



Safety perceptions on productivity in the petrochemical industry

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ABSTRACT

Title: The perception of safety on productivity in the Petro-chemical industry.

The safety slogan for many Petro-Chemical organisation year in year out is “Zero is possible”, and the commitment to drive towards high performance culture. The safety intervention that comes with the new way of looking at the risk doesn't seem to eliminate injuries and fatalities completely. There is something missing from the industry that is dominated by the advances of high quality technologies, and automated plant systems, occupational health and safety incidents and fatalities continue to devastate thousands of lives each year. A piece of puzzle to completely eliminate incident in the workplace is needed.

The organisations with world's highest safety standards are battling to understand why injuries still happen in spite of all the precautions, procedures and methods to prevent them. The philosophy of it all lies with the behaviour of the employees when operating the machinery systems. The most injuries occur as a result of the interface of the maintenance and operators with the plant machinery. Significantly there has been a noticeable improvement in the reduction of health and safety incident rates across the South African petrochemical environment. There seems to be no confidence to sustainably achieve zero serious injuries and fatality. The most disturbing injuries happen when the organisation is doing so well in terms of injuries statistics, and brings the whole celebrations to a standstill. The DuPont way of arriving at the empowered accountability in terms of safety lies with an interdependent safety culture in which safety is omnipresent and embedded in the hearts of all employees.

The Interdependence state can be reached by following this fundamental logic, there must be a high- level understanding of the concept of organisational culture and safety culture which is very critical. Essentially the safety culture shapes the way the organisation behaves towards safety, and the productivity priorities shouldn't be ignored. The values of a high-performance culture is the pillar of commitment by

management and employee together and pledging commitment to health and safety, accountability and involvement, communication and trust, risk awareness and compliance, competency and learning and finally recognition.

The DuPont model suggests that in most organisations the reactive safety culture exist and of course safety is merely a natural instinct with no real perceived value for the individual or organisation. The organisations refer to only do something about safety only when something has gone terribly wrong. The literally display of a dependent safety culture is when employees start to value safety but only, so they do not get caught. The independent safety culture is categorised by empowered accountability of individuals who value safety, and the understanding of the consequence. The most employees that value safety under independent are either have witnessed serious incidents in their career life or have been injured before, they might even know the reality check that goes with it. The final part of the Du Pont model tries to bring to life the ideal world where there is interdependency when it comes to 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 this ideal world the culture is such that its employees' desire to do things safely so that no-one gets injured.

The final fact that the study tried to undertake was the element of behaviour based safety, and it strides towards high performance culture. The initiative is one of the best since the study of employees at risk behaviour observation, but still requires fine tuning in terms of its key performance indicators, and what the organisation can do with the data of the system.

Key terms: Occupational health and safety, organisational culture, safety culture, safety climate, petrochemical environment.

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LIST OF ABBREVIATIONS

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
OHS	Occupational Health and Safety
OHSAS	Occupational Health and Safety Assessment Series
RCR	Recordable Case Rate
SD	Standard deviation
SHE	Safety health and environment
CAIA	Chemical & Allied Industries Association

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CHAPTER 1

INTRODUCTION AND PROBLEM STATEMENT

1.1 INTRODUCTION

The safety performance of an organisation is suggested to influence on business performance, productivity and quality (Ansari & Modarress, 1997). Organisations globally, are developing innovative ways to improve safety, as positive safety performance is perceived to deliver positive business performance and increased shareholder confidence, which in turn may result in increased investments or appreciation of the organisation's share price (Ansari & Modarress, 1997). Based on this statement, it can be assumed that an organisation that is good at business management should also produce good safety results.

The challenge for the modern organisation remains to improve the predictive qualities of safety performance – an area where limited research was conducted. There is quite a big distinction between the safety compliance and safe operation that embedded safety culture within the organisational performances. Currently, organisational and behavioural issues are proving to be core to the centre of challenges facing organisations and have so far proved to have little solutions. The challenges implied by interpersonal processes such as safety climate and employee safety behaviours in periods of organisational change significantly impact on the predictability of safety performance. Organisations need to address, comprehend and action factors such as group safety climate to ensure improvement in safety performance.

The global business environment is continuously impacted by change. Technological advances, competitive change, economic and regulatory change to name but a few. These changes impact significantly on occupational safety. Introducing new technologies needs to be well managed through proper documentation and rigorous risk management should be implemented to manage the changes and also train people to be competent in handling the inventions. Although there has been a vast improvement in the last decade in the standard of

risk and safety management regarding hazardous occupational environments globally, organisations are still experiencing accidents, injuries and fatalities, especially in the chemical industry (Venkataraman, 2006).

Lamm, Massey, and Perry (2006) reckons that there is increasing and compelling evidence that providing a healthy and safe working environment has the potential to increase labour productivity and in turn increase business profits. They also refer to the argument of some commentators that productivity gains are often at the expense of workers' health and safety. It is imperative to ensure that making systems safe requires time and planning. This will mean that all unsafe conditions will be identified through proper risk assessments and that preventative controls will be outlined. Businesses characteristically endeavour to become more productive and in doing so are driving their workers to work longer, harder and with higher use often in extremely hazardous conditions whilst only employing health and safety measures to keep reimbursement costs down (Lamm, *et al.*, 2006). Handling and managing hazardous environment requires the organisation to develop risk elimination action plan and implement it, the urgency of that may outline the organisations stance towards safety of its employees.

(Lamm, *et al.*, 2006) also suggested that efforts to increase productivity through occupational health and safety, can have contradictory results. They refer to gaps in literature, noting that while there is evidence that occupational injuries and illnesses impact on productivity losses, it is not clear whether or not reducing injuries and illnesses will automatically influence productivity gains. It can again be argued that fit and sound employees will be able to put more focus on improving productivity.

The South African chemical industry is a hazardous environment and known for numerous injuries and fatalities annually. According to the 2015 Responsible Care report issued by CAIA, ten fatalities were recorded by signatory organisations in South Africa (CAIA, 2015). The report indicates that injuries resulting from operational incidents, especially exposure to chemicals have declined since 2013. Safety management in South-African organisations is likely to be impacted by leaders in all levels of the organisation.

This creates the need to understand the role of leadership as the quality of leadership ultimately influences organisational climate, of which safety climate is a subset, and may impact significantly on overall organisational and safety performance. Leadership styles and practices influence individual behaviour of employees and employees' compliance with safety rules and regulations. To date little is known regarding causal relations between safety climate, the precursors and the mechanisms that may influence safety performance within organisations.

It is not uncommon for organisations to experience stagnation in their safety performance. To improve safety performance, many organisations implement hard controls such as engineering controls or rely on safety management systems. "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).

Mechanical application of safety management systems is not going to assist the organisation in achieving the levels of safety performance it aspires to. Any organisation that has reached a plateau on safety performance, may find that it is necessary to reach the hearts and minds of the employees and management in order to go beyond this unassailable plateau (Hudson, 2007). The safety conscious organisations tend to recognise the importance of safety climate as a business imperative rather than a subset of business.

Safety is the literal elimination of danger, risk, or threat of harm, injury, or loss to personnel and/or property, whether caused intentionally or by accident. The golden rule of safety is to ensure that everybody that walks through the industrial gates should return back home in the very same state that they came in. There is always a war of priorities in terms of safety over productivity. In most industries today, safety is displayed as the number one priority, but deep within the organisation structures, it's actually that productivity that takes precedence. This is clear from the incident registers and the number of un-investigated incident volumes, as noted in many organisations.

This study explores the perceptions and opinions of permanent employees on safety climate in an operational unit within a South-African Chemical company.

1.2 PROBLEM STATEMENT

When the priorities of a Petrochemical organisation are turned on its head, the results are staggering. The element of luck runs out, and disasters are the order of the day. The means of managing the safe operations requires consistency, and understanding the consequences that underline the worst-case scenario. In essence, it is imperative to have the knowledge of the culture that exists within the core of the petrochemical organisation.

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 has also been the case in the petrochemical environment of South Africa. During the course of the last few years the overall trend in safety performance in the South African petrochemical industry has enhanced considerably, evident in a noteworthy reduction in the serious injuries and incident rates reported by some of the major Petrochemical organisations (Fitzgerald, 2005:325). This enhancement has been the art of unwavering support towards safety drive through the incessant focus on safety management systems and implementation of process safety, behavioural based safety initiatives. The fundamental progress hasn't been a smooth sailing transaction as it was shadowed by remarkable serious incidents that included fatal episodes in some cases (Fitzgerald, 2005:325).

There have been safety interventions as a result of those occurrences that left the petrochemicals organisation's bosses scrabbling for answers. Perhaps the answers lie within the belly of the petrochemical organisations, which are its own employees. The interventions feedback highlighted something that has been neglected for years, and has been embroiled in the form of behaviour of employees towards safety. The culture of the petrochemical organisation

highlighted the lower perception of risk as the cause for many disturbing incidents, and it left a big mark questioning the mind-set of the employees.

1.3 RESEARCH OBJECTIVES

The research objectives are divided into general and specific objectives.

1.3.1 General Objective

The primary objective of this study is to explore the perceptions and opinions of permanent employees regarding the safety climate within a South African Petro-chemical organisation.

1.3.2 Secondary Objectives

The secondary objectives of the study are:

- To determine how safety culture and safety climate is conceptualised from the literature.
- To determine perceptions towards safety from the literature.
- To determine employees' perceptions in relation to the safety climate across the Operational units and the Safety, Health and Environment function within a South African Petro-chemical organisation.
- To determine the correlation relation between negative and positive perceptions towards the safety climate within the current research.
- To determine the factors from the research that contributes to adverse safety behaviour.
- To determine the differences in perceptions in relation to the safety climate across the Operational units and the Safety, Health and Environment function within the organisation in terms of demographic characteristics.
- To make recommendations for future research.

1.4 THE CONTEXT OF THE STUDY

The study focuses on the perceptions of employees within a Petro-chemical organisation in relation to the safety climate. The study will be conducted on permanent employees working in a specific operational unit within a South-African Petro-chemical organisation.

1.5 RESEARCH METHODOLOGY

1.5.1 Literature Study

In phase 1 a complete review regarding will be done. The sources that will be consulted include:

- Previous journals on the similar studies
- Topic comments on the linked
- Internet on the international research topic
- Search for topics that has safety impact on productivity
- Serious incidents in the Petrochemical industries causes, and learnings
- The benefits of good safety culture in terms of realising productivity

1.5.2 Research Design

Research design can be described as the map we follow to obtain research participants and to gather relevant information from these participants. It also explains what the intention with the participants is in order to reach a conclusion concerning the research problem (Welman, Kruger, & Mitchell, 2005:52).

A cross-sectional survey was used to collect the data and to attain the research objectives. Cross-sectional survey designs are used to examine groups of subjects in various stages of development simultaneously (Burns & Grove, 1993) in a short period of time, which can vary from one day to a few weeks (Du Plooy, 2001). The survey is a data-collection technique in which questionnaires are used

to gather data about an identified population. This design is also used to assess interrelationship among variables within a population (Shaughnessy & Zechmeister, 1997). The cross-sectional survey design is best suited to address the descriptive and predictive functions associated with the correlation design, whereby relationships between variables are examined.

1.5.3 Research participants

According to Singleton and Straits (2011) the target population contains members of a group that a research is interested in studying. The results of the study are generalised to this population, because they all have significant traits in common.

The identified target population is the operations fraternity which includes the production, and all maintenance groups (Mechanical, Electrical, and Instrumentation departments). The reason for selecting this population is based on the observed experience, and mainly because they are most of times pressed for time in terms of meeting production volumes. The priority as stated by the organisation in terms of executing work on the premises is clearly stated as safety, integrity, schedule, and lastly cost in chronological order.

The deviation that has been observed over the years led to initiation of this study to pin point the root cause analysis of the problem. The fatalities that were seen by the organisation in general were investigated, but none pointed towards this frail relationship. The research seeks to go beyond the line of duty to highlight, and seek clarity on the parity of the observed population who are on the front line of the execution of work.

The research will be conducted in a public South African Chemical company in Johannesburg – a subsidiary of a JSE and NYSE listed global company. One of the main reasons for the selection of this company is due to the large heterogeneous and diverse permanent workforce ($N = 400$). Most of the employees have company e-mail addresses and direct access to the company's intranet network, making the target population more accessible for research.

Simple random sampling method, and more specifically, a convenience sample will be used to collect the data.

1.5.4 Measuring Battery

A survey questionnaire will be formulated to measure perception of employees, and management towards safety and their perceived productivity output as a result. Biographical information will also be drawn from the questionnaires for future research purposes on correlations. The safety violation that was committed by an employee in the past will be evaluated against the perception of prior to present mind set.

Data on the employees' perceptions of safety climate will be collected through the use of a self-developed safety climate survey consisting of several questions which seek to investigate the current safety perception in the Petrochemical environment.

Safety climate factors that will be measured include management safety commitment, employee safety commitment and effective safety management in the workplace. Respondents are required to complete all items using a 5-point Likert scale ranging from Strongly disagree (1) to Strongly agree (5). The questionnaire will be distributed to all permanent employees within the four manufacturing units of the company as well as the Safety and Health department.

The researcher is employed at the company where the research will be conducted and permission has been obtained from executive management of the company to conduct the study. The selected respondents will receive the survey electronically and manually. Participation will be voluntary and anonymous. Feedback will be presented to the company following the completion of the study and utilised in the company's safety improvement plans.

1.5.5 Statistical Analysis

The statistical analysis will be carried out with the help of the SPSS-programme (IBM SPSS Statistics 24, 2016). Exploratory factor analysis will be conducted by means of an oblique rotation using direct Oblimen (an Opblique method rotation) on the main constructs of the study. This technique presumes a nominal correlation between factors and is utilised to determine the possible dimensions of the constructs. The purpose of factor analysis will be to reduce the initial number of variables into a smaller and therefore more manageable (easier to analyse and interpret) set of underlying dimensions (Yong & Pearce, 2013:79), called factors.

The adequateness of the sample will be determined by means of the Kaiser-Meyer-Olkin (KMO) correlation matrix and the diagonal element of the Anti-Image Correlation. The Bartlett's test of sphericity was also calculated. This test allows for the examining of the relationship between variables and signifies if the data is suitable to continue with a factor analysis (Field, 2009:647). The KMO values will be interpreted as indicated in the table below (Hair, Anderson, Thatham, & Black, 1998:99).

Table 1.1
Interpretation of KMO values

KMO Value	Interpretation
≥ 0.80	Commendable
0.70	Average
0.60	Mediocre
0.50	Miserable
< 0.50	Undesirable

The Anti-image correlation matrix contains the negative partial co-variances and correlations. Diagonals are used as a measure of sampling adequacy. The Anti-image correlation matrix has a cut-off above 0,50. If this required is not met, this means that distinct and reliable factors cannot be produced. Items causing diffused correlation patterns as indicated by the diagonal value in the Anti-Image Correlation matrix, will then be removed (Yong & Pearce, 2013:88).

Descriptive statistics (e.g. means, standard deviations, skewness and kurtosis) will be used to analyse the data. Cronbach's alpha coefficients will be used to determine the internal consistency, homogeneity and un-dimensionality of the measuring instruments (Clark & Watson, 1995). Coefficient alpha contains important information regarding the proportion of variance of the items of a scale in terms of the total variance explained by that particular scale.

Pearson product-moment correlation coefficients will be used to specify the relationships between the variables. In terms of statistical significance, it is decided to set the value at a 95% confidence interval level ($p \leq 0,05$). Effect sizes (Steyn, 1999) will be used to determine the practical significance of the findings. A cut-off point of 0,30 (medium effect, Cohen, 1988) will be set for the practical significance of correlation coefficients.

Multiple regression analyses will be conducted to determine the percentage variance in the dependent variables that are predicted by the independent variables. The effect size (which indicates practical significance) in the case of multiple regressions are given by the following formula (Steyn, 1999):

$$f^2 = R^2 / 1 - R^2$$

A cut-off point of 0,35 (large effect, Steyn, 1999) will be set for the practical significance.

