

Analysing Biographical Differences on Employees' Perception of Safety Control Measures with Special Emphasis on the Cost Thereof at a Colliery

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Abstract: The purpose of this article is to determine whether biographical differences influence employees' perception on safety control measures and the cost thereof. A quantitative research approach was followed for which data were collected by means of a structured questionnaire from 151 employees at a colliery in South Africa. Exploratory factor analysis was used to reduce the employees' perceptions into nine factors. This was followed by an analysis of means using one-way analysis of variance (ANOVA) and t-tests to determine differences between perceptions of these factors and the biographical groupings of the employees. Five biographical variables were included, namely (i) years of experience, (ii) English proficiency, (iii) qualification, (iv) gender, and (v) designation. Within a meta-theoretical conceptual scope, a cross-sectional analysis revealed the following statistically significant perception differences: Firstly, from a biographical variable view, English proficiency groupings differ significantly among six of the nine factors. Secondly, from a factor classification view, both direct and indirect cost of work accidents/injuries and perceptions in relation to direct and indirect cost of an unsafe work environment differ significantly in three biographical variables, namely years of experience, English proficiency and qualification. To be more specific, the most experienced group (21+ years' of experience), the poor/fair, and even to a lesser extent, the good English proficiency groups and the group with no tertiary training should be educated especially about the effect that work accidents, injuries and an unsafe work environment have on the direct and indirect costs of the colliery. The study recommend that the employees with higher qualifications, excellent English proficiency as well as those with relatively fewer years of experience should do higher risk jobs as they are more receptive to safety rules and procedures.

Keywords: *Biographical factors, colliery, mine, production costs, safety controls*

1. Introduction

The importance of the study surfaces against the backdrop that workplace safety is an organisational issue that continues to be a great concern within firms, resulting in negative implications on financial and human capital. This is evident in the South African mining industry where mine accidents have resulted in 96 and 71 fatalities in 2013 and 2014, respectively, while 3 136 mine workers suffered injuries in 2013 and 2 686 in 2014 (DMR, 2013 & 2014/15). It is believed that between 1900 and 1991, approximately 7 000 miners were killed in South Africa and more than one million were permanently disabled (Inggs, 2016). Injuries make it impossible for mine workers to perform their duties at work resulting in the loss of income and loss of quality of life, and this produces a humanitarian and a socio-economic problem. Accidents also result in enormous costs for firms and sometimes lead to the closure of mining companies and thereby increase the unemployment rate within the country. Unfortunately, these crippling injuries and fatalities are the result of not new but repeat accidents (Chamber of Mines, 2015). Statistics indicate a drop in fatality and injury rates since the end of the apartheid era (1994). However, mine workers are still dying in the country's mines due to accidents. Therefore, the Minister of Mineral Resources, Advocate Ngoako Ramatlhodi, continues to place an emphasis on the health and safety of mine workers. The government also continues to use the provisions of the Mine Health and Safety Act to ensure that mine workers have a safe and dignified work environment and will not rest until this is achieved (DMR, 2014/15). According to the requirements of this act, the mining industry must have safety control mechanisms in place to ensure safety, for the employees to adhere to safety measures and ensure their own safety, and as a result, enable the mining companies to reduce accidents and costs due to accidents.

It is crucial therefore for the entire firm to ensure compliance and adherence to safety rules, to share the same attitude towards safety, and to understand the consequences of non-compliance in relation to production cost. In this regard, previous studies have investigated employees' perceptions and attitudes with

regard to different safety aspects in the workplace. For example, a 'safety climate questionnaire' was used by, *interalia*, Hecker & Goldenhar (2014), Laurence (2005) and Glendon & Litherland (2001). Harvey et al. (2002) used the 'safety attitude questionnaire' developed by Donald & Carter (1993). English & Branaghan (2012) referred to the 'safety compliance questionnaire' developed by Mason et al. (1995). These mentioned studies did not pay very much attention to the relation between workplace safety and production costs. Theories stipulate an association among firm safety and production costs. Some production costs can be traced directly to safety, namely costs are spent on safety mechanisms to increase safety performance, which leads to cost savings due to reduction in accidents and injuries (Son et al., 2000). Furthermore, indirect costs that cannot be traced directly to an accident or injury were also incurred at the workplace (Cloete & Marimuthu, 2015). The argument of the study is that although direct and indirect costs can objectively be quantified, employees' perspectives, which are much more subjective, may shed light on this issue from a different angle, i.e. analysing employees' perception of inadequacies in the safety aspects and their understanding of the relationship between safety and production costs. Therefore, the purpose of the study is to determine the influence of biographical differences on employees' perception of safety control measures and the cost thereof. Related studies applied biographical variables to identify views of different employee groups in the workplace (Van der Walt et al., 2016; Smit et al., 2015; Donald et al., 2015; Apreko et al., 2015). Similarly, this study exploited employees' views based on five variables, namely (i) years of experience, (ii) English proficiency, (iii) qualification, (iv) gender, and (v) designation.

