Framework in creating a positive safety culture with the introduction of life saving rules in a municipal electricity utility

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Abstract

Safety culture assessment provides a means of identifying areas that require improvement. Measuring safety culture provides a tangible indicator of the current status. The objective of this research is to assess the behavioural and situational aspects in order to construe the safety cultural core of the organisation. The primary research question is directed at establishing the situational aspects, with specific reference to Safety Management Systems. Additionally, the safety behavior of the organization is also tested.

In order to achieve the aim of the study, a quantitative descripto-explanatory research design will be employed to guide data collection and analysis.

The theoretical framework guides the research where the aim is to improve the situation in order to better the behavior. The framework will guide the municipality with the successful implementation of life saving rules by performing a safety culture assessment.

Introduction

Sol Plaatje Municipality

Sol Plaatje Municipality is situated on the north eastern border of the Northern Cape Province within the Frances Baard District Municipality, almost in the center of South Africa. The Sol Plaatje Municipality is named after a prolific journalist Solomon T. Plaatje. Solomon Plaatje was one of the most gifted and versatile Black South Africans of his generation. He made an outstanding contribution in the field of literature in both, his native tongue, Setswana and English.

The Municipality consists of the City of Kimberley, which also serves as the capital of the Northern Cape. Ritchie, a small urban settlement is also situated in the municipal area.

Sol Plaatje Municipality is licensed to purchase electricity from Eskom and then distribute the electricity via the 66kV, 11kV and low voltage network. The municipality has recently increased its NMD from 112MVA to 140MVA.

Theory background

According to Vaughan (1996, cited in (Brown et al., 2000, p. 447)) serious accidents occur as a result of hazards and risks which are plainly ignored and employees become unconcerned. 'Safety management and safety culture are all about change – a change toward enhanced operational safety' (Oltedal, 2011, p. 37).

Cameron and Quinn (1999) emphasises the importance of understanding organisational culture and describe how identifying important aspects thereof helps in changing the organisational culture. According to Hofstede et al (1990) organisational culture can be regarded as a set of three (3) layers whereby they basically exclude values in describing organisational culture. In dealing with culture, it would not be fair not to mention the phrase 'the way we do things around here' (Bower, 1966, p. 22).

Cakit et al (2019) states that good safety management performances can also be a positive spinoff from driving a safety culture within the workplace. A positive safety culture refers to the commitment and drive from management in order to improve on overall safety within its organisation (Vecchio-Sadus and Griffiths, 2004). Cakit et al (2019) further states that this promotes adherence to rules and procedures within the workplace.

'The assessment of an industry's perceived safety culture is a crucial step toward identifying opportunities for safety performance and ultimately enhancing organisational success within the industry' (Çakıt et al., 2019, p. 5).

Hence the evaluation of the safety culture of an organisation helps in identifying potential gaps in improving its safety performance. Rules and procedures feature as key elements of any safety culture (Pidgeon, 1991).

'Safety rules and procedures are presented as one of the key cornerstones of the risk control system' (Hale and Borys, 2013, p. 208). O'Dea and Flin (2001) states that failure of employees in following rules can be classified as the third most important contributor to accidents. The abundance of rules and procedures within various sectors pertaining to safety, should provide evidence to the importance of it and the necessity in managing compliance. Hale and Borys (2013) argues that rules and procedures are unavoidable and is an excellent tool in influencing safety behaviour. 'Safety rules and procedures are integral part of safety management system designed to prevent incidents and ensure decent workplace' (Abanum et al., 2020, p. 22). Guldenmund (2000) regards rules within the workplace as the single most popular measure of safety culture.

Hale and Borys (2013) discussed in detail two (2) concepts relating to rules which they described as objective and categorisation of rules. Rasmussen (1997) proposes that the main objective of a rule is in creating a **safe zone** where operations can occur safely and where adequate risk mitigation measures has been put in place. Safety rules can hence be used to demarcate the safe area by defining the boundaries where the work can be executed safely (Amalberti et al., 2006). Hale and Borys (2013) states that the control measures which was identified for the safe zone, will basically ensure that no harm is done to any person performing the required work within this zone.

Mathis (2016) argues that there is a fundamental flaw in how life-saving rules in general is derived and implemented at certain companies or institutions. These rules are potentially regarded as those that can prevent fatal or near fatal incidents from occurring.

The life saving rules was designed in order to change the safety culture within an organisation and emphasizing that these rules can actually prevent fatalities within the workplace (Bryden et al., 2016). The IOGP safety rules 'provide operational workers and supervisors with simple, clear icons and instructions on the actions that they are expected to take to prevent fatalities' (Walker et al., 2012, p. 101).

Eberson (2018) has identified that majority of companies have developed its life saving rules based on detailed analysis on incidents and fatalities within its organisation. It is evident that this type of approach is common within the various sectors and industries and has been adopted by most. Chauke (2011) makes a very interesting observation about how life savings rules can challenge the status quo by changing behaviour of

employees. Peuscher and Groenewag (2012) states that the formulation of life saving rules needs to be evidence based and it is not as simple as just performing a brief analysis and magically formulating your own set of rules. The formulation of life saving rules for an organisation should be a structured approach in order to make an immediate impact on the safety culture.

Organisations must be in a position to continuously improve on safety within the workplace and is thus required to ensure that its occupational health and safety management systems is adequate (Górny, 2019). 'Organisations often adopt safety management systems or behaviour based system approaches to managing their safety functions in an attempt to achieve performance excellence' (Wachter and Yorio, 2014, p. 117).

Weichbrodt (2015) states that safety management systems are comprised of safety rules that are specifically implemented in order to prevent incidents and serious injuries from occurring within the workplace. 'Life saving rules are integral of safety rules and procedures and are popular in the oil and gas industry' (Abanum et al., 2020, p. 22).

Theoretical Framework

'A major shortcoming with most of safety culture models is the lack of the integration into general models of organisational culture' (Choudhry et al., 2007, p. 999). Cooper (2000) states that he regards safety culture as a sub-derivative of organisational culture which impacts the frame of mind and values of employees in respect to performance aspects of health and safety. Organisational and safety culture supports each other as they are inter-connected (Williams, 1991). Safety culture does thus not function on its own, but is influenced by organisational processes and systems (Cooper, 2000).

The study intends to anchor its focus on a general model of organisational culture. Organisational culture can simply be described as the personality of an organisation (Matkó and Takács, 2017). The two general models of organisational culture which was considered for the study was

- Reciprocal Determinism
- Schein's Iceberg Model

'Schein's model of culture perhaps provide some grip on a culture's elusiveness and is, moreover, especially relevant for safety' (Gilbert et al., 2018, p. 23). Figure 1 shows the different levels of culture as described by Schein (2004) where he depicts it as three levels.
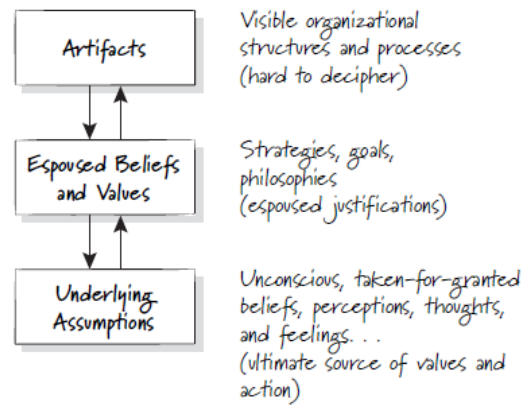

(Schein, 2004, p. 26)

Figure 1: Schein's three layers of organisational culture

Schein (2004) describes the underlying assumptions as forming the base of the organisational culture whereby artefacts and espoused beliefs and values are considered what you can see.

Reciprocal determinism is the theory which states that a person's behavior both influences and is influenced by personal factors and the social environment (Cooper, 2000). Figure 2 shows this model by Bandura.
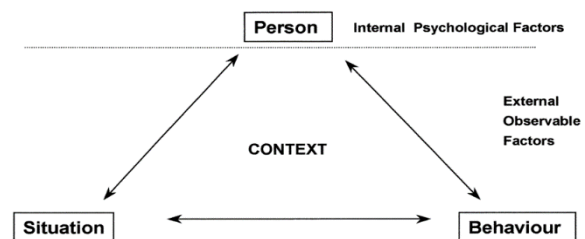
(Cooper, 2000, p. 6)

Figure 2: Bandura's model of reciprocal determinism

The two models are basically built on the same premise. The goal is to eventually change the underlying assumptions or the psychological factors in order to impact on the safety culture of the organisation. Cooper **(2000)** states that if you optimise the situation, you optimise the behaviour.

Inputs into the study

A typical safety management system would include risk assessments which is a perfect and simple tool in gaining insights into creating a safer and healthier workplace (Álvarez-Santos et al., 2018). 'Organisations need to recognise that risks result from uncertainty brought about by failures to recognise hazards' (Górny, 2019, p. 106). The following table shows the risk assessments for the Infrastructure and Services Directorate.

TOTALS PER SUB-DIRECTORATE					
SUB DIRECTORATE	TOTAL ACTIVITIES LINKED	TOTAL RISK ASSESSMENT CONDUCTED	TOTAL CONTROL EFFECTIVENESS IDENTIFIED	TOTAL MONITOR ITEMS FOR CONTROLS IDENTIFIED	TOTAL MITIGATION VALUE ASSIGNED
WATER AND SANITATION	273	269	863	22	271
CITY ELECTRICAL ENGINEER	404	402	2274	501	1037
HOUSING ADMINISTRATION	43	41	239	4	76
ROADS AND STORMWATER	52	52	327	6	116

Table 1: Risk assessments performed within Infrastructure and Services   Directorate

The risk assessments conducted within Table 1, yielded the following top ten (10) risks within the Infrastructure and Services Directorate:

- Electrical switching and isolation
- Working at heights
- Working in confined spaces
- Chlorine gas handling
- Work being performed within deep excavations
- Moving machinery accidents
- Lifting operations
- Unauthorised persons operating machinery
- Machine guarding
- Intoxication at work

Neitzel (1990) identifies four (4) common causes of fatalities within the private sector workplace, namely falling, struck by an object, injury due to electrical shock and employees caught between objects. Within the construction industry, the following is identified as the top five construction risks: Working at heights, electrocution, vehicle accidents, falling objects and back injuries (Zou et al., 2014).

The study will focus on high potential incidents including fatalities for the period 2012-2021. A high potential injury is defined as an incident which could lead to a fatality.

The fatality classification is related to only two high risk activities, viz confined spaces and vehicle safety. The risk classification for the high potential incidents is dominated by the following:
- Vehicle safety
- Working at heights
- Electrical lockout

Methodology

As introduction, a safety culture assessment based on the adopted questionnaire was performed in order to identify key aspects which would assist in formulating a set of life saving rules. The following additional inputs will further aid in identifying the final set of life saving rules prior to applying the safety management rule principles and the lessons learnt form IOGP:

- Risk assessments
- Generic set of life saving rules
- High risk activities identified by OHSA including applicable regulations
- Analysis of high potential incidents and fatalities

Life-saving rules are primarily developed from analysis of previous high potential incidents or fatalities and from major hazards which employees are likely to be exposed to. The gap which was identified is that life-saving rules is not informed by any applicable legal directive, rule management guidelines or any deficiencies or shortcomings identified within the safety culture of an organisation. The literature review chapter however does offer guidance on implementation of life-saving rules, but is not detailed or specific enough. A quantitative data collection research method was used within this study.

The definition of safety culture which covers the important aspects, is defined 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' (ACSNI Study Group on Human Factors, 1994, p. 9). Cooper (2000) argues that there is very limited research performed on the product of the safety culture shortcomings and determining this product could assist in creating the positive safety culture. The constructs chosen within the adopted survey, will feature as the variables within this product, and would thus assist in identifying strategies in order to create this positive safety culture.

A quantitative approach was followed in this study. The survey questionnaire was adopted from Cakit et al (2019). This survey was used to assess the safety culture within the Infrastructure and Services Department. Ten (10) multiple choice questions were added which was informed by the highest ranking rules derived from Table 1.

Figure 3 indicates the research design which clearly articulates the research material gathered in order to develop the set of life saving rules for the organisation.
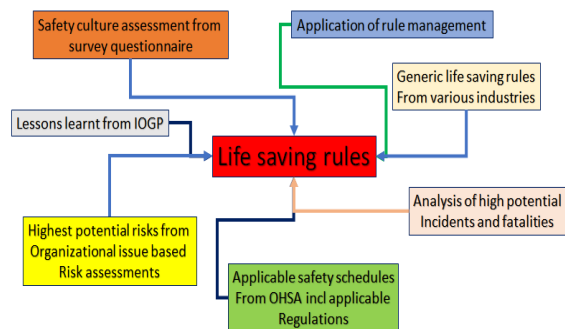
Figure 3: Inputs into the development of life saving rules for the municipality

The study aimed at assessing the safety culture within the municipality through a field survey and using the analysis thereof to inform the development of a set of life saving rules for the organisation. A multiple-choice question with 10 options was included within the questionnaire whereby participants had to choose the five (5) most applicable life saving rules. The research was hence performed in a non-contrived setting based on it being a descriptive study and using a field study with very little intervention from the researcher (Sekaran and Bougie, 2016).

Qualtrics was used to create the survey questionnaire which is a digital software application. 'Survey platforms are completely web-based and offer a more intuitive and streamlined interface' (Molnar, 2019, p. 162). Waclawski (2012) states that using a digital software application decreases the chances of human error and creates a much better attractive option thus increasing the responses rate. Table 2 depicts the general layout of the questionnaire including the measures. A 5-point Likert scale was used.

| Purpose	# Questions
Screening questions	5
Management commitment	6
Employees personnel attitude	6
Workplace pressure	7
Safety Management system	9
Violation behaviour	4
Personnel safety motivation	4
Personnel error behaviour	4
High Risk Activity	1
Total questions	46

Table 2: General layout of questionnaire

SPSS software was used in order to perform the descriptive statistical analysis including correlations and reliability analysis on the data received. The aim is thus to link up the different constructs through the use of statistics. A descripto-explanatory research design approach was used in order to perform the analysis. 'Descriptive study is undertaken in order to ascertain and be able to describe the characteristics of the variables of interest' (Sekaran and Bougie, 2016, p. 115).

Survey Data Analysis

The survey questionnaire was distributed through email and hard copies was hand delivered to the relevant respondents. The majority of feedback received was via hard copies. In total, 340 questionnaires were distributed whereby 176 were returned to be used within the data analysis. Figure 4 highlights the analysis approach followed based on the data captured.
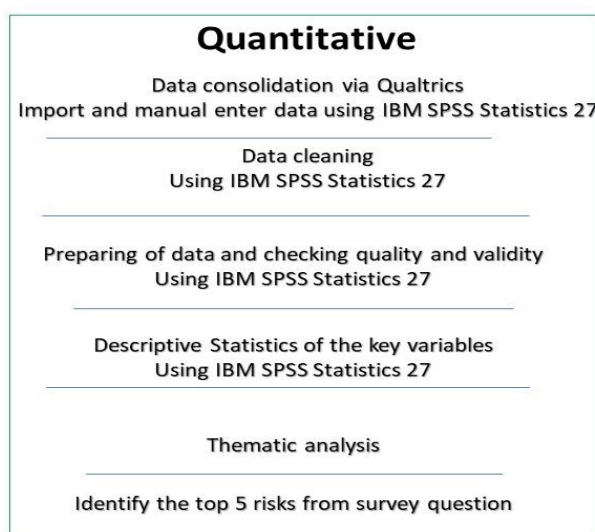
Adapted from (Kjølbro, 2016, p. 41)

Figure 4: Analysis approach

The assessment is important as it would identify the type of intervention required against the maturity level of the safety culture of the municipality. Pitching the wrong intervention, won't deliver on the desired outcome.

Pallant (2020) states that if you have less than ten (10) items per construct, it is difficult to get a high alpha. An alpha value of 0.5 in this instance would be acceptable (PALLANT, 2020). Table 3 details the internal consistency of the composite measures. All of the Cronbach's alpha was more than 0.50 and hence acceptable.

Composite measure	Items	Cronbach's α
Management commitment	6	0,872
Employee personel attitude	5	0,848
Workplace pressure	4	0,578
Safety management systems	8	0,872
Behavior	4	0,731
Personnel safety motivation	3	0,659

Table 3: Reliability Analysis

The following represents the analysis of the data received based on the surveys. The analysis of each construct is displayed.

Management Commitment	Mean	Std. Deviation	N
Management provides efficient safety training for workers	2,78	1,482	171
If I report a mistake to my supervisor, management supports me	2,58	1,401	171
Management encourages workers to report every safety incident to a supervisor	2,14	1,452	171
Management strongly supports safety for workers	2,60	1,528	171
Management puts safety first even if it causes a delay in work	2,87	1,555	171
My supervisor values my opinion for improving safety	2,44	1,464	171

Table 4: Results for Management Commitment

Employee Personnel Attitude	Mean	Std. Deviation	N
Safety rules provide a safe work environment	1,74	1,176	171
I make sure to use necessary safety equipment	1,81	1,195	171
I alert my colleagues who does not follow safety rules	1,85	1,201	171
I try to follow safety rules, even if they decrease my performance	1,79	1,223	171
Safety rules are important and necessary to prevent accidents at my work	1,38	0,965	171

Table 5: Results for Employee Personnel Attitude

Workplace Pressure	Mean	Std. Deviation	N
I sometimes compromise on safety to finish the work on time	2,10	1,396	171
Sometimes it is expected from me to compromise on safety in order to get more work done	2,23	1,372	171
It is difficult to work when applying all safety rules	2,90	1,502	171
I can easily get necessary safety equipment from my workplace	2,81	1,603	171

Table 6: Results for Workplace Pressure

Safety Management Systems	Mean	Std. Deviation	N
Safety responsibility and accountability are clearly decided	2,26	1,369	171
Management and all employees place importance on safety	2,50	1,391	171
Safety is always reinforced, even if it was only a near miss	2,69	1,444	171
Management places importance on safety, and it is a strategic concern for top management	2,70	1,535	171
Everyone is responsible for safety	1,33	0,919	171
The policies and actions within the municipality demonstrate a sincere commitment to safety	2,30	1,406	171
Hazard identification and risk assessment (HIRA) is often performed	3,08	1,671	171
Unsafe behaviour is often corrected	2,70	1,510	171

Table 7: Results for Safety Management Systems

Behavior	Mean	Std. Deviation	N
I feel it is important to maintain safety at all times	1,05	0,271	171
I believe safety in the workplace is a key issue	1,20	0,613	171
I feel it is important to encourage others to use safety practices	1,18	0,528	171
I feel it is important to promote safety programs	1,19	0,584	171

Table 8: Results for Behaviour

Personnel Safety Motivation	Mean	Std. Deviation	N
I am capable of following all safety regulations and procedures	1,29	0,700	171
It is clear to me how to follow safety rules and procedures	1,47	0,849	171
I have rarely made errors that caused risks whilst performing my work	1,88	1,162	171

Table 9: Results for Personnel Safety Motivation

Two open ended questions were included which was aimed at providing additional information on the safety culture assessment. A total of 293 phrases was captured from the survey responses received. The data was simplified using thematic coding in order to organise the data and to arrive at the priority codes (Kiger and Varpio, 2020).
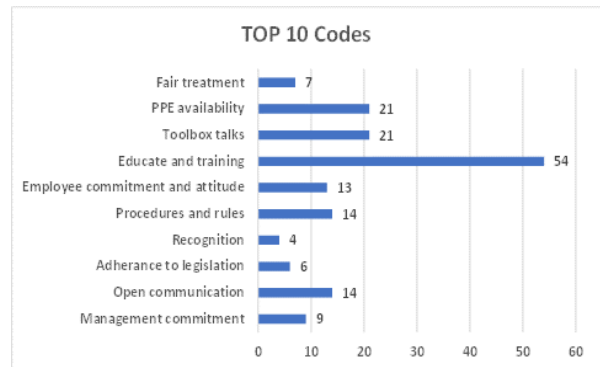

