

**Gordon Institute
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Impact of improved safety on productivity

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ABSTRACT

The research investigates if there is a relationship between a focus on improved safety and productivity. This relationship can help companies improve the approach in dealing with two variables that line managers' battle with daily. Data was collected from 115 respondents and interview conducted with 6 senior managers in the petroleum industry. The research confirms that there is a relationship and that when a company focus on improving safety they could at the same time improve productivity. An investment on productivity could also improve productivity if they focus on it during design. These two variables support goal number eight of the United Nations sustainable development goals. The research also found that employees believe that the company is not doing enough to invest in safety and there is not enough belief in safety. The research also found that investing in productivity can also improve safety and employees and management with the right safety culture. Safety is a licence to operate and productivity is necessary for the sustainability of the business.

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirement for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other university. I further declare that I have obtained the necessary authorisation and consent to carry out the research.

Mboye Khathutshelo

09 November 2015

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Chapter 1: Introduction to the research problem

Espen Barth Eide, who is the managing director and member of the managing board of the World Economic forum said that the relationship between productivity, social development and environmental stewardship is complex (WEF Global Competitiveness report, 2014/15). Laurence (2010) suggests that a sustainable mine is one is a safe mine and Jagoda, K. Lonseth and A. Lonseth (2012) found that companies are constantly looking to improve productivity, through many different methods. In the past few years, companies have had a lot of pressure from regulators, society and employees to improve safety performance and comply with safety legislation and regulations. At the same time, it has been difficult times for companies with hostile industrial actions, unfavourable economic environment and high production costs that are resulting in low productivity.

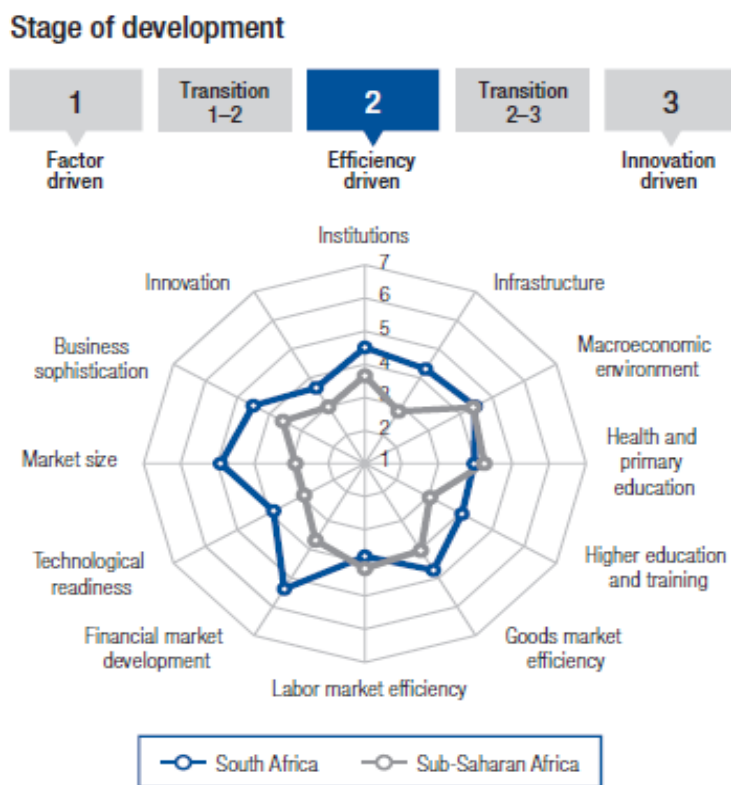
Productivity is defined is the ratio between outputs and inputs. De Looze, Ten Have, Van Rhijn and Kuijt-Evers (2011) expand this definition by explaining that the inputs comprise all factors utilised to produce the output of demand. The input factors include labour as well as capital and resources and the output may be in terms of physical volumes or financial indicators (De Looze, 2011). The deputy minister of labour Nkosi Patekile Holomisa at the launch of productivity statistics launch 2014 defined productivity as an economy's ability to produce goods and services capital inputs and labour inputs. Productivity is, in essence, the ability of persons, enterprises, economies or any other defined system to efficiently use the resources at their disposal, to produce products or offer services that satisfy the consumer or user (<http://www.labour.gov.za/>).

The global competitiveness index 2014/15 indicates that in order to ensure sustainable growth more especially in the emerging markets, in the long run, will depend not on monetary policies, but on boosting the level of productivity of economies. In order to achieve a higher level of productivity, new actions in terms of engaging in much-needed structural reform and productivity-enhancing investments are required (WEF Global Competitiveness report, 2014/15). The World Economic Forum defines competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country. The level of productivity, in turn, sets the level of prosperity that can be reached by an economy. The productivity level also determines the rates of return obtained by investments in an economy, which in turn are the fundamental drivers of its growth rates. In other words, a

more competitive economy is one that is likely to grow faster over time. On top of the need of these reforms and investments that organisations need to do there are increased legislation on improving safety and environmental requirements (WEF Global Competitiveness report, 2014/15).

If one looks at the Global competitiveness index for South Africa one of the areas that South Africa is not doing well on is the labour market efficiency (see figure 1), it is even worse than the Sub-Saharan Africa region. The labour market is inefficient and according to Prophet Analytics analyst Peter Aling labour productivity had declined since the 1980s and in 2012 productivity had dropped to the 40 year low. (Fin24.com, 2012)

Figure 1: WEF South Africa global competitiveness index



On top of the requirements to improve safety, there are all these pressures of improving workplace safety and complying with new and improved environmental laws and requirements. Companies are faced with a challenge of improving safety while improving productivity. In 2010/2011 the department of labour compensation fund paid over R2.7 billion in compensation for injuries and diseases sustained in the workplace in the five high-risk

industries which are iron and steel, Air road transport, building and construction, agriculture and chemical sector. To quote the department of labour director for Electrical & Chemical Engineering Jacob Malatse said:

“While our endeavour is to protect vulnerable workers, monitoring the impact of legislation, South Africa continue to be plagued by a lack of adherence to occupational health and safety. People continue to die and many succumb to occupational injuries. The loss of work-time because of hazards means a loss of income, a decline in gross domestic product (GDP) and a cost to the country,” (Department of labour)

According to the International labour organisation, every 15 seconds a worker dies from a work-related accident or disease. Every 15 seconds, 153 workers have a work-related accident. Every day, 6,300 people die as a result of occupational accidents or work-related diseases – more than 2.3 million deaths per year. 317 million accidents occur on the job annually; many of these resulting in extended absences from work. The human cost of this daily adversity is vast and the economic burden of poor occupational safety and health practices is estimated at 4 percent of global Gross Domestic Product each year. (International labour organisation)

1.1 Motivation for the research

Line managers are faced with two of these problems, reducing the incident and complying with stringent legislation and at the same time after 2008 as Jacob Malatse said;

“The economic crisis has impacted negatively to OHS since 2008. With the global economic crisis expected to deteriorate, adherence to OHS is expected to suffer as a result,” (Department of labour)

The crisis of 2008 has resulted in pressure on companies to invest in productivity and make sure that the limited input can produce as much as possible to the last cent. At the same time the pressure of the legislation to comply with all the occupational health and safety requirements and the new environmental legislation. The government is introducing an environmental law to reduce greenhouse gases (GHG) from the refineries, and working on

carbon pricing and tax mechanisms. The legislations are getting stringent and the penalties are getting higher and higher including jail time for none compliance.

The United nations have agreed on sustainable goals that are following up to the millennium development goals. The goals were adopted at the United Nations conference on sustainable development that was held in June 2012 at Rio de Janeiro. If one looks at goal number eight which is “decent work and economic growth” and look at the following points:

- 8.2. Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value-added and labour-intensive sectors
- 8.8 Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular, women migrants, and those in precarious employment (United Nations)

These two points address the two variables that this research is looking at. The motivation for this research is to see if these two points may be addressed simultaneously.

1.2 Research question

There is increased the burden on companies to comply with safety regulation (Hale, 2013). The regulations by the government and regulators keep on being increased and modified and companies have to spend a lot of resources and time in making sure they comply with the regulations. Safety in the workplace is not just a burden in terms of legislation but it is part of the sustainability of the organisation, but there is still very little research on the link between safety and financial performance (Hajmohammad, 2013). As the regulation and laws are becoming more stringent and they become more costly in order for the organisation to comply. The cost of none compliance is even greater. The penalties that the government imposes are very high but more important the reputation of the company.

The research question is “does focus on safety improves productivity” The research looks at the following research questions:

Research question 1:

How does focus on improving safety improve productivity?

What other factors are associated with safety improving productivity?

Research question 2:

How are the factors related in explaining safety improving productivity?

Chapter 2: Literature review

2.1 Safety

According to the International labour organization-world health organization, occupational safety and health must intend to promote and preserve the highest degree of physical, mental and social well-being of the employees and workers in all occupations (Molamohamadi and Ismail, 2014).

According to Molamohadi (2014) the genuine desire of sustainable development and occupational safety, health, and environmental is human welfare and satisfaction. Sustainable development is a strategy to meet the needs of the present world population without causing an adverse effect on health and on the environment, and without depleting or endangering the global resource base, hence without compromising the ability of the future generations to meet their needs (Molamohamadi and Ismail, 2014).

2.1.1 Safety in high-performance systems

High-performance work systems assume employees are a primary source of competitive advantage that is difficult for others to imitate (Zachratos, 2005). If this is the case; one could conclude that the well-being of the employee will be the primary focus of organizations in building a sustainable differentiated competitive organization. This then will lead to a number of studies or research on the relationship between safety and productivity, but such research papers are rare to find and those that are available do not model this relationship; they are not very conclusive.

The focus is either on psychological impact in terms of human resources for safety or productivity and efficacious as a separate element instead of looking at the combination of safety and productivity. The studies on implementation of quality management (QM), lean, just-in-time or other operational improvements look mostly on making production faster and in the reduction of waste but does not look at the impact on safety (Pagell, 2009).

This is quite alarming given the importance of safety in any organisation. Safety is an important requirement in an organisation because of the human and financial costs

associated with unsafe behaviour (Hofmann, 2003). According to Hofmann, Morgeson and Gerras (2003) the costs of injuries runs into billions of dollars in lost wages and productivity, medical costs and administrative expenses and that excludes the psychological costs like pain, suffering, grief and loss or the damage to the organisation's reputation and might negatively impact recruitment and other efforts.

Zacharatos, Barling and Iverson (2005) quotes Preffer (1998) who indicates that a high-performance work system assumes that employees are a primary source of competitive advantage that is difficult for others to imitate. The high-performance work system according to Zacharatos (2005) implies that workers are capable of continuous improvement and will perform at higher levels if they are motivated to do so. In order for the organisation to continuously perform at a high level; it needs to make sure that the operating environment for its employees is encouraging for employees to perform at the highest level possible.

Even though this issue seems very important, Mullen (2004) indicates that less than 1% of organisational research focuses on issues concerning occupational health and safety. According to Mullen (2004), this statistic is very low considering the significant impact on social and economic costs associated with occupational safety such as occupational fatalities, work-place injuries, and lost productivity.

2.1.2 Safety as part of sustainability

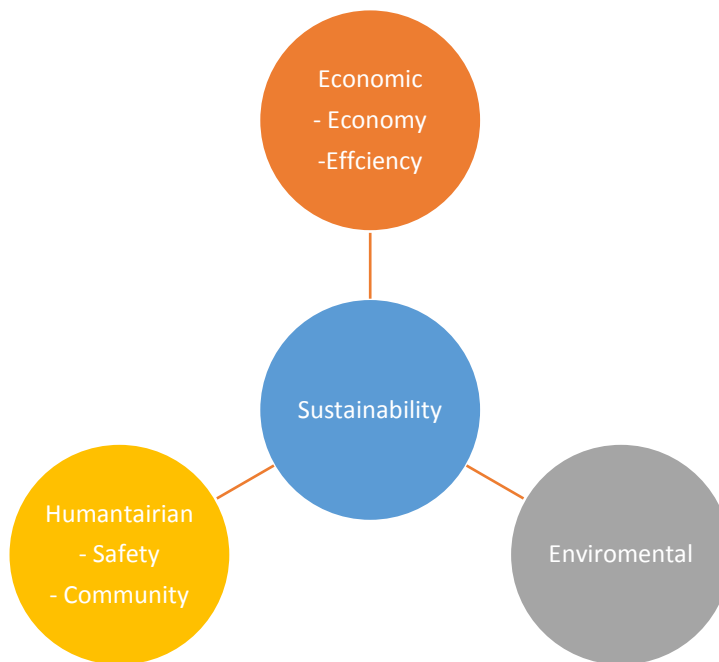
Sider (1982) writes about the coal mining industry experiencing a spectacular decline in labor productivity in the United States in the 1970s after a steady increase in the nineteen fifties and sixties. The factor which is most cited was the introduction by the department of labor; the Coal Mine Health and Safety Act of 1969 by diverting resources from output producing to accident-reducing activities. Even though this was 40 decades ago, one cannot help but wonder if the question is still relevant; does focus on workplace safety take resources away from productivity?

Haugh and Talwar (2010) define sustainability by drawing on the principle of the Brundtland commission: "Meeting the needs of the present without compromising the ability of future

generations to meet their own need”. Haugh and Talwar (2010) indicate that there are three pillars of sustainability: namely, economic, social and environmental. The economic sustainability is fundamental to corporate financial success; in the long run the organization cannot survive if the expenditure exceeds income (Haugh 2010). Social sustainability embodies the humanitarian context of the business and environmental sustainability considers the impact of business on the quality and quantity of natural resources (Haugh, 2010).

Laurence (2011) argues that managers should focus on the following areas in order to be sustainability: Safety, Environment, Economy, Efficiency and Community. The five areas of sustainable development that Laurence talks about can be grouped into the three pillars that were suggested by Haugh and Talwar (2010) a year earlier. Economy and efficiency can be classified under economic sustainability, safety and community under humanitarian and environmental as a pillar on its own.

Figure 2: Sustainability pillars



Laurance (2011) was to some degree supported by Funk (2003) where he indicated that companies that actively manage a wide range of sustainability indicators are better able to create long-term value for all stakeholders, and one important stakeholder is the employee. Wilkinson, Hill and Gollan (2001) supports Funk (2003) and Laurance (2011) that human resources sustainability requires the organisation to recognise and place value on human capabilities which take a more holistic and integrated approach to people management. Do

managers confront the challenge of aligning the interest and needs of their most important? Resource, their staff, so that business success can be achieved and maintained (Wilkinson, 2001).

Laurence (2011) suggests that the sustainable organisation is one that is safe, demonstrates leading practices in environmental management and community engagement, is economically robust and which, very importantly, efficiently uses the mineral resources. Are these resources competing for the limited resources that managers have or do they complement each other? Will high safety performance result in high economic performance for the mines? Which will lead to sustainability of the mine and continues a positive contribution to community development?

Is what Laurence (2011) suggesting achievable? Gomes, Kneipp, Kruglianskas, da Rosa and Bichueti (2013) support Laurence (2011) in that continual improvement in health and safety were associated to business improvement. The conundrum faced by mine managers and engineers is to protect the workforce while achieving the production goals (Pagell, 2014).

2.1.3 Leadership in Safety

Berry, Mirabito and Baun (2010) said that the first pillar in an effective workplace wellness program is multilevel leadership. Leadership plays an important role in creating a culture of safety. Du and Sun (2012) argue that one way to decrease human error or incidents are effective safety leadership. These are the same leaders who are supposed to make sure that the organisation is sustainable which implies according to Laurence (2011) that the organisation is profitable, efficiency, environmentally sustainable and is involved with the community that it operates within. This means that these leaders have to juggle a lot of balls and they are expected not to drop even one. The shareholders are looking for profits, the government and society looking for a cleaner environment, community looking for development, and the employee looking for a safe place to work. The question that still arises is that are these competing priorities or complementary?

Zacharatos (2005) demonstrates that transformational leadership would be an appropriate leadership model for occupational safety. Zacharatos (2005) said employees would appreciate those instances when management took safety seriously. Clarke (2013) support Zacharatos (2005) in that transformational leadership supports improvements in workplace safety but suggests that further research is needed. These studies emphasise the importance of leadership in improving occupational safety?