This article forms part of a greater research project investigating safety control mechanisms and production costs at a colliery in South Africa. The broader aim was to identify the tools that can be applied to make visible the areas for improvement in relation to safety, commitment and application of or compliance with the safety rules within firms and thereby reduce accidents and accident costs within this vital industry to ensure sustainability. The first part (Mokoena & Oberholzer, 2015) applied a deductive theory-testing methodology and developed a questionnaire that focused on safety control mechanisms in relation to (i) firms' compliance, (ii) employees' compliance, (iii) employees' attitudes, and finally paid special attention to (iv) production costs. The questionnaire was completed by 151 employees at a colliery and an exploratory factor analysis reduced employees' perceptions into nine manageable factors. Data for this study were obtained from the first part's results and the rest of the 151 completed questionnaires. This study followed a quantitative method and built thereupon by employing an analysis of means (one-way analysis of variance (ANOVA) and t-test) to determine differences between perceptions (of these nine factors) and the five mentioned biographical groups of the employees. Within a meta-theoretical conceptual scope, a cross-sectional analysis was used to determine whether there are statistically significant differences from a (i) biographical groupings view, and (ii) a factor classification view. The layout of the study is as follows: The next section provides a background, including the conceptual scope and a literature review. This is followed by the method, findings and a discussion. The study is summarised and concluded in the final section.

Conceptual scope: This study was done within the conceptual scope of a meta-theory, which is "a theory devised to analyze a theory" or "the investigation and analysis of theories" (Collins English Dictionary, 2012). Stephen Hawking says in this regard: "Any physical theory is provisional, in the sense that it is only a hypothesis: you can never prove it. No matter how many times the results or experiments agree with some theory, you can never be sure that the next time the results will not contradict the theory." (Hawking s.a.). With reference to this quote, this study does not aim to test some theories or hypotheses based on biographical differences, for example to prove Henwood et al. (2008) Gender Theory that safety is more salient to women than men. The purpose of this study rather is to determine different biographical groups of employees' perceptions at a colliery and the results may differ from investigating another firm. Nevertheless, this study's results may serve as a good example to establish hypotheses for future studies. Furthermore, the construct of the nine factors may also be used in any other firm to determine inadequacies by investigating biographical differences of employees' perceptions with regard to safety measurements and the cost thereof.

2. Literature Review

Biographic variables: Maree & Pietersen (2015) state that important information can be obtained by including biographical questions in a survey. Main-type variables are, for example, age, qualification, gender, home language, marital status, income and occupation. Studies such as those by Van der Walt et al. (2016),

Smit et al. (2015), Donald et al. (2015) and Apreko et al. (2015) also studied biographical variables of employee groups in the workplace. In this study, biographical variables are investigated within the context of the South African mining industry. Variables included in the study, firstly, is years of experience. The safety culture perspective of workers may be influenced in the era it was established. For example, during the apartheid era (before 1994), mine workers were oppressed and their safety was not an important aspect of the apartheid laws. The mine workers did not have the right to complain or strike if they had concerns about their safety and positions were occupied based on skin colour and not qualification. However; the current laws give mine workers rights, especially in relation to their safety. Among these rights, miners are given the right to refuse dangerous work and the right to leave dangerous working places (RSA, 1996). Secondly, English proficiency is included because it may have an influence on effective communication. English is the most commonly used business and commercial language in South Africa (South Africa Info, 2015), but this is the mother tongue of only 9.6 percent of the population (Statistics South Africa, 2011). In addition to language proficiency, the third biographical variable, qualification, is included because approximately 30 percent of mine workers are illiterate (Thwala, 2008). Fourthly, gender is included, and finally, designation is included to determine whether there are perception differences between mine managers and workers.

Safety control: Sevim & Gedik (2010) define safety controls as all ‘methodised works’ used to detect, examine and prevent workplace dangers. If hazards cannot be eliminated, they must be mitigated through safety controls to reduce the harmful degree of accidents. Safety is therefore the protection from harm or danger. Therefore, safety control entails the protection of employees at work from danger, especially in the mines. It can be achieved through occupational safety, which is the elimination of conditions that may pose danger to the health and safety of employees in the workplace (Noe et al., 2014). Due to implementation costs that are incurred to ensure employee safety, some firms still do not have safety measures in place. Nevertheless, there are firms that do their utmost best to provide safe workplaces for miners even though a many mine workers believe that safety rules must be broken to get the job done (Laurence, 2005). This was validated by Paul & Maiti (2007) that risky behaviour is a common cause of accidents. This indicates that safety measures can be put in place; however, if they are overlooked, accidents will occur and result in injuries and fatalities. For this reason, the safety culture within a firm should be improved. Lu & Tsai (2008) define safety culture as “...the principles, standards, attitudes, views, perceptions, competencies and patterns of behaviour that indicate the commitment of employees to safety, the style and the know-how of an organization’s health and safety management.”

Special emphasis on production cost: The South African mining industry is considered to be production- and profit focused. This was confirmed and substantiated by Busani Masango who has worked in different mines in South Africa that mining companies do not put sufficient safety measures in place to prevent accidents. All they care about is profit and fail to realise the enormous costs that are incurred due to accidents. He also stressed that “working conditions in the mines are unbelievable” (Inggs, 2016). Firms that are production oriented do everything possible to achieve the set production and profit targets. However, these high production targets and constraints of time put a great deal of pressure on the employees, and as a result, they are encouraged to take shortcuts and violate safety rules, which jeopardise safety compliance and decrease the safety levels of operations (Masia, 2010). Consequently, the country has failed to reach its target of zero harm in 2013 and still has the highest fatality frequency rate (0.09) when compared to the international benchmarks, USA (0.07), Canada (0.07) and Australia (0.02) (Chamber of Mines, 2015). At times, mine workers are exposed to dictatorial management styles and a ‘don’t care’ attitude from the managers encouraging employees to take risks and removing employees’ focus off the safety controls (Masia, 2010).