Multivariate analysis of variance (MANOVA) will be used to determine the significance of differences between the safety perceptions of different demographic groups. MANOVA tests whether or not mean differences among groups in a combination of dependent variables are likely to have occurred by chance (Tabachnick & Fidell, 2001). In MANOVA, a new dependent variable that maximises group differences is created from the set of dependent variables. Wilk's Lambda will be used to test the likelihood of the data, on the assumption of equal population mean vectors for all groups, against the likelihood on the assumption that the population mean vectors are identical to those of the sample mean vectors for the different groups. When an effect is significant in MANOVA,

one-way analysis of variance (ANOVA) will be used to discover which dependent variables have been affected. Seeing that multiple ANOVAs will be used, a Bonferroni-type adjustment is made for inflated Type I error. Tukey tests will be to indicate which groups differed significantly when ANOVA's were performed.

1.6 LIMITATIONS OR ANTICIPATED PROBLEMS

This study will be focused on the perception of safety and the impact therefore on productivity within an organisation in the South African petrochemical environment. The target population will consist of senior, first-line managerial personnel as well as lower-level employees responsible for production, technical support, maintenance, and OHS activities. Due to the demanding 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. It will be suicidal to ignore the facts identified by the study as it highlights the plight of the future of the Petrochemical organisations in relation to safety.

1.7 MANAGERIAL IMPLICATIONS OF THE RESEARCH

Managers should recognise the fact that safety behaviour is becoming a competitive advantage in the Petrochemical industry in terms of companies that boast good safety records, are being perceived as preferred employers. The fact of the matter is that in the Petrochemical environment the element of process safety has become the pinnacle of operations, due to the fact that if the process safety is not adhered to companies face the risk of explosions and fires which can burn down their plants.

The study will pursue the relationship to the brink of the consequences, and highlight the rationale behind forging ahead with the principle of safe operation in relation to just focusing on the production volumes. The state of mind of the employees is of outmost importance in the Petrochemical operation of today, and ignoring it could be detrimental to the existence and success of the organisation.

Managers should stimulate workers to play their supervisory role, encouraging employees to supervise the implementation of safe production responsibility system. Managers should ensure that appropriate accident prevention and control measures have been adopted in the production and business activities in order to avoid personal injury and property, and the purpose is to ensure the safety of employees and ensure smooth production and business activities could be carried out.

The management can immensely gain insight on how it's employees think of their environment and safety perception in handling highly volatile chemicals, and the future aspiration of the organisation. This study will put into perspective how safety culture can cultivate a highly engaged workforce and effective performance teams. It will suggest to managers to focus on emotional intelligence to minimize unsafe behaviour.

1.8 ETHICAL CONSIDERATION

Participants will not be subjected to any physical or mental discomfort. The contents and recommendations of the research will be provided only to the organisation, and all information in this regard will be kept confidential. Participation is voluntary, and no information provided will be used to identify the specific person. The questionnaire is designed to ensure participant anonymity to enhance trustworthiness of responses given.

1.9 CHAPTER DIVISION

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

- Chapter 2: Literature Review
- Chapter 3: Research Design and Statistical Analysis
- Chapter 4: Empirical Study
- Chapter 5: Conclusions and Recommendations

1.10 CHAPTER SUMMARY

Exploring the relationship between safety and production is of essential importance because it will help to identify a reason/gap behind why certain organisation chose to choose the latter as a definition of victory in their organisational strategy focus.

Chapter 1 focused on the motivation for: the research; the problem statement; objectives; the context; research method; limitations and problems; managerial implications and ethical considerations engaged in this study. This was followed by a division of the chapters that follow:

Chapter 2 will focus on the literature review and the conceptualisation of the safety culture in petro chemical organisations embroiling the productivity. The concept of safe operation has been historical linked with the fear of taking responsibility and sacrificing the productivity and the latest literature suggest that it has been long wrongly conceived.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Safety climate is the main concept in this study as it describes organisational culture and individual behavioural processes. A more succinct definition of safety culture has been suggested: “Safety culture is how the organization behaves when no one is watching”. At the cornerstone of Safety climate rests behaviour based safety, which examines the acceptable norms within the heart of the organisation.

The root cause analysis of many major worldwide accidents including the Chernobyl catastrophe has been accredited to failures arising from the culture of the organisation rather than mechanical failure (Hudson, 2007:698; Knegetring & Pasman, 2009:162). 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, some of the biggest occupational incidents include the Kinross gold mine disaster in 1986, the St Helena mining incident in 1987 (Dixon, 2001:1), and the Sasol Secunda’s Monomers explosion in 2004.

Companies which have developed effective safety cultures understand the psychology of why employees behave a certain way and are focused to get their employees to fundamentally care about their own safety and that of their fellow employees (Troxell, 2009:12). Research has validated that the association between a positive safety culture and world-class safety performance is unambiguous (Gardner, 1999:26; Gregory, Harris, Armenakis, & Shook, 2009:678, Olive, O’Connor, & Mannan, 2006:139). Still, the reality nevertheless is that many organisations diverge in their understanding of the concept of safety culture and the steps necessary to impact it in a positive way (IAEA, 2002:16).

It is therefore imperative to further explore the concept surrounding organisational safety culture and the key elements that are the fundamentals of achieving the high-performance culture in an organisation. In achieving this, the literature review covers the following aspects:

- The importance of safety in the workplace
- The significance of safety culture and safety climate
- DuPont safety culture model
- The concept of organisational culture and culture change
- Good safety performance lead to good business performance
- Evolution of health and safety performance
- Behaviour based safety approach

The literature research and empirical application in this study is not limited to the surface level of safety culture known as the safety climate and therefore it goes deeper into the psychological motivation behind employee behaviour with regard to occupation health and safety.

2.2 THE IMPORTANCE OF SAFETY AND OHS IN THE WORKPLACE

Chemical Industry Organisations globally are challenged with increased competitiveness, reducing cost and saving time, driven by rapid globalisation and decreasing earning capacity (Sasol, 2015). Global economic markets depreciated and precisely the decline in the price of commodities such as Brent crude oil, led to falling prices for basic chemicals in particular during 2015 (Sasol, 2015). This led to industrial production and the chemical industry lagging behind expectations. BASF, the world's largest chemical company, recorded a decline of 14% in sales from 2014 to 2015. Chemical organisations were forced to review their organisational structures, cost structures, strategy and production in a bid to remain competitive under hostile macro-economic conditions.

The South African Chemical Industry did not escape the volatile macro-economic conditions, categorised by a steep decline in international oil and commodity

chemical prices driven mainly by global economic uncertainty in certain key markets and softer demand for products and services (Sasol, 2015). Sasol Ltd – a well-known global competitor in the chemical industry, based in South Africa declared in their interim financial results on 31 December 2015 that oil prices decreased by 47%, given oil supply concerns and a lack of clear signals from the Organisation of the Petroleum Exporting Countries in rebalancing the global oil market (Sasol, 2015). The Rand/US dollar exchange rate, on the other hand, weakened by 24% due to negative market sentiment over the South African economy and dollar strength compared to most emerging market currencies (Sasol, 2015). Sasol recorded a decrease of 63% on earnings attributable to shareholders for the six months ended 31 December 2015 to R7,3 billion from R19,5 billion in the prior period and profit from operations of R14,9 billion decreased by 50%, compared to the prior period on the back of challenging and highly volatile global markets (Sasol, 2015).

Although Sasol is known to foster good safety performance and has a well-established safety culture and is alleged to apply world-class safety practices, in these inauspicious global-economic conditions, managing safety may come at an unwarranted expense (Sasol, 2015). This can easily lead to low expense towards safety resources which in the end may have detrimental effect on the safety of the employees while trying to save money. This leads to the question arising that why then would any company in this industry spend valuable resources on safety management?

The right to life is a fundamental human right (SA Constitution, 1994). It is a right that must also be protected in the working environment. The discouragement of occupational injuries is a communal policy issue to which governments respond to by passing legislation that recommends minimum safety standards that must be adhered to (Barling & Frone, 2004). Deviating from these standards will cause the organisation to incur penalties. In South-Africa, these standards are prescribed in the Occupational Health and Safety Act No. 85 of 1993 and Regulations (OHSACT, 1993), Compensation for Occupational Injuries and Diseases Act (COIDA) for general industry and the Compensation for Occupational Injuries and Diseases in Mines and Works Act (COIDMWA) and the Mine Health and Safety

Act 29 of 1996 specifically for the mining industry. South-African employers deviating from these standards prescribed in the Acts shall be guilty of an offence and liable to a fine or imprisonment.

Trade unions also tend to make occupational safety one of their primary goals. The South-African chemical industry is highly unionised with trade unions such as CEPPWAWU, SACWU and Solidarity being the main role players. Where unions are unable to impact on legislation, they seek to influence at the bargaining table (Barling & Frone, 2004).

Management, however, also has a vested interest in safety performance of the organisation. Managers, have a moral and a legal obligation to provide a healthy and safe working environment for all employees (Alli, 2001). The prevention of occupational injuries and accidents positively influence safety performance. Positive safety performance is apparent to have a positive effect on the business performance and increased shareholder confidence, which in turn may result in increased investments or appreciation of the organisation's share price. Accidents and injuries may cause production interruptions, additional costs, and negative publicity, harm public relations and impact the attainment of strategic objectives. Hence it is a fair assumption that organisations that are good at business management also produce good safety results.

Employers and employees have begun to recognise the importance of eliminating all occupational injuries and illness (ILO, 2011). This is mainly because of people's increased expectations for decent working conditions as well as the growing gratitude of the catastrophic consequences that unsafe and unhealthy working environments can have on humans, productivity, employment and the economy in general (ILO, 2011). There is an increasing recognition that OHS should not be viewed as a liability on the business but that all stakeholders must be obligated to invest in OHS as a key management and performance indicator (Alli, 2001). Many organisations have implemented Safety Management Systems (SMS) as an effective way of ensuring compliance with technical, organisational and legal safety aspects (Hudson, 1999).

Despite the continuous improvement of the safety management systems, risk management systems and human behaviour systems within the South African Chemical Industry over the last couple of years, occupational incidents continue to occur. This results in loss of individual income, productivity losses and ultimately negatively impacts the organisations revenue whilst many workers still face unsafe or unhealthy conditions in the workplace today (ILO, 2011).

The challenge for the organisation remains to improve the prognostic qualities of safety performance – an area where limited research was conducted. When compliance with safety standards and conformance to technical matters formed the heart of safety performance, it was not too difficult to make reliable extrapolations (ILO, 2011). However, today, organisational and behavioural issues are coming more to the forefront, while the contexts are increasingly turbulent and complex (ILO, 2011). The challenges implied by interpersonal processes such as safety climate and employee safety behaviours in periods of organisational change, significantly impact on the predictability of safety performance (ILO, 2011).

A concept that is becoming more and more protuberant in considerations about occupational health and safety is the impact of safety culture on the consequence of an accident (Gadd & Collins, 2002; Guldenmund, 2006; Wiegmann, Von Thaden, & Gibbons, 2007). The concept of safety culture is not new as it already emerged from the investigation after the Russian Nuclear disaster at Chernobyl back in 1986 (Gadd & Collins, 2002; Guldenmund, 2006).

From the above discussion, it seems eminent that organisations not only need to address, but also comprehend and action factors, such as group safety culture and safety climate, to ensure continuous improvement in their safety performance.

2.3 THE SIGNIFICANCE OF SAFETY CULTURE AND SAFETY CLIMATE

The question whether there is a difference between culture and climate has been the topic of numerous academically debates and discussions. The following section aims to differentiate between these two constructs.

2.3.1 Definition of Safety Culture

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 recognises, thinks about and react to various environments (Farmer, 2010). 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, providing both guidance and influencing behaviour (Kreitner & Kinicki, 2007:76).

The term ‘safety culture’ was first introduced in the International Atomic Energy Agency’s initial report following the Chernobyl disaster (IAEA, 1986). A review of major accidents such as the King’s Cross fire (Fennell, 1988), Piper Alpha (Cullen, 1990) and the Herald of Free Enterprise (Sheen, 1987) have found inadequacies in organisational structures and safety management systems, bringing the importance of safety culture into consideration.

According to (Reichers & Schneider (1990), organisational cultures produce climate and become more established over a period of time. Safety culture is seen as a core functional element of organisational philosophy and exists at a higher level of intellection than safety climate (Reichers & Schneider, 1990). It seems credible that safety culture and safety climate are not reflective of a unitary concept, rather, they are complementary independent concepts. Table 2.1 provides a conceptual framework for understanding organisational safety culture.

Table 2.1***Definitions of Safety Culture (Guldenmund, 2010:25)***

Author	Definition
Cox & Cox (1991)	Safety cultures reflect the attitudes, beliefs, perception, and values that employees share in relation to safety (Safety culture)
International Nuclear Safety Advisory Group (1991)	Safety culture is the assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance
Pidgeon (1991)	The set of beliefs, norm, attitudes, roles and social and technical, practices that are concerned with minimising the exposure to employees, managers, customers, and members of the public to conditions considered dangerous or injurious
Ostrom, Wilhelmsen, & Kaplan (1993)	The concept that the organisations' beliefs and attitudes manifest into actions, policies and procedure, affects its safety performance
Geller (1989)	In a total safety culture TSC, everyone feels responsible for safety and pursue it on daily basis
Barends (1996)	The collective mental programming towards safety of the group of organisational members
Lee (1996)	The safety culture of an organisation is the product of individual and group values, perceptions, competencies, and patterns of behaviour that determines the commitment to, and the style, and proficiency of, an organisational' s health and safety management

2.3.2 Organisational culture

The conception of organisational culture has been the interest to a host of functions including social, personnel and organisational psychologists but also to sociologists, anthropologists and political scientists (Guldenmund, 2010). When reviewing safety culture, a review of the organisational culture and climate is also a qualifier. Organisational culture is thought of as a critical enabler of employee

behaviour and attitudes that eventually influences organisational effectiveness and performance (Balthazard, Cooke, & Potter, 2006).

During the 1970s and 1980s the concept of organisational culture gained momentum and became the topic of various research papers and instigated many debates. The distinction between culture and climate needs to be made since the research done in the 1970s was under the auspice of safety climate, however during the 1980s the term climate was gradually replaced by the term culture in this type of research (Jones & James, 1979:205). Therefore, it is deduced that these two concepts were developed successively and not parallel. (Jones & James, 1979:205) described climate as a set of perceptually based, psychological attributes. Emphatic distinction between organisational culture and climate was made by Ekvall in 1983. He divided the organisation's social system into four segments namely:

- (1) Organisational culture – the principles and morals about people, work, the organisation, and the community that are shared by most members of the organisation;
- (2) Social structure – the unceremonious organisation;
- (3) Organisational climate – common characteristics of behaviour and expression of feelings by organisation members; and
- (4) Work relationships – the nature of the relationship between management and employees is critical in fostering a united approach toward safety excellence.

(Ekvall, 1983) maintained that although these segments are correlated, and they are also discernible (Ekvall, 1983).

Glick (1985:608) argued that culture research preceded climate research and the two concepts stem from diverse disciplines. He further stated that whilst research on culture stems from anthropology and is more focused on dynamic processes at work in an organisational culture, research on climate stems from social psychology.

Hofstede (1986), being one of the most renowned scholars in the field of culture research, found parallels between climate and culture on the basis of accountability. He well argued that culture is considered to be top management accountability, whilst climate is the accountability of middle and lower management since they are the influencers on job satisfaction.

(Schein, 2009:27) 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 reacts to various environments” He further argues that “climate precedes culture thus climate is culture in the making” (Schein, 1992:229). Noting that climate in essence, is a reflection and manifestation of cultural assumptions, he suggested that climate should be replaced by culture, with a more profound and broader meaning (Schein, 1992:230).

The term organisational climate appeared to have been coined to refer to a global, integrating concept underlying most organisational events and processes. Nowadays, this concept is referred to by the term organisational culture whereas the term organisational climate has come to mean more and more the overt manifestation of culture within an organisation. Therefore, climate follows naturally from culture, or put another way, organisational culture expresses itself through organisational climate (Guldenmund, 2010:18).