Bass (1990) demonstrate in Table 1 below the difference between transactional and transformational leadership:

Table 1: The description of transformational and transactional leader (Bass, 1990)

Transformational leader	Transactional leader
Charisma: Provides vision and sense of mission, instills pride, gains respect and trust. Inspiration: Communicates high expectations, uses symbols to focus efforts, and expresses important purposes in simple ways. Intellectual Stimulation: Promotes intelligence, rationality, and careful problem solving. Individualized consideration: Gives personal attention, treats each employee individually, coaches, and advises.	Contingent Reward: Contracts exchange of rewards for effort, promises rewards for good performance, recognizes accomplishments. Management by exception (active): Watches and searches for deviations from rules and standards, takes corrective action. Management by exception (passive): Intervenes only if standards are not met. Laissez-Faire: Abdicates responsibilities, avoids making decisions.

Clarke (2012) added to Zacharatos' (2005) study, looks at the model of safety leadership which incorporate both transformational and active transactional leadership style. Clarke (2012) argues that a combination of both transformational and active transactional leadership style should result in effective management of workplace safety, as it brings together leader behaviours that ensure safety through the encouragement of positive engagement with safety as well as safety compliance. Clarke's (2012) study highlights the importance of leadership style as an antecedent of safety perceptions and behaviour.

Clarke (2012) therefore argues that transformational leadership on its own is not enough to build a safety culture and improve safety behaviour. He argues that although the role of transformational leadership in relation to safety was supported in line with previous research, the findings indicate that active transactional leadership behaviours (which capture aspects of monitoring, proactive approach to potential problems and feedback on error) are also critical.

Clarke (2012) suggests that while it may be possible to ensure safety compliance through the use of active transactional leadership alone, this style has only an indirect effect on safety participation. Clarke's (2012) work indicates that transformational leaders may be viewed as 'playing lip service' to safety issues, whereas the critical element of active transformational leaders is that they seem to 'walk the talk': transactional behaviours, such as active monitoring and intervention when a problem occurs, demonstrate clearly to employees in a highly visible way the importance attached to their work activities in terms of safety.

Pagell, Dibrell, Veltri and Maxwell (2014) asked an important question; "is an efficacious operation a safe operation?" This is a question that every leader must be asking every time they are faced with a decision to where to invest the limited resources.

2.1.4 Safety culture

Cooper (2000) indicates that many industries around the world are showing an increasing interest in the concept of safety culture as a means of reducing the potential for large-scale disaster, and accidents associated with routine work. Cooper indicates that the term safety culture first made its appearance in 1987 after the 1986 Chernobyl disaster. Safety culture is loosely used to describe the corporate atmosphere or culture in which safety is understood to be and is acceptable as the number one priority.

Cooper (2000) defines safety culture (adopted from the United Kingdom Health and Safety Commission):

“As the product of individual and group values, attitudes, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation’s health and safety programmes. Organisations with a positive safety culture are characterised by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in efficacy of preventative measure”

Glendon and Stanton (2000) indicate that safety culture is identified for example by disaster enquiries as being fundamental to an organization’s ability to manage safety-related aspects of its operation. Glendon and Standton (2000) summarises safety climate dimensions from six studies that influence safety culture:

- Management attitudes
 - Management commitment towards safety
 - Management attitudes towards safety
 - Employee perceptions towards management concern with their well being
 - Employee perception of management response to their concern

- Training
 - Importance and effectiveness of safety training
 - Personal authority, training and enforcement of policy
 - Training and management attitudes
 - Communication and training

- Procedures
 - Incident investigation and development of procedures
 - Adequacy of procedure

- Risk perception
 - Level of risk at workplace
 - Employee physical risk perception
 - Work environment

- Work pace
 - Effects of work pace on safety
 - Work pressure

- Workers involvement
 - Status of safety committee
 - Workers involvement in safety

A safety culture according to Edwards, Davey and Armstrong (2013) has ties with more traditional concepts of culture. Culture is the way we do things around here (Edwards, 2013). The beliefs and values that refer specifically to health and safety from the subset of organizational culture referred to as a safety culture (Parker, 2005)

Parker, Lawrie, and Hudson (2005) quotes Reason (1997) who proposed that organization with effective safety culture has:

- A safety information system that collects, analyses and disseminates information from incidents and near misses, as well as from regular proactive checks on the system;
- A reporting culture where people are prepared to report their errors, mistakes and violations;
- A culture of trust where people are encouraged and even rewarded to provide essential safety-related information, but also in which it is clear where the line between acceptable and unacceptable behaviour is drawn;
- Is flexible, in terms of the ability to reconfigure the organisational structure in the face of a dynamic and demanding task environment;
- The willingness and competence to draw the right conclusions from its safety system, and is willing to implement reform when required.

In order to measure the safety culture of the organization Flin, Mearns, Connor and Bryden (2000) suggest that there has been a movement from away from safety measures purely based on retrospective data or lagging indicators such as fatalities, lost time accident rate and incidents toward the leading indicators such as safety audits or measurements of safety climate. These are predictive measures enabling safety condition monitoring which may reduce the need to wait for the system to fail in order to identify weaknesses and to take remedial actions.

Flin, Mearns, Connor and Bryden (2000) indicated that the most measured dimensions to determine the safety culture agreeing with Glendon and Stanton (2000) that are those elements related to management, safety systems, risk, followed by work pressure and competence. Alignment is that Gledon and Stanton (2000) includes worker involvement and Flin, Mearns, Connor and Bryden (2000) looks at worker competence.

2.1.5 Measuring safety climate

In any high-reliability industries where significant hazard is present, operating companies and their regulators pay considerable attention to safety assessment (Finn, Mearns, O'Connor & Bryden, 2000). According to Finn (1998) organization have moved from measuring lagging indicators like fatalities, injuries and incidents and are now focused on leading indicators like safety audits or measurements of safety climates.

According to Finn (2000) the following themes should be measured in order to determine the safety climate:

- Management
- Safety system
- Risk
- Work pressure and
- Competence

Competence is very important because it focuses on the employees whom according to Fam study (2008) there is a significant relationship between the number of unsafe behavior and accident record. Fam, Azadeh, Faridan and Mahjub (2015) goes on to suggest that in order to improve the safety clement for employees the following should considered:

- 1) Employing task risk analysis methods to screen determine risky jobs in order to do ergonomic evaluations and appropriate interventions
- 2) Setting and implementing an executive system to accomplish PPEs programs successfully. Such programs mainly include appropriate selecting, maintenance and cleaning of PPEs.

- 3) Design and implementation of accident proneness tests before employment to recognise and screen employees with higher natural tendencies in causing accidents. This might prevent such employees from doing critical (safety concerned) jobs.
- 4) Planning and conducting safety-training programs based on behavioural based safety in order to improve unsafe behaviour and change false safety attitudes consequently.
- 5) Design and implementation of punishment and award system considering employees' patterns of behaviours
- 6) Periodic evaluation of workers' behaviour in order to provide proper inputs for interventions and measuring the effectiveness
- 7) Implementation of a risk management system to determine the risk of unsafe behaviours and presenting suitable engineering and administrative controlling methods.

2.2 Productivity

2.2.1 What is productivity?

Melo, Cruzes, Kon and Conradi (2011) shows that there are several productivity studies that have been carried out, but productivity remains a controversial issue. There are several concepts involved in its definition, such as effectiveness, efficiency, and performance, generating misunderstandings. Productivity is commonly defined as the ratio of output to input. Productivity describes the relationship between the products being produced and the amount of resources being used in the transformation process (Sundkvist, 2011).

Syverson (2010) puts it simply as productivity is the efficiency in production. To illustrate this Syverson (2010) indicates that two producers may have different labor productivity levels even though they have the same production technology; if one happens to use capital much more intensively.

2.2.2 How is productivity measured?

According to Jagoda, K. Lonseth and A. Lonseth (2013) developing a measure to evaluate factors affecting productivity and performance is extremely important for managers as well as workers. Even for this study we need to define how we are going to measure productivity in order to develop some relationships.

Sundkvist, Hedman and Almstrom (2011) measure productivity by using the formula:

$$Productivity = M \times P \times U \times Q \quad [1]$$

Where: M = Method – the productivity measure of an individual operation or activity performed

P = Performance – the speed that the activity is carried out at in practice

U = Utilisation – the portion of the planned production time that actually has been used to create value for the customer

Q = Quality – the yield of a specific process

This formula is good if one is trying to measure the productivity of an individual task or machine or of a production line. The formula to measure the productivity of a machine changes by replacing (P×U×Q) with the Overall Equipment Efficiency (Stundkvist, 2011). If one is looking to measure the productivity of an organisation one will have to look at the definition of productivity first.

$$Productivity = \frac{Output}{Input} \quad [2]$$

Syverson (2010) indicates that due to the limitation of data the standard approach of measuring productivity has been the use of revenue. Capital is measured using the

establishment of its capital stock (Syverson, 2010). According to Pretorius (2004), the output of the organisation can be measured using net profit (NP) while the input can be regarded as the investment made (INV). If one substitute these variables to equation [2], it product the following equation:

$$Productivity = \frac{NP}{INV} \quad [3]$$

The overall productivity of an organisation expressed in monetary terms is the return on investment (ROI) (Pretorius, 2004). For the purpose of this study, productivity will be measured as using equation [3], since mine managers are concerned with the productivity of the system as a whole i.e. the organisation.

2.2.3 Human capital impact on productivity

Much literature on human capital exists that has tied several factors to labour quality, including education, training and overall experience, and tenure at a firm (Syverson, 2010). Syverson acknowledges that a smaller set of work has looked at human capital's impact on productivity. Tohidi (2010) explores 10 factors that affect productivity of labour force:

1. Reward system
2. Leadership
3. Training and learning
4. Goals
5. Intra group wage inequality
6. Size of team
7. Motivation
8. Models of effectiveness
9. Team measurements
10. Information technology

Melo, Cruzes, Kon, and Conradi (2011) agrees with Tohodi (2010) in that the factors that affect productivity is personnel motivation; and the motivation to work in the company. Islam and Shazali (2010) agrees that in labour intense industries a favourable working environment, such as working with a good team, having a good boss, and liking the physical surroundings in the workplace, is a contributory factor for motivating the workforce towards higher output.

Islam (2010) finds that there is a positive and significant relationship between productivity and degree of skill for labour-intensive manufacturing industries. Islam (2010) also find that productivity and favourable working environment have a positive and strong relationship and contribute to job satisfaction is a complementary positive factor of productivity.

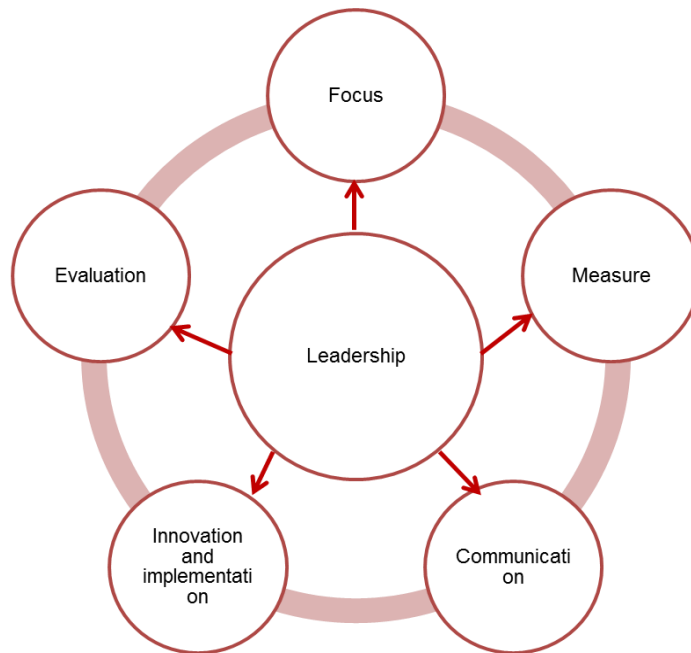
2.2.4 Leadership in productivity

Syverson (2010) shows that researchers have long proposed that managers drive productivity differently? Managers are conductors of an input orchestra; they coordinate the application of labour, capital and intermediate inputs (Syverson, 2010). Melo, Cruzes, Kon, and Conradi (2011) indicate that to manage productivity effectively, it is important to identify the most relevant difficulties and develop strategies.

The study conducted by Jagoda, Lonseth and A Lonseth (2012) shows that people prefer to be led rather than being managed. This is because the term manager denotes a paternalistic relationship where the hierarchy of the organisation suggests that those higher in the organisation have better knowledge of operational excellence than those working on the floor (Jagoda, 2012). Jagoda (2012) defines a leader as a facilitator of results, mentor to their staff and turn them into efficient and effective workers.

In the continuous improvement model for productivity improvements (Figure 2 below) Jogoda, Lonseth and A. Lonseth (2012) puts leadership in the centre to improve productivity. The responsibility of the whole model functioning relies on leadership (Jogada, 2012); the staff needs to be lead and coached.

Figure 3: Continuous improvement model for productivity improvement (Jogoda, Lonseth and A. Lonseth, 2012)



Jagoda, Lonseth and A Lonseth (2012) conclude that a bottom-up approach leads to empowering the workers to take the lead on the productivity improvement initiatives; this leads employees to accept the changes made and sustainability of the initiatives. This approach allows managers to focus their time on long-term improvements.

2.2.5 The Goal

According to Godratt and Fox (1986); they define the goal of the organisation as “to make money in the present as well as in the future”. This definition is supported by Sundkvist, Hedman and Almstrom (2011) when they say that the ultimate goal for any commercial operation must be to generate profitably, return on investment or assets, to its owners.

If the goal of the organisation is to generate a profit it means equation [3] is the right measure to use as it links productivity to profit. It means if one improves productivity, it will improve the re turn on investment for the owners. To support this logic Jagoda, K. Lonseth and A. Lonseth, (2013) indicate that because of lack of understanding of the relationship between productivity, profitability and performance has led to the application of piecemeal solutions for problems in productivity. If organisations understand this link they are able to

make the right decisions when it comes to improving productivity than view the concepts of productivity and productivity improvement in a negative way as a signal of a new spate of layoffs (Pretorius, 2004).

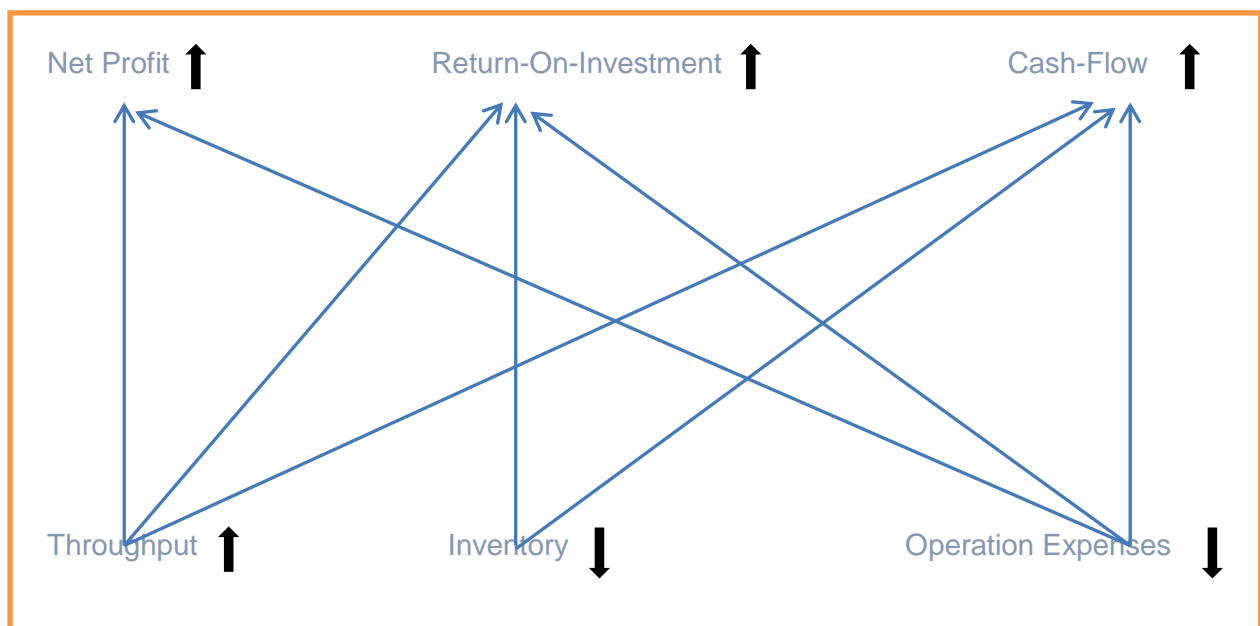
2.2.6 Measuring the goal

In order for the organisation to achieve the goal, Goldratt and Fox (1986) measure the progress toward achieving this goal by measuring three operational measurements. The three are:

- Throughput – The rate at which the system generates money through sales
- Inventory – All the money the system invests in purchasing things the system intends to sell and
- Operational expense – All the money the system spends in turning inventory into throughput.

