean**	**SD**
E6	Most employees are aware of the potential hazards in their work environment.	1.1	1.1	11.8	52.7	33.3	4.16	0.76
E15	Work instructions and procedures are followed to the letter.	1.1	12.9	12.9	59.1	14.0	3.72	0.90
E18_r	We often become complacent when it goes well and then incidents occur.	10.8	48.4	24.7	14.0	2.2	2.48	0.94
E19	Hazard identification is a prime focus in my daily job.	1.1	4.3	8.6	55.9	30.1	4.10	0.81
E24	Doing things safely have become a habit for most employees rather than an obstacle.	1.1	3.2	9.7	65.6	20.4	4.01	0.73
E27	Safety is seen as a condition of employment.	2.2	3.2	6.5	50.5	37.6	4.18	0.86
E35_r	Some people get away with unsafe acts.	18.3	35.5	21.5	20.4	4.3	2.57	1.14
E46_r	Employees in this organisation often by-pass safety systems or procedures to complete their work faster.	4.3	15.1	17.2	39.8	23.7	3.63	1.13
E47_r	Compliance with rules and regulations is considered adequate.	8.6	71.0	12.9	5.4	2.2	2.22	0.76

The majority of respondents (86%) indicated that most employees are aware of the potential hazards in their work environment and identifying these hazards are part and parcel of their daily jobs. Most respondents (86%) indicated that doing things safely have become a habit rather than an obstacle and is perceived a condition of employment although not officially the case. Respondents reacted positively (73%) in regard to the adherence to instructions and procedures although 19% indicating that some employees often by-pass safety systems or procedures to complete their work faster.

On a negative side, 54% of the respondents agreed than some individuals get away with unsafe acts and 59% indicated that the organisation often becomes complacent

when all goes well after which incidents occur. Although participants believe that working safely has transformed into a habit for most employees, the majority (80%) agrees that mere compliance with safety rules and regulations is perceived as adequate.

The results obtained from the iterative reliability analysis for the nine statements forming part of the element, risk awareness and compliance, yielded a Cronbach alpha coefficient of 0.592, indicating a low internal consistency between the underlying statements describing the element.

From Table 3.10 it can be seen that by removing statement E47_r, the alpha coefficient will increase to 0.638 which is still lower than the desired value of close to 0.7. However, by further removing statements E18_r, E46_r and E35_r, the Cronbach alpha increases to 0.712 which indicates an acceptable level of reliability. Therefore, the mean values of items E6, E15, E19, E24 and E27 will be considered for the analysis of the component, risk awareness and compliance, for the remainder of the study.

Table 3.10: Item reliability analysis – Risk awareness and compliance

Item	Item-Total Correlation	Cronbach's Alpha if item deleted
E6	.360	.546
E15	.590	.473
E18_r	.004	.637
E19	.334	.551
E24	.367	.546
E27	.364	.541
E35_r	.341	.545
E46_r	.317	.554
E47_r	-.066	.638

3.6.6. Recognition

The descriptive statistics in response to the statements forming part of the element, "recognition", are listed in Table 3.11.

Table 3.11: Descriptive statistics – Recognition

		Frequencies (%)					Descriptives	
Item	**Statement**	**1**	**2**	**3**	**4**	**5**	**Mean**	**SD**
F10	My organisation is known for recognising individual contribution towards safety.	5.4	15.1	26.9	46.2	6.5	3.33	0.99
F22	I am proud to be associated with this organisation when it comes to safety.	2.2	3.2	10.8	48.4	35.5	4.12	0.88
F29	A job well done is a job done safely.	1.1	0	2.2	38.7	58.1	4.53	0.65
F30	Being rewarded for good safety performance helps to promote safe behaviour.	1.1	2.2	3.2	46.2	47.3	4.37	0.75
F36	Good safety performance will lead to good business performance.	1.1	2.2	2.2	32.3	62.4	4.53	0.75
F42_r	Although working safely is expected from everybody, it is rarely recognised.	2.2	24.7	23.7	38.7	10.8	2.69	1.03

As seen in Table 3.11, five out of the six statements revealed a mean response greater than 3.00 indicating a positive agreement towards the safety culture component, recognition. It is however observed that one of the statements revealed a response lower than 3.00 indicating a negative agreement towards recognition. Item F29 stating that "a *job well done is a job done safely*" scored the highest with a mean value of 4.53 with a standard deviation of 0.65, whilst item F42_r stating that "a*lthough working safely is expected from everybody, it is rarely recognised*" scored the lowest with a mean value of 2.69 and a standard deviation of 1.03.

The vast majority of respondents (97%) agreed with the statement that "a job well done is a job done safely". A strong positive agreement (95%) with the notion that recognising good safety performance aids in promoting safe behaviour was also observed which ultimately leads to good business performance. A feeling of pride was noted by 85% of respondents with regard to associating themselves with their organisation when it comes to safety. Participants agreed to a lesser extent (53%)

that their organisation is known for recognising individual contribution towards safety with half of the respondents indicating that working safely is rarely acknowledged.

The results obtained from the iterative reliability analysis for the six statements forming part of the element, recognition, yielded a Cronbach alpha coefficient of 0.552, indicating a low internal consistency between the underlying statements describing the element.

Table 3.12: Item reliability analysis – Recognition

Item	Item-Total Correlation	Cronbach's Alpha if item deleted
F10	.258	.529
F22	.518	.391
F29	.258	.524
F30	.270	.518
F36	.379	.473
F42_r	.157	.586

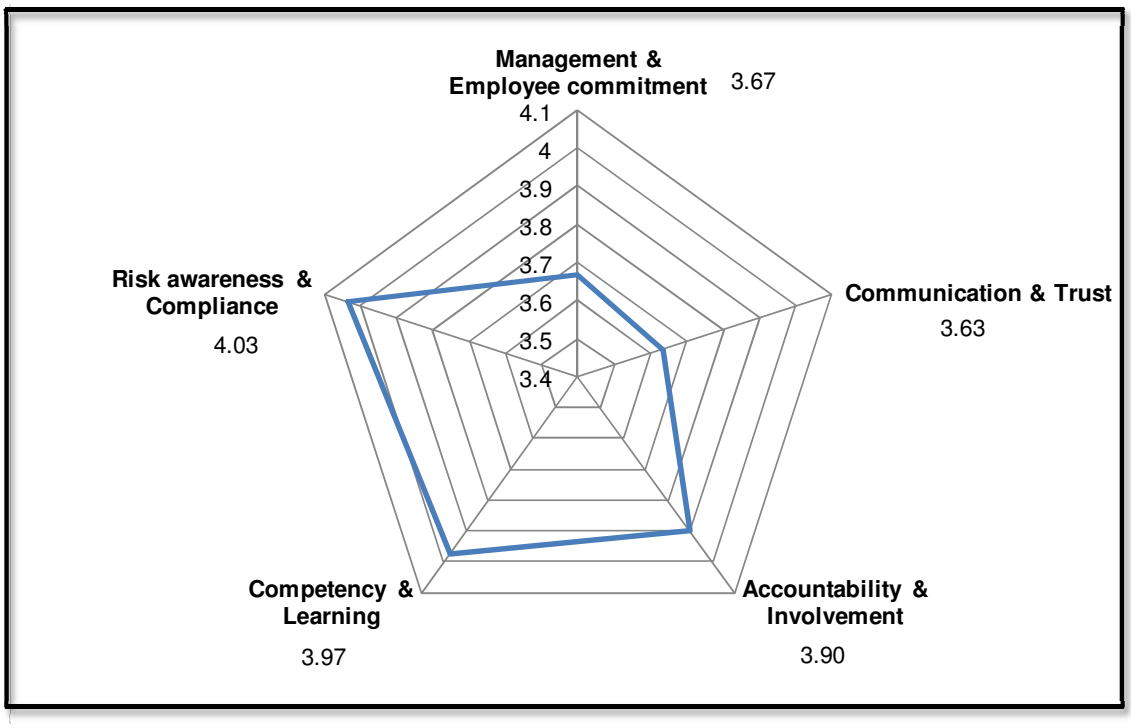
From Table 3.12 it can be seen that by removing statement F42_r, the alpha coefficient will increase to 0.586 which is still lower than the desired value of close to 0.7. By removing item F10 the alpha coefficient improves to a value of 0.594. However, by further removing any of the remaining four statements, the Cronbach alpha value decreases. This indicates that the statements in the component, recognition cannot be analysed as a group although each statement can still be interpreted individually.