2.3.2.1 Characteristics of organisational culture

The following characteristics have been given to organisational culture and from the aforementioned discussion, it is evident that these characteristics also apply to organisational climate:

- Culture is an abstract concept rather than a concrete phenomenon.
- Culture is relatively stable.
- It has multiple dimensionalities.
- It is shared by (groups of) people (Hofstede, 1986).
- Culture is a synergistic aggregate composed of several parts.

- Numerous dissimilar cultures may be eminent within an organisation (Schneider, 1975).
- It constitutes practices and has multiple layers (Hofstede, 1986) – this also implies that culture can be learned.
- Culture is purposeful in the intellect that it supplies a structure of orientation for behaviour (Hofstede, 1986; Schneider, 1975).

Based on the characteristics, organisational culture can be described as a relatively stable, multidimensional, all-inclusive construct shared by (groups of) organisational members that supplies a frame of reference and provides meaning to and/or is typically exposed in certain practices (Guldenmund, 2010).

Expansion of organisational culture is principally shaped by the owners, directors and subsequent senior leaders of the organisation. Subcultures such as social culture, religious culture and geographical culture reinforce the organisational culture (Farmer, 2010). Organisational culture sets the ideology of safe operation in motion and eliminates the uncertainty regarding the direction of the organisational structure and influences the policies and procedures of the organisation in pursuit of the strategic objectives. These organisational transformations enable leadership capacity and social processes, which in the end impact employee behaviour and attitudes (Farmer, 2010). The employee behaviour and attitudes are manifested in the safety culture and climate, which ultimately impact on the safety performance. This forms the basis for a clear understanding of the organisational culture. A conceptual framework to understand organisational culture is depicted in Figure 2.1.

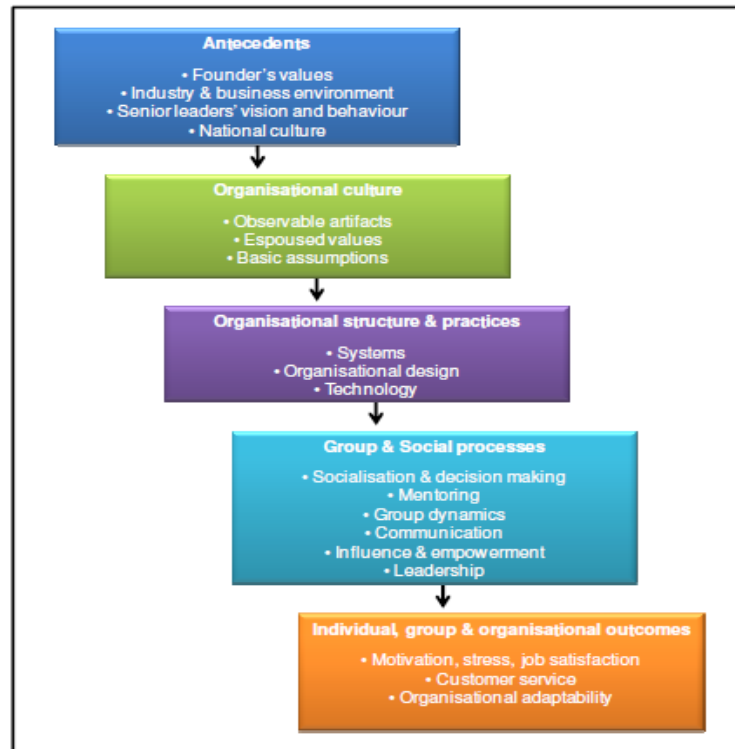


Figure 2.1: Understanding organisational culture (Ostroff, Kinicki, & Tamkins, 2003:566)

In general, researchers agree that organisational culture as a concept provides a framework for organisational life. There is however, disagreement on how to describe the culture or climate of the organisation – how it is determined and how can it be epitomised? (Ostroff, *et al.*, 2003:566)

2.3.3 The components of safety culture

From the literature review it is evident that although the perspectives of the classification of safety culture differ, there is agreement on the components. The components of organisational safety culture are illustrated in Figure 2.2.

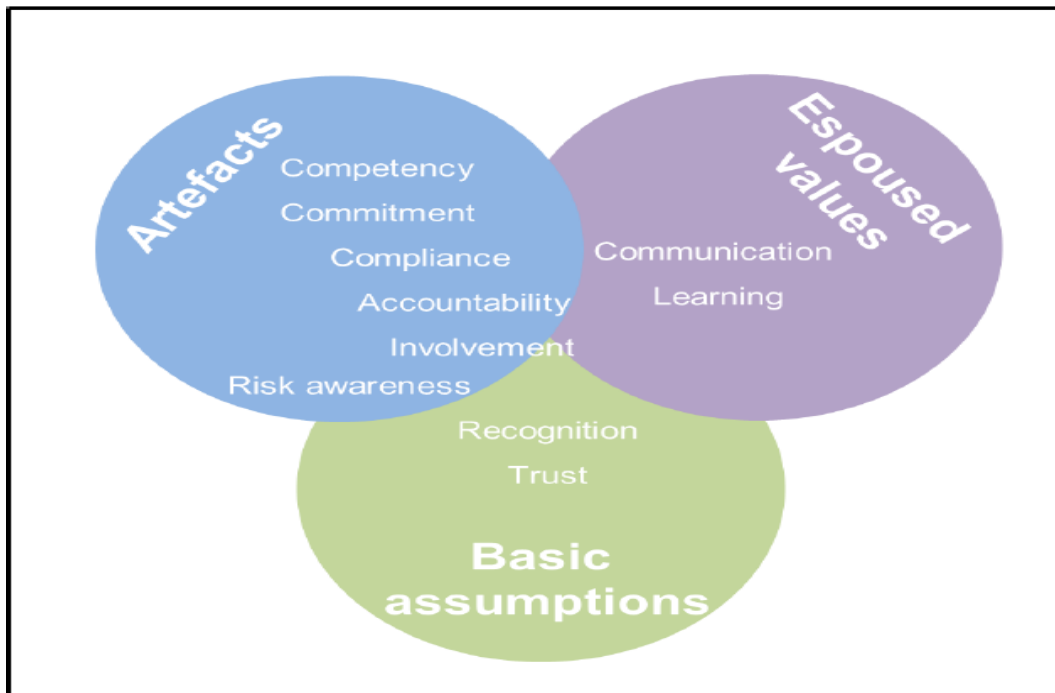


Figure 2.2: Components of a safety culture (Fleming, 2001:3)

Safety culture can be examined on three levels, namely: artefacts, espoused values and basic assumptions. The easiest to observe is artefacts; however, to interpret the artefacts, a good knowledge of espoused values is required. Most of the components are assigned to artefacts and espoused values, with a lesser number associated with basic assumptions (Fleming, 2001:3). All of the components, i.e. artefacts, espoused values, and basic assumptions, play a role in influencing the organisational safety culture, and all of them can be measured and observed to a certain extent in order to create a better understanding of the maturity of the organisation's safety culture (Fleming, 2001:3).

2.3.3.1 Artefacts

Artefacts comprise of

Commitment - generally employees of an organisation want to obey to the organisational culture and their discernment of the method in which the organisation values safety, directly affects the safety culture.

Involvement – safety culture is influenced by the extent to which employees are formally and informally involved in safety decision-making. The more involved they are in the decision making, the more important they feel, and responsibility and accountability of ownership improves, and that translate to the higher influence on safety culture.

Competence – is an amalgamation of understanding, knowledge and skills of employees and impacts on the organisation's safety performance.

Compliance – failing to comply with safety rules and procedures will certainly result in negative safety performance. Non-compliance should not be tolerated as this is imperative to create a strong safety culture.

Accountability – employees need to be aware of their responsibility for their own, as well as other employees' safety. This will ensure a caring culture which is supportive of a positive safety culture.

2.3.3.2 *Espoused Values*

Espoused values comprise of:

Communication – an effective informal and formal safety communication system in both directions (top-to-bottom) is essential to disseminate safety information in the organisation. Effective communication promotes trust and enhances positive safety culture.

Learning – commitment to organisational learning is critical in learning from past safety incidents and problems. This will enhance safety culture since employees will be encouraged to share and learn from experiences across organisational boundaries.

2.3.3.3 *Basic Assumptions*

Basic Assumptions comprise of:

Trust – employees need to be encouraged to share safety information in order to create a positive safety culture. This will enhance the reporting of near misses and incident which can be investigated and learnings communicated to prevent future re-occurrences. Management must create an environment that motivates sharing without blaming. Employees need to feel protected and trust management to reveal safety information without ramifications.

Risk awareness – safety minded organisations make good use of employees' natural habit-forming abilities through building effective learning practices into safety programs (Trybus, 2008:54). Employees differ in respect of their risk awareness based on cognitive skills, previous safety knowledge and safety experiences.

Recognition – influencing safety culture through recognition practices could lead to positive reinforcement of the safety culture.

2.3.4 Safety culture in the organisation's health and safety management

Organisations develop safe working practices to ensure legal compliance and implement best practices. Furthermore, it can create an environment in which senior management can lead from the front on this through a positive attitude to compliance (Turner, 1991). This can only be achieved when the organisation learns that from what's happening in the workplace, through analysis of accidents and near misses, it is possible to develop suitable improvements to safe working practices. A requirement for a positive safety culture is decent information (Krause, 2005:17). In order for the information to flow, the workforce needs to be eager to participate and be willing to report their mistakes, near hits and accidents. Positive safety culture creates such a conducive environment. "If two locations have similarly well-developed enabling and sustaining systems, similar technology and workforce, but different incident frequency rate levels, the difference between them will likely be found in their cultures" (Krause, 2005:17). (Geller, 2001) coined the concept of Total Safety Culture (TSC) and argues that although difficult, it is achievable. TSC is rooted in the disciplines of engineering and psychology.

TSC is illustrated in Figure 2.3 as “The Safety Triad” (Geller, 1989) and incorporates three interactive dynamic factors, namely environmental factors (equipment, tools, procedures, standards, temperatures and layout); person factors (attitudes, beliefs and personalities); and behaviour factors (safe and at-risk work practices). To achieve TSC all three factors require attention continuously as a change in one of the factors impacts the other two factors. In a TSC everyone in the organisation is responsible for safety, supports safe practices and acts on safety matters in their daily activities, they support safe work practices and actively care for one another’s safety. Safety is a core value of the organisation and receives priority in every situation.

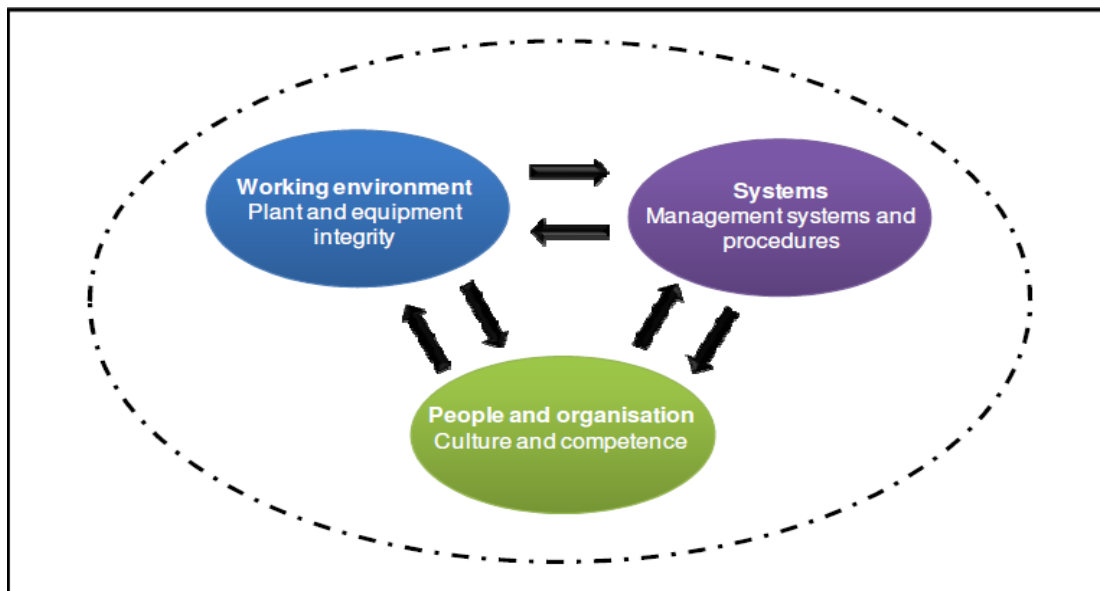


Figure 2.3: Interactions in occupational health and safety management (IOSH, 2011)

The safety culture emphasises the role of social forces in the organisation to improve safety performance. Safety culture encompasses across the entire organisation, exerting a constant effect, whether good or disadvantageous. (Parker, Lawrie and Hudson, 2006:552) noted that the enhancement of safety culture is more effective than increased supervision or more rigorous procedures or systems in enhancing safety performance.

2.3.5 Safety climate

Safety climate refers to a specific characteristic of organisational climate that focuses on those shared perceptions of organisational policies, procedures and practices that serve as an indicator of the importance of employee safety and health (Zohar, 2000). Safety practitioners are interested in the measurement of safety climate to inform them on safety performance initiatives. This effort has been on-going for the past five and a half decades (Guldenmund, 2000). Safety improvement measures were traditionally focused on establishing policies and procedures to control and manage the physical work environment in an effort to reduce exposure to accidents and incidents. In recent years there has been a shift in safety research from individual level factors to organisational factors as precursors of safety performance. According to the existing literature on safety climate, there have been several progressive definitions for safety climate. (Guldenmund, 2010) listed the following safety climate definitions:

Table 2.2

Safety climate definitions (Guldenmund, 2010:25)

Author	Definition
Glennon (1982)	Employees' perceptions of the many characteristics of their organisation that have a direct impact upon their behaviour to reduce or eliminate danger
Brown & Holmes (1996)	A set of perceptions or beliefs held by an individual and/ or group about a particular entity
Dedobbeleer and Beland (1991)	Molar perceptions people have of their work setting
Niskanen (1994)	Safety climate refers to a set of attributes that can be perceived about particular work organisations and which may be induced by the policies and practices that those organisations impose upon their workers and supervisors
Coyle, Sleeman, & Adams (1995)	The objective measurement of attitudes and perceptions towards occupational health and safety issues
Cabrera et al. (1997)	The shared perceptions of the organisational members about their work environment and more precisely, about their organisational safety policies
Williamson, Feyer, Cairns, & Biancotti (1997)	Safety climate is a summary of concept describing the safety ethic in an organisation or workplace which is reflected in employees' beliefs about safety

The definition that solidified the fundamental meaning of safety climate states that, “safety climate is employees’ perceptions of the priority given to safety over productivity” (Zohar, 1980: 97). The definitions of safety climate are clearly related to those of safety culture with the main differences in the definitions being that whereas safety culture is categorised by communal fundamental beliefs, values, and attitudes towards work and the organisation in general, safety climate appears to be closer to operations, and is categorized by day-to-day perceptions of employees towards the working environment, working practices, organisational policies, and management (Zohar, 1980: 97)..

Safety climate is described as a “snapshot” of a specific time in an organisation and is measured by a set of dimensions (Castro & Martins, 2010) and is the expression of normative values, beliefs and behaviours at a point in time. Safety climate refers to a specific feature of organisational climate that focuses on those shared perceptions of organisational policies, procedures and practices that serve as a gauge of the importance of employee safety and health (Zohar, 2000). Perceptions of safety climate can influence employees’ attitudes towards safety, the way they perform their work and the way they interact with each other on safety issues. Each of these factors impacts directly on safety performance.

Based on the review of safety climate definitions, there have been inconsistencies in defining safety climate and these inconsistencies have deterred researchers from reaching a consensus on an assessment methodology (Zohar, 1980:97). However, subsequent literature has not diverged much from Zohar’s original set of constructs of safety climate which clustered the five core constructs of safety climate: management commitment to safety, supervisory safety support, co-worker (safety) support, employee (safety) participation, and competence level (Zohar, 1980: 97).