Goldratt and Fox (1986) go on to explain the impact that these operational measurements have on the bottom line financial measurements. This impact is best illustrated by figure 1:

Figure 4: The direct impact of the operational measurements on the bottom line financial measurements (Goldratt and Fox, 1986)



This diagram shows that the organisation increases throughput it will result in an increase in net profit, return on investment and cash flow. It also shows that a decrease in operational expenses will result in an increase in all three bottom line financial measurements. Lastly, when the organisation manages inventory well and keep it at minimum it will result in increased return on investment and cash flow. (Goldratt,1986). All three of these operational measurements have an impact on the return-on-investment (ROI) which from equation [3] is shown that is productivity. For an organisation to increase productivity they need to focus on the three operational measurements.

2.3 Chapter summary

Literature that focuses on the relationship between employee safety in the workplace and productivity or effective and efficient (efficacious) (Pagell, 2014) operation is still rare to find. One would think that employee safety and efficacious operation as a fundamental element of a sustainable production and business would be the focus of research in determining the relationship. Pagell, Dibrell, Veltri and Maxwell (2014), conclude in their study that there is a greater deal of future research needed to fully understand the relationship between operational practices and outcomes and safety practices and outcomes.

Jagoda, K. Lonseth and A. Lonseth (2012), summarises the some different studies that have been done to identify the most influential factors affecting productivity. These studies show the following factors quality, knowledge, investment, equipment losses, maintenance working methods and labour quality affect productivity. None of these studies focuses on safety. Jagoda, K. Lonseth and A. Lonseth (2012) go on to show that some studies found that productivity is positively correlated with a favourable working environment. Which means the employee feels safe and understands the contribution that he is making to the bottom line of the company.

One commonality that one can see from different studies of safety and productivity is that in order to improve them they depend on the competence of human capital. Syverson (2010) indicates that the higher the labour quality improves productivity and this is tied to the level several factors as education, training, overall experience and tenure at the organisation.

Similarly, Flin, Mearns, Connor and Bryden (2000) indicate that worker competence is important in building a safety culture. One is tempted to conclude that high competent labour force should have a positive impact on safety and productivity.

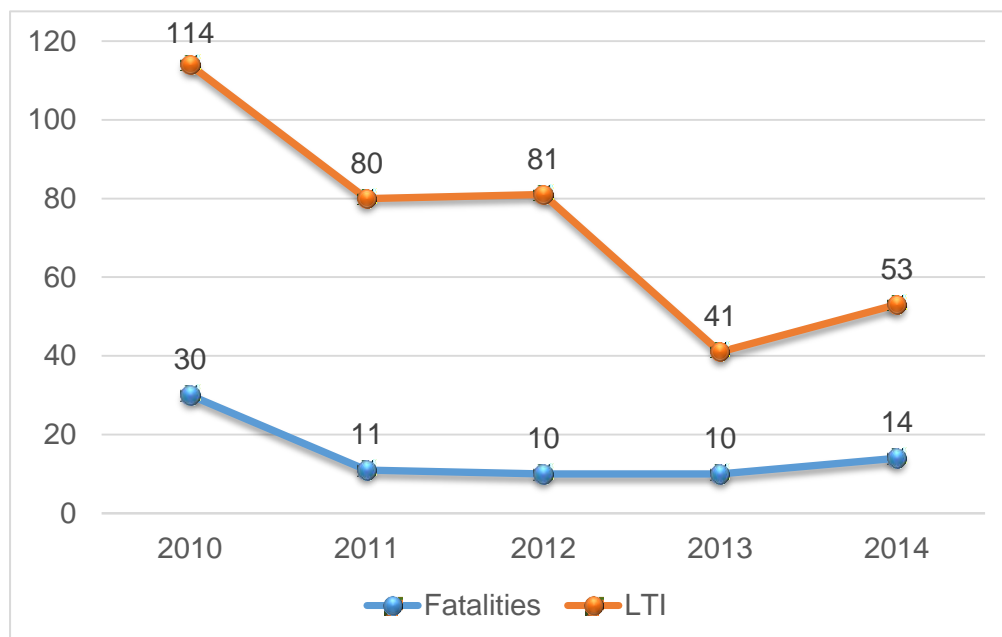
Limited studies have considered a bottom-up approach for productivity improvements (Jogada, 2012), meaning making the working environment favourable to the employee by making it safe for them to be productive. This study wants to answer the question "How improvements in safety impact productivity?" The study will look at how safety impact on the three operational measurements and thus the financial bottom line measurements which include productivity i.e. ROI.

Chapter 3: Research question

There is increase burden on companies to comply with safety regulation (Hale, 2013). The regulations by the government and regulators keep on being increased and modified and companies have to spend a lot of resources and time in making sure they comply with the regulations. Safety in the workplace is not just a burden in terms of legislation but it is part of sustainability of the organization, but there is still very little research on the link between safety and financial performance (Hajmohammad, 2013). As the regulation and laws are becoming more stringent and they become more costly in order for the organization to comply. The cost of none compliance is even greater. The penalties that the government imposes are very high but more important the reputation of the company.

Different industries have inherently different levels of risk. The petroleum industry has to deal with the process of that has high risk from the drilling of crude/gas or mining of coal, to the refining of the crude in which there are different risks and then logistic of transporting to the different service stations. Even though this research focuses on the downstream part of the business, most industries from the airlines to delivering mail has its own risks that companies need to eliminate or at least reduce to as low as reasonably practicable. The petroleum industry in South Africa; had even with all its efforts and focus on safety still had 14 fatalities in 2014 (South African Petroleum Industry Association).

Figure 5: Petroleum industry safety performance: Fatalities and Lost time injuries (SAPIA)



Even though the industry has seen improvement in terms of safety performance there is still over 53 lost time injuries and 52% of those are from the refineries. In the past 10 years the industry managed to reduce the number of fatalities from 35 to 14, that is a 40% reduction and this is due to improved legislations and monitoring and the effort that the industry from the industry to be sustainable.

The challenge faced by managers is that in these challenging economic times they have limited resources in their disposal to utilize to generate better profit for their shareholders. In South Africa, there is also added pressure for companies to invest in community development, compliance to Broad-Based Black Economic Empowerment and other government requirements. With all these requirements and the limited resources in the managers' disposal, the question is where do they prioritize?

The aim of this research is to look at the two of the many priorities that managers are faced with and try to establish if the two are competing or complementary priorities. The aim is to determine the relation between safety and productivity. If a line manager invests in a safe working environment for their employee will the act result in improved productivity which could lead to better economic returns?

Table 2: Consistency matrix for the research question

Title: Impact of improved safety on productivity			
Research Question	Literature review	Data collection tool	Analysis
How does focus on improving safety impact productivity?	Pagell, M., Dibrell, C., Veltri, A., Maxwell, E. (2014)	Questionnaire	Pearson correlation to determine the correlation between improved safety and productivity
	Zacharatos, A., Barling, J., Iverson, R.D. (2005)	Interviews	Content analysis on open ended questions to get depth on the correction if it exist or not.

Chapter 4: Research methodology

4.1 Research design

The approach of the research was induction. According to Saunders and Lewis (2012), induction is a research approach which involves the development of theory as a result of analysis data. The study was explanatory as it seeks to find the relationship between the improved safety performance and productivity. The strategy that was used in order to determine if this relationship it exists or not will be the use of a survey and secondary data.

The data will be collected using online survey and from the interviews with senior managers who deal with the two variables safety and productivity on a daily basis. These managers are faced with the burden and the conundrum of these changes in legislation and the choice of where to invest to get the return for shareholder and comply with legislation

4.2 Universe

The universe for this research was the South African petroleum industry. The industry contributes 6.48% of the South African gross domestic product and supplies 18% of the country's primary energy (<http://www.sapia.co.za>). The South African petroleum industry produced 23 571 million litres of liquid fuels in 2005 and 36% of the demand is met by synthetic fuel which is produced locally, largely from coal and natural gas (<http://www.energy.gov.za>)

The South African industry has six refineries which in total capacity of 703 000 bbl/day and selling approximately 27 billion litres of petroleum products annually (<http://www.sapia.co.za>). The industry employs direct and indirect employment for over a 100 000 people (<http://www.sapia.co.za>).

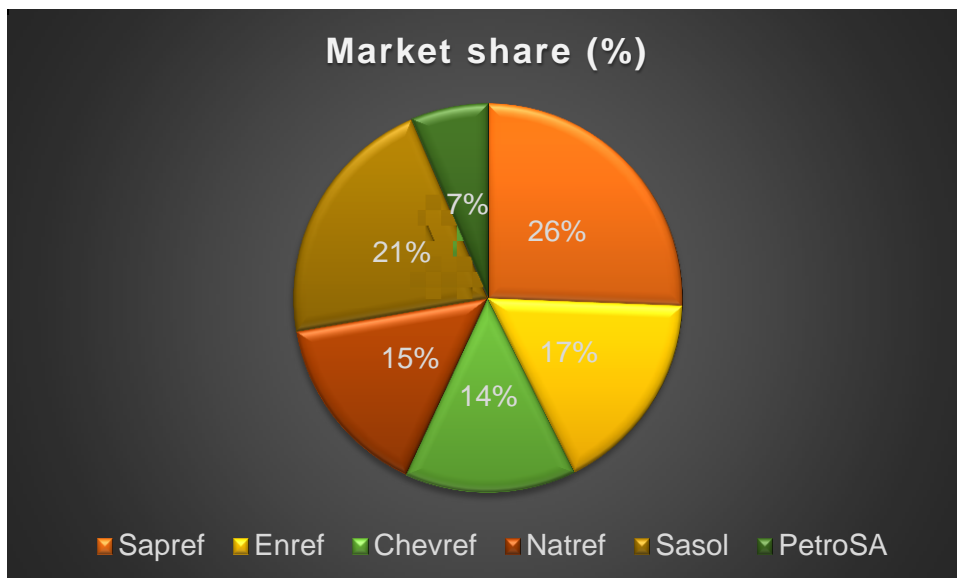
The universe that can give answers to this research is the South African petroleum industry.

4.3 Population

Unfortunately it was impractical given the time and resources to complete this research in the entire universe defined above. The research was focused on the downstream business of the South African petroleum fuel industry. The population excludes exploration and the gas industry but focuses on the liquid fuel players.

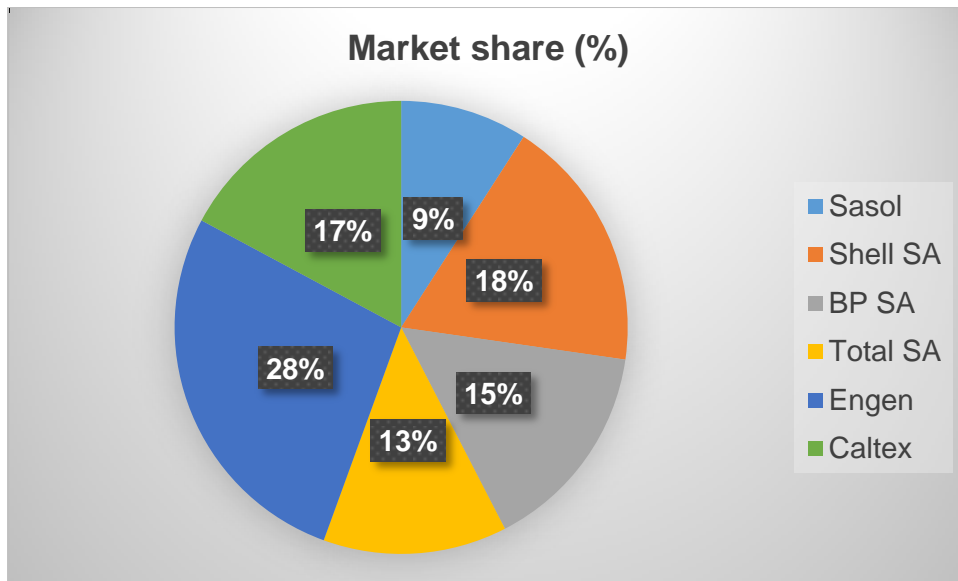
The industry has a capacity to produce 703 000 barrel per day over five refineries. The biggest refinery is Sapref which is 50% owned by Shell SA and the other 50% by BPSA. The Sapref refinery consists of 26% of the total South African refining capacity. This is followed by Sasol that produce coal to liquid and which has the capacity 150 000 bbl/day (<http://www.sapia.co.za>).

Figure 6: Capacity of South African Refining Industry share (<http://www.sapia.co.za>).



Even though the refining is led by Sapref which is owned by BP and Shell the sales and distribution space is dominated by Engen. According to the business monitor report of quarter one 2015, South Africa oil and gas report, estimates that Engen has 1200 retail sites and owns 27% of the market share in the retail space. It leads Shell SA which is in second place by 9%. Figure 6 breaks down the retail market share.

Figure 7: The South African petroleum retail market share (BMI, company data)



The population of this study includes all the refineries, distribution and sales; the downstream business of the South African petroleum industry.

4.4 Sample frame

The sample frame of this research is the over 41 000 employees of the six major downstream leaders including their refineries. The sample will be taken from these employees. The reason for using these companies is that there has been a concentrated effort to improve safety performance. This effort has seen the industry reducing its fatalities over the past five years by over 53.3%; from 30 to 2014 performance of 14 fatalities (<http://www.sapia.co.za>).

These companies are focused on the two pillars of this research, improved safety and increased productivity. These companies subscribe to a common value of zero harm to its employees but still want to be profitable. The South African petroleum industry is very competitive even though it's regulated in terms of pricing.

While the industry is faced with increased regulation in order to improve safety in the refineries and the distribution of the fuel more especially the transportation by road to service stations the industry is also faced with the productivity problem. According to the BMI SWOT

analysis, the industry has an inefficient downstream sector that needs a considerable investment. The current industry facilities are old and need upgrading as the government pursues tighter fuel quality standards. (BMI report, 1Q 2015).

The industry is faced with another problem namely the planned introduction by the government of Euro-4 or Euro-5 fuel specification. This means that the current levels of sulphur in diesel should be reduced from 50ppm to 10 ppm and the reduction of benzene from 5% to 1%. In order to meet these specifications, the refiners will need to invest a total of USD4 billion to upgrade their plants to produce cleaner fuel (BMI report, 4Q 2014).

With all these developments, it makes the industry ideal for this research, with the increase in safety regulation and the demand to invest in safer, environmentally friendly but efficient equipment. Are these two variables complementary in that when one invests in productivity they could also improve safety performance?

4.5 Sampling technique

The research will conduct both quantitative and qualitative study in order to get both depth and width. The qualitative data will be collected via an online survey for the employees that have access to the computer and for those underground employees who don't have access to the computer a paper survey will be conducted. The quantitative survey will be conducted via an interview with managers who are responsible for safety and production.

4.5.1 Qualitative sample

The qualitative sample will be a non-probability sampling. The sample was selected by a quota sampling because the sample had to represent a defined characteristic. The quota is based on that the sample interviewed should be responsible for production and safety in the organisation. The sample that will be interviewed will be senior management responsible for either both or one of the variables. The interview will be conducted with the general managers that are responsible for the overall performance of the organisation but responsible for the safety of the employee and organisation. There will be interviews with the middle managers responsible for facilities, operations and safety performance. The last

group will be the individual who work for the health, safety and environmental departments who supports the operations managers with compliance to safety regulations and policies.