3.6.7. Descriptive statistics of resulting components

In this section the descriptive statistics for each of the safety culture components are discussed following the analysis of the internal consistency of the components in the previous sections. Certain statements had to be removed from the group of statements describing the two components, namely “competency and learning” as well as “risk awareness and compliance” in order to increase the Cronbach alpha coefficient and by implication the reliability of the component feedback. The group of statements describing the component, “recognition”, cannot be analysed as a single entity due to low internal consistency among the statements.

Figure 3.8 shows the mean values for the response to each of the five safety culture components. It is noteworthy that all five components share mean values higher than the neutral response of 3.00 therefore all the components reflect a positive sentiment towards safety culture.

Figure 3.8: Mean scores for safety culture components



From figure 3.8 it is clear that the component with the lowest overall mean score is, communication and trust (3.63) followed by management and employee commitment (3.67), accountability and involvement (3.90), competency and learning (3.97) and finally risk awareness and compliance (4.03).

3.7 FURTHER STATISTICAL ANALYSIS

In this section, the results of the second phase of statistical analysis will be discussed which describes the relationship between the biographical variables and the five reliable safety culture components. Depending on the nature of the biographical variable, that is, the number of categories it consists of, either independent samples t-test or ANOVA will be used. Spearman correlations are also calculated to determine internal correlations among the five safety culture components.

Note that in this section statistical significance (p-values) as well as practical significance (effect sizes) is reported for the sake of completeness. However, p-values and inferences to the study population should be considered with caution, since the sample was a convenience, rather than a random sample from the study population. Emphasis should be placed on practical significance for the sample at hand.

3.7.1. Gender

In this section, the relationships between the gender difference of the respondents and the five safety culture components are analysed. The descriptive statistics are set out in Table 3.13 for the different gender categories opposite each safety culture component. Comparing the mean response for males versus females, it does not appear based on rough analysis that a noticeable difference exists. In order to confirm this observation, an independent samples t-test was done.

Table 3.13: Descriptive statistics for the gender categories

Safety culture component	Gender	Number	Mean	SD
Management & Employee commitment	Male	86	3.655	0.497
	Female	7	3.798	0.329
Communication & Trust	Male	86	3.625	0.624
	Female	7	3.735	0.447
Accountability & Involvement	Male	86	3.907	0.530
	Female	7	3.810	0.312
Competency & Learning	Male	86	3.985	0.648
	Female	7	3.821	0.374
Risk awareness & Compliance	Male	86	4.033	0.561
	Female	7	4.057	0.500

The results of the t-test are depicted in Table 3.14. From the independent samples t-test it is clear that there is no statistical significant difference in the mean scores between the two gender categories for each of the five safety culture components (*p*-values > 0.05). Cohen's d-values indicate a small effect size (practical significant difference) for each of the components (between 0.044 and 0.287).

Table 3.14: Independent samples t-test for the gender categories

Safety culture component	*t* statistic	Degrees of freedom	*p*-value	d-value
Management & Employee commitment	-0.744	91	0.322	0.287
Communication & Trust	-0.456	91	0.562	0.176
Accountability & Involvement	0.478	91	0.476	0.184
Competency & Learning	0.659	91	0.325	0.253
Risk awareness & Compliance	-0.112	91	0.905	0.044

Therefore, no statistical neither practical significant differences exists between the male and female respondents for each of the safety culture components. It should,

however, be noted that only 7.5% (7 from 93) of the total respondents were female which significantly restricts any statistical analysis in this category.

3.7.2. Age

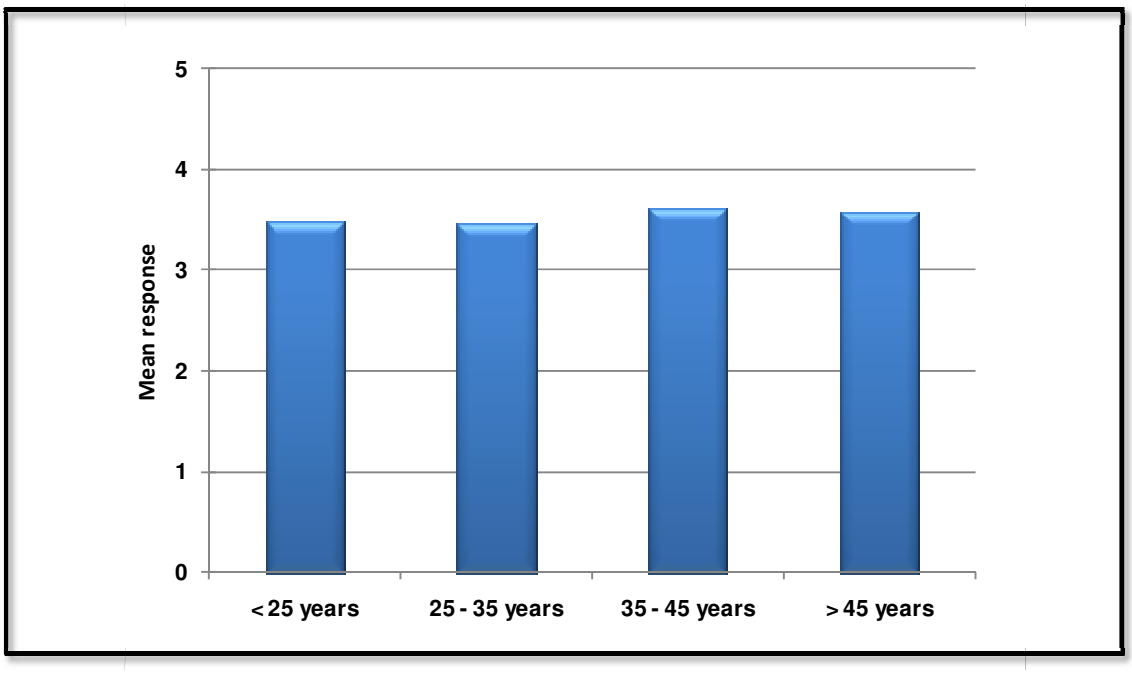
In this section the relationships between the different age groups of the respondents and the five safety culture components are analysed. The descriptive statistics are set out in Table 3.15 for the different age categories opposite each safety culture component. It is interesting to note that the respondents in the age group between 25 and 35 revealed the lowest mean values for all of the safety culture components whereas the respondents in the next age group, between 35 and 45, revealed the highest mean value responses for all components except for the component, competency and learning.