2.3.6 Measurement of safety climate

The major appeal of the safety climate constructs is their potential to be used as leading indicators of accidents and incidents. The multiple definitions of safety climate in the literature (Flin, Mearns, O’Connor, & Bryden, 2000; Guldenmund,

2000) have determined to a large extent what variables research teams have incorporated when developing measures of safety climate. The principal debate appears to be whether safety climate should be restricted to workforce perceptions about management and the manner in which management reconciles safety with productivity (Brown & Holmes, 1986; Dedobbeleer & Beland, 1991; Zohar, 1980, 2000), or whether the role of management is incorporated with other safety issues such as risk perception, worker involvement, personal accountability, perceptions of the physical environment, and job communication (Cox & Cox, 1991; Cheyne, Cox, Oliver, & Tomas, 1998; Lee, 1998; Mearns, Flin, Gordon, & Fleming, 1998; Williamson, *et al.*, 1997).

Safety climate is regularly considered a subcategory of an organisational climate; similarly, safety performance is considered to be a subsystem of organisational performance. Hence, the safety climate can influence safety performance. Many studies (Coyle, *et al.*, 1995; Diaz & Cabrera, 1997) reported that the higher the score of a safety climate, the better the safety performance. Another study (Zohar, 1980) demonstrated a direct link between the safety climate and safety records in organisations. His research indicated that the analysis of a perceived safety climate could identify the areas that need to be improved.

Some studies (Dedobbeleer & Beland, 1991; Williamson, *et al.*, 1997) have not distinguished safety climate from safety performance. Even though certain studies (Coyle, *et al.*, 1995; Felknor, Aday, Delclos, Bureau, & Kapadia, 1997) did make links between safety climate and safety performance, only the accident rate was considered to be the index of safety performance resulting in the narrowing of the content of safety performance. Wu (2001) analysed the correlation between safety climate and safety performance through the safety climate scale and safety performance scale he developed, and on which he applied product-moment correlation and canonical correlations. The results of that study revealed that a significant positive correlation between the safety climate and safety performance. Blair (2003) maintained that seven issues namely establish expectations, engineering support, exemplary behaviour, educate employees, enable employees, encourage employees, and evaluate effectiveness, regarding safety performance needed to be improved; three concerning the safety climate and four

concerning safety leadership, in order to reveal any correlation among safety leadership, safety climate, and safety performance.

From a meta-analysis (Beus, Payne, Bergman, & Arthur, 2010) it was found that a stronger safety climate is more indicative of group behaviour than weaker climates. That implies that strong safety climates should have larger associations with safety related outcomes than weak safety climates will do and past safety incidents influence employees' perceptions of the safety climate. The concept of safety climate is of particular interest to organisations, as it has a number of implications for the relationship between individual and group perceptions of safety management and behaviours at work that can have an impact on safety performance. Creating a favourable sustainable safety climate, taking into consideration the contribution of past accidents, could lead to improved safety performance.

Safety climate is associated with safety practices (Zohar, 1980), compliance with safety standards (Goldenhar & Hecker, 2013), and lower occurrences of workplace injuries (Clarke, 2006; Neal, Griffin, & Hart, 2000; Zohar, 2003) and has also been found to predict safety behaviour (Cooper & Phillips, 2004; Hoffmann & Stetzer, 1996). Management values, management and organisational practices, communication, and employee involvement in workplace health and safety, were all found to be important components of healthy safety climates (Neal & Griffin, 2000). Several studies supported that these factors are precursors of safety outcomes (Dedobbeleer & Beland, 1991; Hoffmann & Stetzer, 1996; Niskanen, 1994; Zohar, 1980). Despite the predictive validity of safety climate on safety performance resulting from the study by Neal and Griffen (2000), the relationship between safety climate and safe behaviour has not been properly explained and requires further research.

Research in the safety climate field made significant progress over the last few years based on the literature review of papers post 2001. Neal and Griffin (2006) conducted a longitudinal study on the safety climate predictability. The study was carried out in an Australian hospital employing over 700 staff from 1996 – 1999 (Neal & Griffin, 2006). The results from the study supported the claim that when a

positive safety climate is perceived by individuals, they will reciprocate by allocating effort to discretionary safety activities. These results support the arguments by many in the field that organisations attempting to improve safety performance should focus on creating a positive safety climate in order to motivate people to actively participate in safety activities, rather than simply implementing policies and standard work procedures. The study results strengthen the argument that safety climate is an antecedent to safety performance (Neal & Griffin, 2006).

It relates to accidents (Probst, 2004) and is invariant across domains (Clarke & Flitcroft, 2008) and has been tested at both the group (Zohar & Luria, 2005) and individual level of analysis (Kelloway, Mullen, & Francis, 2006).

An examination of the safety climate literature, illustrates there are general themes within studies trying to further identify the nature of safety climate (e.g. Glendon & Litherland, 2001; Seo, Torabi, Blair, & Ellis, 2004), consequences (e.g. Hofmann, Morgeson & Gerrass, 2003; Zohar & Luria, 2005) and its precursors (e.g. Barling, *et al.*, 2002). Although separate, these three aspects, namely nature, consequences and precursors of safety climate, are integrally linked by their inherent dependence on sound measurement to further establish the nature of safety climate.

Several recent studies have examined the prophetic value of safety climate metrics for safety outcomes. Nahrgang, Morgenson, and Hofmann (2010) and Christian, Bradley, Wallace, and Burke (2009) conducted Meta analyses to test hypothesised pathways between safety climate and related constructs and safety behaviours, injuries, and incidents. Nahrgang, *et al.* (2010) found that the exposure to risks and hazards emanating from job demands are mostly predictive of accidents, injuries, and adverse events, while a supportive safety climate, was the strongest inverse predictor of adverse safety outcomes. Christian, *et al.* (2009) concluded in their research that organisational safety climate was significantly interrelated with safety performance and safety outcomes.

Most safety climate studies are cross-sectional so that causal relationships cannot be assessed. However, a few longitudinal studies have shown significant or near-significant correlations between safety climate measures and subsequent safety behaviour and injury severity measures (Johnson, 2007). Recently, however some researchers (Bergen, Payne, Taylor, & Beus, 2013) examined the leading and lagging relationships between safety climate and four types of safety incidents, suggesting that safety climate has a varying “shelf life” depending on the type of incidents being considered. Furthermore, they noted that the relationships were bi-directional, in that safety climate were in some cases predictive of incidents, while in other cases incidents were predictive of the safety climate in the organisation.

As noted by Flin, *et al.* (2002), safety climate researchers have not reached a consensus on an assessment methodology that addresses the relationship between safety climate and safety behaviours.

Due to the lack of a coherent framework that links employee perceptions of the work environment to specific safety behaviours, there has been little research done to determine the manner in which safety climate translates into improved safety performance for organisations. Further research on to what extent safety climate changes over time and what influences those changes is required. To fully understand how safety climate affects the occurrence of accidents, the safety climate to accident rate relationship should be evaluated. In the next session the DuPont Safety Culture Model will be discussed to highlight the ideal safety culture of interdependency and what should be implemented to achieve that state.

2.4 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 2.6 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).

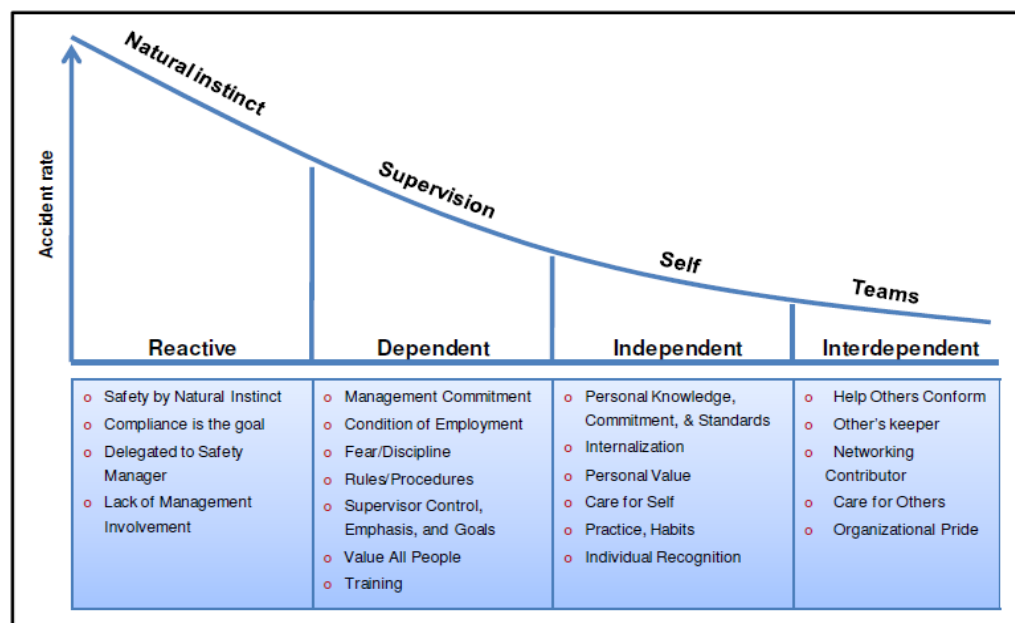


Figure 2.4: DuPont safety culture model (DuPont, 2009:14)

The independent safety culture is one that each and every ambitious organisation seeks to achieve, and moreover it might be more of an ideal state, but it motivates the workforce to greater heights. Creating an independent safety culture presents some difficulty of which cost, and time are often the most important restrictions experienced (DuPont, 2009:14). There is a say that says "If you think safety is

expensive, try an incident”, and this should encourage organisation to strive towards better safety systems irrespective of cost to organisation (DuPont, 2009:14). 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 prime focus is on personal accountability and responsibility (DuPont, 2009:14). The employees lean towards understanding and the consequence of their actions and are increasingly pledging commitment to adhering to safety standards in an effort to improve their own safety at the working environment. 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 (DuPont, 2009:14). 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 (Betitichi, Mendibil, Nudurupati, Turner, & Garengo, 2004:28).

2.5 SAFETY CULTURE CHANGE

There can never be any change in the organisation unless its leaders are prepared for that change. In order for change to be effective, it is important that there is a belief in the change. Changing an organisation's safety culture is a slow and challenging affair (Farmer, 2010). 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 responsibility 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 SAFETY PERFORMANCE IS GOOD BUSINESS PERFORMANCE

The focus over the years has been on the consequences of non-compliance to legislation rather than the benefits of striving towards high performance safety culture (Farmer, 2010). Creating a safe working environment has the connotation of being seen as the single most wasteful exercise that hinders the efficiency resource use and creating delays in getting work done in prescribed scheduled time. 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, and in many Petrochemical organisations, safety performance forms part of their key business indicators which encourages employees' behaviour to prevent workplace accidents (Fernández-Muñiz, Montes-Peón, & Vázquez-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).

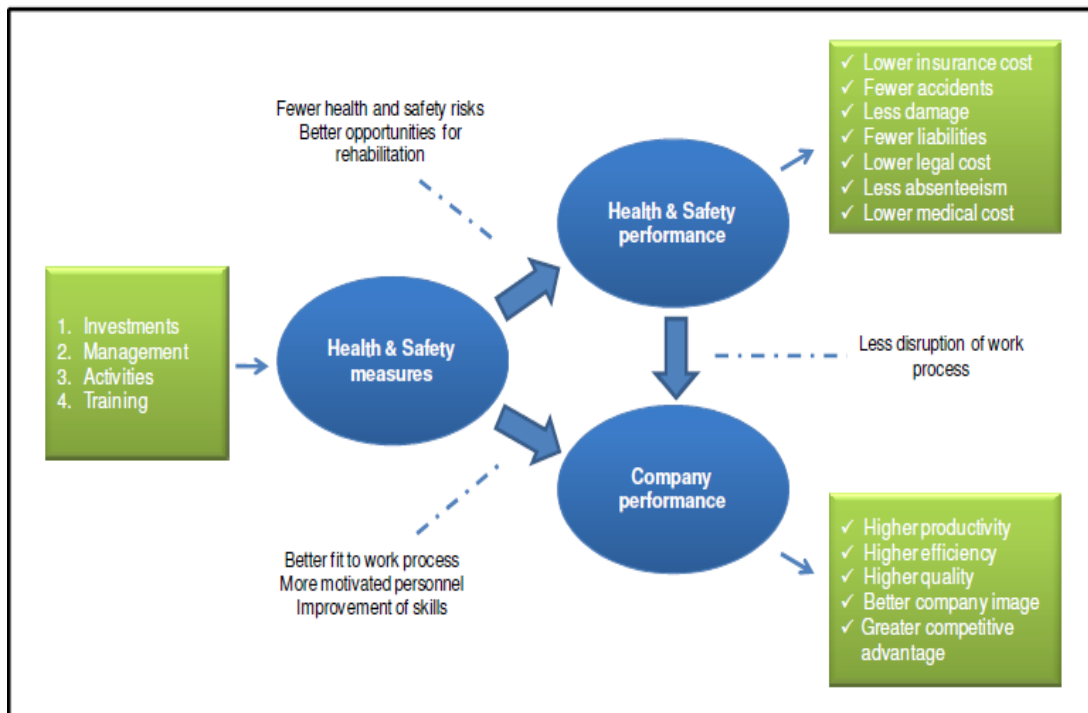


Figure 2.5: From safety performance to business performance (Fernández-Muñiz, *et al.*, 2009:982)

Figure 2.4 is an illustration of the good safety performance's direct proportionality to the improved productivity, and business leverage. 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).

An organisation should avoid tolerating known unsafe working conditions, whether by design or deterioration of facilities equipment as that can easily become the norm and create a carelessness culture, and defeating efficiency reporting of unsafe conditions. The behaviour based safety that was implemented by major Petrochemicals organisation like Sasol, have embarked on a mission to remove barriers as a way of management by example approach to deal with unsafe conditions on the plants. 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).

2.7 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 2.5 shows, schematically, how the technology, culture and the systems approach, each reach a plateau, in terms of incident rates and the next step necessary to enable further improvement. It is important though to acknowledge that it all start with the fit for purpose technology, then supported by the robust system, and eventually the culture embodied all the success of driving the incident to the lowest possible in the organisation.

As those very safety systems e.g. ISO 1400, 1800, and 9000 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).

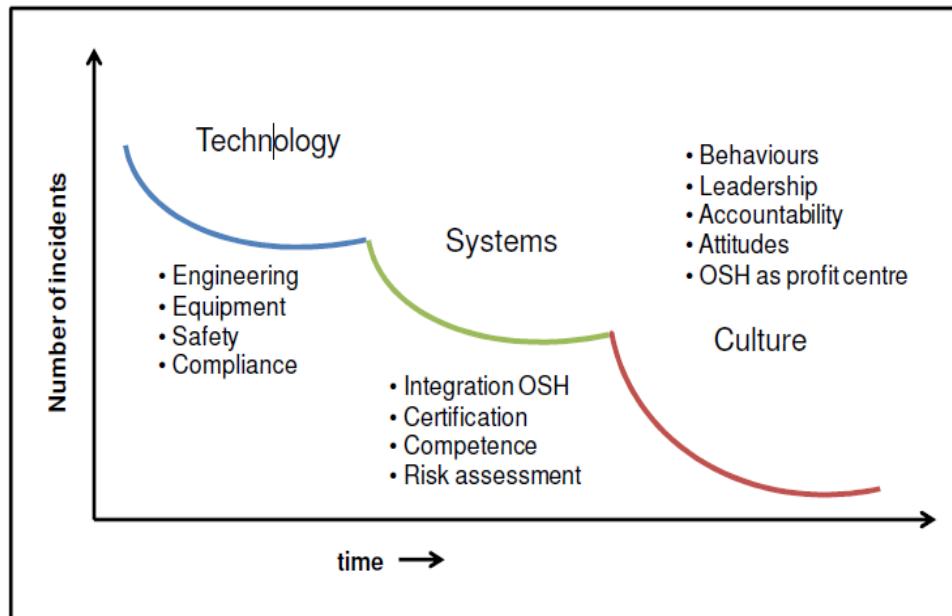


Figure 2.6: Evolution of safety performance (Hudson, 2007:700)

The evolution of safety highlights the importance of Technology in driving the right behaviour to reduce incidents in the workplace. The Technology that's referred to is design frontend loading, which will ensure that the correct equipment is used for the process, and this is followed by the rigorous risk assessment in HAZOP. The compliance to design specification is key critical to prevent incidents caused by wrong selection of bill of material. Subsequent to Technology is the element of safety system, which will essentially guide the organisation in terms of implementing robust system. The organisation should periodically subject its system to the auditing system to verify assurance in terms of adherence to its developed standards. The certification issued by this certificate houses is not only to demonstrate compliance, but commitment to safety of its employees. The risk assessment will identify the hazards, and eliminate hazards through the correct controls, and develop action plans to manage the residual risk that couldn't be eliminated. The risk assessment should never be a paper exercise but a live system that support incidents prevention, and all involved with the process should be trained, and declared competent to work independently. The last aspect involves shaping the culture of an organisation with leadership taking a pivotal role in leading the culture reforms. It is important to ensure that employees involvement forms part of the frontend loading process. The responsibilities and accountability of the right behaviour should be curved outright to eliminate any

confusion in terms of roles and responsibilities. Organisations should teach the employees the consequence of their behaviours in omission of certain duties and neglect thereof. The attitude should be right for the correct behaviour to follow, and essentially behaviour needs to be understood in order to address it. Culture is organisational behaviour and behaviour is a result of what the organisation deems as norm and acceptable conduct.