4.5.2 Quantitative sample

For the quantitative part of the study the sample will be done in two parts. The first part will be for the employees that have access to a computer. Those employees with access to the computer; will receive the survey from their line managers in order to get cooperation from the employees. The manager will be those that have been interviewed. That sampling will be non-probability convenient sampling. This will introduce a lot of bias because the manager could send the survey only to employees who are aligned to him and his thinking.

For the staff that have no access to computers a simple random probability sampling will be used. The underground employee will be selected randomly during the start of the shift and after shifts in the different shafts. The will be given the printed paper survey to complete and those will be collected after completion.

4.6 Sample size

The sample size for the research was broken down into three categories; qualitative, quantitative and secondary data from the organisation.

4.6.1 Quantitative study

The qualitative data was collected via an interview with six managers responsible for the productivity of the organisation but also for safety and complying with the mining legislation as governed by the department of minerals and energy. The interview was also conducted with the safety department as a supporting department responsible for these managers. The following five interview questions were asked of the interviewees.

- Is safety and productivity conflicting or complimentary priorities?
- What was the last major investment into safety and what has been the impact on safety and productivity?

- What was the last major investment into productivity and what has been the impact on safety and productivity?
- What was the last major incident and how has the incident affected productivity?

The thirty minutes interview was conducted with the following individuals as listed in table 2 below:

Table 3: Interviewed candidates

Role
Operations HSEQ manager
ESM HSEQ manager
Regional operational manager
Storage and handling manager
Regional retail manager
General manager HSEQ

The data will be analysed using Atlas software in order to determine themes and quotes that support the study and those will be used in the discussion with the findings from the qualitative results.

4.6.2 Qualitative study

For the qualitative study, the data was collected via a questionnaire (see appendix 2). Bartlett, Kotrilik and Higgins (2001) indicated that it is important within a quantitative survey design to determine the sample size and deal with nonresponse bias. Barlett, Kotrilik and Higgins (2001) quote Halton and Burnett (1997) that one of the real advantages of quantitative methods is their ability to use smaller groups of people to make inference about the larger groups that would be prohibitively expensive to study.

For this research the study used estimated the survey error (alpha level) of 0.05 as is used in most educational research. (Bartlett, 2001). For alpha level of 0.05 utilises the t-value of 1.96 (Bartlett, 2001). Since this is a categorical study the general rule for the acceptable margin of error is 5% according to Bartlett, Kotrilik and Higgins (2001). The following formula was used to determine the sample size. The estimated variance that was used for this

research was 95% as it is recommended to estimate variance in the population (Bartlett, 2011). The formula used to estimate the sample size followed Bartlett, Kotrilik and Higgins (2001) equations below

$$n_0 = \frac{(t)^2 \times (p)(q)}{(d)^2}$$

$$n_0 = \frac{(1.96)^2 \times (0.5)(0.5)}{(0.05)^2} = 384$$

Where:

t = value for selected alpha level 0.5 which is 1.96

(p)(q) = estimated variance of 0.5 = 0.25

d = acceptable margin of error = 0.05

Since the sample size is less than 5% then it is acceptable and there is no need to correct the sample. The research made the assumption that the response rate will be at 65% since there is restructuring currently running and the atmosphere is not really positive. Therefore the final sample size is $384/0.65 = 591$. 591 was the target sample size for this research.

The following approach was used to analyse the data:

The survey was carried out in the form of a questionnaire and a 5 point Likert scale was provided.

- The researcher first categorized all survey questions into specific themes.
- The mean score of each theme was calculated.
- Survey reliability was calculated using Cronbach's alpha.
- Data profiling and descriptive statistics were first drawn up in order to understand /the data in terms of frequency distributions, variable correlations, number of useable variables, levels of missingness in the data and the need for variable transformations where necessary
- Pearson correlation tests were carried out for continuous variables in order to variable correlation

- Test for association on categorical variables was carried out using Fisher's exact test since the data set was small
- Wilcoxon's sign ranked tests were carried out to assess whether respondents believe that safety performance improves productivity
- A logistic regression model was developed to understand the interaction of variables which are associated with the target variable.

4.6.3 Secondary data

The following secondary data was used in order to supplement the research and give it depth and understanding of the relationship between the two variables. The secondary data was sourced from SAIPA.

The secondary data that was over a period of five years from 2010 till 2014 and the following data was requested

Safety performance

- a. Fatalities
- b. Lost time injury

4.7 Bias

- The interviewer works for the company that the study was conducted on and that could have bias towards the organisation
- The interviewees are at the same level and in the same organisation and that could have bias since they are responsible for the two variables; safety and productivity
- The respondents to the quantitative survey work for the same company and the result might be bias towards the organisation
- The respondents might have also felt that there could be implications to them responding to the survey, if they don't have favourable response to the company they might be victimised.

4.8 Limitations

- Language could be a barrier when the conduct the survey
- The shop floor staff might not know of projects to improve efficiency, productivity and safety
- The data that will be collected from the company might be influenced by other factors such as industrial action affecting productivity. So the relationship between safety investment and return on investment might not be difficult to prove
- Using secondary data will provide a number of pitfalls:
 - The data might meet the research partially, meaning it might not be in a format that supports the research fully.
 - Definition used in the data may have changed over time (Saunders and Lewis, 2012)
 - There was limited availability of industrial data and there was no data for the company performance. There secondary data was not used
- Research questionnaire – There might be a challenge in distributing them to the hourly workers. They might need to do them manually; which might be difficult to administer.
- The interviewees are senior managers at the same company and are responsible for the two variables being investigated and because of time. It would have been beneficiary to conduct the interview with all levels of employees.
- The data reliability was quite low and that could have also affected the outcome and in future studies more respondent are recommended and this could give more reliable data

Chapter 5: Results

5.1 Quantitative

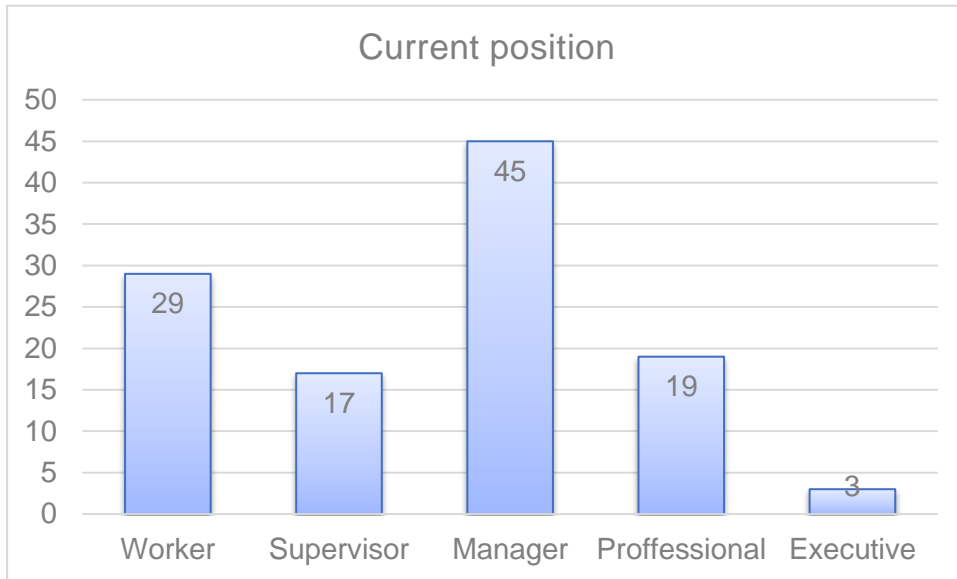
The data was collected in using Survey Monkey and the survey was carried out in the form of a questionnaire and a 5 point Likert scale was provided. The researcher first categorized all survey questions into specific themes. The mean score of each theme was calculated. Survey reliability was calculated using Cronbach's alpha.

Data profiling and descriptive statistics were first drawn up in order to understand the data in terms of frequency distributions, variable correlations, number of useable variables, levels of missingness in the data and the need for variable transformations where necessary. Pearson correlation tests were carried out for continuous variables in order to variable correlation. Test for association on categorical variables was carried out using Fisher's exact test since the data set was small. Wilcoxon's sign ranked tests were carried out to assess whether respondents believe that safety performance improves productivity. A logistic regression model was developed to understand the interaction of variables which are associated with the target variable.

5.1.1 Current position

The respondents position where categorised by current position at the company. Two individuals did not answer this question and 39.8% respondents who answered the question were managers out of the 113 who answered the question. This was followed by workers who make 25.7%, then professional and supervisors. Only three executives responded.

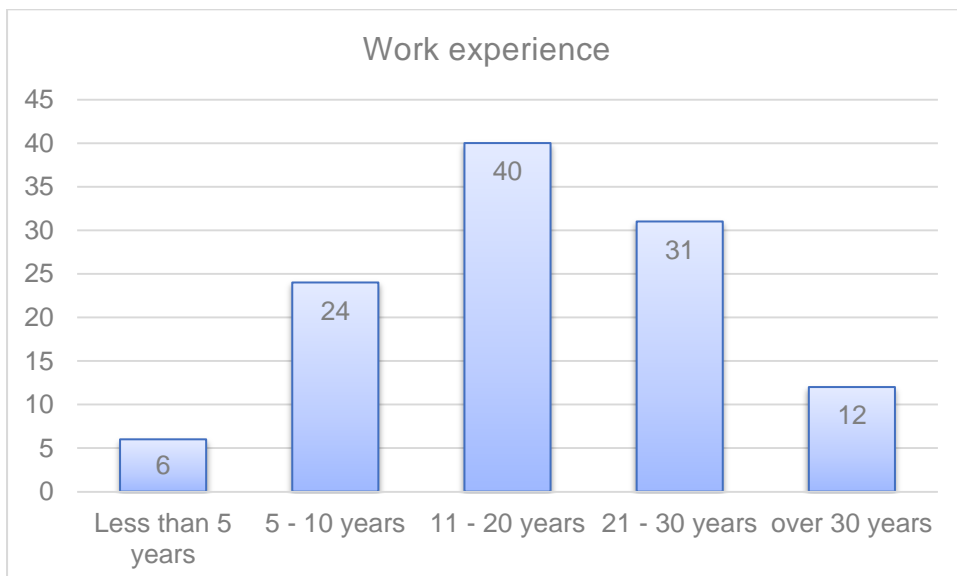
Figure 8: Number of respondents by current positions of respondents.



5.1.2 Work experience

The employees who answered the survey had a variety of experience. Two respondents skipped this question. Over 73% of respondents had more than 10 years of experience with 35.4% having between 11 and 20 years of experience. Only 5.3% of respondents had less than 5 years of experience. This means that most of the respondents had knowledge and understanding of the workplace and have seen the evolution of the industry over the past 10 years.

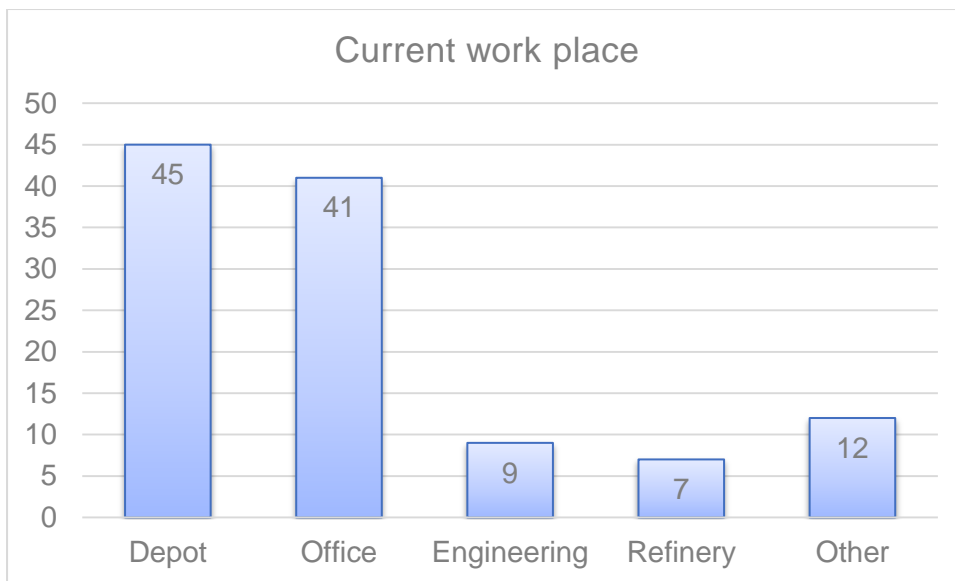
Figure 8: Number of respondents by work experience



5.1.3 Current work place

The respondents worked in different areas within the company. Most of those respondents worked in the depot and those made 39.5% while the least of the respondent worked in the refinery and made 6.1%. 10.5% answered as other meaning they might work in the lubricant plant or any other place that was not defined. Close second respondents were based in the office and made up 36%. Only one respondent did not answer this question.

Figure 9: Number of respondents by work experience



5.2 Research themes from data

The analysis was carried out based on the themes above. Since item 13 had a reverse ordering, it was converted to be of the same order as the other items.

Table 4: The themes coming from the questionnaire (for questions refer to appendix 2)

Theme	Items
Invest on Safety	2,3,6
Invest on Productivity	4,5,7
Focus on Safety	1,8,10,11
Focus on Productivity	9,
Believe in Safety	14,
Believe in Productivity	15,
Safety improves Productivity	12,13,16
Productivity Improves Safety	17,

5.3 Themes descriptive

From the descriptive stat one can note that investing in safety and productivity had the lowest mean score; this will be discussed further in the next chapter but it is significant. One can also note that the focus on productivity is higher than the focus on safety but the belief in safety is much more than the belief in productivity.

Table 5: Themes descriptive statics

Variable	Minimum	Maximum	Median	Mode	Skewness	Kurtosis
Invest on Safety	1	4	1	1	1.538	1.828
Invest on Productivity	1	4	1.58	1	1.003	0.083
Focus on Safety	2.5	5	4	4	-0.209	-0.304
Focus on Productivity	2	5	5	5	-1.241	1.358
Believe in Safety	1	5	4	4	-0.362	-0.097
Believe in Productivity	2	5	4	4	0.154	-0.597
Safety improves Productivity	2	5	4	4.33	-0.665	0.019
Productivity Improves Safety	1	5	4	3	-0.133	-0.456
Target	0	1	1	1	-2.113	2.509

5.4 Survey reliability

Table 6 shows the Cronbach coefficient alpha and survey data is partially reliable.

Table 6: The Cronbach coefficient alpha

Variables	Alpha
Raw	0.532
Standardized	0.540

Table 7: The Cronbach coefficient alpha with deleted variables

Theme	Raw variables correction with total	Alpha
Safety improves Productivity	0.401	0.450
Invest on Safety	-0.013	0.585
Invest on Productivity	-0.079	0.622
Focus on Safety	0.343	0.483
Focus on Productivity	0.134	0.533
Believe in Safety	0.547	0.359
Believe in Productivity	0.412	0.438
Productivity Improves Safety	0.396	0.436

5.5 Pearson Correlation tests on continuous variables

For Pearson correlation tests, the general rule of thumb is that if the correlation between 2 variables is above +/- 0.7 then the variables are highly correlated, +/- 0.4 --- +/- 0.7 correlated, +/-0.2 -- +/- 0.4 weakly correlated and 0 -- +/- 0.2 then there is no correlation. If the value is positive (+) then it is called positive correlation, if it is negative then it is called negative (-) correlation. As an example, variable 1 (safety improves productivity) is positively correlated to variable 6 (belief in safety).

Table 8: The Pearson correlation tests on continuous variable

	1	2	3	4	5	6	7	8
1 safety_imp_product	1							
2 invest_on_safety	-0.15634	1						
3 invest_on_productivity	-0.12998	0.61776	1					
4 focus_on_safety	0.28233	0.06992	0.11814	1				
5 focus_on_productivity	0.03089	0.01918	-0.16099	0.06972	1			
6 belief_in_safety	0.60615	-0.14753	-0.2683	0.22339	0.18081	1		
7 belief_in_productivity	0.3156	-0.19968	-0.09529	0.16327	0.13201	0.55338	1	
8 prod_imp_safety	0.35289	-0.22461	-0.26615	0.24456	0.19812	0.60443	0.44326	1

5.6 Univariate Analysis

In order to understand whether respondents generally feel that safety performance improves productivity, a univariate analysis was carried out on the theme “safety improves performance”. The results are listed below on table 8.