Table 3.15: Descriptive statistics for the age categories

Age group	Management & Employee commitment		Communication & Trust		Accountability & Involvement		Competency & Learning		Risk awareness & Compliance	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Younger than 25 years	3.656	0.599	3.491	0.882	3.847	0.632	3.795	0.571	3.800	0.766
Between 25 – 35 years	3.460	0.449	3.487	0.587	3.695	0.533	3.344	0.497	3.896	0.530
Between 35 – 45 years	3.875	0.425	3.786	0.537	4.132	0.432	3.750	0.482	4.238	0.507
Older than 45 years	3.735	0.441	3.744	0.484	3.977	0.431	3.601	0.453	4.159	0.417
All age groups	3.666	0.486	3.633	0.611	3.900	0.517	3.795	0.571	4.034	0.555

Figure 3.9 shows the overall mean response for each age category towards all the safety culture components analysed in this study.

Figure 3.9: Overall mean response for age group categories



It can clearly be seen that employees older than 35 reacted more positively in relation to all statements than compared to younger employees within the age group between 25 and 35 years showing the least agreement to the 50 statements listed in the questionnaire with an overall mean value of 3.46. The age group younger than 25 years revealed an overall mean value of 3.48, slightly above their more senior colleagues.

From results of the ANOVA omnibus test as shown in Table 3.16, it can be noted that the components, management and employee commitment, accountability and involvement and risk awareness and compliance each reveals a p-value < 0.05 indicating a statistical significant difference between the mean values for different age groups within these three components.

Table 3.16: ANOVA: Comparison between different age groups for each component

Safety culture component	Sum of squares	Degrees of freedom	MS	F stat	*p*-value
Management & Employee commitment	19.746	89	0.222	3.021	**0.034**
Communication & Trust	32.694	89	0.367	1.533	0.211
Accountability & Involvement	22.308	89	0.251	2.975	**0.036**
Competency & Learning	34.843	89	0.391	1.567	0.203
Risk awareness & Compliance	25.709	89	0.289	2.978	**0.036**

To determine which of the age groups within these three components are causing the distinction, post-hoc tests have been conducted in which the p-values and effect sizes are evaluated between the age groups for each of the three components. Discussions will focus on interpretation of the effect sizes (practical significance).

Table 3.17 below shows the post-hoc tests results comparing the different age categories within the component, management and employee commitment.

Table 3.17: Post-hoc tests: Comparison between age categories for management and employee commitment

Age group	Less than 25 years	Between 25 - 35 years	Between 35 - 45 years	More than 45 years
Less than 25 years	-	0.642 (0.328)	0.557 (0.365)	0.965 (0.132)
Between 25 - 35 years	0.642 (0.328)	-	0.068 **(0.925)**	0.146 (0.613)
Between 35 - 45 years	0.557 (0.365)	0.068 **(0.925)**	-	0.836 (0.317)
More than 45 years	0.965 (0.132)	0.146 (0.613)	0.836 (0.317)	-

The p-value is shown with the effect size in brackets

From Table 3.17 is it noted that a practical important difference exists between the age categories, 25 to 35 years and 35 to 45 years, revealing an effect size of 0.925.

A medium to strong practical significant difference is also observed between the categories 25 to 35 years and older than 45 years, with a resulting effect size of 0.613. Small practical significant differences are observed between age groups less than 25 years and 25 to 35 years, less than 25 years and 35 to 45 years, with resulting effect sizes of from 0.328 and 0.365 respectively. An interesting observation is the insignificant practical difference between the youngest respondents, less than 25 years and the eldest, older than 45 years, with a resulting effect size of 0.132.

Table 3.18 below shows the post-hoc tests results comparing the different age categories within the component, accountability and involvement.

Table 3.18: Post-hoc tests: Comparison between age categories for accountability and involvement

Age group	Less than 25 years	Between 25 - 35 years	Between 35 - 45 years	More than 45 years
Less than 25 years	-	0.827 (0.240)	0.379 (0.450)	0.883 (0.205)
Between 25 to 35 years	0.827 (0.240)	-	0.073 **(0.818)**	0.172 0.528
Between 35 to 45 years	0.379 (0.450)	0.073 **(0.818)**	-	0.818 (0.359)
More than 45 years	0.883 (0.205)	0.172 0.528	0.818 (0.359)	-

The p-value is shown with the effect size in brackets

From Table 3.18 is it noted that a practical important difference exists between the age categories, 25 to 35 years and 35 to 45 years, revealing an effect size of 0.818. A medium practical significant difference is also observed between the categories 25 to 35 years and older than 45 years, with a resulting effect size of 0.528. Small to medium practical significant differences are observed between age groups less than 25 years and 35 to 45 years as well as between 35 to 45 years and older than 45 years, with resulting effect sizes of from 0.450 and 0.359 respectively. Small practical significant differences are observed between age groups less than 25 years and 25 to 35 years, less than 25 years and older than 45 years, with resulting effect sizes of from 0.240 and 0.205 respectively.

Table 3.19 below shows the post-hoc tests results comparing the different age categories within the component, risk awareness and compliance.

Table 3.19: Post-hoc tests: Comparison between age categories for risk awareness and compliance

Age group	Less than 25 years	Between 25 - 35 years	Between 35 - 45 years	More than 45 years
Less than 25 years	-	0.957 (0.126)	0.105 (0.571)	0.241 (0.468)
Between 25 - 35 years	0.957 (0.126)	-	0.282 **0.644**	0.283 (0.495)
Between 35 - 45 years	0.105 (0.571)	0.282 **0.644**	-	0.976 (0.155)
More than 45 years	0.241 (0.468)	0.283 (0.495)	0.976 (0.155)	-

The p-value is shown with the effect size in brackets

From Table 3.19 is it noted that a lower degree of practical significant difference exit between the age categories for the component, risk awareness and compliance, as compared to the previous two components. A medium to strong practical important difference exists between the age categories, 25 to 35 years and 35 to 45 years, revealing an effect size of 0.644. A medium practical significant difference is observed between the categories less than 25 and 35 to 45 years, less than 25 years and older than 45 years as well as 25 to 35 years and older than 45 years, with resulting effect sizes of 0.571, 0.468 and 0.495 respectively. No practical significant differences are observed between age groups less than 25 years and 25 to 35 years as well as between 35 to 45 years and older than 45 years, with resulting effect sizes of from 0.126 and 0.155 respectively.