The next section will introduce behaviour based safety's benefits and improvements to the safety culture and safety climate, and over and above strengthen the arguments or factors implemented by DuPont.

2.8 BEHAVIOUR BASED SAFETY (BBS)

The fundamental understanding of safety perhaps could be unlocked by the system that is being introduced in large organisations like Sasol in the form of BBS, an initiative from BST. The importance of the system is the fact that it identifies the barriers in the operational process with the potential to encourage certain unsafe behaviour. The identified barrier is presented at the barrier removal team comprising of the senior management, and the barrier merit will be scrutinised, and eventually action plans are developed to eliminate the barrier before it causes an injury. The system identifies a certain pattern of behaviours that are observed with the potential to cause injuries to personnel and focus areas from the data get generated and the organisation is informed about the potential threat.

Creating the kind of culture where safety is a driving value (or isn't), is something done by leaders through their day-to-day actions. In the most effective safety leaders, certain behaviours have been seen to recur, including vision, credibility, action-orientation, collaboration, communication, recognition and feedback, and accountability. The system relies though on the management maturity level, because of its stance on the "No name, No blame" approach. If it happens that management feel that certain behaviours require an intervention with the employee observed the system can easily fall flat, and fails.

Behaviour-based safety is a significant—and underused tool—in the prevention of serious injuries and fatalities (SIF). Employees trained as observers are uniquely positioned to identify changes in exposure and provide leaders with data to save lives. Organisations can leverage employee expertise to focus on key areas of the work being done, expand critical behaviour inventories, and use collected information to assess exposures with SIF potential. When people know what to look for, they can target precursors to SIFs and take the necessary steps to prevent an incident before it can become a tragedy.

Behaviour-based safety is a performance improvement engine that can drive safety and the organisation's overall functioning. It is a way to advance leadership capabilities, leverage frontline knowledge, and engage people in matters that concern them the most. The organisation as a whole lives and dies on the behaviour of its people; BBS can contribute to the improvement of overall performance. The principles that make BBS work, and that make it relevant, are critical to everything organisations do. But how effective the system is, depends on its implementation and the leadership that guides it. If BBS is implemented in an effort to drive good safety behaviour, the results could be an astounding safety culture of high performance in terms of productivity and safety.

2.9 CHAPTER SUMMARY

The first part of this chapter looked at how the global and South-African Petrochemical Organisations has undertaken to improve their safety performance strategy. The significant impact of non-conformance on the entire organisation, is not only limited to economical reprisal. There is a strong link between effective safety management and good business management practices, which in turn lead to good business performance as revealed through the research.

Subsequently the concept of safety climate and safety culture was in depth explored. The link between organisational culture, safety culture and their influence on safety climate was investigated and amended. Safety culture components and characteristics were explored in order to comprehend which characteristics mostly influence safety climate. Comprehensive arguments relays

that a Safety culture culminates into a Safety climate which in turn could translate into a measurable component of how the organisation's performance. Safety climate measurement research examined the predictive value of safety climate metrics for safety outcomes and revealed that due to the lack of a coherent framework that links employee perceptions of the work environment to specific safety behaviours, there has been little research done to determine the manner in which safety climate translates into improved safety performance for organisations.

The evolution of safety almost perfectly outlines the importance of front end loading in terms of proper safe conscious designs, followed by robust systems will eventually encourage the safe behaviours in return. The emphasis is on eradication of unsafe conditions that in most cases stems from designs that doesn't address the safe operations and maintenance. Equally so, it is important to acknowledge the work done by DuPont in highlighting the different stages in the lifecycle of safety culture towards interdependence, and in so doing reducing the number of incidence in the workspace. The crux of the matter is essentially to evaluate and determine the organisational current status, and once that is established, develop strategic plans to move the organisation towards the ideal of interdependence state.

The final analogy expatiated the understanding of the most complex aspect which is human interface with the environment in which they operate in terms of safety and their exposed health. The behaviour based safety is the most powerful tool in terms of the final puzzle of understanding certain observed unsafe acts by employees, but the one question is "is it being applied correctly?"

The following chapter sets out the research methodology applied and the statistical analysis utilised.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

In this chapter the research methodology applied for investigating the perceptions towards safety among a sample of participants employed in the petro-chemical industry, is described. The description includes the measuring instrument, the sample, the method employed to gather data and the statistical analysis utilised.

3.2 RESEARCH APPROACH

A quantitative research approach was followed when conducting the research. This approach can be defined as describing the phenomena by a study of the human behaviour which is observable and of the general laws of relationships and/or causality applicable to people at any given time (Welman, *et al.*, 2005:6-7).

3.3 RESEARCH DESIGN

Research design can be described as the map we follow to obtain research participants and to gather relevant information from these participants. It also explains what the intention with the participants is in order to reach a conclusion concerning the research problem (Welman, *et al.*, 2005:52).

A cross-sectional survey was used to collect the data and to attain the research objectives. Cross-sectional survey designs are used to examine groups of subjects in various stages of development simultaneously (Burns & Grove, 1993) in a short period of time, which can vary from one day to a few weeks (Du Plooy, 2001). The survey is a data-collection technique in which questionnaires are used to gather data about an identified population. This design is also used to assess interrelationship among variables within a population (Shaughnessy & Zechmeister, 1997). The cross-sectional survey design is best suited to address

the descriptive and predictive functions associated with the correlation design, whereby relationships between variables are examined.

3.4 PARTICIPANTS

According to Singleton and Straits (2011) the target population contains members of a group that a research is interested in studying. The results of the study are generalised to this population, because they all have significant traits in common.

The identified target population is the operations fraternity which includes the production, and all maintenance groups (Mechanical, Electrical, and Instrumentation departments). The reason for selecting this population is based on the observed experience, and mainly because they are most of times pressed for time in terms of meeting production volumes. The priority as stated by the organisation in terms of executing work on the premises is clearly stated as safety, integrity, schedule, and lastly cost in chronological order.

The deviation that has been observed over the years led to initiation of this study to pin point the root cause analysis of the problem. The fatalities that were seen by the organisation in general were investigated, but none pointed towards this frail relationship. The research seeks to go beyond the line of duty to highlight, and seek clarity on the parity of the observed population who are on the front line of the execution of work.

The research was conducted in a public South African Chemical company in Johannesburg – a subsidiary of a JSE and NYSE listed global company. One of the main reasons for the selection of this company is due to the large heterogeneous and diverse permanent workforce ($N = 400$). Most of the employees have company e-mail addresses and direct access to the company's intranet network, making the target population more accessible for research.

Simple random sampling method, and more specifically, a convenience sample will be used to collect the data.

3.5 MEASURING BATTERY

A self-constructed survey was compiled following focus groups with job incumbents within the petro-chemical industry, namely the **Perceptions towards Safety**. A 5-point Likert Scale were utilised, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The reliability and validity of the survey were determined through statistical analysis.

3.6 STATISTICAL ANALYSIS

The statistical analysis was carried with the help of the SPSS-programme (IBM SPSS Statistics 24, 2016). Exploratory factor analysis was conducted by means of an oblique rotation using direct Oblimen (an Oblique method rotation) on the main constructs of the study. This technique presumes a nominal correlation between factors and is utilised to determine the possible dimensions of the constructs. The purpose of factor analysis is to reduce the initial number of variables into a smaller and therefore more manageable (easier to analyse and interpret) set of underlying dimensions (Yong & Pearce, 2013:79), called factors.

The adequateness of the sample was determined by means of the Kaiser-Meyer-Olkin (KMO) correlation matrix and the diagonal element of the Anti-Image Correlation. The Bartlett's test of sphericity was also calculated. This test allows for the examining of the relationship between variables and signifies if the data is suitable to continue with a factor analysis (Field, 2009:647). The KMO values are interpreted as indicated in the table below (Hair, *et al.*, 1998:99).

Table 3.1

Interpretation of KMO values

KMO Value	Interpretation
≥ 0.80	Commendable
0.70	Average
0.60	Mediocre
0.50	Miserable
< 0.50	Undesirable

The Anti-image correlation matrix contains the negative partial co-variances and correlations. Diagonals are used as a measure of sampling adequacy. The Anti-image correlation matrix has a cut-off above 0,50. If this required is not met, this means that distinct and reliable factors cannot be produced. Items causing diffused correlation patterns as indicated by the diagonal value in the Anti-Image Correlation matrix, is removed (Yong & Pearce, 2013:88).

Descriptive statistics (e.g. means, standard deviations, skewness and kurtosis) were used to analyse the data. Cronbach's alpha coefficients were used to determine the internal consistency, homogeneity and un-dimensionality of the measuring instruments (Clark & Watson, 1995). Coefficient alpha contains important information regarding the proportion of variance of the items of a scale in terms of the total variance explained by that particular scale.

Pearson product-moment correlation coefficients were used to specify the relationships between the variables. In terms of statistical significance, it is decided to set the value at a 95% confidence interval level ($p \leq 0,05$). Effect sizes (Steyn, 1999) were used to determine the practical significance of the findings. A cut-off point of 0,30 (medium effect, Cohen, 1988) was set for the practical significance of correlation coefficients.

Multiple regression analyses were conducted to determine the percentage variance in the dependent variables that were predicted by the independent variables. The effect size (which indicates practical significance) in the case of multiple regressions are given by the following formula (Steyn, 1999):

$$f^2 = R^2 / 1 - R^2$$

A cut-off point of 0,35 (large effect, Steyn, 1999) was set for the practical significance.

Multivariate analysis of variance (MANOVA) were used to determine the significance of differences between the safety perceptions of different demographic groups. MANOVA tests whether or not mean differences among

groups in a combination of dependent variables are likely to have occurred by chance (Tabachnick & Fidell, 2001). In MANOVA, a new dependent variable that maximises group differences is created from the set of dependent variables. Wilk's Lambda was used to test the likelihood of the data, on the assumption of equal population mean vectors for all groups, against the likelihood on the assumption that the population mean vectors are identical to those of the sample mean vectors for the different groups. When an effect was significant in MANOVA, one-way analysis of variance (ANOVA) was used to discover which dependent variables had been affected. Seeing that multiple ANOVAs were used, a Bonferroni-type adjustment is made for inflated Type I error. Tukey tests were done to indicate which groups differed significantly when ANOVA's were performed.

3.7 RESEARCH OBJECTIVES

The research objectives were divided into general and specific objectives.

3.7.1 General Objective

The primary objective of this study was to explore the perceptions and opinions of permanent employees regarding the safety climate within a South African Petro-chemical organisation.

3.7.2 Secondary Objectives

The secondary objectives of the study were:

- To determine how safety culture and safety climate is conceptualised from the literature.
- To determine perceptions towards safety from the literature.
- To determine employees' perceptions in relation to the safety climate across the Operational units and the Safety, Health and Environment function within a South African Petro-chemical organisation.

- To determine the correlation relation between negative and positive perceptions towards the safety climate within the current research.
- To determine the factors from the research that contributes to adverse safety behaviour.
- To determine the differences in perceptions in relation to the safety climate across the Operational units and the Safety, Health and Environment function within the organisation in terms of demographic characteristics.
- To make recommendations for future research.

3.8 CHAPTER SUMMARY

This chapter dealt with the methodology utilised, as it pertained to the research study. The selection of the participants was explained, and the measuring instrument utilised. The preferred statistical methods for the analysis of the data were furnished together with a discussion around each method chosen.

In Chapter 4, the empirical results of the study will be discussed.

CHAPTER 4

EMPIRICAL STUDY

4.1 INTRODUCTION

Chapter 3 provided an outline of the research methodology and the research techniques applied. Chapter 4 details the results of the empirical study.

4.2 PARTICIPANTS

The envisaged population size for the study was 190 participants from both male and female employees, managers, and support functions within the organisation. The setting for data collection was in the Sasol Satellite Operations in the Gauteng region. The Questionnaire was sent through manual hard copies to all the participants within the organisation, and it was the simple collection methodology to 190 Petrochemical employees, and they were asked to partake in the survey of 107 questions. Only 152 participants partook in the survey, representing an 80% response rate. All 107 questionnaires were analysed. A copy of the questionnaire is attached hereto as Annexure A.

Table 4.1 presents the descriptive information of the sample.

Table 4.1***Characteristics of the participants***

Item	Category	Frequency	Percentage
Gender	Females	56	36,80
	Males	96	63,20
Ethnic Group	White	26	17,10
	African	102	67,10
	Coloured	12	7,90
	Indian	12	7,90
	Younger than 25 years	12	7,90
Age Group	25 to 35 years	51	33,60
	36 to 45 years	62	40,80
	46 to 55 years	24	15,80
	56 years and older	3	2,00
	Up to Grade 11	1	0,70
Educational Level	Grade 12	68	44,70
	Diploma	60	39,50
	Degree	18	11,80
	Post-degree	5	3,30
	0 – 5 years	36	23,70
Years' service in the Organisation	6 – 10 years	61	40,10
	11 – 20 years	43	28,30
	20 years and more	12	7,90
	0 – 5 years	34	22,40
Years' service in Current Position	6 – 10 years	64	42,10
	11 – 20 years	44	28,90
	20 years and more	10	6,60
	Technical	59	38,80
Department	Production	67	44,10
	Maintenance	26	17,10
	Yes	36	23,70
Leadership Role	No	116	76,30
	Yes	5	3,30
Disciplined for safety violation	No	147	96,70

The study population consisted mainly of African (67,10%), males (63,20%), working in the Technical (38,80%) and Production (44,10%) departments. The majority of the sample were between the ages 36 to 45 years with 6 to 10 years' experience in the organisation, with either a Grade 12 or diploma as highest

educational level. 23,70% of the sample are currently in a leadership role and only 5 participants indicated that they have previously been disciplined for safety violations.

4.3 RESULTS

A principal component factor analysis was performed on the self-constructed Perceptions towards Safety Survey on the sample of employees working in the petro-chemical industry. Results indicated that a commendable KMO correlation matrix of 0,93 ($p < 0,05$) was obtained. An investigation in the Anti-image correlation matrix noted no problematic items. Analysis of the eigen values (larger than 1) and the scree plot indicated that ten factors could be extracted, explaining 81,55% of the total variance.

Next, a principle axis factor analysis was followed using a direct oblimin rotation to perform further factor analysis. The factors were labelled Safety Management, Risk Behaviour, Safety Systems and Training, Receptiveness towards Safety Information, Prioritising Safety, Reporting incidents and near-misses, Equipment, Tools and Workplace Conditions, Safety promotion, Reactions to Safety Investigations, and Compliance.

Safety Management relates to the management of safety within the business unit with relation to housekeeping, meeting set safety targets, prioritising process safety management and ensuring pro-active ownership of contractor safety. It is inclusive of the involvement of senior management in safety initiatives, and the role of the immediate supervisor to ensure the safety of all employees.

Risk Behaviour relates to the behaviour of employees to take chances due to pressure from colleagues, to get the job done, to keep production going and as a result of incentives for productivity.

Safety systems and training relate to the training employees have received with regards to safety as well as their understanding of the health and safety procedures within the organisation.

Receptiveness towards Safety Information refers to the acknowledgement of and attention given to safety information received as well as the relevance of safety information

Prioritising Safety relates to safety being a condition of employment and a priority in the organisation.

Reporting incidents and near-misses relate to reporting of accidents and near-misses within the working environment.

Equipment, tools and workplace conditions relate to the availability of the correct tools and equipment to execute the work, the maintenance of equipment and compliance with safety regulations and the use of safe equipment and tools. It also relates to a safe working environment.

Safety promotion relates to the promotion of safety behaviour through effective preventative measures.

Reactions to Safety Investigations refer to the connotation employees make to accident/incident investigations.

Compliance relates to employees taking responsibility for safety in line with the organisation's stipulated health and safety requirements.

The descriptive statistics and alpha coefficients of the identified factors are indicated in Table 4.2.

Table 4.2***Descriptive Statistics and Alpha Coefficients***

Item	Mean	SD	Skewness	Kurtosis	α
Safety Management	145,17	36,25	-1,63	1,13	0,99
Risk Behaviour	12,24	6,58	0,81	-1,00	0,97
Safety Systems and Training	55,73	10,46	-2,15	3,94	0,97
Receptiveness towards Safety Information	16,64	6,06	0,25	-1,06	0,84
Prioritising Safety	7,34	2,22	-1,08	0,10	0,83
Reporting incidents and near-misses	30,55	11,44	-0,00	-1,09	0,93
Equipment, tools and workplace conditions	62,36	14,32	-1,50	1,05	0,98
Safety Promotion	14,44	3,85	-1,36	0,92	0,85
Reactions to Safety Investigations	7,14	1,99	-0,95	-0,05	0,65
Compliance	31,70	7,12	-1,99	3,08	0,95

Table 4.2 indicates that acceptable Cronbach's alpha coefficients ranging between 0,65 and 0,99 were obtained. These alpha coefficients compare well with the guideline of 0,70 (0,55 in basic research). This demonstrates that the dimensions (internal consistency of the dimensions) explain a large part of the variance (Nunnally & Bernstein, 1994). It is evident from Table 4.3 that the scales of the measuring instruments have relatively normal distributions, with low skewness and kurtosis, except for Safety Systems and Training, and Compliance where the data was negatively skew and peak.

The product-moment correlation coefficients between the identified Safety Factors are given in Table 4.3.

Table 4.3***Product-Moment Correlation Coefficients between the Safety Factors***

Item	1	2	3	4	5	6	7	8	9
1. Safety Management	.	.	.	.	.	.	.	.	.
2. Risk Behaviour	-0,55 ⁺⁺⁺	.	.	.	.	.	.	.	.
3. Safety Systems and Training	0,84 ⁺⁺⁺	-0,39 ⁺⁺	.	.	.	.	.	.	.
4. Receptiveness towards Safety Information	-0,26 [*]	0,47 ⁺⁺	-0,18 [*]	.	.	.	.	.	.
5. Prioritising Safety	0,54 ⁺⁺⁺	-0,22 [*]	0,53 ⁺⁺⁺	-0,12	.	.	.	.	.
6. Reporting incidents and near-misses	-0,56 ⁺⁺⁺	0,65 ⁺⁺⁺	-0,46 ⁺⁺	0,40 ⁺⁺	-0,19 [*]	.	.	.	.
7. Equipment, Tools and Workplace Conditions	0,94 ⁺⁺⁺	-0,49 ⁺⁺	0,83 ⁺⁺⁺	-0,27 [*]	0,51 ⁺⁺	-0,50 ⁺⁺	.	.	.
8. Safety Promotion	0,81 ⁺⁺⁺	-0,47 ⁺⁺	0,76 ⁺⁺⁺	-0,16 [*]	0,58 ⁺⁺⁺	-0,53 ⁺⁺⁺	0,77 ⁺⁺⁺	.	.
9. Reactions to Safety Investigations	0,57 ⁺⁺⁺	-0,24 [*]	0,61 ⁺⁺⁺	-0,26 [*]	0,29 [*]	-0,27 [*]	0,55 ⁺⁺⁺	0,51 ⁺⁺⁺	.
10. Compliance	0,84 ⁺⁺⁺	-0,40 ⁺⁺	0,91 ⁺⁺⁺	-0,26 [*]	0,49 ⁺⁺	-0,45 ⁺⁺	0,82 ⁺⁺⁺	0,73 ⁺⁺⁺	0,67 ⁺⁺⁺

* $p \leq 0,05$ – statistically significant

+ $r > 0,30$ – practically significant (medium effect)

++ $r > 0,50$ – practically significant (large effect)

Table 4.3 shows that Safety Management had negative statistical and practical significant (large effect) correlations with Risk Behaviour and Reporting incidents and near-misses. This implies that an increase in effective Safety Management inclusive of housekeeping, meeting safety targets, and management involvement in ensuring the safety of employees, will result in a reduction of Risk Behaviour, i.e. taking unsafe chances and risks, and the reluctance to Report incidence and near-misses. Safety Management had positive statistical and practical significant correlations (large effect) with Safety Systems and Training, Prioritising Safety, having Equipment, tools and conducive Workplace Conditions, Safety Promotion, Reactions to Safety Investigations and Compliance.

Risk Behaviour had negative statistical and practical significant (medium effect) correlations with Safety Systems and Training, Equipment, Tools and Working Conditions, Safety Promotion, and Compliance. This implies that Risk Behaviour is likely to increase when employees perceive that the Safety Systems and Training is insufficient and when they do not have the Equipment and Tools to

safely execute their tasks and not have conducive Workplace Conditions to work safely. Risk Behaviour is further likely to increase when Safety is not promoted with preventative measures and when there is a lack of Compliance. Risk Behaviour had positive statistical and practical significant (large effect) correlations with Reporting incidents and near-misses and (medium effect) Receptiveness towards Safety Information. This implies that an increase in Risk Behaviour results in employees being less inclined to Report incidents and near-misses. It is also indicative that taking risks may increase when employees are not receptive of and give the necessary attention to safety information provided.

Safety Systems and Training had positive statistical and practical significant (large effect) correlations with Prioritising Safety, Equipment, Tools and Working Conditions, Safety Promotion, Reactions to Safety Investigations and Compliance. This implies having effective Safety Systems and Training in the organisation, increases the importance of Safety in the organisation and the overall perception towards safety. Safety Systems and Training had a negative statistical and practical significant (medium effect) correlation with Reporting incidents and near-misses. With effective safety training and having efficient safety systems in place, increases the likelihood of employees reporting incidents and near-misses and not having a reluctance to report on these incidents.

Receptiveness towards Safety Information had a positive statistical and practical significant correlation (medium effect) with Reporting incidents and near-misses. This implies the less receptive employees are to receive, acknowledge and adhere to safety information, the less likely they are to report on incidents and near-misses, and vice versa.

Prioritising Safety had positive statistical and practical significant (large effect) correlations with Equipment, Tools and Workplace Conditions, Safety Promotion and (medium effect) Compliance. This is indicative that the prioritising of safety in the organisation in terms of making it an employment condition and a priority, increases the positive perception towards safety.

Reporting incidents and near-misses had a negative statistical and practical significant (large effect) correlation with Safety Promotion, and negative statistical and practical significant (medium effect) correlations with Equipment, Tools and Working Conditions, and Compliance. This implies that the lack of reporting incidents and near-misses negatively impacts all attempts to promote safe behaviour.

Equipment, Tools and Workplace Conditions, Safety Promotion, Reactions to Safety Investigations and Compliance all had positive, statistical and practical significant (large effect) correlations with one another. This implies that these factors are conducive to a positive perception towards safety in the organisation.

From the previous results, three factors were noted as being negative, i.e. Risk Behaviour, lack of Reporting incidents and near-misses and Receptiveness towards Safety Information. The results of a multiple regression analysis with negative perceptions towards safety (Risk Behaviour, Reporting incidents and near-misses and Receptiveness towards Safety Information) as dependent variables and positive perceptions towards safety (Safety Management, Safety Systems and Training, Prioritising Safety, Equipment, Tools and Workplace Conditions, Safety Promotion, Reactions to Safety Investigations and Compliance) as independent variables are reported in Table 4.4.

Table 4.4***Multiple regression analyses with negative perceptions to safety as dependent variables***

Model	Unstandardised Coefficients		Standardised Coefficients	T	p	F	R	R ²	ΔR ²
	B	SE	Beta						
Dependent Variable: Risk Behaviour									
(Constant)	22,53	2,56		8,79	0,00*	10,83*	0,59	0,35	0,35
Safety Management	-0,16	0,04	-0,89	-3,85	0,00*				
Safety Systems and Training	0,10	0,11	0,15	0,87	0,39				
Prioritising Safety	0,39	0,25	0,13	1,56	0,12				
Equipment, Tools and Working Conditions	0,08	0,09	0,17	0,82	0,41				
Safety Promotion	-0,28	0,21	-0,16	-1,31	0,19				
Reactions to Safety Investigations	0,27	0,30	0,08	0,89	0,37				
Compliance	0,07	0,17	0,07	0,40	0,69				
Dependent Variable: Receptiveness towards Safety Information									
(Constant)	22,10	2,73		8,11	0,00*	2,91*	0,35	0,12	0,12
Safety Management	-0,02	0,04	-0,14	-0,51	0,61				
Safety Systems and Training	0,23	0,12	0,39	1,96	0,05				
Prioritising Safety	-0,07	0,27	-0,03	-0,26	0,80				
Equipment, Tools and Working Conditions	-0,10	0,10	-0,24	-0,99	0,32				
Safety Promotion	0,22	0,22	0,14	0,96	0,34				
Reactions to Safety Investigations	-0,49	0,32	-0,16	-1,54	0,13				
Compliance	-0,25	0,18	-0,29	-1,40	0,16				
Dependent Variable: Reporting incidents and near-misses									
(Constant)	51,93	4,36		11,90	0,00*	12,10*	0,61	0,37	0,37
Safety Management	-0,22	0,07	-0,71	-3,13	0,00*				
Safety Systems and Training	-0,03	0,19	-0,03	-0,17	0,87				
Prioritising Safety	1,18	0,43	0,23	2,77	0,01*				
Equipment, Tools and Working Conditions	0,20	0,16	0,25	1,23	0,22				
Safety Promotion	-0,98	0,36	-0,33	-2,72	0,01*				
Reactions to Safety Investigations	0,56	0,51	0,10	1,10	0,27				
Compliance	0,06	0,28	0,04	0,20	0,84				

* $p < 0,05$

Table 4.4 shows that 35 percent of the variance explained in Risk Behaviour was predicted by the positive factors of Safety Perceptions ($F = 10,83$, $p < 0,05$). Safety Management was the only significant predictor of Risk Behaviour. Table 4.4 also shows that 12% of the variance in Receptiveness towards Safety Information was predicted by the positive factors of Safety Perceptions ($F = 2,91$, $p < 0,05$). None of the factors were significant predictors. Table 4.4 shows that 37% of the variance explained in Reporting incidents and near-misses was predicted by the positive

factors of Safety Perceptions ($F = 12,20$, $p < 0,05$). Safety Management, Safety Prioritised and Safety Promotion were significant predictors of Reporting incidents and near-misses.

MANOVA analysis was conducted to determine differences on some demographic characteristics and the factors of safety perception in terms of the total population. Results were first analysed for statistical significance using Wilk's Lambda statistics. ANOVA was used to determine specific difference whenever statistical differences were found. The results of the MANOVA and ANOVA analysis are given in Table 4.5

Table 4.5

MANOVA – Differences in factors of safety perceptions

Variable	Value	<i>F</i>	<i>Df</i>	<i>P</i>	Partial Eta squared
Gender	0,86	2,27	10,00	0,02*	0,14
Race	0,86	2,30	10,00	0,02*	0,14
Age	0,79	3,69	10,00	0,00*	0,21
Educational Level	0,83	1,36	20,00	0,14	0,09
Years' service in Organisation	0,55	3,03	30,00	0,00*	0,18
Years' service in current position	0,61	2,49	30,00	0,00*	0,15
Department	0,78	1,88	20,00	0,01*	0,12

* $p < 0,05$

In analysis of Wilk's Lambda values, indicated that statistically significant differences ($p < 0,05$) regarding factors of safety perceptions could be found for the total group between gender, racial, age, years' service in the organisation, years' service in current position and department.

The relationship between factors of safety perceptions and the demographic factors were further analysed using ANOVA. The Games-Howell procedure was used to determine whether there were any statistical differences between the groups.

The results of the ANOVA based on gender are given in Table 4.6.

Table 4.6***Differences in factors of safety perceptions and gender***

Item	Females	Males	<i>p</i>	Partial Eta Squared
Safety Management	154,87 ^a	139,51 ^b	0,01*	0,04
Risk Behaviour	10,29 ^b	13,38 ^a	0,01*	0,05
Safety Systems and Training	57,88	54,48	0,05	0,03
Receptiveness towards Safety Information	15,48	17,32	0,07	0,02
Prioritising Safety	8,20 ^a	6,84 ^b	0,00*	0,09
Reporting incidents and near-misses	27,27 ^b	32,47 ^a	0,01*	0,05
Equipment, Tools and Working Conditions	65,70 ^a	60,41 ^b	0,03*	0,03
Safety Promotion	15,45 ^a	13,85 ^b	0,01*	0,04
Reactions to Safety Investigations	7,20	7,12	0,81	0,00
Compliance	32,95	30,97	0,10	0,02

* Statistically significant difference: $p < 0,05$

^a Group differs statistically significantly from type (in row) where ^b is indicated

From Table 4.6, the results indicated that there is a statistical significant difference between gender and Safety Management, Risk Behaviour, Prioritising Safety, Reporting incidents and near-misses, Equipment, Tools and Working Conditions, Safety Promotion. Female participants are more positive towards Safety Management, value the Prioritising of Safety and the Promotion of Safety, than male participants. They also perceive that they have the Equipment, Tools and Working Conditions conducive for working safely. Male participants are more inclined to engage in risk behaviour than female participants. They are also more likely to not report on incidents and near-misses in comparison to their female counterparts.

The results of the ANOVA based on race are given in Table 4.7. Owing to the small numbers in some racial groups, the following groups were clustered together: White, Coloured and Indian.

Table 4.7***Differences in factors of safety perceptions and race***

Item	White, Coloured & Indian	African	<i>p</i>	Partial Eta Squared
Safety Management	135,74 ^b	149,79 ^a	0,02*	0,03
Risk Behaviour	12,96	11,88	0,35	0,01
Safety Systems and Training	54,66	56,26	0,38	0,01
Receptiveness towards Safety Information	16,00	16,96	0,36	0,01
Prioritising Safety	6,98	7,52	0,16	0,01
Reporting incidents and near-misses	31,06	30,30	0,70	0,00
Equipment, Tools and Working Conditions	59,80	63,61	0,12	0,02
Safety Promotion	13,90	14,71	0,23	0,01
Reactions to Safety Investigations	7,24	7,10	0,68	0,00
Compliance	31,60	31,75	0,91	0,00

* Statistically significant difference: $p < 0,05$

^a Group differs statistically significantly from type (in row) where ^b is indicated

From Table 4.7, the results indicated that there is a statistical significant difference between racial groups and Safety Management. African participants are more positive towards Safety Management.

The results of the ANOVA based on age groups are given in Table 4.8. Owing to the small numbers in some age groups, two groups were created, i.e. 35 years and younger and 36 years and older.

Table 4.8***Differences in factors of safety perceptions and age groups***

Item	35 years and younger	36 years and older	<i>p</i>	Partial Eta Squared
Safety Management	139,92	148,89	0,13	0,02
Risk Behaviour	13,92 ^a	11,05 ^b	0,01*	0,05
Safety Systems and Training	56,02	55,53	0,78	0,01
Receptiveness towards Safety Information	18,48 ^a	15,35 ^b	0,00*	0,07
Prioritising Safety	7,79 ^a	7,02 ^b	0,03*	0,03
Reporting incidents and near-misses	32,08	29,47	0,17	0,01
Equipment, Tools and Working Conditions	59,81	64,16	0,07	0,02
Safety Promotion	14,51	14,39	0,86	0,00
Reactions to Safety Investigations	7,05	7,21	0,62	0,00
Compliance	31,60	31,76	0,89	0,00

* Statistically significant difference: $p < 0,05$

^a Group differs statistically significantly from type (in row) where ^b is indicated

From Table 4.8, the results indicated that there is a statistical significant difference between age groups and Risk Behaviour, Receptiveness towards Safety Information, and Prioritising Safety. Participants, 35 years and younger are more inclined to engage in risk behaviour and less receptive towards safety information, than participants 36 years and older. Participants, 35 years and younger however, also values the Prioritising of Safety.

The results of the ANOVA based on Years' service in the organisation are given in Table 4.9.

Table 4.9***Differences in factors of safety perceptions and Years' service in the organisation***

Item	0 – 5 years	6 – 10 years	11 – 20 years	20 years and more	<i>p</i>	Partial Eta Squared
Safety Management	131,33 ^b	144,90	156,47 ^a	147,58	0,02*	0,06
Risk Behaviour	17,17 ^a	10,95	10,09 ^b	11,67	0,00*	0,18
Safety Systems and Training	54,78	54,84	58,42	53,50	0,25	0,03
Receptiveness towards Safety Information	18,78 ^a	17,15	14,63 ^b	14,92	0,01*	0,07
Prioritising Safety	7,47	7,72	6,95	6,42	0,15	0,04
Reporting incidents and near-misses	36,97 ^a	29,13	27,51 ^b	29,42	0,00*	0,10
Equipment, Tools and Working Conditions	57,22	62,62	66,28	62,33	0,05	0,05
Safety Promotion	13,97	14,54	14,65	14,58	0,87	0,01
Reactions to Safety Investigations	7,47	6,71	7,70	6,58	0,05	0,05
Compliance	31,36	30,92	33,12	31,58	0,48	0,02

* Statistically significant difference: $p < 0,05$

^a Group differs statistically significantly from type (in row) where ^b is indicated

From Table 4.9, the results indicated that there is a statistical significant difference between Years' service in the organisation and Safety Management, Risk Behaviour, Receptiveness towards Safety Information, and Reporting incidents and near-misses. Participants with 11 to 20 years' service in the organisation are more positive towards Safety Management than participants with 5 and less years' service in the organisation. Participants with 5 and less years' service in the organisation are more inclined to engage in risk behaviour and are less receptive to safety information, than participants with 11 to 20 years' service in the organisation. They are also more likely to not report on incidents and near-misses in comparison to participants with 11 to 20 years' service in the organisation.

The results of the ANOVA based on Years' service in current position are given in Table 4.10.

Table 4.10***Differences in factors of safety perceptions and Years' service in current position***

Item	0 – 5 years	6 – 10 years	11 – 20 years	20 years and more	<i>p</i>	Partial Eta Squared
Safety Management	122,82 ^b	154,31 ^a	149,46	143,80	0,00*	0,12
Risk Behaviour	16,41 ^a	11,50	10,11 ^b	12,10	0,00*	0,13
Safety Systems and Training	52,47	57,72	56,14	52,30	0,08	0,05
Receptiveness towards Safety Information	17,27	17,53	15,21	15,20	0,19	0,03
Prioritising Safety	7,06	8,13 ^a	6,59 ^b	6,60 ^b	0,00*	0,10
Reporting incidents and near-misses	35,15 ^a	30,13	27,75 ^b	30,00	0,04*	0,06
Equipment, Tools and Working Conditions	53,41 ^b	65,77 ^a	64,71	60,60	0,00*	0,12
Safety Promotion	13,06 ^b	15,36 ^a	14,21	14,30	0,04*	0,05
Reactions to Safety Investigations	7,06	7,11	7,41	6,50	0,60	0,01
Compliance	29,56	32,88	31,93	30,40	0,16	0,03

* Statistically significant difference: $p < 0,05$

^a Group differs statistically significantly from type (in row) where ^b is indicated

From Table 4.10, the results indicated that there is a statistical significant difference between Years' service in current position and Safety Management, Risk Behaviour, Prioritising Safety, Reporting incidents and near-misses, and Equipment, Tools and Working Conditions, Safety Promotion. Participants with 6 to 10 years' service in their current position are more positive towards Safety Management than participants with 5 and less years' service in their current position. Participants with 5 and less years' service in their current position are more inclined to engage in risk behaviour, than participants with 11 to 20 years' service in the organisation. They are also more likely to not report on incidents and near-misses in comparison to participants with 11 to 20 years' service in their current position. Participants with 6 to 10 years' service in their current position values the Prioritising of Safety more than Participants with 11 years and more service in their current position. They also perceive that they have the Equipment, Tools and Working Conditions conducive for working safely and they are more

positive to Safety Promotion than participants with 5 and less years' service in their current position.

The results of the ANOVA based on department are given in Table 4.11.

Table 4.11

Differences in factors of safety perceptions and Department

Item	Technical	Production	Maintenance	<i>p</i>	Partial Eta Squared
Safety Management	142,95	148,16	142,50	0,67	0,01
Risk Behaviour	12,71	12,06	11,62	0,75	0,00
Safety Systems and Training	56,17	55,31	55,81	0,90	0,00
Receptiveness towards Safety Information	15,19 ^b	16,84	19,46 ^a	0,01*	0,06
Prioritising Safety	7,58	7,25	7,04	0,54	0,01
Reporting incidents and near-misses	30,41	31,39	28,73	0,60	0,01
Equipment, Tools and Working Conditions	61,64	63,88	60,04	0,46	0,01
Safety Promotion	14,66	14,34	14,19	0,84	0,00
Reactions to Safety Investigations	7,27	7,25	6,58	0,28	0,02
Compliance	31,44	32,08	31,31	0,84	0,00

* Statistically significant difference: $p < 0,05$

^a Group differs statistically significantly from type (in row) where ^b is indicated

From Table 4.11, the results indicated that there is a statistical significant difference between Departments and Receptiveness towards Safety Information. Participants employed in Maintenance are less receptive towards safety information than participants employed in the Technical department.

4.4. CHAPTER SUMMARY

This chapter reported on the results of the empirical research and discussed the quantitative results. A Self-constructed survey, Perceptions towards Safety were administered. Principal component factor analysis was performed on the survey and a commendable KMO correlation matrix was found. Ten factors could be extracted, explaining 81,55% of the total variance. These factors were labelled Safety Management, Risk Behaviour, Safety Systems and Training,

Receptiveness towards Safety Information, Prioritising Safety, Reporting incidents and near-misses, Equipment, Tools and Workplace Conditions, Safety promotion, Reactions to Safety Investigations, and Compliance.

Acceptable Cronbach's alpha coefficients ranging between 0,65 and 0,99 were obtained. These alpha coefficients compare well with the guideline of 0,70 (0,55 in basic research). This demonstrates that the dimensions (internal consistency of the dimensions) explain a large part of the variance (Nunnally & Bernstein, 1994). The scales of the measuring instruments have relatively normal distributions, with low skewness and kurtosis, except for Safety Systems and Training, and Compliance where the data was negatively skew and peak.

Three negative factors were identified, namely Risk Behaviour, Receptiveness towards Safety Information and Reporting incidents and near-misses. Regression analysis indicated that Safety Management was the only significant predictor of Risk Behaviour. This implied that the more positive participants are with regards to safety management, the less likely are they of displaying risk behaviour. Safety Management, Safety Prioritised and Safety Promotion were also significant predictors of Reporting incidents and near-misses.

MANOVA analysis was conducted to determine differences on some demographic characteristics and the factors of safety perception in terms of the total population. Statistically significant differences were found in terms of gender, racial, age, years' service in the organisation, years' service in current position and department. The results depicted that female participants are more positive towards Safety Management, and valuing the Prioritising of Safety and the Promotion of Safety. They also perceive that they have the Equipment, Tools and Working Conditions conducive for working safely. Male participants are more inclined to engage in risk behaviour and are also more likely to not report on incidents and near-misses. African participants were noted to be more positive towards Safety Management.

Participants, 35 years and younger are more inclined to engage in risk behaviour and less receptive towards safety information, than participants 36 years and

older. Participants, 35 years and younger however, also values the Prioritising of Safety. Participants with 11 to 20 years' service in the organisation are more positive towards Safety Management. Participants with 5 and less years' service in the organisation are more inclined to engage in risk behaviour and are less receptive to safety information. They are also more likely to not report on incidents and near-misses.

Participants with 6 to 10 years' service in their current position are more positive towards Safety Management. Participants with 5 and less years' service in their current position are more inclined to engage in risk behaviour, and they are also more likely to not report on incidents and near-misses. Participants with 6 to 10 years' service in their current position values the Prioritising of Safety and they perceive that they have the Equipment, Tools and Working Conditions conducive for working safely and they are more positive to Safety Promotion. Participants employed in Maintenance are less receptive towards safety information than participants employed in the Technical department.

In Chapter 5 the conclusions pertaining to the research questions, the limitations of the research and recommendations regarding future research, are discussed.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This concluding chapter provides the interpretations on the results presented in Chapter 4. From the interpreted results, conclusions are drawn against the primary and secondary objectives that were set for this research study. In addition to this, the various limitations identified during the progression of the study are revealed and discussed. Finally, recommendations are presented for both the safety environment and for future research opportunities as it stemmed from this research study.

5.2 CONCLUSIONS

The general objective of this research was to explore the relationship between safety and productivity in Petrochemical organisations. The following conclusions can be drawn, based on the research objectives posed in the research.

The first objective was to determine how safety culture, and safety climate is conceptualised from the literature. According to (Smith, 2013) culture in itself is a very big word. It's a comprehensive concept that has wide-ranging reach and influence throughout the organisation, and too often leaders misguidedly believe it has little to do with their scope of guidance and delegate its care and feeding to the Human Resources department. That can prove to be a costly mistake. Leaders should feel accountable for influencing the overall culture in their organisations as part of their duties as leaders, and safety leaders should especially welcome the prospect, given the criticality the role of culture plays in making and sustaining a safe workplace (Smith, 2013).

Research finds that there are a handful of factors that have substantial impact on creating a safe work environment, and all of them relate to the overall culture of the company. Towers Watson-ISR (Cited by Smith, 2013) has identified eight

cultural drivers of workplace safety that deliver the greatest return on safety investment and productivity, they are:

- **Communication**; how employees perceive the quality and quantity of communication in the company is the clear winner as the most influential driver in creating a culture of safety;
- **Senior management**, through their commitments and actions, senior leaders establish visible support of safety and operational excellence and employees will take notice of this;
- **Teamwork**, where teamwork is reinvigorated, and co-workers are willing to help one another, even if it means doing something outside their normal routine, safety results are more than three times fold better than where collaboration between groups, divisions, or business units isn't scored highly by employees;
- **Workload**, obviously, workload plays an important role in safety outcomes. Heavy workloads hinder safety performance, but this effect is buffered when strong teamwork takes hold, and it's not surprising to find teamwork and workload sharing identical survey results;
- **Supervision**, It's no surprise that how employees feel about their direct supervisor heavily influences their commitment levels about their job in general, but research also has discovered that the traits of good leadership or lack of them affect workers' safe work performance;
- **Involvement**, by encouraging and enable employees to trust and encouraging them to solve problems will heighten their sense of responsibility and enrich their motivation to take ownership of projects, reducing the likelihood of safety issues;
- **Individual impact**, there is also an element of individuality which is beyond involvement, individual impression is about empowerment and employees clearly understanding the significance of their individual job to the organisation's success and how their group's goals precisely align to the company's overall strategy;
- **Respect and well-being**, the literature further emphasize the fact that a culture which emphasise employee well-being and production quality

(rather than just bottom-line numbers) are more likely to make safety a top primacy.

The second objective was to determine perceptions towards safety from the literature. Literature demonstrate that perception of organisational safety climate refers to the shared perceptions about organisational values, norms, beliefs, practices and procedures (Gyekye, 2005). It describes the social and organisational environments in which workers execute their projects. The climate of an organisation has been known to be an important antecedent of workplace performance as workers' perceptions of the state of affairs and structures in place in their organisations have affected their perceptions of safety and work behaviour. According to research reports, perceptions of organisational climate tend to influence interactions among workers shape their affective responses to the work environment (Gyekye, 2005).

Workers need to feel important within their organisation, and when they feel valued, their perception towards their organisations is that of compassionate and will be satisfied with the organisational structures in place. They are more likely to differentiate that the organisations value their safety and general well-being as well. This assessment in turn reflects positively on their perceptions of the fundamental safety climate and influences organisational behaviour. It is true that when workers' basic needs are met unfailingly and the workers reciprocate their feelings through job satisfaction and productively, they display greater emotional attachment, involvement and express stronger feelings of fidelity and devotion to their organisations

According to (Gyekye, 2005) a number of studies have dependably found strong and positive relationships between job satisfaction and productive organisational behaviours such as perceived organisational support, organisational citizenship behaviours and fairness perception additionally, research reports on the job satisfaction-safety link have indicated that satisfied workers, more than their dissatisfied counterparts, are motivated into safe work behaviours and register relatively lower accident rates.

The third objective was to determine employees' perceptions in relation to the safety climate across the Operational units and the Safety, Health and Environment function within a South African Petro-chemical organisation. Through a factor analysis the following factors were identified to be applicable to the sample utilised in the current research. These factors were labelled Safety Management, Risk Behaviour, Safety Systems and Training, Receptiveness towards Safety Information, Prioritising Safety, Reporting incidents and near-misses, Equipment, Tools and Workplace Conditions, Safety promotion, Reactions to Safety Investigations, and Compliance. Three factors were noted as being negative and contributing to negative perceptions, i.e. Risk Behaviour, lack of Reporting incidents and near-misses and Receptiveness towards Safety Information.

The fourth objective was to determine the correlation relation between negative and positive perceptions towards the safety climate within the current research. Pearson product moment correlations depicted that the positive identified constructs correlated positively with one another and negative with the negative identified constructs. Results indicated that an increase in effective Safety Management inclusive of housekeeping, meeting safety targets, and management involvement in ensuring the safety of employees, will result in a reduction of Risk Behaviour, i.e. taking unsafe chances and risks, and the reluctance to Report incidence and near-misses. Risk Behaviour is also likely to increase when employees perceive that the Safety Systems and Training is insufficient and when they do not have the Equipment and Tools to safely execute their tasks and not have conducive Workplace Conditions to work safely. Risk Behaviour is further likely to increase when Safety is not promoted with preventative measures and when there is a lack of Compliance. An increase in Risk Behaviour results in employees being less inclined to Report incidents and near-misses. It was also indicated that taking risks may increase when employees are not receptive of and give the necessary attention to safety information provided.

With effective safety training and having efficient safety systems in place, the likelihood of employees reporting incidents and near-misses and not having a reluctance to report on these incidents, increases. It was further indicated that the

less receptive employees are to receive, acknowledge and adhere to safety information, the less likely they are to report on incidents and near-misses, and vice versa. The lack of reporting incidents and near-misses negatively impacts all attempts to promote safe behaviour.

The fifth objective was to determine the factors from the research that contributes to adverse safety behaviour. Regression analysis indicated that Safety Management was the only significant predictor of Risk Behaviour. This implied that the more positive participants are with regards to safety management, the less likely are they of displaying risk behaviour. Safety Management, Safety Prioritised and Safety Promotion were also significant predictors of Reporting incidents and near-misses.

According to (Reason, 2008) there several factors that contribute to unsafe behaviour namely;

- **Correct but unrewarding compliance**, even in the best organisations there will be rules that are necessary, but which are exasperating. These according to the literature should be scrutinised for necessity, and if not scrap them;
- **Incorrect but rewarding violation**, Literature indicates that they are precarious because they can easily become a habit, and they are wrong. Essentially an incorrect but hypothetically rewarding unsafe behaviour increases the likelihood of it being repeated times over until it becomes a routine and might end up being likened to skill based activities;
- **Incorrect but rewarding compliance**, adherence to inappropriate rules even when they can be seen as such, can be physiognomies of employees for whom any kind of non-compliance is a source of substantial personal distress. It is not as such in their DNA to bend the rules, good or bad for that sake;
- **Mistaken compliance**, this can easily happen where the compliance is in conflict with the general safety of the people and a good example is that of Piper Alpha where the emergency procedure stipulated that the gathering

point was in an area that was directly in line of fire that killed a lot of people and unfortunately people who complied ended up dying as a result of this;

- **Correct violation**, among those who survived the Piper Alpha tragedy there were those who deviated from the instruction and lived.
- **Correct but unrewarding violation**, the employee realise that the procedures are inappropriate for the task at hand, but chose not follow them. Even though the employee will not implement the instruction he will still guilty conscious for not following the rules or procedure for that matter;
- **Malicious compliance**, the compliance to those rigid procedures even when they don't make sense or don't benefit the organisation.

The sixth objective was to determine the differences in perceptions in relation to the safety climate across the Operational units and the Safety, Health and Environment function within the organisation in terms of demographic characteristics. MANOVA analysis was conducted to determine differences on some demographic characteristics and the factors of safety perception in terms of the total population. Statistically significant differences were found in terms of gender, racial, age, years' service in the organisation, years' service in current position and department. The results depicted that female participants are more positive towards Safety Management, and valuing the Prioritising of Safety and the Promotion of Safety. They also perceive that they have the Equipment, Tools and Working Conditions conducive for working safely. Male participants are more inclined to engage in risk behaviour and are also more likely to not report on incidents and near-misses. African participants were noted to be more positive towards Safety Management.

Participants, 35 years and younger are more inclined to engage in risk behaviour and less receptive towards safety information, than participants 36 years and older. Participants, 35 years and younger however, also values the Prioritising of Safety. According to Morrison (2015), beginning at middle age, adults start to accumulate more emotional stability and emotional intelligence. In most cases, older workers are less likely to be injured on the job. The younger workers are most times associated with being more risk prone. They are less experienced and

sometimes they experiment with the high-level risk unknowingly and their mistakes can be fatal. This suggests that older workers not only know how to avoid certain risks, but also are more willing to speak up or point out patterns that could lead to injuries. It is evident in the literature that older workers bring with them a wealth of knowledge from their years of experience. But they also bring increased risk of on-the-job fatalities and severe injuries.

Participants with 11 to 20 years' service in the organisation are more positive towards Safety Management. Participants with 5 and less years' service in the organisation are more inclined to engage in risk behaviour and are less receptive to safety information. They are also more likely to not report on incidents and near-misses. Participants with 6 to 10 years' service in their current position are more positive towards Safety Management. Participants with 5 and less years' service in their current position are more inclined to engage in risk behaviour, and they are also more likely to not report on incidents and near-misses. Participants with 6 to 10 years' service in their current position values the Prioritising of Safety and they perceive that they have the Equipment, Tools and Working Conditions conducive for working safely and they are more positive to Safety Promotion. Participants employed in Maintenance are less receptive towards safety information than participants employed in the Technical department.

5.3 LIMITATIONS

Several limitations were identified in this study. These limitations might have influenced the results of this study and the final generalisation of conclusions.

The safety environments of the Petrochemical industry in which the organisation operate are unique and therefore the findings of the study may not be valid to organisations other than Petrochemical industries. The study might perhaps have been bias on the fact that simple random sampling within selected Petrochemical industry was used.

The sample size is a further limitation due to time and financial resources and further studies with a bigger sample size must confirm these findings. Measuring

safety perception is very complicated. The study was also limited to a sample in the Gauteng area only and further studies in other provinces must confirm these findings.

Although the confidentiality of the survey was guaranteed, it is likely that the respondents were not convinced and consequently not disclosing complete honest answers in the questionnaire.

5.4 RECOMMENDATIONS

This section provides recommendations for both the Petrochemical environment, in which the study was conducted, as well as for potential future research.

5.4.1 Recommendations for the Petrochemical Organisations

The findings of the study can serve as a motivation and a guideline for the Petrochemical organisation with regards to safety perception on productivity. Safety behaviour is a requirement in the workplace is inevitable that the safety laws will soon yield a much tougher stance towards management with regards to injuries, fatalities, and irreversible injuries. The findings on this document can be used as a motivational vehicle towards achieving high performance culture in terms of safety and productivity.

The recommendation for the Petrochemical organisation is that all employees should be trained and declared competent in the in-depth knowledge of the consequences of the catastrophic failures that these organisations are synonymous with. In conclusion Petrochemical organisation shouldn't undermine the occupational health safety injuries which can equally cause irreversible damage to employees and distort a company image in the stakeholder's environment.

5.4.2 Recommendations for Future Research

Despite the limitations identified in this research study, the findings do propose valued recommendations for future research:

- To conduct a study on a greater sample size
- To include co-variates such as culture and religion
- To conduct a study on various facets/ branches of Safety culture and climate

5.5 CHAPTER SUMMARY

Chapter 5 provided conclusions concerning the objectives of the research study. Limitations were identified and discussed and recommendations were made for the Petrochemical organisations as well as for possible future research.

ANNEXURE A: QUESTIONNAIRE

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 Sasol Satellite Operations 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 106 statements associated with safety related aspects in your daily work environment.

It will take approximately 20 minutes to complete.

Yours faithfully,

Gilbert Nedzamba

MBA final year: NWU Graduate School of Business

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.

Biographical information

Please answer the following questions by marking the appropriate boxes

1. Gender

Male

☐

1

Female

☐

2

2. Race

African

☐

1

White

☐

2

Indian

☐

3

Coloured

☐

4

Other

☐

5

3. In which age group can you be categorized?

24 years and younger

☐

1

25 - 35 years

☐

2

36 - 45 years

☐

3

46 - 55 years

☐

4

56 years and older

☐

5

4 Highest qualification?

Up to grade 11

☐

1

Grade 12

☐

2

Diploma

☐

3

Degree

☐

4

Degree +

☐

5

5 Years of service in the *Sasol Group*

Less than 1 year

☐

1

2 - 5 years

☐

2

6 - 10 years

☐

3

11 - 20 years

☐

4

More than 20 years ☐ 5

6 Years of service in the Sasol Environment

Less than 1 year	☐	1
2 - 5 years	☐	2
6 - 10 years	☐	3
11 - 20 years	☐	4
More than 20 years	☐	5

7. Current department: _____

8. Leadership role Yes ☐ 1 No ☐ 2

9. **Current** **position:**

10. **Current** **job** **level:**

11. Years of service in your current *position*

Less than 1 year	☐	1
2 - 5 years	☐	2
6 - 10 years	☐	3
11 - 20 years	☐	4
More than 20 years	☐	5

Have you ever been disciplined for safety violation?

Perception of Safety survey on Productivity performance

Please read through the statements and answer them as honestly as possible, using the following scale:

1	2	3	4	5
Disagree Strongly	Disagree	Neither Disagree nor Agree	Agree	Agree Strongly

1.	Management involvement					
a.	Management sets a positive example.	1	2	3	4	5
b.	Management is willing to make money available to improve health and safety.	1	2	3	4	5
c.	Management attentively listens to safety ideas and concerns and take appropriate action	1	2	3	4	5
d.	Management would not hesitate to stop the operations if the plant is unsafe.	1	2	3	4	5
e.	Management operates an open door policy on safety issues	1	2	3	4	5
f.	Safety is a priority for management.	1	2	3	4	5
g.	Management is involved in safety only after incidents have occurred	1	2	3	4	5
h.	Personnel are actively encouraged to participate in initiatives which can improve safety.	1	2	3	4	5
i.	Management do not tolerate lack of discipline when it comes to safety compliance	1	2	3	4	5
j.	Management cares about the safety and well-being of their subordinates	1	2	3	4	5
k.	Management commitment to safety is visible through their actions ("walk the talk")	1	2	3	4	5
l.	Management talks a lot about safety in the midst of an accident but when everything goes well they tend to quiet down	1	2	3	4	5
2.	Health and safety meetings/Safety officials					
a.	Health and safety meetings are used to improve the health and safety of employees.	1	2	3	4	5
b.	We are given the opportunity to speak out at Health and Safety meetings.	1	2	3	4	5

c.	The team works together to solve problems raised at Health and Safety meetings.	1	2	3	4	5
d.	Safety officials are sufficiently empowered to enforce matters/regulations related to safety.	1	2	3	4	5
e.	Safety officials do a pretty good job.	1	2	3	4	5
f.	The health and safety committee makes an important contribution to health and safety here	1	2	3	4	5
g.	The health and safety committee meetings are held once a month as prescribed	1	2	3	4	5
h.	The members of the health and safety committee are appointed in terms of Section 19 of the OHS act.	1	2	3	4	5
3.	Immediate supervision					
a.	My supervisor gives feedback on suggestions and requests.	1	2	3	4	5
b.	My supervisor welcomes it if we report unsafe conditions or behaviors.	1	2	3	4	5
c.	My supervisor ensures that hazards reported to him are attended to.	1	2	3	4	5
d.	My supervisor views Health and Safety as a priority.	1	2	3	4	5
e.	My supervisor is concerned about the workers safety.	1	2	3	4	5
f.	My supervisor discusses hazards in the workplace with me.	1	2	3	4	5
g.	My supervisor does not tolerate unsafe conditions and acts.	1	2	3	4	5
h.	My supervisor / manager shows complete trust in my ability to identify risks	1	2	3	4	5
4.	Equipment, tools and workplace conditions					
a.	All equipment used complies with the safety regulations.	1	2	3	4	5
b.	All equipment is well maintained.	1	2	3	4	5
c.	The correct tools and equipment are always available.	1	2	3	4	5
d.	I feel comfortable that the equipment I work with is safe					
e.	Employees are not allowed to work with unsafe equipment.	1	2	3	4	5
f.	The necessary PPE is easily obtainable	1	2	3	4	5
g.	My workplace is conducive to safe execution of tasks	1	2	3	4	5
5.	Personal and team responsibility					
a.	Health and Safety is my responsibility.	1	2	3	4	5
b.	I have a responsibility to the safety of my colleagues.	1	2	3	4	5
c.	I am encouraged to make safety improvement suggestions	1	2	3	4	5

d.	I can refuse work when I feel that my safety is endangered.	1	2	3	4	5
e.	Employees are aware of the potential hazards in their work environment	1	2	3	4	5
f.	We often analyse routine and new task to look for ways of doing a job safer	1	2	3	4	5
g.	Everyone is accountable for their own safety	1	2	3	4	5
h.	I feel comfortable when allowing others to carry out tasks in my area of responsibility	1	2	3	4	5
i.	Employees in this organization undergo comprehensive and meaningful safety training	1	2	3	4	5
j.	Co-workers often give tips to each other on how to work safely	1	2	3	4	5
k.	Hazard identification is a prime focus in my daily job	1	2	3	4	5
l.	Employees would rather keep safety information such as near misses to themselves	1	2	3	4	5
m.	Employees would often help their fellow colleagues to conform to safety rules	1	2	3	4	5
n.	Doing things safely has become a habit for most employees rather than an obstacle	1	2	3	4	5
o.	Employees in this organisation are motivated to exert only as much effort as is necessary for task completion regardless of safety	1	2	3	4	5
p.	Employees at all levels are involved in decisions when it comes to safety	1	2	3	4	5
q.	Employees in this organisation possess the necessary knowledge and skills to allow them to work safely	1	2	3	4	5
r.	My team generally complies with all health and safety rules.	1	2	3	4	5
s.	I am responsible to inform management of important safety issues.	1	2	3	4	5
t.	I am a fully trained and aware of my role as Leopard observer	1	2	3	4	5
u.	I have done a Leopard observation in the last thirty days and have acted upon the deviations I have observed	1	2	3	4	5
v.	I have adhered to all safety requirements at work and in my personal life (e.g. complying to work place procedures and adhering to all road safety rules when driving my vehicle)	1	2	3	4	5
w.	I can influence health and safety performance here.	1	2	3	4	5
6.	Safety systems and training					

a.	The training I had, covered all the Health and Safety risks associated with the work for which I am responsible.	1	2	3	4	5
b.	Training has given me a clear understanding of all those aspects of my job which are critical to safety.	1	2	3	4	5
c.	Sufficient time and effort is committed to safety in my business unit	1	2	3	4	5
d.	Work instructions and procedures are followed to the letter	1	2	3	4	5
e.	Employees in this organization undergo comprehensive and meaningful safety training	1	2	3	4	5
f.	All employees are accountable for safety and everyone's safety is equally important	1	2	3	4	5
g.	I am trained to operate all the equipment and tools required to do my job.	1	2	3	4	5
h.	I fully understand the Health and Safety procedures associated with my job.	1	2	3	4	5
i.	The safety systems and policies used by Sasol is effective in addressing the real safety issues.	1	2	3	4	5
7.	Communication					
a.	I am satisfied with the way that I am kept informed regarding safety issues.	1	2	3	4	5
b.	I report a safety hazard to the right authorities.	1	2	3	4	5
c.	Relevant safety information is communicated to me on a regular basis					
d.	I am always informed about the outcome of meetings which address Health and Safety.	1	2	3	4	5
e.	There is good communication at shift handover.	1	2	3	4	5
f.	Information on recurring causes of accidents / incidents is effectively distributed to all appropriate personnel.	1	2	3	4	5
g.	Safety information is always brought to my attention by my supervisor.	1	2	3	4	5
h.	A safety communication campaign serves as a good reminder to live and work safely	1	2	3	4	5
i.	I think that safety messages are only for those who work in the factory	1	2	3	4	5
j.	From the safety communication I receive, I am able to work within Sasol's safety regulations.	1	2	3	4	5
k.	I feel overwhelmed by the amount of safety information I receive.	1	2	3	4	5
l.	I do not acknowledge safety information as I believe that I am already capable of working safely.	1	2	3	4	5

m.	I do not pay attention to safety information as it cuts into my work time.	1	2	3	4	5
n.	I believe that safety information is only for new employees	1	2	3	4	5
8.	Risk					
a.	I sometimes feel under pressure from my work mates to take chances.	1	2	3	4	5
b.	If I don't take a risk now and then, the job wouldn't get done.	1	2	3	4	5
c.	I can get the job done quicker by ignoring some rules.	1	2	3	4	5
d.	Sometimes it is necessary to ignore safety regulations to keep production going.	1	2	3	4	5
e.	Incentives encourage me to break rules.	1	2	3	4	5
9.	Accidents/incidents and near-misses					
a.	People who cause accidents here are not held sufficiently accountable for their actions	1	2	3	4	5
b.	People are willing to report accidents	1	2	3	4	5
c.	We often become complacent when it goes well and then incidents occur	1	2	3	4	5
d.	The organization learns from past mistakes and implements appropriate preventative measures as soon as possible	1	2	3	4	5
e.	Solutions for safety problems are most often short-term and do not address the root cause	1	2	3	4	5
f.	The majority of incidents are due to failures arising from the culture of the organization rather than mechanical failure	1	2	3	4	5
g.	People are willing to report near-misses	1	2	3	4	5
h.	Accident investigations are mainly used to identify who is to blame	1	2	3	4	5
i.	Accident investigations prevents accidents recurring	1	2	3	4	5
j.	Management acts only after accidents have occurred	1	2	3	4	5
10.	Culture	1	2	3	4	5
a.	My organization is known for recognizing individual contribution towards safety	1	2	3	4	5
b.	Safety is how we do things around here	1	2	3	4	5
c.	I am proud to be associated with this business unit when it comes to safety	1	2	3	4	5
d.	Although safety is regarded as top priority it's sometimes overlooked due to productivity or cost implications	1	2	3	4	5

e.	Safety is seen as a condition of employment	1	2	3	4	5
f.	Being rewarded for good safety performance helps to promote safe behavior	1	2	3	4	5
g.	Some people get away with unsafe acts	1	2	3	4	5
h.	Good safety performance will lead to good business performance	1	2	3	4	5
i.	The reason for not achieving our safety targets is because everyone does not value safety as important	1	2	3	4	5
j.	Although working safely is expected from everybody, it is rarely recognized	1	2	3	4	5
k.	The way we conduct safety investigations is indicative of a world-class organization	1	2	3	4	5

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