Table 9: The result of the Univariate analysis basic measure on variable safety improves productivity

Location		Variability	
Mean	3.99	Standard Deviation	0.69
Median	4.00	Variance	0.47
Mode	4.33	Range	3.00
		Interquartile Range	0.67

The mean score for this response was 3.99 and median of 4 which is higher than the neutral score of 3.

H₀: Respondents are neutral as to whether safety performance improves productivity that is respondents generally chose a score of 3 on the Likert scale.

Assumption:

1. Assume that if respondents are neutral, they would choose a score of 3 on the Likert scale
2. Assume that a score above 3 represents a positive score and a score of below 3 is a negative score.

A Wilcoxon Sign ranked test was used to test the concern.

Table 10: Tests for Location: H₀=3

Test	Statistics		P value	
	Student's t	t	15.35	Pr > t
Sign	M	45.5	Pr >= M	<.0001
Signed Rank	S	2747	Pr >= S	<.0001
Student's t	t	15.35	Pr > t	<.0001

Table 11: Location counts: $H_0=3$

Count	Value
Num Obs > H_0	99
Num Obs $\hat{=}$ H_0	107
Num Obs < H_0	8

From the table 10 results, we can conclude that we reject the concern at 5% significance level. We can conclude that we find no evidence to believe that safety performance does not improve productivity.

5.7 Modelling and Research questions testing

In this study, in order to understand the other factors that are associated with “safety performance improving productivity”, firstly the following transformation was carried out on the variable “safety improves productivity”:

$$Target = \begin{cases} 1 & \text{if safety improvement score} > 3 \\ 0 & \text{if safety improvement score} \leq 3 \end{cases}$$

For continuous variables, Pooled T tests for the difference of means were carried out. For categorical variables, Fisher’s exact tests for association were carried out.

5.7.1 Research question 1: Continuous variable

Generally the concern is: There is no difference in mean scores for (target=1 respondents) and (target = 0 respondents). The tests were carried out at 5% significance level. The summary of results is on displayed on table 12 below.

Table 12: The results of the continuous variable tests for difference in means

Variable	Test statistic	p value	conclusion
Believe in Productivity	Pooled T	0.0403	reject null
Believe in Safety	Pooled T	<.0001	reject null
Focus on Productivity	Pooled T	0.058	fail to reject null
Focus on Safety	Pooled T	0.026	reject null
Invest on Productivity	Pooled T	0.2	fail to reject null
Invest on Safety	Pooled T	0.21	fail to reject null
Productivity Improves Safety	Pooled T	0.0017	reject null

In conclusion, we reject the concern on the following variables: focus on safety, focus on productivity, belief in safety, belief in productivity and production improving safety. We find no evidence to suggest that they are not correlated with safety improving performance. The variable distribution plots of the significant variables is shown in the graphs below so as to visually understand their correlation with the target.