Figure 5: Top 10 codes on creating a positive safety culture

The three key themes identified in how Sol Plaatje Municipality can create a positive safety culture, were
- Training of employees on safety
- PPE availability
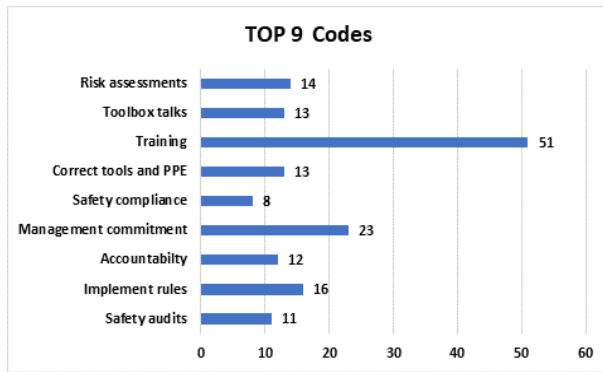- Toolbox talks (meetings)

Figure 6: Top 10 codes on ensuring safety compliance

The three key themes identified in how Sol Plaatje Municipality can ensure safety compliance within the organisation, were identified as:
- Training of employees on safety
- Management commitment
- Implementation of rules

The last question in the survey, requested the participants to indicate the top 5 hazards within the workplace. Figure 7 indicates the results thereof:
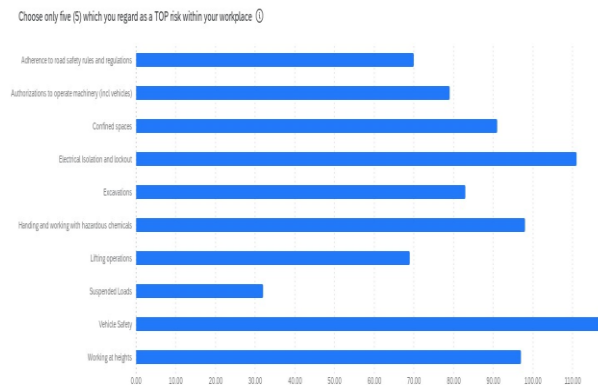

Figure 7: Results of Top 5 Hazards Identified

In summary, the Top five (5) hazards was identified as follows:

- ❖ Vehicle Safety
- ❖ Electrical isolation and lockout
- ❖ Hazardous Chemicals
- ❖ Working at heights
- ❖ Confined spaces

Conclusions

65% of the participants had more than 10 years' experience. There seems to be strong sense of management commitment towards safety. The employees' attitude towards safety, and in specific safety rules can improve. This will help in improving the situation.

Workplace pressure is evident form the data analysed. From the safety management systems construct, a high mean value was scored, however, the safety behavior and motivation of the employees came out below average. This indicates that we can better the safety behavior of the municipality and improve on the safety management systems.

From further analysis of the assessment, it indicates that the municipality should improve on the safety training and education of the employees. The employees regard implementation of rules as very key in ensuring safety compliance.

Implementation and recommendations

A behavior-based program is not recommended. The safety situation must change and improved in order to better the safety behavior of the municipality. Hence the following is recommended:

- Implementation of 6 life saving rules
- Training of employees on safety
- Better management of PPE

It is recommended that excavations be added to the list of life saving rules because it came in close to confined spaces. The six life saving rules to be implemented is thus:

- ⚜ **Vehicle Safety**
- ⚜ **Electrical isolation and lockout**
- ⚜ **Hazardous Chemicals**
- ⚜ **Working at heights**
- ⚜ **Confined spaces**
- ⚜ **Excavations**

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