Occupational Safety Culture in Devki Steel Mills Limited in Athi River, Machakos County, Kenya

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Abstract

Workers in Devki are exposed to several occupational hazards resulting in an average of three workers going on sick leave monthly. The management sought to reduce these incidences using a leading indicator through Safety Culture. Determining the safety culture was the main study objective. Independent variables were artefacts, espoused values and basic assumptions. The study made use of an analytical cross sectional design. The study population was 800 permanent employees from which a sample of 260 respondents was selected through the stratified sampling technique. The study used an interviewer administered questionnaire and observation checklist to collect primary data. The data was analysed with aid of the SPSS software. Results were interpreted using a safety culture assessment tool provided by Worksafe. The tool categorised a score that lies between 0% and 49% as *Poor*, 50% and 74% as *Average* and above 75% as *Good*. Artefacts scored 76%. The aspired values scored 42.9% and Basic Assumptions scored 39.3%. Management commitment to safety had the highest correlation to safety culture at 51.2%. The study concluded that: 1) The artefacts were installed for regulatory compliance; 2) A lot of the stated values were not practiced; 3) Workers' attitude towards safety was improving but a lot more should be done in the areas of resource allocation to safety programs. From the first three objectives, the Worksafe NSW Tool ranked the organisation as having an Average safety culture with a mean score of 52.7%; 4) From Pearson's correlation, the most important attribute in building a good safety culture was Management commitment and injury management was the least important. The study recommends that: 1) The organisation incorporates use of care based artefacts; 2) Workers opinions on safety matters are sought, 3) The company should provide safety training; 4) The management should proactively promote safety.

1. Introduction

Manufacturing industries have a critical part to play in the economic growth and advancement of nations through creating meaningful work to the citizens.

Approximately 150 million work related accidents happen in the world every twelve months, of which 300,000 are fatal. In Kenya, The manufacturing segment is the second largest formal employer with an estimated 286,000 workers. However, it is the largest contributor of occupational accidents at 2560 reported accidents from 2010 to 2011 [1].

Devki Steel Mills Limited has set production targets which are seen to override all other competing demands. The workplace seeks to strike a balance between optimal production and safe work practices. There had been accidents in Devki Steel Mills Limited and its environs that necessitated the study. The study was warranted by the need to gauge how workers handled safety issues which were the root causes for the occupational accidents.

The consequences of accidents may be, but not limited to, injury, permanent disability, death, legal fees, compensation costs, increased medical costs, machine downtime, workers unrest and dented corporate image. The management, therefore, acknowledged that it required new ways of handling safety issues to guarantee a safe workplace for all lawfully within their premises. This safety culture survey being a leading indicator of safety performance can be used to predict future safety performance or signal future adverse occurrences.

2. Literature Review

2.1. Heinrich Domino Theory

Heinrich Domino carried out a study in 1931 and developed the Domino theory, which positions the human being as the most vital element in accident occurrence. Based on his study, he concluded that eighty-eight percent of accidents are a result of unsafe acts, ten percent are due to unsafe conditions and only two percent were due to unpredictable factors [2].

2.2. Safety Culture as a Measure of Safety Performance

Safety Culture research is built on accident causality research and conceived from the necessity to comprehend the non-technical reasons for accidents with respect to root causes and system failures.

2.3. Management Commitment to Safety in Manufacturing Industries

In target based manufacturing industries, employees don't take risks intentionally but rather take shortcuts to increase efficiency or speed, and these are as a result are reinforced that is, the benefits of doing so are instant and positive (task completed in less time). In contrast, the outcomes of unsafe acts and conditions are usually delayed or rare (injuries are occasional and often minor) [3]. This research has theoretically added on to existing safety culture literature based on a Kenyan context. Furthermore, the organisation gained real-world knowledge of the issues that influence its safety performance to form a basis of future safety interventions [4].

2.4. Artefact Interpretation & Safety Culture

Workers may think that the meaning they ascribe to an artefact in their workplace is objective, although in the real sense, these meanings are ascribed to members of the workplace by the indirect values that exist in the organisation. This study investigated the extent to which Devki Steel Ltd. made use of artefacts to communicate to employees and the interpretation of artefacts by employees in the organisation. The research investigated the gap between the artefacts available and the interpretation of these artefacts by the workers. This was done through observation during the workplace inspection.

2.5. Espoused Values

These can be defined as the qualities stated or desired by the organisation. Espoused values include written or verbal declarations made by the employer or the top most managers. These values were investigated through documentation analysis and the administered questionnaire. The sources of espoused values this research investigated included Safe operation/work procedures, Existing written Policies, commitment of Management, Injury investigation reports, Return to work and Consultation reports

2.6. External Inspections

Safety culture is known to highlight the key areas for the workplace to concentrate on to see the greatest result in improved safety culture. The safety culture study focuses mainly on behavioural trends that lead to safety incidents in the workplace. The study addresses the gap between the organisations aspired values highlighted in the safety policy, OSHA 2007 legislation, safe operating procedures and the degree to which these values are implemented on a daily basis. Additionally, there is a lack of a common methodology to the development of safety culture in manufacturing industries. Therefore, this study addressed the lack of a common methodology to the development of safety culture in production based processing and manufacturing industries in Kenya.

2.7. Factors Associated with Safety Culture

Safety Culture is a subset of the overall organisational culture. In the past it was generally accepted that organisational culture was developed by managers, under the influence of broader cultures for example, national culture. Safety culture is more unconscious and is promoted or hindered by organisational culture.

3. Materials and Methods

3.1. Study Design

The research made use of an analytical cross section study design. A triangulated approach was adopted in which qualitative and quantitative data was collected.

3.2. Variables

The independent variables included, Artefacts: Visible and audible elements for promoting safety in the organisation (safety signage, PPE's, warning system, tools and machinery), Espoused Values: Values that are aspired to or stated and upheld by the organisation (written Policies, safe work Procedures, management assurance, injury management, return to work and consultation) and Basic Assumptions**:** The primary, common beliefs regarding safety amongst members of the organisation (reporting safety, supervision, communication, training and management commitment/safety priority). The dependent variable was the Workplace Safety Culture.

Using the assessment tool designed by Worksafe NSW, the organisational safety culture can fall in three categories, Poor, average and good.

3.3. Study Population

The study population was made of the Eight hundred permanent workers in Devki Steel Mills Limited.

3.4. Sampling Technique

Athi River town in Machakos County was selected due to its preference for large scale industrial establishments making it more industrialised than most towns in Kenya. Devki Steel Mills was selected since it is a top manufacturer of steel products in Kenya. The sample was selected through the stratified proportionate random sampling technique. All participants were divided according to their mandates in the organisation. Participants then picked numbers from a raffle and those who picked even numbers were selected to participate in the study. The number of workers selected from each stratum was proportional to the population size of the stratum in the Study population.

3.5. Sample Size Determination

The study made use of the Krejcie and Morgan formula [5] to determine the sample size.

$s = X^2 NP(1-P) \div \left(d^2 (N-1) + X^2 P(1-P) \right)$, where:

s = required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population size (made up of 800 permanent employees).

P = the population proportion (assumed to be 0.50 since this would provide the max sample size).

d = the degree of accuracy expressed as a proportion (0.05).

Therefore: $s = \dfrac{3.841 \times 800 \times 0.5(1-0.05)}{0.05^2(800-1) + 3.841 \times 0.5(1-0.5)}$.

260 workers made up the sample size used to represent the Study population in the study (Table 1).

3.6. Data Collections Tools and Methods

The study was mainly concerned with opinions, and attitude of workers in DEVKI. A multi-method combining both qualitative (observations) and quantitative (interviewer administered questionnaire) methods was used.

3.7. Data Analysis

Data was collected and analysed using SPSS version 24.0 statistical software. Descriptive statistics, to measure frequency, central tendency and spread, was made use of to analyse and summarise questionnaire responses. Qualitative data was analysed through content analysis. Data was presented using charts and tables. WorkCover, New South Wales, scale was used to deduce the appropriate safety culture score in each category assessed.

3.8. Logical and Ethical Considerations

Kenyatta University graduate school gave authority to undertake the study. Kenyatta University Ethical Review Committee gave the Ethical clearance. A research permit to undertake the study was granted by NACOSTI under license number NACOSTI/P/20/4627. Clearance to conduct the study at Devki Steel Mills Limited was granted from the management. Permission was obtained from all department heads before proceeding with the inspection. Individual workers were made aware of the purpose of the proposed study and provided written informed consent before participating in the study. Confidentiality was guaranteed throughout the study.

Table 1. Sample distribution per stratum (table created by author).

NO	CADRE	POPULATION	SAMPLE
1	MANAGEMENT	12	4
2	SUPERVISORS	27	9
3	WORKERS	761	247
4	TOTAL	800	260

4. Results

4.1. Response Rate

In total, 260 questionnaires were delivered, fully filled and returned for analysis. This represented a response rate of 100%.

4.2. Demographic Characteristics

The study considered level of education, age of the respondents and years of work experience as the demographic characteristics of the respondents.

4.3. Respondents Age

The results show that the highest proportion of respondents is at the productive age of 31 - 40 years at 43.0%. This implies that the company prefers those at productive age due to the physical nature of tasks performed in the company. Employees aged between 51 - 70 years were the minority in the company at 17%. This is also attributed to the physical nature of work at the company (Table 2).

4.4. The Respondents Level of Education

The results show that a majority (55%) of the workers had attained tertiary (college and University) education level. This shows that the majority of workers had the required capacity to comprehend safety issues at the workplace. Despite 45 % having a secondary level of education, they still had the aptitude to understand safety issues in the company (Table 3).

4.5. Years Worked at Devki Steel Mills Limited

Majority of the employees (70%) had worked for over 10 years. This indicated

Table 2. Distribution of respondents by age (table created by author).

Years	Frequency	Percent (%)
20 - 30	49	19.0
31 - 40	112	43.0
41 - 50	55	21.0
51 - 70	44	17.0
Total	**260**	**100**

Table 3. Distribution of respondents by education level (table created by author).

Years	Frequency	Percent (%)
Secondary	117	45.0
Tertiary College	104	40.0
University	39	15.0
Total	**260**	**100**

that they had enough experience to adopt and implement a good safety culture in the company (Table 4).

4.6. Safety Culture Assessment Using WorkCover NSW Tool

The study analysed each attribute measuring each objective. The tangible elements for promoting safety were investigated using the observation checklist. The "yes" responses which denoted the existing artefacts were used to rate the performance of this objective which translated to existing artefacts.

There spondent's responses for the attributes in objectives two and three were fed into a safety culture assessment tool designed by WorkCover New South Wales (NSW). The tool calculated the cumulative score for each attribute through use of weighted average for Yes, Occasional and No responses. Thereafter, the average score for each attribute gave the overall score for objectives two and three.

For scores above 75%, the assessment tool concludes that Workers think the company has a good safety culture in the assessment area. The occupier needs to constantly monitor, evaluate and review the systems to maintain this level or improve. For scores from 50% to 74%, the assessment tool concludes that the workers think the company has commenced with making improvements on safety culture and is on the right path; however there are additional actions that can be done in the assessment area to further improve. For scores between 0% & 49%, workers are conveying a lack of belief in the company's commitment to safety culture. This also implies that systems may not be in place or are not effective (Table 5).

The sum of averages lies between 50% & 74% which according to the assessment tool shows that the company has an Average safety culture. This implies the company has started implementing safety measures although a lot still remains to be done to achieve a good rating of an average score above 75% (Table 6).

4.7. Factors Associated with Safety Culture

After determining the mean scores of both the dependent and independent variables, it was important to identify the relationship between the variables. This would assist in determining how the variables impact each other affecting

Table 4. Employees' years of experience (table created by author).

Years	Frequency	Percent (%)
0 - 10	78	30.0
11 - 20	120	46.0
21 - 30	31	12.0
Over 30	31	12.0
Total	260	100

Table 5. Summary of the Findings (table created by author).

Objectives	Attributes	Score (%)	Average Score per Objective
Objective 1	• Tangible elements for promoting safety Identified	76.00	76%
Objective 2	• Safe work procedures & Policies • Injury management & Return to work • Consultation/communication	42.70 52.95 32.95	42.9%
Objective 3	• Reporting Safety • Training & Supervision • Management Commitment & Safety priority	45.85 42.70 29.25	39.3%

Table 6. Summary of safety culture assessment based on WorkCover NSW assessment tool (table created by author).

	Cumulative Average Score from Objective one to three		
	Mean Score (%)	Level of Compliance	Remarks
Objective One	76.0	(75 - 100)%	Good
Objective Two	42.9	(0 - 49)%	Poor
Objective Three	39.3	(0 - 49)%	Poor
Sum of Averages	**52.7**	**(50 - 74)%**	**Average**

the safety culture at thus achieving the fourth objective of the study. To compare means, Pearson's correlation method was used and the results were as presented in the correlation table (Table 7).

From Table 7, there is a fairly strong positive correlation (of 49.8%) between Training and supervision of Employees on Safety Culture and the safety culture in the company. This means that the more the employees are trained about safety culture, the more the general safety culture in the organisation should improve.

There is also a positive correlation (of 43.2%) between safe work procedures and safety culture at Devki Steel Mills Limited in Athi River, Machakos County. This means that with improved safe work procedures, there will be a better safety culture in the company.

Furthermore, there is a fairly strong positive correlation (of 49.1%) between consultation of workers on safety and the general safety culture of the organisation. This means that the more the employees are consulted about their safety the more improved the general safety culture will be in the company.

As with the previous variables, there is a fairly strong positive correlation (of 45.1%) between reporting safety incidents with the general safety culture of the organisation. This means that the more the cases of safety incidents and safety loopholes are reported, the more improved the safety culture of the organisation will be.

The data also revealed that there is a significant positive correlation (of 51.2%) between the management commitment to workers health& safety and the general safety culture in the company. This means that the more the commitment of

Table 7. Correlations (table created by author).

		Training and supervision of Employees on Safety Culture	Safe Work Procedures	Consultation with workers on Safety Matters	Reporting Safety Incidents	Management Commitment to Health Safety of Workers	Injuries Management and Return to Work	Safety Culture Assessment
Training and supervision of Employees on Safety Culture	Pearson Correlation	1						
	Sig. (2-tailed)							
	N	260						
Safe Work Procedures	Pearson Correlation	0.059	1					
	Sig. (2-tailed)	0.346						
	N	260	260					
Consultation with workers on Safety Matters	Pearson Correlation	0.239**	0.194**	1				
	Sig. (2-tailed)	0.000	0.002					
	N	260	260	260				
Reporting Safety Incidents	Pearson Correlation	-0.283**	0.113	0.209**	1			
	Sig. (2-tailed)	0.000	0.069	0.001				
	N	260	260	260	260			
Management Commitment to Health Safety of Workers	Pearson Correlation	-0.173**	0.042	0.063	-0.010	1		
	Sig. (2-tailed)	0.005	0.503	0.313	0.869			
	N	260	260	260	260	260		
Injuries Management and Return to Work	Pearson Correlation	0.366**	0.036	0.191**	-0.370**	-0.035	1	
	Sig. (2-tailed)	0.000	0.567	0.002	0.000	0.569		
	N	260	260	260	260	260	260	
Safety Culture Assessment	Pearson Correlation	0.498**	0.432*	0.491**	0.451**	0.512**	0.389**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.001	0.000	0.000	
	N	260	260	260	260	260	260	260

**Correlation is significant at the 0.01 level (2-tailed).

management to the health & safety of the workers, the better the general safety culture.

Finally, under determining the relationship between the dependent and independent variables, the researcher found out that there is a weak positive correlation (of 38.9%) between injury management and return to work and safety cul-

ture of the company.

These findings are statistically significant following the obtained significant value (p = 0.000) which is below 0.01.

5. Discussion

Objective one of the study was to determine the availability of tangible elements for promoting safety in the company. The study analysed attributes that measure the objective through an observation checklist filled during a workplace inspection and desk survey for documentation. The workplace made extensive use of Safety Signage to communicate Hazards to staff and visitors. Noisy areas, hot surfaces and areas where highly flammable goods are handled are well marked with appropriate warning signs. Fire fighting equipment had been installed in all departments in addition to the fire alarm system to warn workers of a fire emergency. Workers were also observed to make use of PPEs provided while working which included helmets, overalls, gloves and safety shoes. The tools and equipment used had safeguards to protect workers from dangerous moving parts. Elevated areas in the furnace department had railings installed that were not highly visible.

The safety signage present were installed to meet regulatory standards under OSHA 2007 as recommended in the safety audit reports which were provided for review by the group human resource manager. Workers were observed to comply with the warning signs displayed. Therefore, these artefacts pointed more to compliance than commitment to safety and health of workers.

These findings are supported by the work of Griffin *et al.* [6] which suggests that members of organisations can work safely only because they conform to the rules and external pressures rather than because of internal acceptance and commitment to safety.

The study's second objective was to determine the aspired values upheld by the employer in the company. To realize this objective, the study analysed safe work procedures & Policies, Injury management & return to work and Consultation/communication. Respondents reported that there existed safe procedures although they were mostly outdated. On injury management & return to work, the program was observed to be functional as the organisation had employed a full time Nurse to handle workplace injuries. Also, seriously injured workers were financially compensated through the Workmen Injury Benefit Act of 2007. A study conducted in Malaysia supports this. It found that management of injury improves the safety and health practices in the organisation and eases the workers agony in the event of injuries sustained as a result occupational accidents [7]. The organisation scored poorly on communication as workers were rarely asked on opinions regarding their safety in the workplace. These findings differ with that of a study on safety culture in a manufacturing organisation which revealed that continually seeking workers input to improve safety policies and procedures will have a direct impact on workers safety perception. These

perceptions in turn have the most direct influence on safety outcomes [8].

Objective three of the study was to determine the workers' attitudes towards safety. To achieve the objective, the study analysed the objective's attributes of Reporting Safety, Training & Supervision and Management Commitment & Safety priority. Workers reported that they are encouraged by management to always report safety incidents of which a majority of workers at 75% complied. A study conducted in Geneva supports this stating that the true status of safety and health in the workplace at the enterprise, industry and national levels is promoted by accurate disease and accident data. This provides better knowledge to enable leading stakeholders to take the right decisions [9]. However, respondents believed that safe work procedures and safety training programs were never reviewed after incidents. This shows that chances of accidents recurring are still high. A study conducted in Washington DC supports this finding. It found that interventions implemented after incident reporting enhanced staff engagement, improved incident reporting rates, and reduced occurrence of high impact events [10].

On management commitment, workers responded that they occasionally get away with unsafe practices that favour faster production. Also, respondents felt that management had not committed enough resources of time and money for safety in the organisation. Workers generally expressed a lack of belief in the management's commitment to safety culture.

This result is supported by McGonagle *et al.* [11] which shows that the commitment to safety by the management predicts employee job-related safety behaviours and incidents/injuries. Consequently the more the management is seen to prioritise safety, the more the workers will behave in a safe manner.

The fourth study objective was to determine the factors that promoted or hindered a positive safety culture. To achieve this objective, the study used a Pearson correlation analysis to determine the factors associated with safety culture.

The extensive availability of Safety Artefacts and a robust injury management program were seen to influence the promotion of a good safety culture in Devki Steel Mills Limited. The top management is committed to complying with the requirements of OSHA (2007) evidenced by the implementation of recommendations from the latest fire safety audit report. A study done in Norwich on the Safety Culture maturity model places compliance at level 2: Managing, in which Safety is solely defined in terms of compliance to rules, procedures and engineering controls. The study reported that safety interventions do not work in an organisation that is not aware of its current level of safety culture maturity [12]. This shows that as much as focusing on compliance is discouraged it is a necessary step towards development of a positive safety culture.

From Pearson's correlation, the strongest positive correlation to Safety culture was Management commitment to Safety of Workers. It followed that, commitment to safety by management positively contributed to organizational commitment, job fulfilment and productivity.

Training and supervision of workers was the second strongest positive corre-

lation to Safety culture in Devki Steel Mills Limited, Athi River. Training at all levels—that is, worker to worker, supervisor to worker and even worker to management—is key to ensure everyone is on track to maintaining a safe workplace. This is in line with work done by Bhatt [13]. He concludes that wholesome training has to incorporate provision of feedback for improvements and, similarly, accepting and incorporating that feedback as constructive criticism.

The weakest correlation to safety culture was Injury management and return to work. This is because this attribute is reactive in nature and can only be implemented after an incident has occurred. This is in agreement with work done in the United States of America which concludes that the main drawback of reactive safety measures is that they do not eradicate the likelihood of a traumatic event occurring. The effects of an accident can reduce overall job satisfaction and morale of workers as an organization that only reacts after an accident has occurred is perceived by the workers to only care about profits [14].

6. Conclusions and Recommendations

6.1. Conclusions

The study concluded that the visible and audible elements for promoting safety (artefacts) were in line with regulatory requirements of the Occupational Safety & Health Act, 2007 (OSHA 2007). This shows that the company is keen on compliance with the provisions of the act. PPE use was good amongst workers but poor amongst the contractors. Housekeeping in the workplace was acceptable except in the Furnace Department.

The study concluded that the majority of the stated values in Devki Steel Mills Limited were not upheld. Safe work procedures were established however the implementation of safe work procedures was poor. The company had a good injury management and return to work program implemented by the Nurse and Human resource manager. Induction training for new and inexperienced workers is not regularly undertaken. Training on occupational safety is also done occasionally and not at regular intervals. Further, the safety policy is not regularly updated to reflect changes in work procedures.

The study concluded that workers' attitude towards safety culture in Devki Steel Mills Limited was improving but a lot more should be done in the areas of Induction, Training, Updating safe work procedures and increased resources allocated to safety programs. Management commitment was also viewed to be low on safety matters and high on production matters.

As the Pearson Correlation test revealed, the strongest correlation to Safety culture is the commitment to Safety by the management whereas the weakest correlation to safety culture is Injury Management and return to work.

6.2. Recommendations

Following the study's conclusions, the workplace should maintain the high level of compliance with OSHA 2007. The management should however diversify the

types of signage used from purely fire and mandatory signs to also include warning and awareness signage that shows commitment to workers safety.

Supervisors should enforce the use of PPE's amongst contractors who are within the company premises. The pre-qualification of contractors should include safety parameters during the vetting process. This will ensure contracts are awarded to companies with an existing and working safety management program.

As observed during the study, housekeeping conditions in the Furnace department should be improved. The establishment of an appropriate housekeeping program will promote the methodical movement of items through the cycle of production and the orderly storage of goods.

The company should organise regular training, tool box talks and display safety promotional signs to instil safety awareness in the minds of employees. Workers should understand that good safety practice is the duty of both management and staff and this will greatly improve the safety in all work areas. Furthermore, it is just as important that workers are empowered to provide feedback on what's working and what's not based on their practical application [13].

To improve the workers attitude towards safety, the management should be seen to prioritise safety above production. There should be consistency in the message that safety should come first in all departments. The management should commit more resources of time and money to safety training and other programs like medical examinations.

Also, there is a need to move beyond reactive measures aimed at avoiding prosecution to proactive measures aimed at preventing accidents. The visibility of management's commitment on safety matters should be improved. Lastly, the management can seek to undertake this safety culture survey every three years to monitor any changes in workers perception on safety matters.

Conflicts of Interest

The authors declare no conflicts of interest.

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