Figure 10: Distribution of focus on safety

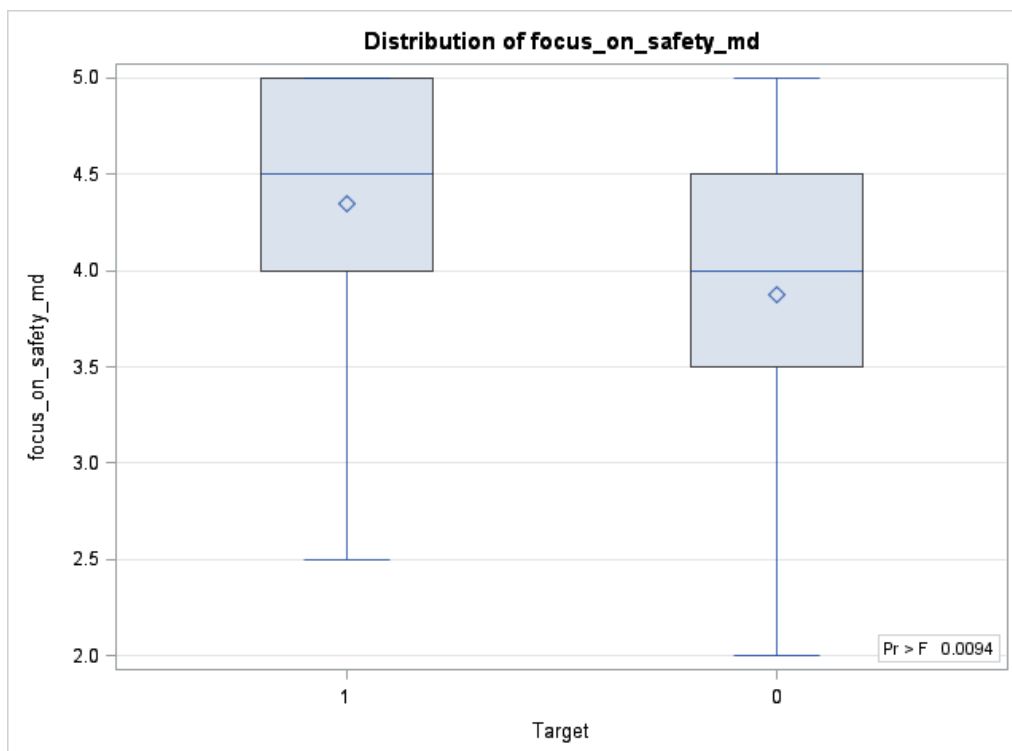


Figure 11: Distribution of focus on productivity

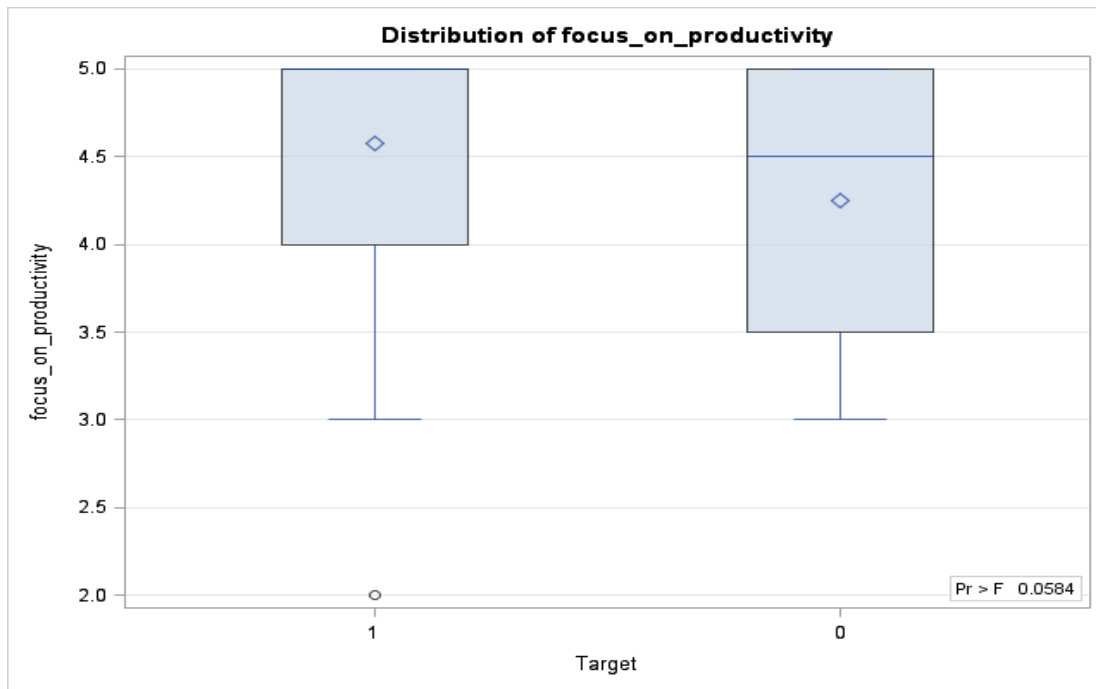


Figure 12: Distribution of belief in safety

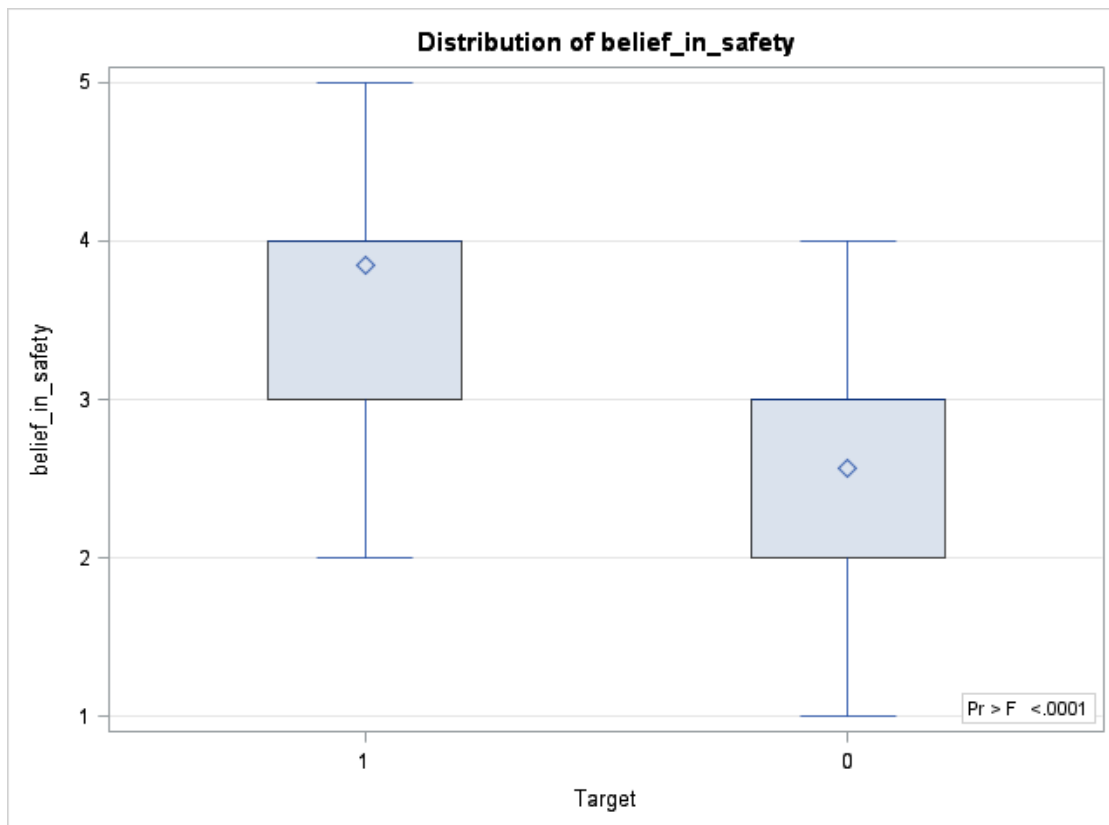


Figure 13: Distribution belief in productivity

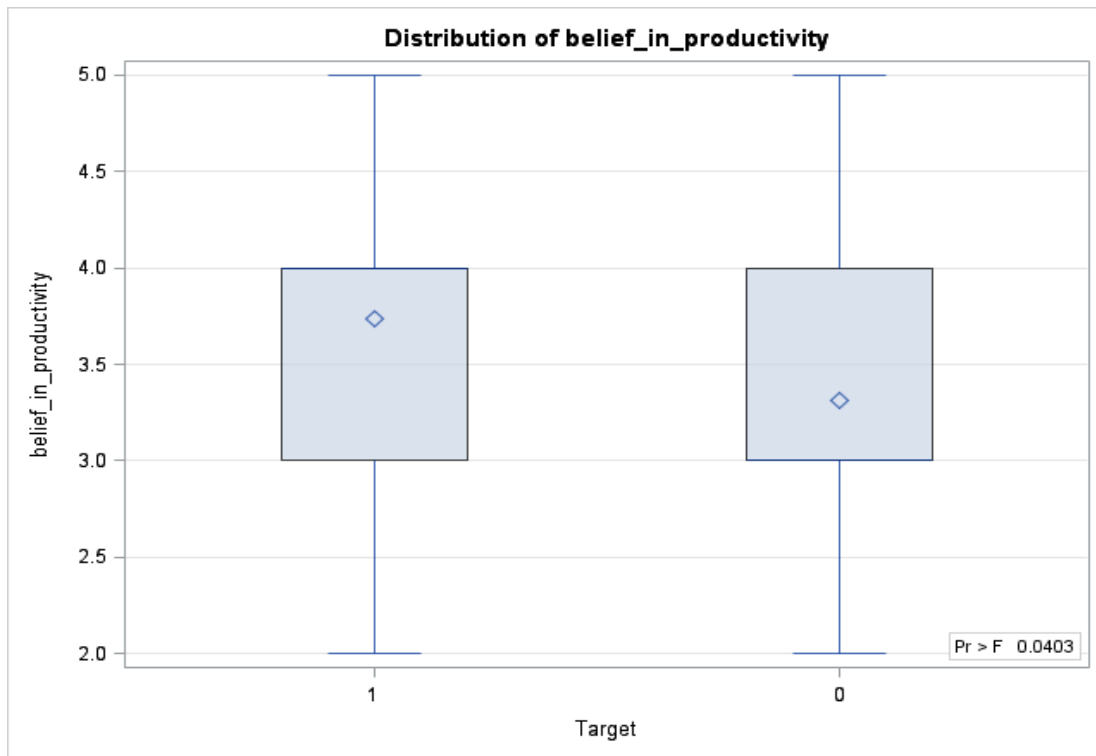


Figure 14: Distribution of productivity improve safety

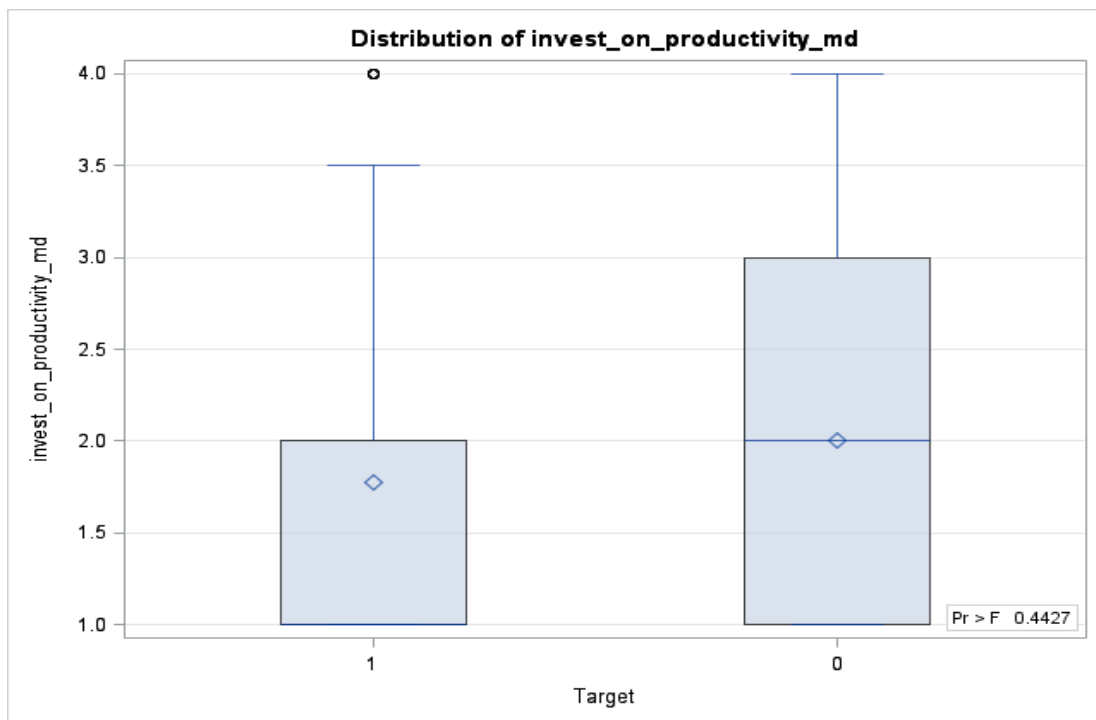


Figure 15: Distribution of productivity improves safety

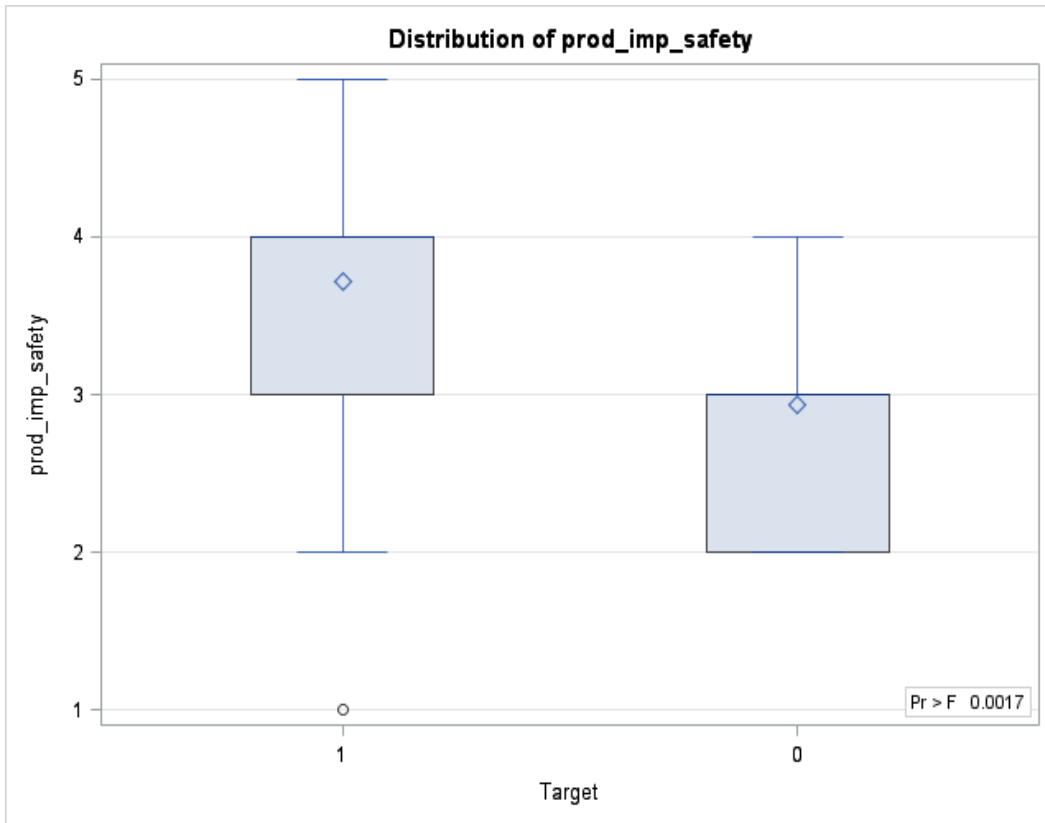
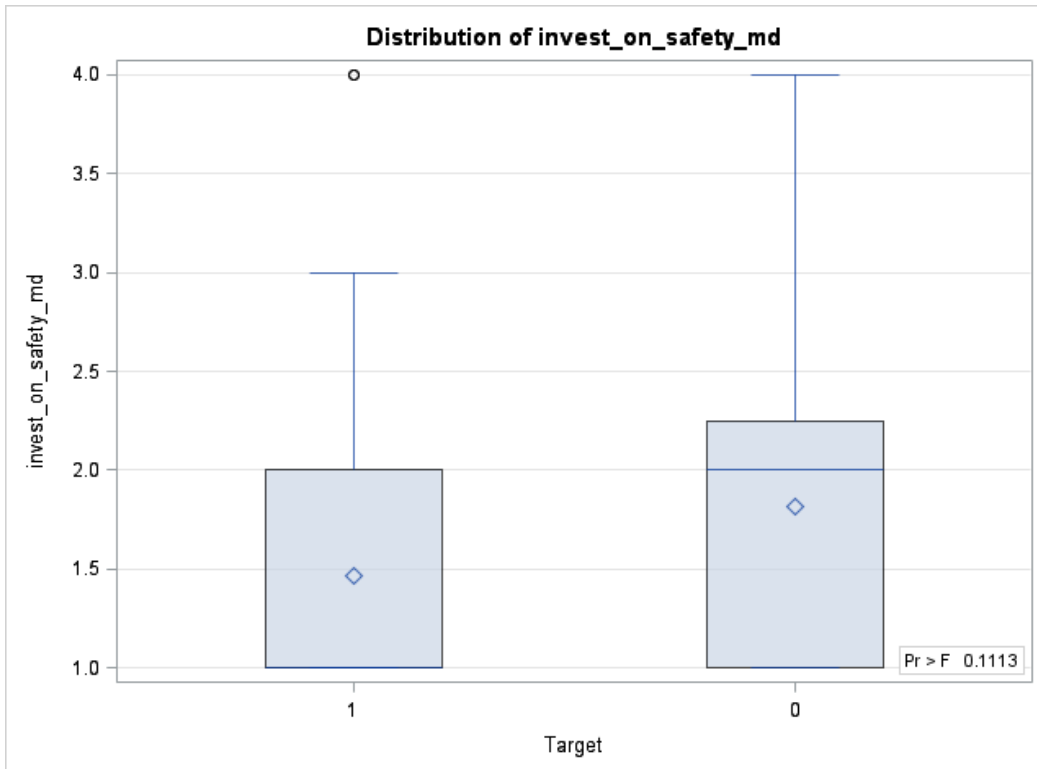


Figure 16: Distribution of invest on safety



5.7.2 Test of association (categorical variable)

Generally the concern is: There is no association in mean scores for (target=1 respondents) and (target = 0 respondents) with the variable under analysis. The tests were carried out at 5% significance level. The results are shown in table 12 below.

Table 13: Summary of result from association test

Variable	Test statistic	p value	conclusion
Current position	Fisher's Exact Test	0.98	fail to reject null
Work Experience	Fisher's Exact Test	0.54	fail to reject null
Work Area	Fisher's Exact Test	0.19	fail to reject null

The results fail to reject the concern at 5% significance level across all categorical variables tested. Therefore, we find no evidence to conclude that any of the variables above is associated with “safety improving performance”.

5.7.3 Research question 2

Model Specification: This model was built to assist in identifying factors that are associated with safety performance improving productivity.

Target Definition: The following transformation was carried out on the variable “safety improves productivity”:

$$Target = \begin{cases} 1 & \text{if safety improvement score} > 3 \\ 0 & \text{if safety improvement score} \leq 3 \end{cases}$$

Sampling: For the purpose of the modelling exercise, the full model data set was used for training the model and a simple random selection of 50% of the data was used to validate the model.

Methodological Approach: Logistic regression was chosen because the model has a dichotomous dependent variable. The logit model predicts the log of the odds of a categorical event or outcome. When the log of the odds from the resulting model is

converted back to a probability the possible range of values is restricted to be between 0 and 1.

For k explanatory variables and $I = 1, \dots, n$ individuals, the model is

Equation 1:

$$\log \left[\frac{p_i}{1 - p_i} \right] = \alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_k x_{ik}$$

Where p_i is the probability that the dependent variable is 1.

By the very nature of the linear summation, the logit model assumes that the predictors are linear in log-odds space with the outcome. Unfortunately, few relationships are exactly linear. To mitigate the impact of the linearity assumption and for other beneficial reasons, some predictors have been transformed.

Table 14: Model fit statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	78.14	25.75
SC	80.70	56.52
-2 Log L	76.14	1.75

Table 15: Testing global concern: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	74.3882	11	<.0001
Score	37.1577	11	0.0001
Wald	4.0994	11	0.9669

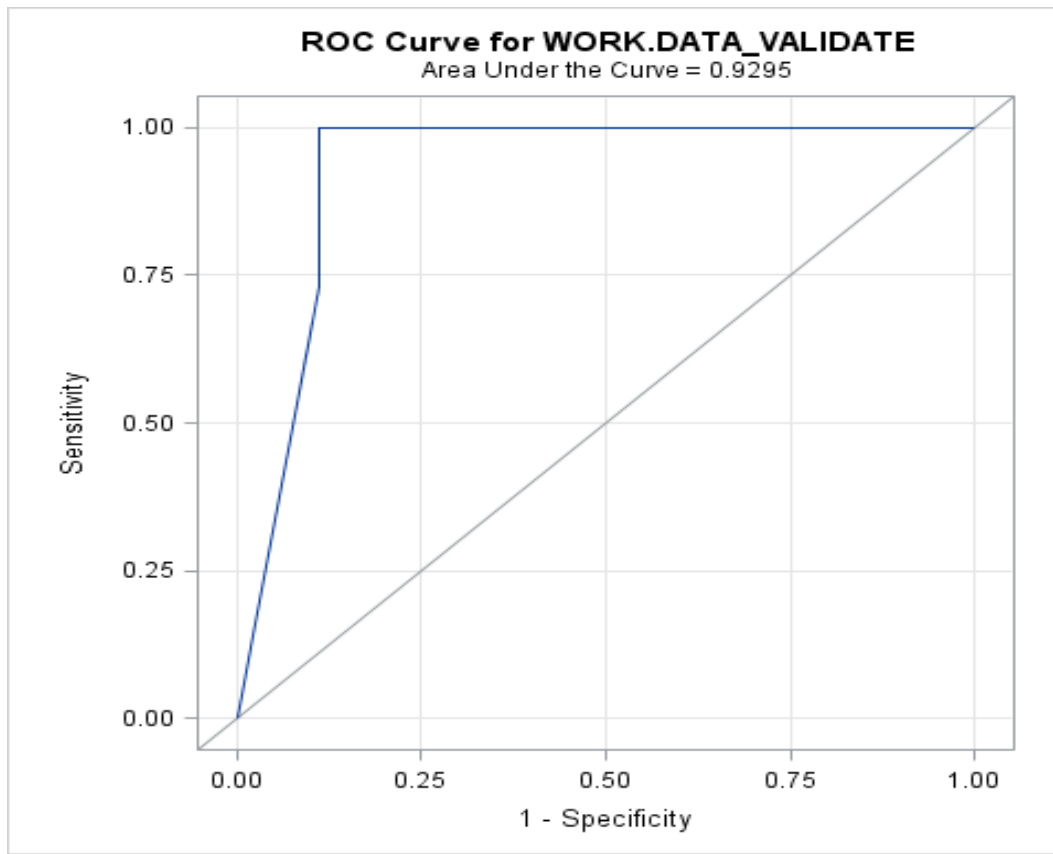
Based on the Likelihood ratio test, the models fits well at 5% significance level.

Table 16: Type 3 analysis effects

Effect	Chi-square	Wald Chi-Square	Pr > ChiSq
Investment on productivity	1	2.70	0.10
Focus on safety	1	2.76	0.10
Belief in safety	1	3.94	0.05
Current position	4	3.36	0.50
Current work area	4	3.92	0.42

From the analysis of effects above, belief in safety, investing on productivity and focus on safety are significant at 10% level. This implies that these are most important variables which are associated with “safety performance improving productivity”.

Figure 17: The Roc curve



From the ROC chart above figure 15, the area under the curve is 0.92, this is a very high score.

5.8 Qualitative

In order to get depth on the research a partial qualitative study was performed. Interviews were conducted with six respondents who are all employed within the petroleum industry who are responsible for either operation or safety. Table 16 below shows the interviewees and since the research promised that their identity will be kept anonymous, only their titles are shown and they are identified as participants.

Table 17: Interview participants

Respondent	Title
Participant 1	Operations HSEQ Manager
Participant 2	ESM HSEQ Manager
Participant 3	Regional Operations Manager
Participant 4	Storage and Handling Manager
Participant 5	Regional Retail Manager
Participant 6	General Manager: HSEQ

Each participant was asked four open ended questions as below:

- i. Is safety and productivity conflicting or complimentary priorities?
- ii. What was the last major investment into safety and what has been the impact on safety and productivity?
- iii. What was the last major investment into productivity and what has been the impact on safety and productivity?
- iv. What was the last major incident and how has the incident affected productivity?

The answers were grouped under the same themes from the quantitative study (see table 3)

5.8.1 Invest in safety

The participants were positive that investment in safety was necessary in order to run the business. If the business invests in safety there is a step change in the perception of employee and that is good for the company. The investment leads to improved company

safety performance and it also protects the company from litigations and paying fines which means it protects the company finances.

P1: “That kind of investment I think it’s good for the company”

P1: “I think we are starting to enjoy and to see the benefits of having HSEQ and safety people in the depots. It’s working very well and that’s another thing that I think that was a good investment”

P2: “If I take the investment and I link it directly to what should have been done around safety, so let’s say all remain equal and we took hundred million and we put safety for the past five years. I would say there has been a step change from where we were and I say that primarily because we have embedded a lot of project related staff into the Management system. if you look at the statistics they should speak for themselves where we have double digits LOPCs about 5years ago and I am talking in the order of between 15 and 25 major LOPCs per year in Engen we are not sitting with 3 major LOPC. Where we had TRCs, where we sitting at 35 to 45 TRCs per annum, we are now sitting in the space of 18 to 25 and lot of them are quit subjective”

P4: “So it protects the money that we have. So we are not removing money from investing in efficiency but investing in safety for me is still part of investing on how to do work right the first time:

5.8.2 Invest in productivity

The respondent indicated that a lot more money is invested in productivity but those project can also be used to improve safety more especially process and equipment safety.

P1: “I know that we invested a lot money”

P2: “But as you change the ergonomics designers on the site in the bid to improve productivity for example your access bunding you would say put an extra set of stairs here, I want the guys to get there quicker and maybe no having safety in mind but now you don’t a guy trying to jump over a bund wall and injuring himself. So from that perspective I think in a lot of cases there is a direct correlation between safety and production”

P3: “The investment to say let’s go to materless which was faster. Now it’s faster its safer, safely loading, safely to offload and it’s quicker in terms of turning that vehicle.”

P4: “For me that’s the large investment that was focusing on mainly on productivity but has had a great impact on safety and productivity.”

P6: “Impact at a certain extent was there because; we have seen reduced incidents compared to the previous times and having invested in safety equipment.”

5.8.3 Focus on safety

Focus on safety has an impact on finances of the company. The department of labour issue fines and the process of investigation and reporting cost a lot of resources and time but if these incidents are dealt with before they could save the company a lot of time and resources.

P1: “Was an incidents but the impact of the incidents financially it was negative and overall it’s positive because now everybody is aware of what’s the worst that can happen.”

P3: “it doesn’t matter how productive you are you not going to have business without safety.”

P4: “Productivity is almost how; safety is efficiency and effectiveness”

P6: “They have prioritised in their minds productivity to the extent that safety can be compromised, so one has to strike the balance, it’s much cheaper if you do it productive and you considering safety and unlike dealing with consequences of having to deal with a disaster of an incident because someone was pushing productivity”

5.8.4 Focus on productivity

The company spends more money on productivity, the concern sis that sometimes when individual are not meeting their productivity targets then they use safety and its requirements as an excuse, but forget that if there is an incident it will require capital to mitigate the incident.

P1: “On productivity; I know that we invested a lot of money”

P2: “On the productivity I am really concern because safety is sometimes is used as a flogging tool to say this is why I didn’t deliver boss”

P3: “Major incident can affect your productivity and also requires a lot of capex in order to mitigate that it does not happen again”

5.8.5 Believe in safety

There is a high belief in safety and the impact it has on the company. Safety has the ability to shut the business down and the culture of safety improves productivity. Safety is a value and the company needs it in order to operate efficiently. One cannot separate safety and productivity, one of the participants says it’s like two side of a coin.

P1: “I don’t look at safety as a priority cos I always say that priority changes every day, I look at it as a value”

P1: “Although safety is not capital generating, we don’t generate capital in safety but then it’s one of the aspects of business that can have business like shutdown

P1: “what we trying to achieve is that we want to change culture, we want safety to be a way of doing things”

P2: “so I find most of the time its conflicting that’s the way it is and the way it should be it should be complimenting, it should enhance the way we work”

P2: “I think that incident improved productivity and its improved safety as well’

P3: “safety guarantees business and where productivity ensures sustainability. Now one is a licence and the other one is sustainability”

P3: “It must be safe and it must be safe at all times”

P4: “You will realise that if there is a safety incident in most cases the work has to be

stopped, so that we can focus on the incident and focus on bring the worker back to work. So it takes a lot of time, energy and resources from what you would have done under normal circumstances'

P6: "If you don't take safety into consideration it means you are doing your job your pushing productivity however, things are not done safely and we know in safety if things go wrong especially in our industry it can turn to bring disaster"

P6: "What we have seen its more safety awareness amongst the employees, more safety driven, employees know for instance that they have to stick to procedure without breaking them and you will see overtime while these ideas are entrenched in their way of thinking it will you know change the organisation"

5.8.6 Believe in productivity

There is a belief in productivity and that an investment in productivity if done right can improve safety.