Mine workers in South Africa are exposed to known and unknown hazards; as a result, their chances of being killed or suffering severe non-fatal injuries due to accidents are very high compared to employees in the private industry. Sari et al. (2009) established that fatal injuries in the mining industry were nearly 12 times the rate of private industry resulting in an increase in the production cost and a decrease in profitability for the industry. To ensure safety and prevent accidents and costs, management’s commitment and enforcement of the application of safety rules are essential. This can be achieved through the allocation of resources towards safety controls and the implementation of ways and means to better understand the reasons why employees break rules or why rules are ineffective. The hazardous nature of mining can result in a large

number of miners being exposed to injury or death in the mines, which creates a negative effect on the financial performance of mining companies, as costs are incurred (Fernandez-Muniz et al., 2009). These costs include cash and disability benefits, as well as medical expenses for the injured employees and damage to property. The costs that are incurred due to accidents increase the production cost and therefore result in a decrease in profitability (Ural & Demirkol, 2008). The hazardous nature of mining also imposes additional costs as mines are required by law to have safety regulations and standards in place to ensure the safety of employees. Past studies, such as those by Conaway (1972) and Trienekens & Zuurbier (2008) acknowledge that the costs of meeting the safety standards are enormous as the cost of producing coal increased significantly after implementation.

Production cost: Cloete & Marimuthu (2015) define cost as a resource given up in order to realise a specific objective. Horngren et al. (2015) noted that production cost is the combination of three elements: direct material, direct labour and manufacturing overheads. Direct labour as defined by Cloete & Marimuthu (2015) is the cost incurred in the conversion of raw material into finished goods while direct material is the main ingredient of the product. Production overheads (indirect costs) are cumulative costs incurred during production, but cannot be directly attributed to complete products. Examples of production overheads are repairs, depreciation and maintenance. Mining companies also incur these costs in the normal operations of the business.

Direct cost: Son et al. (2000) posit in the Safety Control Cost Theory that there is a relationship between safety performance and costs. Therefore, this theory propagates that the higher the design, implementation and safety levels to be achieved, the lower the overall costs incurred within the organisation will be. To achieve higher levels of safety, extra costs are incurred and these costs will normally be borne by the employer. It can therefore be concluded that under a perfect state of safety, there will be no accidents and as a result there will be no costs associated with accidents. Based on the results, the study will establish employees' perceptions as to whether or not the colliery in question has safety measures in place to guarantee workplace safety. It will also determine whether or not the implementation and the application or the lack of safety control measures is perceived to increase or reduce the production cost at the colliery under review.

Indirect cost: The Indirect Cost Theory of Accident Prevention (Brody et al., 1990) affirms that for every accident that occurs, indirect costs are incurred. Indirect costs are the costs that are incurred by firms due to accidents, but cannot be directly attributed to a specific accident (Cloete & Marimuthu, 2015). Indirect costs are also referred to as hidden costs because many employers are not aware of these costs. For this reason, these costs are not insured and are entirely absorbed by the employer. HW Heinrich (1959), who began analysing work accidents in the late 1920s, concluded that indirect costs are substantial and generally a multiple of direct costs incurred due to accidents with an average ratio of 4:1 (indirect costs/direct costs) (Brody et al., 1990). Some researchers have come to the conclusion that the sum of indirect costs due to accidents constitutes a potentially fruitful source of savings and are therefore likely to motivate owners to invest in preventive measures. For example, 350 disabling accidents in Quebec in 1988 incurred an indirect cost in excess of \$1 100 per accident and \$2 900 per time lost per accident (Brody et al., 1990). The authors revealed that by recognising the uninsured indirect costs and by making this information available to all employees, costs can be minimised through accident-reducing activities that are regarded as more profitable through prevention. This study will attempt to determine employees' perceptions as to whether or not there are any indirect costs that are incurred due to accidents at the site and highlight the implications that these indirect costs have on the production cost at the colliery under study.

Summary of argument and research questions: According to the Safety Control Cost Theory and Indirect Cost Theory, costs are incurred in order to put accident prevention measures in place. These costs can be incurred due to safety training that is provided to employees, safety incentives, staffing for safety, provision of safety facilities and safety programmes in order to improve safety performance and as a result reduce accident costs. Investing in safety must be viewed as a means to improve the bottom line and naturally to reduce the incidence of injuries. This is because, if there is a high safety investment, the chances of incurring high injury cost become relatively low. On the other hand, if investments in safety are low, the chance of sustaining high injury cost can be relatively high (Teo & Feng, 2011). This was substantiated in the study by

Son et al. (2000) at SI Construction Company in Korea over a period of three years (1993-1995). The study concluded that when the rate of investment increased, the accident rate, direct cost, indirect cost, cost of damage and the total cost were reduced. However, if companies continue to increase investment in safety, this can trigger an increase in the total cost. The argument of the study is that although direct and indirect costs can objectively be quantified, employees' perspectives may shed light on this issue from a different angle. That will be helpful to answer two research questions; firstly, which groups of employees need to be educated on how safety performance can reduce direct and indirect production cost?, and secondly, what management actions should be enhanced to improve safety performance to reduce production costs?

3. Methodology

Within the conceptual scope of a meta-theoretical approach, a quantitative research paradigm was adopted as this study seeks to quantify data and apply some statistical analyses. Structured questionnaires were distributed with the intention of analysing different employee perceptions according to biographical variables, namely designation, gender, years of experience, qualification and English proficiency with regard to the compliance of the colliery, adherence and application of safety rules by the employees, as well as the production cost within the colliery using a one-way ANOVA and t-test. The population of the study was a colliery in South Africa with 1 023 employees, including top management. A sample of 218 mine workers was randomly selected to represent the entire population by completing structured questionnaire. 151 usable questionnaires was returned. The questionnaire, consisting of 56 five-point Likert scale questions/items, ranging from 1, strongly disagree to 5, strongly agree was used to examine the participants' perceptions. The items were divided into five sections, namely (i) biographical information, and four constructs, namely (ii) the compliance of the colliery with safety legislation, (iii) established the employees' compliance regarding the application of safety controls, (iv) determined the perceptions and attitude of participants towards safety controls, and (v) established the participant's' perceptions with regard to safety controls and production cost. The questionnaire contained modified questions adapted from questionnaires used by the following authors: Laurence (2005), Glendon & Litherland (2001), Cox & Cheyne (2000), Donald & Canter (1993)– Safety Attitude Questionnaire–Harvey et al. (2002) and Mason et al. (1995). A number of new questions were developed by the researcher to place a greater emphasis on production costs and safety controls.

Table 1: Reliability of the factors and results

Factor number	Names of factors	Percentage of variance explained	Reliability
1	Organisational compliance to safety legislation	49.12	0.92
2	Management commitment	12.27	0.49
	Cumulative %	61.46	
3	Employees' compliance and commitment to safety	41.91	0.86
4	Supportive work environment	17.78	0.44
	Cumulative %	59.69	
5	Employees' perceptions on safety culture	45.95	0.90
	Cumulative %	45.95	
6	Direct and indirect cost of work accidents and injuries	25.36	0.84
7	Direct and indirect cost of unsafe work environment	13.51	0.87
8	Work environment in relation to safety and indirect cost	9.63	0.68
9	Cost reduction due to adherence to safety	7.89	0.71
	Cumulative %	56.39	

(Source: Authors' computations with the aid of SPSS version 21.0)

Experts in the accounting and safety field established the content and construct validity to ensure that the questionnaire contains the concepts it intended to cover by enabling the researcher to identify and eliminate problematic questions in relation to wording and the arrangement of questions. Exploratory factor analysis was employed to establish the underlying dimensions of the four constructs. Cronbach's alpha was computed for sections(ii) to (v) to determine the reliability of the scale with scores of 0.87, 0.80, 0.77 and 0.86, respectively. In total, nine factors were identified, i.e. factors 1 and 2 from section (ii), the compliance of the colliery with safety legislation, factors 3 and 4 from section (iii), established the employees' compliance

regarding the application of safety controls, factor 5 from section (iv), determined the perceptions and attitudes of participants towards safety controls, and factors 6, 7, 8 and 9 from section (v), established the participant's' perceptions with regard to safety controls and production cost. The names and the reliability of the nine factors are indicated in Table 1. All factors have reliability scores above the acceptable level of 0.70, except for factor 2 (0.49), factor 4 (0.44) and factor 8 (0.68). Data of the five biographical variables are exhibited in Table 2, including the groups and the number of respondents of each variable's group. Note that 'English proficiency' is the only variable where all 151 respondents selected a group. Only 149 and 147, respectively, selected a group with regard to the other variables.

Table 2: Biographical data of respondents

Experience	1-10 years	11-20 years	21+ years
n = 149	n = 68	n = 42	n = 30
English proficiency	Poor + fair	Good	Excellent
n = 151	n = 39	n = 76	n = 36
Qualification	No tertiary	Tertiary	
n= 149	n = 54	n = 95	
Gender	Male	Female	
n= 149	n = 90	n = 59	
Designation	Management	Non-management	
n= 147	n = 62	n = 85	

(Source: Authors' computations with the aid of SPSS version 21.0)

The data from the questionnaire were analysed using a one-way ANOVA and t-test to establish differences between group means and their significance (Clow & James, 2014). As per Table 2, ANOVA was effectual to analyse experience and English proficiency, since there are more than two independent groups, while the t-tests were effectual to analyse qualification, gender and designation, since only two independent groups' means were compared. Differences were considered significant if the p-value was less than or equal to 0.05, while a p-value greater than 0.05 was considered not significant (Naidoo & Maseko, 2012). Regarding the ANOVA, if significant differences were found, post hoc comparison, based on Turkey's HSD test, was utilised to establish exactly where the differences were found (Clow & James, 2014). Regarding the t-test, Levene's test for equality of variances was used to determine whether equal variances were assumed/not assumed.

4. Results and Discussion

Results of the exploratory factor analysis: The appendix indicates the results of the analysis of the questionnaire. The exploratory factor analysis analysed 50 of the 56 statements (questions) into nine factors. To establish the number of factors under each section, eigenvalues were examined. The study followed Kaiser's criteria to extract factors – the eigenvalue >1 rule and the scree test (Williams et al., 2010). Under sections (ii) and (iii), two factors were identified, three under section (iv) and six under section (v). It was then established which questions loaded onto these factors and rotated using Varimax with Kaiser Normalisation to improve the loadings of these questions. The rotated component matrix revealed items that loaded onto more than one factor, those that loaded below 0.5 and the factors that loaded fewer than three items. Only variables whose loadings were greater than 0.5 were accepted. Factors with fewer than three items were rejected due to the declaration by Varonen and Mattila (2000) that it takes at least three variables to define a factor. The items that loaded onto more than one factor and were all below 0.5 were also rejected in order to simplify and improve the interpretability of factors (Field et al., 2013). Nonetheless, the questions that loaded onto more than one factor were allowed to represent the factor with the highest loading, provided the loading is >0.5 (O'Toole, 2002). At the end of this process, nine factors (appendix) were identified, in the sequence of two each from sections (ii) and (iii), one from section (iv) and four from section (v).

The overall employees' perceptions with regard to safety and related production costs indicate that the colliery investigated is in a sound position, because employees understand the good work done by the colliery/management, understand their own role in the safety process and understand the relationship between safety and production cost. Note that factors 1, 2, 4, 6, 8 and 9 consist of positive individual statements that were presented in the questionnaire (appendix). With the five-point Likert scale in mind, all

six of these factors' means are above the mid-point of 3, implying that the respondents agree with these (positive) statements. Factors 3, 5 and 7 consist of a number of negative statements. On average, all these mean averages are lower than 3, implying that respondents disagree with them, which is good. These averages indicate the agreement of the employees regarding the compliance of the colliery to safety legislation, management commitment and reduction of costs at the colliery due to the implementation and application of safety measures (factors 1, 2 and 9). In the next section, a more in-depth analysis was done to determine significant differences between different groups.

Analysis of means: Table 3 is a cross-sectional exhibition that summarises all the significant mean differences of groups' perceptions. Firstly, from a biographical variable view, English proficiency groupings differ significantly among six of the nine factors. Secondly, from a factor classification view, both direct and indirect cost of work accidents/injuries (factor 6) and perceptions in relation with direct and indirect cost of an unsafe work environment (factor 7) differ significantly in three biographical variables, namely years of experience, English proficiency and qualification. Note that there are no significant mean differences found for factors 2, 4 and 8, and also no significant differences for the two biographical variables, gender and designation.

Table 3: Cross-sectional analysis of significant differences between groups

Factor	Biographical variables		
	Experience	English proficiency	Qualification
1		Excellent and poor + fair	
3		Excellent and good	
5		Excellent and poor + fair	
		Poor + fair and good	
		Poor + fair and Excellent	
6	11-20 and 21+ years	Excellent and poor + fair	No tertiary and tertiary
7	0-10 and 21+ years	Excellent and poor + fair	No tertiary and tertiary
		Excellent and good	
9		Excellent and poor + fair	

(Source: Authors' computations with the aid of SPSS version 21.0)

The rest of the discussion is a detailed analysis of all the statistically significant mean differences from a biographical variable view.

Differences identified between years of experience: Table 4 exhibits the results where significant differences were found between groups' experiences (0-10 years, 11-20 years and 21+ years) according to the one-way ANOVA. The means of each group are given in parentheses.

Table 4: Posthoc results of differences between years of experience using the Turkey HSD test

Dependent variable	Years of experience		Mean differences	Std. error	Sig.
Factor 6	11-20 years (3.67)	0-10 years (3.52)	0.15	0.150	0.564
	21+ years (3.16)		0.51	0.182	*0.017
Factor 7	0-10 years (2.83)	11-20 years (2.70)	0.13	0.205	0.796
	21+ years (2.23)		0.60	0.229	*0.027

(Source: Authors' computations with the aid of SPSS version 21.0)

* Significance at 0.05 level.

It can be hypothesised that experienced workers are aware of and understand the physical hazards and the cost implications thereof (Kecojevic et al., 2007; Paul & Maiti, 2007). For example, retraining, passage of time and regular cost reports presented at the safety meetings are believed to equip older workers with experience and thereby make them aware of safety requirements (Choudhy & Fang, 2008). This is because training emphasises safe work practices that prevent accidents (Lanoie & Trotter, 1998). For factor 6 (Perceptions of direct and indirect cost of work accidents and injuries), the mean score is the highest for the middle (11 to 20 years) experience group (3.67) and it is significantly higher than the mean score of the 21+

year group (3.16). Note that the statements included in Factor 6 are positively stated, implying that a higher score indicates a higher degree of agreement. Conversely to the literature, experienced employees at the Colliery have the lowest score, probably because experienced employees have been exposed to accidents for more time and are no longer worried about the hazardous environment, encouraging employees to take shortcuts resulting indirect and indirect costs. Furthermore, these 21+ experience group started working before 1994, the apartheid era, when mine safety was not regarded as a high priority, relative to the period after 1994. Consequently, it seems that the most experienced group has the lowest awareness on how failures, injuries and accidents negatively influence production costs indirectly. The statements included in Factor 7 (Perceptions of direct and indirect cost of unsafe environment) are as such that the lower the score the better. Significant mean differences are found between the extreme groups, 0 to 10 years (2.83) and 21+ years (2.23). Consistent with the literature (Keckojevic et al., 2007; Paul & Maiti 2007), this results in some degree of a lack of awareness by the less experienced employees on how an unsafe environment can increase production costs.

Differences identified between means for English proficiency levels: A lack of understanding of safety measures may results in cost accumulation for firms as it was identified by Stevens (2010). He argued that limited English proficiency has economic implications, low productivity and increased safety problems that affect the cost of production. Table 5 exhibits significant differences between groups' English proficiency levels according to the one-way ANOVA.

Table 5: Post-hoc results of levels of English proficiency using the Turkey HSD test

Dependent variable	Years of experience		Mean differences	Std. error	Sig.
Factor 1	Excellent (4.57)	Poor + fair (4.11)	0.47	0.129	*0.001
		Good (4.21)	0.37	0.113	*0.004
Factor 3	Excellent (1.96)	Poor + fair (2.53)	-0.57	0.200	*0.013
		Good (2.37)	-0.41	0.175	0.051
Factor 5	Poor + Fair(2.55)	Good (2.14)	0.41	0.171	*0.046
		Excellent (1.83)	0.72	0.201	*0.001
Factor 6	Excellent(3.64)	Poor + fair (3.29)	0.36	0.151	*0.050
		Good (3.33)	0.32	0.155	0.104
Factor 7	Excellent (2.06)	Poor + fair (2.82)	-0.76	0.235	*0.004
		Good (2.85)	-0.79	0.206	*0.000
Factor 9	Excellent (4.06)	Poor + fair(3.62)	0.44	0.179	*0.045
		Good (3.86)	0.20	0.157	0.427

(Source: Authors' computations with the aid of SPSS version 21.0)

* Significance at 0.05 level

Factor 1's (Organisational compliance with safety legislation) mean for employees with excellent English proficiency is significantly higher than the means of the poor + fair (4.11) and the good (4.21) groups. Although the scores of 4.11 and 4.21 are materially above the mid-point of 3, it is clear that these two groups relatively lack some knowledge about the effort of the colliery to comply with safety legislation. Opposite to factor 1, where a higher score is the better, factor 3 (Employees' compliance and commitment to safety) consists of negative statements where a lower score indicates higher employee compliance and commitment to safety. The results reveal that employees with an excellent (1.96) English proficiency have significantly lower scores than the poor + fair (2.53) groups. Factor 5's (Employees' perceptions on safety culture) statements are also as such that a lower score is better, indicating a better safety culture. For factor 5, the mean score of the poor + fair (2.55) group is significantly higher than the excellent (1.83) and good (2.14) groups. Dimirkesen & Arditi (2015) believe that knowledge and skills development regarding safety is transferred through training and communication, which may also result in improved safety culture. However, safety training, presentations and communication are conducted in English. Due to language barriers, there can be misunderstandings.

Factor 6 (Perceptions on direct and indirect cost of unsafe environment) consists of positive statements, and therefore the higher the mean score the better. Again, there is a significant mean difference between the

extreme groups excellent (3.64) and poor + fair (3.29) insinuating that the limited English proficiency of the latter may lead to poorly trained employees due to failure to understand presentations. This may result in employees who get involved in unsafe acts resulting in the accumulation of costs. Factor 7 (Perceptions on direct cost and indirect in relation to work accidents) contains negative statements, where the lower the mean the better. The excellent group's (2.06) mean is significantly lower than the means of the good (2.85) and poor + fair (2.82) groups. It could be because of the difficulty to understand work-based instructions due to poor English proficiency resulting in accidents as the employees do not know what they are expected or instructed to do (Trajkovski & Loosemore, 2006). Factor 9 (Perceptions on cost reduction due to adherence to safety measures and procedures) consists of positive statements, which implies the higher the mean the better. Again, there is a significant difference between the two extreme groups, excellent (4.06) and poor + fair (3.62) groups. English language proficiency may reduce errors that result in accidents. This is because the employees understand the safety rules and procedures well and they also have the ability to make suggestions regarding rules that are impossible to apply, resulting in improved employee confidence, job satisfaction and morale, argued Mikulecky (2011).

Differences between means for qualification: Table 6 exhibits the results of the t-test to determine significant mean differences between the two groups' qualification, i.e. no tertiary and tertiary education. For both factors 6 and 7 equal variances were assumed.

Table 6: t-test results of qualification levels using Levene's test for equality

Dependent variable	Years of experience		Mean differences	Std. error	Sig.
Factor 6	No Tertiary (3.15)	Tertiary (3.66)	-0.51	0.127	*0.021
Factor 7	No Tertiary (2.42)	Tertiary (2.78)	-0.36	0.177	*0.013

(Source: Authors' computations with the aid of SPSS version 21.0)

* Significance at 0.05 level (one-tail)

Factor 6's (Perceptions of direct and indirect cost of work accidents) results show that the respondents with no tertiary qualifications' (3.15) means are significantly lower than those with tertiary qualifications (3.66). The probable reason could be that it is easy for the employees with additional qualifications to understand the safety rules and procedures, safety practices, hazards and the consequences of accidents better than those with lower or without qualifications (Vinodkumar & Bhasi, 2009). Factor 7's (Perceptions in relation to direct and indirect costs of unsafe environment) results show significant differences between the participants with tertiary qualification (2.42) and those with no tertiary qualification (2.78). This difference may be because of the failure to understand the rules and procedures and hazards associated with different tasks, failure to apply proper procedures, taking risks and shortcuts and failing to understand the cost implications of these acts due to lower qualifications.

Differences between means for gender and designated groups: After a t-test was done, no significant differences were found between male and female participants. All p-values were above 0.05. The designation identifies the position held by the respondents at the colliery. The employees at the colliery were grouped into two groups, i.e. management and employees. Management included pit superintendent, assistant pit superintendent, safety officers, foremen and supervisors, while safety representatives, operators and others (administration, finance and human resources) were classified as employees. No significant differences were identified between management and employees (p-values were >0.05).

5. Conclusion

Different employee perceptions were revealed regarding the nine factors identified from the completed questionnaires. The overall employees' perception with regard to safety and related production costs indicates that the colliery investigated is in a sound position, but a more in-depth analysis of biographical variables identified some weaknesses by finding significant differences between different groups. The purpose of the study can be summarised to make conclusions about the research questions of which groups of employees need to be educated on how safety performance can reduce direct and indirect production costs and what management actions should be enhanced to improve safety performance to reduce production

costs. It was evident from this study that the biographical variables (i) years of experience, (ii) English proficiency and (iii) qualification have a statistically significant influence on the perceptions of employees in relation to safety and production cost. To be more specific, and to answer the first research question, the most experienced group (21+ years' of experience), the poor + fair and even the good English proficiency groups and the group with no tertiary training should be educated especially about the effect that work accidents and injuries (factor 6) and an unsafe work environment (factor 7) have on the direct and indirect costs of the colliery. This will enable the colliery to reduce costs incurred due to accidents as the Indirect Cost of Accident Prevention Theory affirms that, for every accident that occurs, there are indirect costs incurred. Furthermore, no differences were established regarding gender and designation, which implies that male and female employees and employees from top management to operators share similar perceptions in relation to safety and production costs.

Focusing on the second research question, the study firstly found that as the employees at the colliery gain experience, the less concerned they become about safety rules and procedures. The concern is specific in the group with 21+ years' experience, which was exposed to a culture of less safety awareness during the apartheid era. Consequently, the less experienced employees should work in the hazardous areas of the colliery and could be used to demonstrate to other employees how to work safely as these employees seem to be more safety conscious than the experienced ones. This is somewhat strange; however, it will enable experienced employees to learn the behaviours and attitudes of inexperienced employees as the Social Learning Theory submits that people learn through observing others' behaviours and attitudes. This is also an indication that experienced employees at the colliery have more chances of being involved in accidents. This raises a concern and it is important that not only the experienced employees at the colliery should change their attitudes and perceptions about safety, but also management. Therefore, management actions should include that managers walk the talk and show commitment to safety, as this can influence the employees' perceptions regarding safety by signalling implied obligation for the workers to act in a safe manner. This includes that management should also provide the employees with support and assurance that the firm cares for their well-being as the employees with supportive perceptions are more compliant with safety procedures. Moreover, attention should be paid to experienced employees who seem to be ignorant of the safety measures and the costs associated with work accidents and injuries, as this may increase health and safety problems and result in negative economic implications for the colliery. Finally, the retraining of experienced workers is recommended in order to provide information on current safety issues and as a reminder of the importance of safety and the cost implications of accidents. This will provide the means of making accidents more predictable so that they can be avoided easily through the application of safety controls and therefore reduce accidents and costs in relation to accidents.

Secondly, regarding to English proficiency, the study found significant perception differences between the groups in six of the nine factors. The group whose English proficiency is indicated as excellent shows a significantly higher notion as the poor + fair group, and to a lesser extent the good English proficiency group, with regard to safety aspects and the direct and indirect costs associated with it. Therefore, employees with excellent English proficiency can understand the processes, hazards and their cost implications better than others, as communication errors and misunderstanding of safety policies and measures can be circumvented. As a result, they are expected to have more positive mind sets and attitudes in relation to safety, because language barriers can affect one's perceptions and attitudes towards safety. In the light that the minority of South Africa's population (9.4 percent) indicates English as first language, management's action required in this regard should include that the colliery considers providing the safety rules, procedures and training to employees in their mother tongue to avoid misunderstandings.

Thirdly, the study found significant perception differences between employees with different levels of qualification. Management action in this regard should be focused on employees without tertiary qualifications. They should be provided with training and education about the various safety processes, hazards associated with different jobs as well as their consequences to enable them to take responsibility for their own safety and the safety of others. Communication channels have to be opened in order to fully understand the concerns of the employees and initiate the development of trust between management and employees so as to provide assurance to the employees about the importance of safety and that their organisation cares about their well-being. To summarise, the management actions needed, and to answer the

second research question, it is recommended that the employees with higher qualifications, excellent English proficiency as well as those with relatively fewer years of experience should do higher risk jobs as they are more receptive to safety rules and procedures.

The study uses the factors that influence safety culture (compliance, individual attitudes and management commitment) to identify the areas for improvement within the colliery in relation to safety, safety culture and the application of safety rules to reduce costs associated with accidents. In a country where mine safety does not receive the priority it deserves, any change in work culture and mind set will have to overcome considerable resistance from all quarters to ensure safety in the country's mines. This study will therefore enable firms especially, in the South African mining industry, to evaluate the state of safety within their firms at any point in time and to design safety interventions and management programmes targeting the sub-groups based on qualification, experience, English proficiency, designation and gender to improve any specific deficiencies in relation to safety and therefore reduce costs in relation to safety. The major limitation of this article is that the results are based on one colliery. Although managers in the mining sector can learn from this experience, the results cannot be generalised as other mines may have different dynamics. Nonetheless, the study provides avenues for further research as indicated earlier and the same study can be replicated and conducted at other mines, and a comparison study can be conducted to determine differences between mines and to enable the generalisation of findings.

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Appendix

Below are the statements from the questionnaire. This is the authors' computations with the aid of SPSS version 21.0). The following 5-point Likert scale below was applied:

Factor 1: Organisational compliance to safety legislation (average of means = 4.27)

Strongly disagree	Disagree	Moderately agree	Agree	Strongly agree
1	2	3	4	5
Statement				Mean S.D.
There are safety measures to ensure the safety of employees				4.37 0.687
Personal protective equipment (PPE) is provided freely at all times				4.34 0.727
There are safety procedures to guide the performance of tasks				4.32 0.742
Employees are made aware of possible hazards associated with their jobs				4.27 0.772
There are regular safety control meetings				4.27 0.754
There is a safety policy regarding the safety of employees				4.26 0.803
Effective documentation ensures the availability of safety procedures				4.21 0.742
Management learns from past mistakes and implements corrective measures				4.19 0.778
The organisation is up to date with the safety legislation				4.17 0.707

Factor 2: Management commitment (Average of means = 3.88)

Safety representatives are involved in putting together the safety procedures	4.05	0.89
Management considers safety to be equally as important as production	4.02	1.013
Supervisors seldom discipline employees who break the safety rules	3.57	1.188

Factor 3: Employees' compliance and commitment to safety (Average of means = 2.33)

Safety rules are only for inexperienced workers	1.94	1.152
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I can get the job done quicker by ignoring the safety rules	2.04	1.190
I often deviate from safety rules	2.28	1.135
Sometimes I fail to understand which rules to apply	2.36	1.106
I have difficulty getting hold of written safety rules	2.42	1.147
Some safety rules are impossible to apply	2.57	1.171
There are too many safety rules that one cannot remember	2.70	1.173

Factor 4: Supportive work environment (Average of means = 3.37)

Safety rules are written in the language that I understand well	3.47	1.249
Employees often give tips on how to work safely	3.47	1.059
I have found better ways of doing my job	3.17	1.232

Factor 5: Employees' perceptions on safety culture (Average of means = 2.12)

Safety is not my role	1.84	1.116
Working safety rules remove skills	1.84	1.154
It is necessary to break the safety rules to get the job done	2.07	1.126
Safety rules are used only to protect management's back	2.16	1.110
Acting with common sense is safer than acting within safety rules	2.20	1.074
Sometimes I do not understand why I have to follow the safety procedures	2.28	1.112
Safety rules make easy tasks complicated	2.44	1.269

Factor 6: Direct and indirect cost of work accidents and injuries (Average of means = 3.53)

Work accidents result in the loss of production	3.89	1.033
Work injuries result in a high absenteeism rate	3.69	1.110
Failure to apply safety measures results in employees getting suspended	3.66	0.984
Failure to comply with safety controls leads to employee dismissal from work	3.58	1.058
Safety measures have reduced the compensation paid to employees every year due to accidents	3.43	1.125
Suspensions/dismissals result in the organisation paying overtime to the employees	3.33	1.189
Equipment idles due to injuries/suspensions/dismissals	3.14	1.110

Factor 7: Direct and indirect cost of unsafe work environment (Average of means = 2.65)

Small injuries should not be reported as they reduce safety bonuses	2.19	1.375
I was hospitalised due to work injury	2.27	1.455
Employees leave the organisation due to lack of safety	2.46	1.321
The organisation was penalised due to lack of safety	2.75	1.308
My productivity has been affected by an injury I sustained at work	2.95	1.402
The organisation has received an incentive from the government in relation to safety	3.3	1.361

Factor 8: Work environment in relation to safety and indirect cost (Average of means = 4.06)

There are safety incentives and bonuses to encourage employees to work safely	4.25	0.814
Competent safety staff ensures a safe working environment for the employees	4.10	0.844
Availability and correct use of PPE helps me to avoid work injuries	4.06	0.791
The organisation provides adequate safety facilities	3.84	1.030

Factor 9: Cost reduction due to adherence to safety (Average of means = 3.85)

Adequate safety procedures lead to less damage to property and equipment in the organisation	3.87	0.947
Safety measures have reduced the costs in relation to accidents	3.86	0.935
Safety measures at work have reduced the cost of fatalities	3.81	1.072