3.7.3. Department

In this section the relationships between the different departments of the respondents and the five safety culture components are analysed. The descriptive statistics are set out in Table 3.20 for the different department categories opposite each safety culture component. By comparing the individual mean response scores for each department, it is difficult to point out any significant differences or distinct trend in

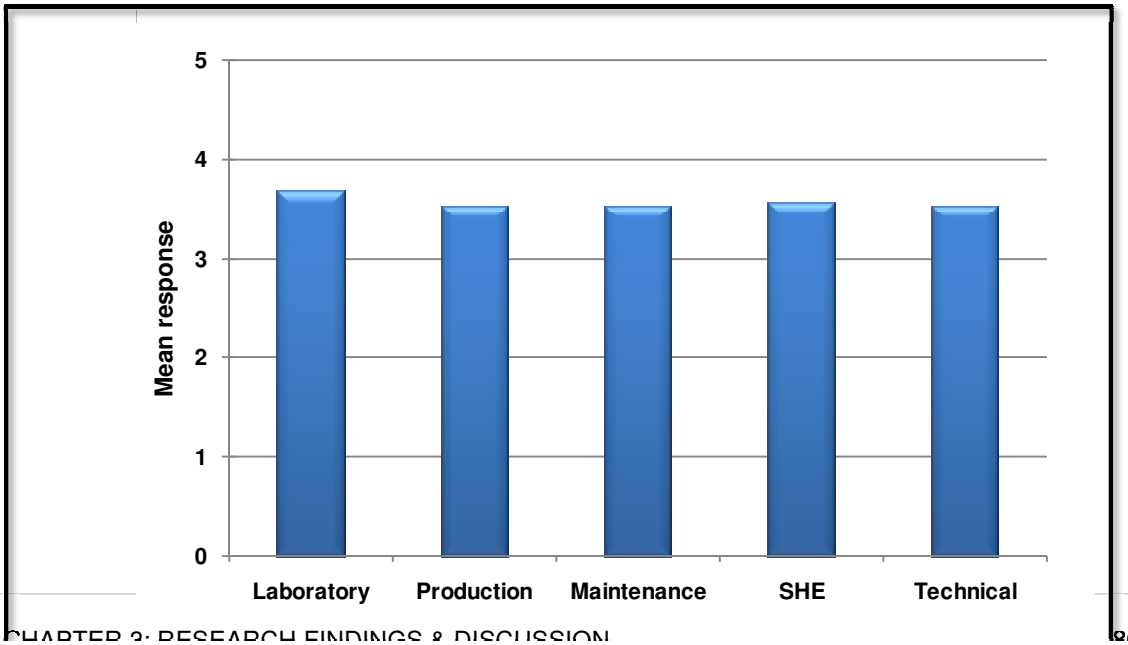
perception. Figure 3.10 shows the overall mean response for each department towards all the safety culture components analysed in this study.

Table 3.20: Descriptive statistics for the different department categories

Department	Management & Employee commitment		Communication & Trust		Accountability & Involvement		Competency & Learning		Risk awareness & Compliance	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Production	3.665	0.532	3.608	0.620	3.909	0.570	3.984	0.676	4.055	0.590
Technical	3.865	0.205	4.042	0.278	3.833	0.168	3.464	0.348	3.278	0.285
Laboratory	3.654	0.054	3.833	0.000	3.944	0.393	3.286	0.583	3.778	0.314
Maintenance	3.598	0.443	3.546	0.761	3.980	0.445	3.956	0.645	4.118	0.442
SHE	3.558	0.384	4.167	0.236	3.528	0.399	3.857	0.000	3.083	0.500

Although the respondents from the laboratory or analytical department revealed the highest mean score response, it should be considered that this department only represents 2.2% of the total respondents which makes an accurate statistical analysis impossible. It is however interesting to observe that the overall mean score for the rest of the departments were closely grouped with the production and maintenance department scoring precisely the same at mean response of 3.53.

Figure 3.10: Overall mean response for each department



Due to the fact that the majority of respondents were from the production (66.7%) and maintenance department (18.3%), it was decided to conduct an independent samples t-test to determine any statistical significant difference between the mean response scores between each of these two departments.

The results of the t-test are depicted in Table 3.21. It is clear that there is no statistical significant difference in the mean scores between the two department categories for each of the five safety culture components (*p*-values > 0.05). Cohen's d-value also indicates an insignificant practical significant difference between the two departments in any of the components (ranging from 0.041 to 0.126).

Table 3.21: Independent samples t-test for the production versus maintenance categories

Safety culture component	*t* statistic	Degrees of freedom	*p*-value	d-value
Management & Employee commitment	0.477	77	0.600	0.126
Communication & Trust	0.348	77	0.760	0.082
Accountability & Involvement	-0.480	77	0.584	0.126
Competency & Learning	0.153	77	0.877	0.041
Risk awareness & Compliance	-0.408	77	0.634	0.107

3.7.4. Tenure

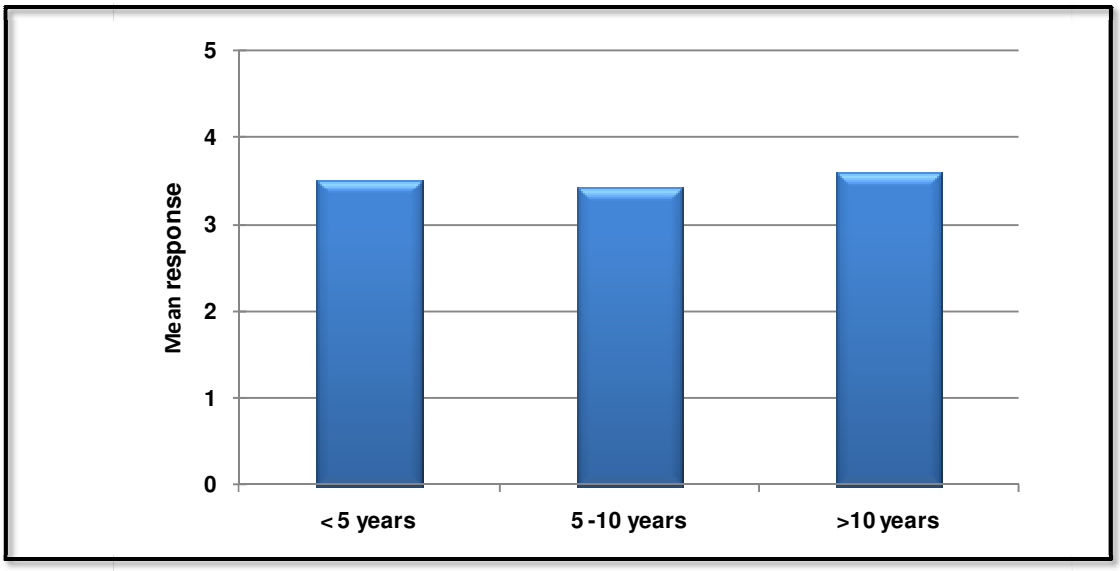
In this section, the relationships between the different years of service of the respondents and the five safety culture components are analysed. The descriptive statistics are set out in Table 3.22 for the different tenure categories opposite each safety culture component.

Table 3.22: Descriptive statistics for the tenure categories

Age group	Management & Employee commitment		Communication & Trust		Accountability & Involvement		Competency & Learning		Risk awareness & Compliance	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Less than 5 years	3.67	0.498	3.650	0.716	3.835	0.553	3.677	0.554	3.832	0.620
Between 5 - 10 years	3.250	0.361	3.169	0.498	3.737	0.480	3.377	0.547	4.000	0.559
More than 10 years	3.750	0.361	3.723	0.524	3.974	0.497	3.574	0.483	4.165	0.480

From Figure 3.11 it is observed that the respondents with more than 10 years of service show a slightly more positive agreement towards the underlying statements describing the safety culture components, compared to the respondents with less than 10 years of experience. This finding is supported by research conducted in a chemical and manufacturing company which examined the relationship between the organisational tenure of employees and safety climate strength (the variability of employees' perceptions of the policies, procedures, and practices regarding workplace safety).

Figure 3.11: Overall mean response for tenure categories



The study concluded that on average, employees with higher levels of tenure have a more positive perception of the current safety climate (Beus, Bergman, & Payne, 2010:1436).

In order to establish whether a statistical or practical significant difference exists between the different tenure categories, the ANOVA test was conducted.

The results of the ANOVA test as shown in Table 3.23, indicate that the components, management and employee commitment, communication and trust, and risk awareness and compliance each reveals a p-value < 0.05 indicating a statistical significant difference between the mean values for different tenure categories within these three components.

Table 3.23: ANOVA: Comparison between different tenure categories

Safety culture component	Sum of squares	Degrees of freedom	MS	F stat	*p*-value
Management & Employee commitment	19.491	90	0.217	5.231	**0.007**
Communication & Trust	31.595	90	0.351	3.972	**0.022**
Accountability & Involvement	23.845	90	0.265	1.320	0.272
Competency & Learning	36.246	90	0.403	0.542	0.584
Risk awareness & Compliance	26.144	90	0.290	3.693	**0.029**

To determine which of the tenure groups within these three components are causing the distinction, post-hoc tests have been conducted in which the p-values and Cohen's d-values are evaluated between the tenure groups for each of the three components. The results for the post-hoc tests comparing the different tenure categories within component, management and employee commitment are shown in Table 3.24 below. Discussion of the post hoc tests will focus on interpretation of the effect sizes (practical significance).

From Table 3.24 it can be seen that for the component management and employee commitment the differences between the tenure categories less than 5 years and 5 to 10 years as well as between 5 to 10 years and greater than 10 years are of practical importance resulting in a Cohen's d-value of 0.853 and 1.078 respectively, implying practical significant differences between the groups. It is interesting to note that there is no practical significant difference between tenure of less than 5 years and more than 10 years revealing a d-value value of 0.151.

Table 3.24: Post-hoc tests: Comparison between tenure categories for management and employee commitment

Tenure	Less than 5 years	Between 5 - 10 years	More than 10 years
Less than 5 years	-	0.088 **(0.853)**	0.800 (0.151)
Between 5 to 10 years	0.088 **(0.853)**	-	0.036 **(1.078)**
More than 10 years	0.800 (0.151)	0.036 **(1.078)**	-

The p-value is shown with the effect size in brackets

The results for the post-hoc tests comparing the different tenure categories within component, communication and trust are shown in Table 3.25 below.

Table 3.25: Post-hoc tests: Comparison between tenure categories for communication and trust

Tenure	Less than 5 years	Between 5 - 10 years	More than 10 years
Less than 5 years	-	0.144 **(7.104)**	0.879 **(5.097)**
Between 5 to 10 years	0.144 **(7.104)**	-	0.078 (0.102)
More than 10 years	0.879 **(5.097)**	0.078 (0.102)	-

The p-value is shown with the effect size in brackets

From Table 3.25 it can be seen that for the component communication and trust the differences between the tenure categories less than 5 years and 5 to 10 years as well as between less than 5 years and greater than 10 years are of practical

importance resulting in a Cohen's d-value of 7.104 and 5.097 respectively. In contrast to the component management and employee commitment, there is no practical significant difference between tenure of 5 to 10 years and more than 10 years for the component communication and trust, revealing a Cohen's d-value of 0.102.

The results for the post-hoc tests comparing the different tenure categories within component, risk awareness and compliance are shown in Table 3.26 below. It can be seen that for the component risk awareness and compliance the differences between the tenure categories less than 5 years and greater than 10 years is of moderate practical significance resulting in a Cohen's d-value value of 0.536

Table 3.26: Post-hoc tests: Comparison between tenure categories for risk awareness and compliance

Tenure	Less than 5 years	Between 5 - 10 years	More than 10 years
Less than 5 years	-	0.747 (0.271)	0.045 **(0.536)**
Between 5 to 10 years	0.747 (0.271)	-	0.754 (0.295)
More than 10 years	0.045 **(0.536)**	0.754 (0.295)	-

The p-value is shown with the effect size in brackets

3.7.5. Management level

In this section the relationships between the two management levels, manage self (MS) and manage others (MO) of the respondents and the five safety culture components are analysed. The descriptive statistics are set out in Table 3.27 for the different tenure categories opposite each safety culture component.

From Table 3.27 it can be observed that although only a small number of respondents were in a managerial level (9.7%), the mean response from the managers were all higher compared to the non-managerial respondents indicating a more positive agreement with the underlying statements. In order to establish whether a statistical or practical significant difference exists, an independent samples t-test was conducted.

Table 3.27: Descriptive statistics for the management level categories

Safety culture component	Management level	Number	Mean	SD
Management & Employee commitment	MS	84	3.651	0.469
	MO	9	3.806	0.644
Communication & Trust	MS	84	3.595	0.617
	MO	9	3.984	0.443
Accountability & Involvement	MS	84	3.878	0.520
	MO	9	4.099	0.456
Competency & Learning	MS	84	3.952	0.641
	MO	9	4.167	0.530
Risk awareness & Compliance	MS	84	4.014	0.563
	MO	9	4.222	0.452

The results of the t-test are depicted in Table 3.28. From the independent samples t-test it is clear that there is a statistical significant difference in the mean value response of the safety culture component, communication and trust, between respondents on managerial level and non-managerial level (p-value < 0.05). A medium to strong practical significant difference with a d-value of 0.630 was also observed.

Table 3.28: Independent samples t-test for the management level categories

Safety culture component	*t* statistic	Degrees of freedom	*p*-value	d-value
Management & Employee commitment	-0.906	91	0.501	0.240
Communication & Trust	-1.837	91	0.034	0.630
Accountability & Involvement	-1.220	91	0.203	0.424
Competency & Learning	-0.967	91	0.284	0.335
Risk awareness & Compliance	-1.070	91	0.228	0.369

Results from Table 3.28 indicate no statistical significant difference in each of the other safety culture components between the two different managerial levels with Cohen's d-value also revealing only a small practical significant difference.

3.7.6. Inter-correlations of components

The results of the inter-correlation between the mean responses for different safety culture components are shown in Table 3.29 below. Correlation coefficient values in the region of ±0.1 are considered small with values of ±0.3 considered medium and values above ±0.5 are considered as substantial.

Examining the correlation coefficients between the different safety culture components as seen in Table 3.29, it is clear that noteworthy positive relationships exist between all five components. Substantial correlations were encountered between the component, accountability and involvement and the other four components, communication and trust (0.631), competence and learning (0.609), risk awareness and compliance (0.590) and management and employee commitment (0.576). Another strong positive correlation was found between components, communication and trust, and management and employee commitment (0.600) as well as between risk awareness and compliance, and competency and learning (0.500).

Table 3.29: Inter-correlations between safety culture components

Safety culture component	Management & Employee commitment	Communication & Trust	Accountability & Involvement	Competency & Learning	Risk awareness & Compliance
Management & Employee commitment	-	**0.600**	**0.576**	0.329	0.421
Communication & Trust	**0.600**	-	**0.631**	0.443	0.418
Accountability & Involvement	**0.576**	**0.631**	-	**0.609**	**0.590**
Competency & Learning	0.329	0.443	**0.609**	-	**0.500**
Risk awareness & Compliance	0.421	0.418	**0.590**	**0.500**	-

Moderate to strong correlation exists between competency and learning, and communication and trust (0.443), risk awareness and compliance, and management and employee commitment (0.421) as well as between risk awareness and compliance, and communication and trust (0.418). Moderate correlation was encountered between component risk competency and learning, and management and employee commitment (0.329).

3.8 CONCLUSION

In light of the results emanating from the empirical study it can be concluded that although an overall positive perception was observed towards the selected safety culture components indicative through the mean response scores above 3, several distinctive shortcomings were also identified. It therefore provides evidence that the organisation under evaluation has not yet reached the desired safety culture maturity stage of interdependence. Although the study population is limited to a single organisation, the shortfalls identified could be common to the larger petrochemical environment and thus could explain the recent fluctuating health and safety performance. This assumption, however, can only be validated through further research within a much greater sample size inclusive of more than one organisation in the petrochemical environment.

Results from the empirical study also pointed out that older employees with higher levels of tenure have a more positive perception of the current safety climate. Although the biographical information of employees involved in health and safety incident were not examined, this observation could imply that the organisation should emphasise its focus specifically around the younger employees.

It is thus clear that the exiting safety culture within the petrochemical organisation could lead to potential health and safety incidents if the shortcomings are not appropriately addressed.

3.9 CHAPTER SUMMARY

The focus of this chapter was to discuss the research design and methodology used in the empirical study, in support of the literature review, in order to meet the research objectives as set out in chapter 1. Specific attention was given to concepts such as the choice of population, method of sampling, the research instrument or questionnaire design, data collection and the statistical methods used in analysing the sample data. This was followed by the discussion of the empirical results obtained from questionnaire feedback. The results were tested for reliability and interpreted based on descriptive statistics and further statistical analysis.

The target population consisted of first-line managers and non-managerial personnel within the production, maintenance, laboratory, technical and safety, health and environment departments. A total of 93 questionnaires were received which constitutes a 47% response rate. The bulk of respondents were male with age profiles covering a broad spectrum ranging from younger than 25 years to older than 55 years. Most of the participants form part of the production department with individual work experience greater than 10 years. Only 10% of respondents were in a first-line managerial capacity. These respondents form a convenience sample from the study population and therefore inferences about the population should be made with caution.

Descriptive statistics for each of the six safety culture components revealed an overall positive result with the mean score for each of these components ranging from 3.63 to 4.02. The safety climate questionnaire developed proved to be reliable based on the calculated Cronbach alpha coefficients; however, the component measuring safety recognition had to be left out from the statistical analysis due to low internal consistency among the statements in this subsection. It was, however, clear that several of the statements describing the maturity of each of the components revealed mean values well below 3 implying that there are some shortfalls within the particular components.

Further statistical analysis revealed no practical significant difference in the response between male and female participants. A practical important distinction was, however, noticed between particular age groups, employees with different levels of experience as well as different managerial levels in relation to certain safety culture components examined in the study. A positive correlation was also observed between all the examined safety culture components.

The next chapter is dedicated to the conclusions and recommendations emanating from the theoretical and empirical research.

CHAPTER 4
CONCLUSIONS AND RECOMMENDATIONS

4.1. INTRODUCTION

In this final chapter, conclusions and recommendations are made relating to the objectives of the study based on the literature information and key findings emanating from the empirical investigation. This will be followed by an evaluation, confirming that the study objectives have been addressed. Finally, recommendations for future research are suggested.

4.2. STUDY MOTIVATION

Since 2002, the health and safety statistics in the petrochemical industry has shown significant improvement through the implementation of behavioural based safety programs and continuous focus on health and safety management systems. An independent safety review commended the progress achieved in the reduction of health and safety incidents which revealed a positive shift in the attitude and commitment of management and employees with regard to occupational health and safety.

Although the overall incident figures has dropped well below historical rates, recent safety statistics in the petrochemical environment suggest a roller-coaster trend in workplace fatalities. The health and safety review concluded that the safety culture in the petrochemical environment is hesitant in progressing towards an interdependent safety culture. Such an observation is supported by several other research studies that have also demonstrated that variable occupational health and safety performance is primarily related to the health of the safety culture in the organisation or industry. Even though safety management systems and engineering controls play a vital role in the fight against reducing occupational health and safety incidents, the

lack of a strong established safety culture increases the risk of potential injuries and even fatalities.

4.3. OVERVIEW OF RESEARCH OBJECTIVES

Hence the primary objective of this study was to assess the present maturity of the safety culture in the South African petrochemical environment by identifying specific cultural shortfalls preventing sustainable improvement in occupation health and safety performance.

In order to achieve this objective the following secondary objectives were deemed necessary.

1. Create an understanding of the concept of organisational culture and safety culture;
2. Explore the different components or characteristics of a safety culture; and
3. Investigate the different development stages of a safety culture.

4.4. CONCLUSIONS

4.4.1. Literature findings

Through a comparative literature review of recent studies in the area of occupational health and safety performance, it was learned that numerous organisations have shown a rising interest in the concept of safety culture due to its positive influence on the reduction of health and safety incidents. The values, beliefs and perceptions reflected by management and employees in regard to health and safety, known as the safety culture, has shown to be the root cause for many occupational accidents and injuries rather than mere technical failure.

Safety culture, a sub-facet of organisational culture, can be accessed through the observation of the three culture levels known as artefacts, espoused values and finally basic assumptions. Although it is extremely difficult to fully comprehend the

details and origin of these culture levels, a simpler though effective approach is to evaluate the safety climate which represents a manifestation of the safety culture.

Research has demonstrated that every organisation or industry exhibits a safety culture. The maturity of the safety culture depends on several components such as commitment, employee involvement, accountability, risk awareness and compliance, competency, learning, communication and trust. The degree of importance that employees and management attach to safety both individually and collectively determines the maturity of the safety culture.

The safety culture can be reactive-orientated which implies that there is no desire to prevent health and safety incidents. Moving beyond this stage, the culture becomes dependent in nature implying that only particular individuals are involved in health and safety therefore not everyone takes responsibility. In this stage, health and safety are largely an organisational goal and not yet a personal virtue. The next stage in safety culture development is called an independent safety culture. In such a culture employees starts to assume personal responsibility for their own safety. Finally, the ultimate stage in development of a safety culture is known as an interdependent safety culture. In an interdependent safety culture, employees do not only care about their own safety but are also concerned about the safety of the fellow colleagues.

4.4.2. Safety culture maturity in the petrochemical environment

The results emanating from the empirical study suggest that an overall positive perception exists towards the development of the prevailing safety culture. Although these characteristics only represent the perception of the workforce, it does provide a useful indication of the strong and weak areas of the safety culture. The overall positive perception noticed towards the different safety culture components is an encouraging sign with regard to current health and safety management practiced in the studied petrochemical organisation. The positive attributes shown in Table 4.1 are indicative of an aspiration to progress towards an interdependent safety culture.

Table 4.1: Positive safety culture characteristics in the petrochemical environment

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

There were however distinct shortfalls observed in the existing culture which can potentially contribute to the fluctuating health and safety performance. These shortfalls are listed in Table 4.2.

Table 4.2: Safety culture shortfalls in the petrochemical environment

Safety culture component	Shortfall
Management and employee commitment	• Safety is sometimes overlooked due to productivity or cost implications
Communication and trust	• Employees tend to withhold safety information such as near miss incidents • The organisation does not have a culture of 'no blame' with an atmosphere of trust.
Risk awareness and compliance	• The organisation often falls into complacency when safety performance goes well. • Some people get away with unsafe acts. • Compliance with rules and regulations is considered adequate.
Competence and learning	• Solutions for safety problems are most often short-term and do not address the root cause.
Recognition	• Although working safely is expected from everybody, it is rarely recognised

As suggested in the literature review, it can be seen that the current safety culture within this petrochemical organisation finds itself in more than one specific safety culture development stage. Some of the characteristics are indicative of a reactive safety culture; for example, the perception that productivity is more important than safety, the observation that complacency sets in when safety performance goes well or the perception that mere compliance to rules and regulations are considered adequate.

The observation that some employees manage to get away with unsafe acts is of great concern as this indicates that some parts of the organisation do not yet share the desired espoused value of safety.

The shortfalls within the communication and trust component could imply that an atmosphere indicative of intimidation or retribution prevails when raising issues such as near miss incidents or mistakes as presented in the literature review. The perception that solutions to safety problems do not address the root cause could be indicative of an inadequate root cause analysis system. The perception that recognition is not often given could explain why some employees do not share the same attitude towards the importance of health and safety. Recognition is a very powerful motivational tool which could encourage employees to practise safe behaviour. Using appropriate reward systems in health and safety management does prove very effective in creating an atmosphere which not only encourages participation but also continuous improvement.

Based on the resulting attributes and shortfalls describing the safety culture in the petrochemical organisation it could be concluded that distinctive characteristics exist indicative of each of the different safety culture development stages. The shortfalls identified could be the reason or part of the contribution in the failure to reach world-class sustainable health and safety performance.

4.5. RECOMMENDATIONS

In this section recommendations are made in response to the safety culture assessment followed by the confirmation of the fulfilment of the study objectives and finally, suggestions are provided for future research.

4.5.1. Improving the safety culture

In order to break loose from the roller-coaster incident trend experienced, a definitive change intervention has to be initiated. Although the particular issues have been identified which currently contribute to the challenge in realising further OHS

improvement, it is recommended that a positive change approach is applied instead of a traditional change process such as Lewin's change model.

The best way of changing the safety culture is to allow the employees themselves to drive the change process with limited supervision. The current list of positive characteristics as mentioned in the previous section can be utilized to identify the desired future state of the organisation's safety culture. Once the desired state is well understood one can inquire into the existing best practices within the organisation and develop groups of themes representing common dimensions of employees' experiences. Employees should then be given the freedom to suggest exciting propositions of how the organisation can move towards the desired state. These propositions should be formulated such that they inspire other members to actively participate.

Senior management's role in resolving these shortfalls is crucial as most of the listed culture deficiencies originate from the lack in management ability to reinforce the importance of OHS either through discipline or recognition. Safety should under no circumstance be considered second priority below production demand or cost implications. Employees will surely lose their faith in management's commitment towards safety. The issue of information hoarding goes hand in hand with the lack of trust in the workplace. Management has to reinforce recognition without reprimand when employees provide information regarding near miss incidents and even mistakes. Effective problem solving techniques have to be incorporated in the safety management framework with appropriate training to avoid repetitive failures which reduce employee motivation and productivity.

Management together with employees have to endure in their safety effort even when high OHS performance is achieved. The culture of "safety can always be improved" should be instilled throughout the workforce as performances can only deteriorate if not going forward.

In order to sustain excellent health and safety performance it is crucial that regular safety climate assessments are conducted to re-evaluate the effectiveness of the culture changes and to identify further improvement areas.

4.5.2. Study evaluation

The primary research objective of this study was to assess the maturity of the safety culture in the South African petrochemical industry by identifying the potential cultural shortfalls preventing further improvement in occupation health and safety performance.

Eight potential culture shortfalls were identified as shown in Table 4.2 which could prevent further improvement of OHS performance and might be contributing to the roller-coaster fatality rate currently experienced. In the current safety culture, health and safety are sometimes overlooked due to productivity or cost implications. Employees tend to withhold safety related information to themselves as a culture of guilt prevails and mere compliance to safety standards is considered adequate. Solutions to health and safety problems are mostly short term and do not address the root cause. Further investigation through an in-depth analysis by means of a qualitative research approach, that is, by conducting focused interviews, is, however, crucial to identify the reasons behind the negative perceptions in order to establish the root cause as well as to determine specific action plans to improve the safety culture. In light of the above mentioned findings, it can therefore be concluded that the primary objective has been achieved.

The secondary research objectives include:

1. Create an understanding of the concept of organisational culture and safety culture and the effect on occupational health and safety performance.

In simple terms, organisational culture can be described as the shared values, assumptions and beliefs in an organisation that ultimately directs employee behaviour. Organisational culture is characterised by three layers known as

artefacts, espoused values and basic assumptions. These layers represent the manifestation of the organisational culture and vary in terms of outward visibility and resistance to change. Understanding and analysing these layers provide the reasons why employees behave in certain ways. Safety culture is a sub-set of organisational culture; in other words, it is the manifestation of the organisation's attitude, values and commitment in regard to the importance of health and safety. Companies which have developed positive safety cultures have demonstrated unequivocal results in closing the elusive health and safety performance gap. In a positive safety culture it is employees' desire to do things safely not only to ensure their own personal safety but also the safety of others.

2. Identify the fundamental components conducive of an effective safety culture.

Although the successful development of an effective safety culture is not dependent on a specific set of components, there is, however, a range of fundamental components which have a significant influence on the safety culture maturity. These components are listed below in no particular order of importance:

- Management and employee commitment;
- Communication and trust;
- Risk awareness and compliance;
- Competency and learning;
- Accountability and involvement; and
- Recognition.

3. Determine the different development stages towards an effective safety culture.

Safety culture can be classified into distinct development stages. Each of these stages represents the degree of maturity of the attitudes and commitment of management and employees in relation to the ongoing health and safety improvement in the organisation. In a reactive safety culture, safety is merely a natural instinct with no real perceived value for the individual or organisation. Moving

towards a dependent safety culture, employees start to value safety but only so they do not get caught. The next stage called an independent safety culture is characterised by self-preservation. In this stage the mindset of employees changed towards an attitude of “I do things safe so I do not get hurt”. In the final stage known as interdependent safety culture, employees embrace safety as a personal virtue not only for their own safety but also in contribution to the safety of their peers. In such a culture it is employees’ desire to do things safely so that no one gets hurt.

It can therefore be concluded that all the secondary study objectives have been successfully achieved.

4.5.3. Future research

The following recommendations are suggested for possible future research:

- In order to provide insight into deeper levels of Schein's typology describing the psychology of why employees behave in a certain way with regard to health and safety, it is suggested that future research should incorporate a qualitative approach by using more intensive observations, focused interviews and self-analysis.
- This study should be extended to other organisations in the petrochemical industry locally and globally to increase the sample size in order to enhance the statistical analysis and the data validity. Results obtained indicating a non-significant statistical difference (p-value > 0.05) but with a large effect size or practical important difference, is often an indication that the sample size was too small which can lead to the failure in reflecting the true effect (Rosenthal, Rosnow & Rubin, 2000:5).
- Using sample techniques such as probability sampling, could allow more accurate inference about the population.
- The study should also be extended to incorporate top management’s perceptions on the safety culture and their views on the reasons for possible deficiencies.

4.6. CONCLUSION

This study has revealed an overall positive perception towards the development of the safety culture within the petrochemical environment; however, several distinctive shortfalls are evident that the safety culture has not yet reached the desired state of interdependence. In the current safety culture, health and safety are sometimes overlooked due to productivity or cost implications. Employees tend to withhold safety related information to themselves as a culture of guilt prevails and mere compliance to safety standards is considered adequate. Solutions to health and safety problems are most often short term and do not address the root cause.

Relevant academic studies have indicated that such an immature safety culture could lead to potential health and safety incidents if the shortcomings are not appropriately addressed through the focused efforts lead by management with active employee involvement.

4.7. CHAPTER SUMMARY

This chapter was dedicated to the conclusions and recommendations emanating from the theoretical and empirical research.

The first section of the chapter focused on the reason why the study was done and the theoretical research findings concerning the development of a safety culture in the attempt to improve health and safety performance. This was followed by the indication of the positive safety culture characteristics observed from the empirical investigation as well as the culture shortfalls identified. It can be concluded that the safety culture in the petrochemical environment with specific reference to the studied organisation is showing positive signs in the endeavour to improve the overall health and safety performance. The culture shortfalls identified do, however, reveal that there are still particular areas of improvement in the safety culture dimensions including management and employee commitment, communication and trust, competency and learning, risk awareness and compliance as well as safety

recognition. The safety culture can thus not be classified into a single development stage as it exhibits features from a reactive culture through to an interdependent safety culture.

The chapter concluded with recommendations to address the culture deficiencies established followed by the confirmation of the achievement of the particular research objectives set out in the study and finally ends off with proposals for potential future research.

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ANNEXURE A: SAFETY CLIMATE QUESTIONNAIRE

Dear Colleague

Thank you for taking time to answer this questionnaire. The research aims to identify the areas of opportunity for improving and sustaining world-class safety performance in the petrochemical environment.

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

Yours faithuflly

Ruan Farmer

MBA final year: Potchefstroom Business School

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

Example: ***Employees are held accountable for safety violations.***

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☑	☐	☐	☐	☐

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

Please select which of the following applies to you:

Male ☐ Female ☐

Age		Department		Years of service		Management level	
<25	☐	Production	☐	< 1	☐	Manage Self	☐
25 – 35	☐	Technical	☐	1 - 5	☐	Manage Others	☐
35 – 45	☐	SHE	☐	5 - 10	☐		
45 -55	☐	Laboratory	☐	> 10	☐		

Questionnaire

1. Sufficient time and effort is committed to safety in my organisation.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

2. Management attentively listens to safety ideas and concerns and take appropriate action.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

3. Relevant safety information is communicated to me on a regular basis.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

4. I am encouraged to make safety improvement suggestions.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

5. Management operates an open door policy on safety issues

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

6. Most employees are aware of the potential hazards in their work environment.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

7. We often analyse routine and new task to look for ways of doing a job safer.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

8. Everyone is accountable for their own safety.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

9. Management is involved in safety only after incidents have occurred.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

10. My organisation is known for recognising individual contribution towards safety.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

11. Safety is how we do things around here.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

12. The organisation learns from past mistakes and implements appropriate preventative measures as soon as possible.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

13. I feel comfortable when allowing others to carry out tasks in my area of responsibility.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

14. Employees in this organisation undergo comprehensive and meaningful safety training.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

15. Work instructions and procedures are followed to the letter.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

16. Co-workers often give tips to each other on how to work safely

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

17. We have systems in place to manage all hazards.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

18. We often become complacent when it goes well and then incidents occur.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

19. Hazard identification is a prime focus in my daily job.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

20. Employees would rather keep safety information such as near misses to themselves.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

21. Employees would often help their fellow colleagues to conform to safety rules.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

22. I am proud to be associated with this organisation when it comes to safety.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

23. Although safety is regarded as top priority it sometimes overlooked due to productivity or cost implications.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

24. Doing things safely has become a habit for most employees rather than an obstacle.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

25. My supervisor / manager shows complete trust in my ability to identify risks.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

26. Management do not tolerate lack of discipline when it comes to safety compliance.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

27. Safety is seen as a condition of employment.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

28. I feel comfortable that the equipment I work with is safe.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

29. A job well done is a job done safely.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

30. Being rewarded for good safety performance helps to promote safe behaviour.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

31. All employees are accountable for safety and everyone's safety is equally important.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

32. The majority of incidents are due to failures arising from the culture of the organisation rather than mechanical failure.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

33. Employees in this organisation are motivated to exert only as much effort as is necessary for task completion regardless of safety.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

34. Management cares about the safety and well being of their sub-ordinates.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

35. Some people get away with unsafe acts.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

36. Good safety performance will lead to good business performance.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

37. Solutions for safety problems are most often short-term and do not address the root cause.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

38. The reason for not achieving our safety targets is because everyone does not value safety as important.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

39. Management commitment to safety is visible through their actions ("walk the talk")

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

40. Employees at all levels are involved in decisions when it comes to safety.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

41. Employees in this organisation possess the necessary knowledge and skills to allow them to work safely.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

42. Although working safely is expected from everybody, it is rarely recognised.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

43. Management talk a lot about safety in the midst of an accident but when everything goes well they tend to quite down.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

44. The way we conduct safety investigations is indicative of a world-class organisation.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

45. Employees will rather spend more time on a task to ensure it is done safely than rushing to complete a job.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

46. Employees in this organisation often by-pass safety systems or procedures to complete their work faster.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

47. Compliance with rules and regulations is considered adequate.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

48. Our organisation has a culture of 'no blame' with an atmosphere of trust.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

49. The organisation keeps on getting the same incidents over and over again.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

50. Safety is primarily driven by management rather than looked for by the workforce.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

Thank you for completing this questionnaire.