P2: "From the productivity perceptive, I think people get the job done now days as opposed to trying to improvise, I think in my own view it enhance productivity somehow"

P3: "Safety guarantees business and where productivity ensures sustainability. Now one is a licence and the other one is sustainability"

P3: "Now they are like know like two sides of the same coin, you need both of them to be able to ensure that the business turns otherwise any of them can actually kill your business.

P3: "Productivity will be how you doing the right things"

5.8.7 Safety improves productivity

The consensus between the participants is that safety improves productivity. An example that one of the participant give is that if one improve safety by making the stairway up the tanks less steep it improves safety of the employees but it also improves productivity because the employees can go up and down the stairway faster.

P1: “Safety and production both of them are complimentary”

P1: “The impact on productivity it’s negative. It had both reputational and production consequences because it was all over the news that we spilled heavy fuel oil into the sea and everything where was covered in oil and the crabs were dying.”

P2: “If somebody climbing up stairs and you make the stairs less steep, it supposed to make them work faster”

P2: “I think productivity has been impacted mainly because of a perceived weight that safety is putting on productivity.”

P4: “For instance, let’s take for instance that there was sign that says, ‘if you going to climb on top of a truck you need a safety harness and all those things. From my experience people started falling because, they didn’t have any protection and resulted in impact severe impact on productivity.”

P5: “I mean if any employee works in an unsafe environment that will have an impact on the productivity”

P5: “If the environment is conducive and safe environment it will lead to improvement in productivity”

P5: “It didn’t affect productivity negatively but affected positively”

P6: “So now basically during those hours and couple of days, where now the product was exposed it had to be cleaned and recovered. Production had to come to a standstill and customers were affected definitely. That’s how an incident would affect productivity.”

5.8.8 Productivity improves safety

Productivity can improve safety, if they designs are done correctly and safety is taken into consideration.

P1: “Safety and production both of them are complimentary”

P2: “If you look at the inherent safety design for example, the whole idea behind inherent safety design is that we design a place that is ergonomically safe so that its lubricant the way people work for a lack of a better word.”

P2: “What I think has happen inherently is that as we improved productivity people have inherently become safer”

P2: “What I am saying Khathu is that I think there has been an unintended consequences in some cases of improving, and in a good consequences by the way, as you improve productivity you improve safety.”

P6: “So in terms of that yes we’ve been improved in terms of the stock outs and then safety aspect of it has improved because there’s minimal activity in the tank farm, previously there was frequent activity because of frequent climb.”

Chapter 6: Discussion

6.1 Introduction

The purpose of this research as discussed was to determine if improved in safety could also improve productivity. Can line managers hit to birds with one stone? Are the two variables complementary or conflicting? The data that was collected produced eight themes that will be explored in this discussion. Table 3 shows the themes that came up from the questionnaire.

The themes are:

- Safety improves Productivity
- Invest in Safety
- Invest in Productivity
- Focus on Safety
- Focus on Productivity
- Believe in Safety
- Believe in Productivity
- Productivity Improves Safety

6.2 Demographic

The questionnaire was distributed to employees at Engen and 115 respondents responded to the questionnaire. The employees were categorised into current job area; workers, supervisor, managers, professionals and executives. Managers made most of the respondents making 39.8% followed by workers and professional making 25.7% and 16.8% respectively. The rest have been supervisors and executives. 2 employees skipped answering the question. The reason for the categorising was to find the diverse view in terms of those tasked with implementing policy and those who are on the ground executing the daily work.

The other categorisation was to categorise by work experience. Most of the respondents had more than 11 years of experience making 73.4% of total respondent. 5.3% of the respondent

had less than 5 years. The respondents were experienced individual who have been in the industry long enough to provide a great view on the question. The last category was the area of work, the depot had the most respondents with 39.5% and the people in the office made 36.0% with the refinery making 6.1%. This will give a diverse view of the topic.

For the qualitative study 6 senior managers were interviewed as per table 3 who gave their views on the themes through the interview that was made out of four questions. The interviews were done in order to give depth to the findings from the qualitative results.

6.3 Research questions

The purpose of the research was to determine if there is a relationship between focus in improving safety will improve productivity. This research question is answered by analysing the collected data to determine these two research question:

Research question 1:

How does focus in safety improve productivity?

What other factors are associated with safety improving productivity?

Research question 2:

How are the other factor related in explaining safety improving productivity?

In order to answer the questions data was collected from 115 respondents in a form of a questionnaire. The following approach was used to analyse the data:

- The survey was carried out in the form of a questionnaire and a 5 point Likert scale was provided.
- The researcher first categorized all survey questions into specific themes.
- The mean score of each theme was calculated.
- Survey reliability was calculated using Cronbach's alpha.

- Data profiling and descriptive statistics were first drawn up in order to understand the data in terms of frequency distributions, variable correlations, number of useable variables, levels of missingness in the data and the need for variable transformations where necessary.
- Pearson correlation tests were carried out for continuous variables in order to variable correlation.
- Test for association on categorical variables was carried out using Fisher's exact test since the data set was small.
- Wilcoxon's sign ranked tests were carried out to assess whether respondents believe that safety performance improves productivity.
- A logistic regression model was developed to understand the interaction of variables which are associated with the target variable.

The survey was carried out according to themes as described by table 4.

6.4 Themes descriptive

6.4.1 Safety improves productivity

There were three question on the questionnaire on safety improves productivity. All 115 respondents answered the questions on safety improves productivity. (See table 5) The median score for safety improves productivity was 4 which is above the average of 3 with a very all standard deviation of 0.69; which means that the respondents were close to the mean. There is a positive perception that safety improves productivity. The perception was so high that there was no selection of a low score of 1, the average minimum 2 and the maximum of 5.

This is aligned to the positive response given by the participants in the interview. The interviewee's view is that safety and productivity are complementary and that the impact of none compliance to safety is negative on productivity both in terms of reputation and productivity because incident puts production on a stand still while investigations are proceeding. While improving safety like the example given by P2, while you make the

stairway less steep at the same time you are improving productivity because it now takes a shorter period to climb up and down the stairway.

Even though there might be a perception that complying with safety might takes time before you actually complete the actual work, like feeling paperwork, putting safety harness and other requirements the consequence of not complying can be disastrous and the fines that could be imposed by authorities and that takes away from the bottom line which is the measure of productivity. To summarise the variable focus on safety and quote P5, “If the environments conducive and safety it will lead to improved productivity. This argument is supported by Hofmann, Morgerson and Gerras (2003) in that the impact of none compliance has financial costs that run to billions of dollars in lost wages and productivity, medical costs and administrative expenses and the reputational costs that might negatively impact the organisation. Mullen (2004) supports this by indicating that there is a high cost of productivity that is lost due to the safety incidents.

6.4.2 Invest in safety

There were 110 respondents who answered all three questions about the theme invest in safety. The questions were 2, 3 and 6. The respondent was negative as the median was 1 below the average of 3. Respondent’s perception was that the company is not investing enough on safety. The standard deviation was also low meaning that the respondents were not far from the mean. The sentiment was high that the maximum score was 4 meaning that there was no score of 5 which is the highest score. The perception of respondents is negative and they feel that there is not enough investment in safety.

Even though the respondent feel that the company is not investing enough on safety but the interviewee believe that kind of investment is good for the company and as the company continue to invest on safety the company start to enjoy the benefits by see the drop in incidents like loss of primary containment, total recordable incidents and fatalities. The investment reduces and protects the money from fines and that money could be invested in efficiency that improves productivity.

6.4.3 Invest in productivity

There were three questions that had to clarify the theme invest in productivity, which were questions 4, 5 and 7. There were the lowest numbers of respondents to this theme, 106 respondents. The respondents' perception was also negative but a bit above the theme invests in safety. Meaning that respondents feel that there is not enough invest in productivity but it's better than the theme invested in productivity. Which could mean that the company is investing more in productivity than in safety but not enough investment is made on both the themes. The maximum score that respondents score the question in the themes was four meaning that there was no high score of 5. (See table 5)

The view from the interview is that there is a lot of money that is invest in productivity much more than in safety. During these productivity investments, it's important that they also address safety.

6.4.4 Focus on safety

The theme focus in safety had the lowest standard deviation of 0.52 which means the respondents were close to the median of 4 which is above the average meaning that they had positive perception to the theme. The theme had four questions, which were 1, 8, 10 and 11. The scores averaged a minimum of 2.5 which is high and close to the average and a maximum score of 5. All 115 respondents answered all the focus in safety. All respondents have a positive perception towards focus on safety. The respondents feel that focus on safety is important within the company. (See table 5)

To quote interviewee P3; "It does not matter how productive, you are not going to have business without safety". When employees or management prioritise productivity at all costs that it compromises safety it ends in financial impact and loss of life and instead of continue with productivity you stand to deal with the disaster of the incident.

6.4.5 Focus on productivity

The focus in productivity had only one question which was question 9. All the 115 respondents answered the question (See table 5). This theme had the highest median of 5, and the respondents did not choose the lowest score of 1, the minimum was 2 and the maximum score was 5. The sentiment of the respondent is that there is focus on productivity but compared to the theme of focus on safety, the company focus more on productivity that they do on safety. This is supported by the perception on invest on safety and productivity. That the company invest more on productivity but not safety hence the focus on productivity has a higher mean than that of focus on safety.

The perception that the company invest more in productivity that they do on safety was also supported by the interviews. The view is that sometimes managers use safety as an excuse to not deliver their performance instead of embracing it as part of doing business. If there are major incident it also takes capital expenditure in order to investigate and mitigate that the incident does not reoccur.

6.4.6 Believe in safety

The theme in believe in safety had one question, which was question 14. 111 respondents out of 115, answered the question. The belief in safety theme had the highest standard deviation, but it was still low. The median was 4 which mean the perception is above the average score of 3 which means the respondent were positive on the belief in safety. The respondents believed that safety project do improve project. Id the company invest more on safety and perception of respondents is that they believed that safety will improve. The maximum score was 5 and the minimum was 1. (See table 5)

All the interviewees were very positive in the belief in safety, in that one of the interviewee said that safety is a value, not a priority, it the way to do business. Safety should be a culture and the company needs to be safety at all times. Interviewee P3, said safety guarantees business and productivity ensures sustainability. There is very high belief in safety and its importance in business. Even though Laurence (2011)'s research was focused on mining but his accession that a sustainable mine is one that is safe. More safety awareness amongst

employees, more safety drives, it's a culture that will improve the belief in safety. Hajmohammad and Vachon (2013) also supports that safety is an entry point to operationalising sustainability for the organisation.

6.4.7 Belief in productivity

There were 112 respondents who answered the one question on belief in productivity and that was question 15. The median score of 4 with a standard deviation of 0.77. The perception of the respondents was positive above the average score of 3. The minimum score was 2 and the maximum score 5. The belief in productivity was 0.01 above that of belief in safety. This supports that the company focused more on productivity than in safety. Safety is a licence to operate and productivity is sustainability according to P3. Belief in productivity can be used in order to improve safety.

6.4.8 Productivity improves safety

The theme about productivity improves safety was the last variable and only 1 respondent did not answer the question. The theme had one question, question 17. The minimum score was 1 and the maximum score 5. The median of 4 which was positive but lower than safety improves productivity. Meaning respondents believe that safety improves productivity more than productivity improves safety.

Productivity can improve safety according to the interviewees, like the example given by interviewee P2, "that in the design of new equipment or processes in order to improve safety, the design could be made inherently and ergonomically safe in order to improve safety". One example given where productivity improved safety by one of the interviewees was installing more tanks in one of the installation which means there are fewer stock-outs and less activity of receiving product which reduce employee exposure levels in turn improves safety. Even though there is not a lot of productivity project that improves safety but if at conception there is more thought there will be improved safety.

6.5 Survey reliability

The survey data reliability was checked using the Cronbach reliability test. The test checks the alpha value which if it is above 0.8 it means that the data is very reliable and if it's between 0.5 and 0.8, it means that the data is partially reliable and below 0.5 it's not reliable. The data had an alpha value of 0.54 suggesting that the questionnaire could be having some reliability issues and might not have high internal consistency. (See table 6)

If one looks at table 7, Invest on safety and invest on productivity had a negative correlation and if removed the alpha value would increase, increasing the reliability. Belief in safety had the highest positive correlation which reduces the reliability to lowest level of 0.359. Belief in productivity and safety improves productivity also had high correlation levels too. This supported by Laurence (2011) that a sustainable organisation is one that is safe and demonstrates leading practices in environmental management and community engagement, is economically robust and which, very importantly, efficiently uses the mineral resources

6.6 Pearson Correlation tests on continuous variables

Pearson correlation test was run in order to check is there is a correlation between the themes. The Pearson correlation is used for continues variable and a correlation above +/- 0.7 means there is a very strong correlation, between +/- 0.4 and 0.7 means it's correlated, between +/- 0.2 and 0.4 there is a weak correlation and below +/- 0.2 it means that there is no correlation.

6.7 Safety improve productivity

The biggest correlation was between safety improve productivity and other theme was belief in safety. There is a positive correlation of 0.606 (See table 8), meaning that respondent who believe in safety also believe that safety improves productivity. There was also a positive correlation between the theme safety improves productivity and belief in productivity and productivity improves safety, the correlation was 0.315 and 0.353 respectively. There is a weak positive correlation with focus in safety and no correlation with focus in productivity.

The correlation with focus in safety was 0.282 and even weaker for focus in productivity with 0.031. (See table 8)

There is a negative a weak correlation between safety improving productivity and invest in safety and invest in productivity with values of -0.156 and -0.13 respectively (see table 8). Even though the correlation is weak, it confirms what the descriptive stats that showed that the respondent believe there in not enough investment into productivity and to safety. One can't help to think if there was more investment on safety and productivity this could help with the perception that safety improves productivity. The negative correlation maybe the result of the internal constituency issues. The reliability of this study is low and maybe if there were more respondents to meet the required sample these correlations could be stronger.

6.8 Other correlations

The biggest correlation was between investment in safety and investment in productivity, with a correlation figure of 0.618 (See table 9). This means the respondents, feel that the investment in safety and productivity is done at almost the same level but from the mean score not done enough. The following significant correlation was between productivity improves safety and the belief in safety. The correlation was at 0.604 meaning those that believe in safety also believe that productivity improves safety. This is followed by the positive correlation between belief in safety and belief in productivity. The correlation was 0.553 (see table 8).

The weakest positive correlation between focus in productivity and invest in safety, of 0.019. (See table 8). This means that the perception is those that focus in productivity don't invest enough in safety. There was one weak negative correlation between invest in safety and productivity improves safety, the negative correlation value of -0.225. The perception from the respondents the respondent who belief invest on safety don't belief productivity improves safety. The rest of the correlations were insignificant meaning that they were below 0.2.

6.9 The research question

6.9.1 Does safety improve productivity: Univariate analysis

In order to understand whether the respondents feel that focus on safety improves productivity, a Univariate analysis was carried out. Table 9, shows the results of the analysis. The mean of 3.99, meaning the respondents were positive with the median also high that the neutral value of 3. A low standard deviation meaning that the respondents were close to the mean. The variance was also low which means that there was a low difference in the respondent's answers.

A concern was that the respondents are neutral as to whether safety improves productivity, which means respondents generally chose a score of 3 on the Likert scale. The following assumptions were used on the concern:

1. The respondent are neutral , they would choose a score of 3 on the Likert scale
2. The score above 3 represent a positive score and below a negative score

A Wilcoxon sign ranked test was used to test the validity of the concern. From table 10 one can see that the alpha value (ρ), is less than 0.001 which means we can reject the concern at 5% significant level. One can conclude that there is no evidence to believe that that focus on safety performance does not improve productivity. Over 99 respondents chose a score above the neutral score of 3 and only 8 chose a score less than a neutral value (See table 11). This means the respondents generally believe that focus in safety improves productivity.

6.9.2 Research question 1

The research looks at understanding what other factors are associated with the variable theme focus in safety improves productivity by running a Pooled T test in which the data was transformed so that all respondents who chose a score of 3 and below were given a 0 and those who scored above the neutral were given 1. This test was done in order to determine that employees who believe that focus in safety improves productivity what other factors/themes do they correlate with.

6.9.2.1 Test of correlation

The concern is that there is no difference in the mean score for respondents with a target of 1 and those with a target of 0. The Pooled T test was run to a significant 5% significant level and the following results were found as presented by table 12. If the alpha value (ρ) is less than 0.05 significant less then we can reject the concern, it above then we fail to reject the concern.

Table 12 summarises the result but one can see that the respondents who believe that focus on safety improves productivity have a correlation with the belief on productivity, belief on safety, focus on safety, and that productivity improves safety. The test fails to reject the concern on focus on productivity, invest on productivity and invest in safety; meaning there is no evidence to suggest that there is a correlation between these variables.

6.9.2.2 Test of association

In order to test for association, the data was transformed as described that the mean score of less or equal to 3 was given a score of 0 and above 3 which is positive a score of 1. The concern to be tested by was there is no association in mean score scores for target 1 respondents and with those of target of 0 with the variable under analysis which is focus on safety improves productivity. The Fisher's exact test was done in order to test the categorical variable for association.

Table 13 shows the summary of results from the Fisher's exact test, and the results is that there is no association with focus on safety improves productivity and any of the demographic, like current position, work experience and current work area. This supports the argument by Pagell, Dibrell, Veltri and Maxwell (2014) that all workers know that safety hazards have been controlled and so they can concentrate on their work, making it less stressful and reducing absenteeism.

Table 17: Association by current position

Target	Executive	Manager	Professional	Supervisor	Worker
0	0%	13%	16%	12%	17%
1	100%	87%	84%	88%	83%

Even though there is no association between the current position and the variable focus on safety improves productivity. One can see that all the groups above were leaning towards a target of 1 meaning that the respondents were mostly positive toward the variable focus in safety improve productivity.

Table 18 below shows the results for the variable focus in safety improve productivity by work experience. One can see as the years of experience grow the sentiment moves more positive. Zacharatoa and Barling (2005) support this argument by saying that each employee from shop floor to top management should feel that they can contribute to occupational safety. This means that current position is not important in the belief that safety improves productivity.

Table 18: Association by work experience

Target	over 30 years	11 - 20 years	21 - 30 years	5 - 10 years	Less than 5 years
0	8%	18%	10%	13%	33%
1	92%	83%	90%	88%	67%

Table 19 shows the distribution by work area. One can see that in the refinery which is the area with the highest risks, all the respondent belief that focus in safety improves productivity. Whereas in a depot where one would have expected since also it's a high risk the same sentiment but 22% thought focus on safety does not improve productivity.

Table 19: Association current work area

Target	Depot	Engineering	Office	Other	Refinery
0	22%	22%	7%	8%	0%
1	78%	78%	93%	92%	100%

6.9.3 Research question 2

In order to identify the factors or theme associated with the variable focus in safety improves productivity. Logistic regression was chosen because I has a dichotomous dependent variable. The model specification and the methodological approaches was described in chapter 5 item 5.1.12.

The mode fit well to 5% significant level from the likelihood ratio test and the model fit result are shown on table 14 and 15. Type 3 analysis of effects as shown in table 13, shows the results and at 10% significant level one can see that the variable most associated with the variable focus in safety improves productivity is belief in safety. Meaning that in order to for the companies to improve productivity through safety is the belief in safety. Companies need to build a culture of safety that its employees believe that they are safe and the company is doing all it can to improve the safety of its employees.

The other two associations are focus on safety and investment in productivity at 10% significant level. These two variables are important in that the company must continue to invest in productivity and continue to focus in safety while doing it. The other variable seems to not be associated with the variable focus in safety improves productivity. These are belief in productivity, invest in productivity, focus in productivity and productivity improves safety.

The other interesting finding from this test is that the area of work, experience and current position had no association with the variable focus in safety improves productivity, meaning that these demographic had no bearing in the belief that safety improves productivity. In conclusion the organization which believes in safety, focuses on safety performance and invests in productivity generally believes that safety performance improves productivity. Figure 15, the Roc curve has an area of 0.92 which is very high and means that the model fits model fits very well and the statistics produced are valid in terms of understanding the effect of safety performance improving productivity.

Chapter 7: Conclusion

7.1 Introduction

The research looked at the concept that if the company focus its effort on increase safety performance that could result in improving productivity and the real productivity measure of the bottom line. This is important because of the importance of the company to make sure that it complies with increased occupational safety and environmental legislation and the impact that those incidents have reputational and financial impact. These factors have become a licence to operate and Laurence (2010) concurred even though his research was focused only in mining that 'a mine needs a social licence to operate' and that licence its responsibility to its employees and environment. Hajmohammad and Vachon (2013) supports this by indicating that organisations have realised that they can enjoy cost savings and gain a long term competitive advantage by being concerned about the future of people and planet and through the creation of the unique sustainability-oriented process.

7.2 Main findings and conclusion

From the results, there were two main findings that have research found. The first finding was that; if a company focuses on safety that may result in improved productivity. The second finding is that, the variable 'safety improves productivity' is correlated to a perception 'belief in safety, belief in productivity, focus in safety and productivity improves safety'.

7.3 Safety improves productivity

There were three questions for the theme of safety improves productivity and the average positive score of 3.99 and all 115 respondents answered all the questions and had a low standard deviation of 6.69. This was supported by the interviewee who indicated that if the company focus on safety by saying that if the environment is encouraging and safe this leads employee to perform without worrying about their safety this is supported by Hajmohammed and Vachon (2013) whom in their study found that the results suggest that commitment to safety and establishing a positive safety culture as the starting point towards achieving a sustainable business can yield great benefits not only in terms of improved

safety performance but also with regards to improvements in firm's environmental and financial outcome.

Hofmann, Gerras and Morgeson (2003) concur when they indicated that safe behaviour is important because of the impact it has on the human and financial costs associated with unsafe behaviour, accidents and injuries. This is the view that is supported by the interviewee P6, who indicated that after the incident production has to stop and come to a standstill added that customers are affected while there is incident clean up and investigation. From the results from the Univariate analysis to test the concern that respondents are neutral as to whether safety performance improves productivity (respondents generally chose a score of 3 on the Likert scale) one can conclude that at 5% significant level there is no evidence to believe that safety performance does not improve productivity. This was a very positive result and if one looks at Table 11, 99 respondents chose on the Likert scale above the 3 score and only 8 choose neutral and the same for below the neutral with none choosing a score of 1. This is in agreement with what Pagell, Dibrell, Veltri and Maxwell (2014) study that found that the results of their study gave strong evidence that at the specific period of their study that it was possible to efficacious and safe at the same time.

7.4 Correlated factors to safety improve productivity

Table 12 shows the themes or factors that have a positive correlation with the variable safety improves productivity. The strongest correlation was with the factor focus on safety (see Table 8). This theme had the highest minimum average score of 2.5 and a maximum of 5 with all respondent answering all questions in this theme (see Table 5) with a mean score of 3.94. This is supported by what interviewee P6, who said that prioritising productivity to the extent that safety is compromised is likely to lead to dealing with a consequence of an incident and dealing with the disaster and that brings productivity to a standstill. It is much cheaper to deal with safety as part of the everyday business than to deal incident afterwards. This is supported by Zacharatos, Barling and Iverson (2005) who indicate that the data from their study demonstrate that a high-performance work system is significantly associated with occupational safety.

Safety is paramount to concern in a high-risk environment (Hofmann, 2003). This is supported by interviewee P3 who indicated that it does not matter how productive the company is doing, but there is a business without safety. The following factor is a belief in safety which the company needs to project. Laurence (2011) indicated that safety is part of sustainability. So the company needs to believe and focus on safety in such a way that safety improves productivity. Since employees according to Zachoratos, Barling and Iverson (2005) indicate that employees are a primary source of competitive advantages that is difficult for others to imitate.

Figure 18: Factors correlated to the variable safety improves productivity



The other two factors that had positive but weak correlations with the theme focus in safety improve productivity. Even though there is a weak correlation but from the results there was a belief that the company focused more on productivity that on safety. This is also supported by the interviewee that the company invest much more money in productivity. There is also a belief that those investments they sometimes also end up improving safety more especially if the design is ergonomically sound. Zacharatos, Barling and Iverson (2005)'s findings which showed that many of the management practices that are frequently applied to improve organisational performance may leave equal or greater effects on occupational injuries. This supports that the company can improve productivity and safety at the same time, there is no need to separate the two variables. Figure 18 show summarises the variable that are correlated to the main variable 'safety improves productivity'.

The other interesting outcome is that there is no association between the variable 'safety improve productivity' and current position, work experience and area of work. All these area believe that safety improves productivity and there is no distinction between groups. Pagell, Dibrell, Veltri and Maxwell (2014) indicates that workers who know that safety hazards have been controlled can concentrate on their work and making work less stressful and reducing absenteeism. That might be because safety has human benefits which for all people in the organisation and for manager also financial for the company (Hajmohammad, 2013). A favourable environment which safety to could contribute to, according to Islam and Shazali (2010) could gear up the morale of workers and contribute to increased manufacturing productivity.

7.5 Business recommendations

“Safety guarantees the business and productivity ensures sustainability; one is a licence to operate the other one sustainably” is a quote from one of the interviewees and it summarises the basic findings of this study. There are a number of learning points that companies could get out of this study

- They might need to invest more on safety or at least create a perception to their employees that there is a will to invest in safety. The perception from this study is that the company focuses more on productivity than they do on safety. Investment in safety is perceived as creating a good environment for employees to work without worrying about their safety. Zacharatos, Barling and Iverson (2005)'s research indicates that a high-performance system is significantly associated with occupational safety.
- Safety is important at all levels of the company, whether they are in the executive, supervisors or shop floor workers. Mullen (2004) implied that if the management is committed to safety it is more likely that the workers will exhibit a commitment to safety. This builds a safety culture that will lead to gain in financial, environmental and safety outcomes as a result of their increased employees” commitment in pursuing organisational goals and objectives (Hajmohammad, 2013)

- The other recommendation for business is that when companies approach projects or processes that are meant to improve productivity or efficiency they don't have to look at safety as an afterthought but can incorporate the safety from the conception to design and implementation. As one of the interviewee said that safety and productivity are two sides of the same coin. Those projects could have benefits to improved safety performance and improvement in the firm's environmental and financial outcome (Hajmohammad, 2013).

7.6 Recommendations for future research

The study had a limitation in terms of the scope, the study was only done with the employees of one company in the petroleum industry, so the research might be limited and maybe the reason the reliability is not strong. In order to get more comparable study in high-risk industry which are Iron and steel, Air Road transport, building and construction, agriculture and chemicals.

The study should be supported by a look at secondary data in order to see the relationship over time of investment into safety, the rate of accidents and return on investment. This relationship could be more useful in order to check that if the company continuously invest in safety, this will increase safety performance and in consequence improve productivity measured by return on investment over the profitability of the organisation. It will also be the beneficiary if the interview is conducted with different levels of the organisation to get a different perception of the organisation. The group of six that was interviewed are senior managers at the same organisation and they might be biased in their response.

In agreement with Pagell, Dibrell, Veltri and Maxwell (2014) that more studies are required. While we believe that our methods are rigorous and our results unambiguous we also believe that there is a great deal of future research needed to fully understand the relationship between operational practices and outcomes and safety practices and outcomes (Pagell, 2014).

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Appendix 1: Research questionnaire

Gordon Institute of Business Science University of Pretoria

You are invited to participate in a research study on the impact of improved safety on productivity. The aim of the research is to determine the relation between safety and productivity. The research is the completion of the Masters in Business Administration from the Gordon Institute of Business Science of the University of Pretoria. The survey will take you not more than 5 minutes to complete

Your decision to participate or decline participation in this study is completely voluntary and you have the right to terminate your participation at any time without penalty. Your participation in this research will be completely confidential and data will be averaged and reported in aggregate.

If you have any concerns, please contact me or my supervisor. Our details are provided below.

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Research questionnaire					
Current position	Worker	Supervisor	Manager	Professional	Executive
Work Experience	<5 years	5 – 10 years	11 – 20 years	21 – 30 year	31 & over
Current work area	Plant	Shaft	Office	Engineering	Other

	Less than 1 year	1 -2 Years	3 – 5 years	More than 5 years	I don't know
When was the last time the mine had a major injury incident	1	2	3	4	5
When was the last time there was a major investment/spending in safety	1	2	3	4	5
When was the last time there was an investment in safer equipment.	1	2	3	4	5
When was the last time there was a major investment in productivity	1	2	3	4	5
When was the last time there was a major investment in efficient equipment	1	2	3	4	5
When was the last time you had a safety related project	1	2	3	4	5
When was the last time you had a productivity improvement project	1	2	3	4	5

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
Safety is a priority	5	4	3	2	1	0
Productivity is a priority	5	4	3	2	1	0
Safety training is provided regularly	5	4	3	2	1	0
Time is spent discussing safety in your team	5	4	3	2	1	0
Safety improves productivity	5	4	3	2	1	0
Safety takes away resource from productivity	5	4	3	2	1	0
The last project on safety improved safety performance	5	4	3	2	1	0
The last project on productivity improved productivity	5	4	3	2	1	0
The last project on safety improve productivity	5	4	3	2	1	0
The last project on productivity improve safety performance	5	4	3	2	1	0

Appendix 2: Research question numbering

Item Number	Item
1	Current position
2	Work Experience
3	Current work area
1	When was the last time the mine had a major injury incident
2	When was the last time there was a major investment/spending in safety
3	When was the last time there was an investment in safer equipment.
4	When was the last time there was a major investment in productivity
5	When was the last time there was a major investment in efficient equipment
6	When was the last time you had a safety related project
7	When was the last time you had a productivity improvement projects
8	Safety is a priority
9	Productivity is a priority
10	Safety training is provided regularly
11	Time is spent discussing safety in your team
12	Safety improves productivity
13	Safety takes away resource from productivity
14	Did the last project on safety improved safety performance
15	Did the last project on productivity improve productivity
16	Did the last project on safety improve productivity
17	Did the last project on productivity improve safety performance

Appendix 3: Interview questions

Gordon Institute of Business Science University of Pretoria

26 Melville Road
Illovo
Johannesburg

I am conducting a research on the impact of improved safety on productivity. Our interview is expected to last about an hour and it is to help give depth to the online survey that is running in parallel to the interviews. Your participation is voluntary and you can withdraw at any time without penalty. Of course, all data will be kept confidential. If you have any concerns, please contact me or my supervisor. Our details are provided below.

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Cell: 082 893 0477

Participant Signature: _____

Date: _____

Signature Researcher: _____

Date: _____

- 1) Is safety and productivity conflicting or complimentary priorities?
- 2) What was the last major investment into safety and what has been the impact on safety and productivity?
- 3) What was the last major investment into productivity and what has been the impact on safety and productivity?
- 4) What was the last major incident and how has the incident affected productivity?

Appendix 4: Copyright declaration



COPYRIGHT DECLARATION FORM

Student details			
Surname:	Mboye	Initials:	KI
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Course details			
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Department:	GIBS		
Supervisor:	Dr Pieter Pretorius		
Supervisor email:	pretoriusp@gibs.co.za		
Confidentiality / Embargo			
Do you need to have your report embargoed? If so, write a letter of motivation to substantiate (please attach letter to this form). Without a letter this will not be granted.			
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If yes, please indicate period requested			
Two years		**Permanent	

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I hereby certify that, where appropriate, I have obtained and attached hereto a written permission statement from the owner(s) of each third-party copyrighted matter to be included in my research report ("the work"), allowing distribution as specified below. I certify that the version of the work I submitted is the same as that, which was approved by my examiners and that all the changes to the document, as requested by the examiners, have been included.

I understand that all rights with regard to intellectual property in the work vest in the University who has the right to reproduce, distribute and/or publish the work in any manner it may deem fit.

I agree that, a hardcopy of the abovementioned work be placed in the Gordon Institute of Business Science Information Centre and worldwide electronic access be given to the softcopy on UPetd and UPSpace.

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Date: