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## Relationship between Safety Culture and Accident Occurrence in Construction Sites in Nakuru County, Kenya

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### **Abstract:**

*The Construction industry has been labeled as one of the riskiest industries globally owing to the high number of workplace related injuries. The scenario in Kenya and Nakuru County in particular is not different owing to the increased number of construction developments going on. Attempts to tame this situation in Kenya led to the development of legislations such the Occupation Safety and Health Act 2007 and the National Construction Act, 2011. However, despite the enforcement of safety laws, the fines and penalties associated with non compliance, the compliance level remains very low in Nakuru County. This raises questions on the efficacy of safety regulations in ensuring safety in construction sites. This study sought to establish the corporate safety culture in the construction industry and its relationship with safety in sites based on the number of accidents reported. Safety culture was assessed based on the safety climate based on the framework by (Cooper, 2000). The study was quantitative in nature and used descriptive research design. It was carried out in Nakuru County in 763 construction sites. The study sample constituted 89 persons in charge of safety in construction. The study relied on both primary and secondary data. Quantitative data was summarized using descriptive statistics which included mean, mode, standard deviations, frequencies and percentages. Pearson correlation analysis was used to determine the relationship between safety culture and accident occurrence. The study found that, there were no dedicated safety officers in construction sites. Therefore safety was a secondary activity in construction. Although a few contractors had safety policies, safety budgets and incorporated safety in building designs, the communication channels between safety workers and managers were poor. The corporate safety culture played a significant role on the number on incidences reported in construction sites.*

**Keywords:** Corporate safety culture, Construction and Occupational safety.

## 1. Introduction

### 1.1. Study Background

The term safety culture can be traced back to the Chernobyl nuclear accident in 1986 when a poor safety culture was identified as a contributing factor to the disaster (IAEA,1986). Since then, safety culture in organizations has increased in popularity and its poor implementation has been constantly featured as major contributor of occupational accidents. Different organizations interpret safety culture differently and, as a result, use different approaches to implement the notion in practice (Cox and Flin, 1998). Weigmann et al., (2002) defines safety culture as “the enduring value and priority placed on workers and public safety by everyone in every group at every level of an organization. Essentially, safety culture is the extent to which individuals and groups commit to personal responsibility for safety, act to preserve, enhance and communicate safety concerns, strive to actively learn, adapt and modify both individual and organizational behavior based on lessons learned from mistakes, and be rewarded in a manner consistent with these values.”Fernández-Muñiz et al. (2007) defined safety culture as a set of values, perceptions, attitudes and patterns of behavior with regard to safety shared by members of the organization; as well as a set of policies, practices and procedures relating to the reduction of employees’ exposure to occupational risks, implemented at every level of the organization, and reflecting a high level of concern and commitment to the prevention of accidents and illnesses.

Safety culture has three distinct but interrelated dimensions: psychological, behavioral, and corporate. The psychological dimension refers to the safety climate of the organization, which encompasses the attitudes and perceptions of employees towards safety and safety management systems. The behavioral dimension is concerned with what people do within the organization, which includes the safety-related activities, actions, and behaviors exhibited by employees. Lastly, the corporate dimension refers to the organization’s safety policies, operating procedures, management systems, control systems, communication flows, and workflow systems (Health and Safety Executive, 2005).

1.2. Problem Statement

Construction industry has been labeled as one of the riskiest working environment globally owing to the high number of statistics on workplace related injuries and accidents despite the Occupation Safety and Health legislations governing the industry. Organizational safety culture on the other hand has been identified as an effective means to sustainable implementation of occupational safety and health. However, there have been limited studies assessing the safety culture within the construction industry and how it can be used to complement the law in enhancing occupational safety. This study sought to establish the safety culture in construction industry and its role in enhancing safe working environment in construction sites in Nakuru County.

1.3. Theoretical Framework

The study was based on the model for assessing organizational safety culture by (Cooper, 2000). Cooper conceptualizes safety culture from three perspectives: psychological, behavioral and situational. According to Cooper (2000) the situational aspects of safety culture refer to the organizations activities that influence safety culture such as organizations policies, operating procedures, management systems, control systems, communication flows, and workflow systems (Thompson & Luthans, 1990), as well as factors such as noise, heat, light, and physical proximity associated with the immediate working environment (Peponis, 1985). According to Glendon & McKenna (1995), this wide range of organizational cultural activities could be measured via audits of safety management systems.

1.4. Conceptual Framework

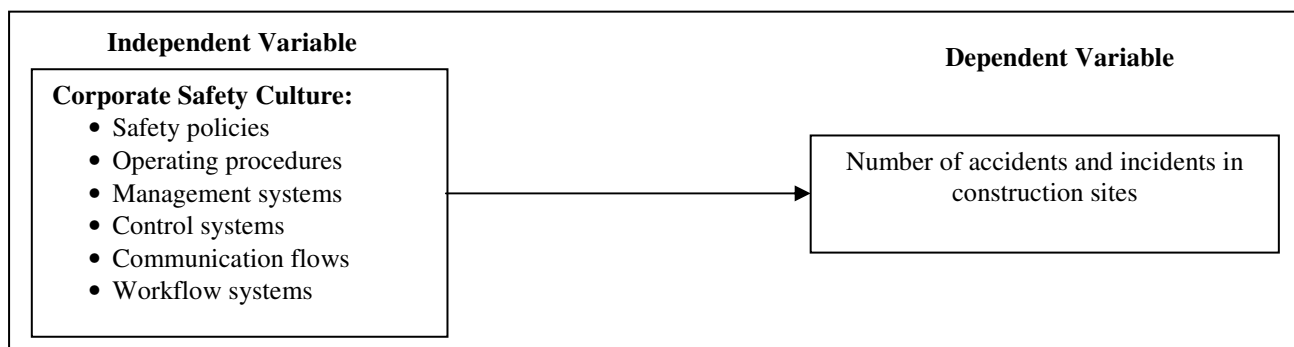


Figure 1

1.5. Study Objective

To examine the relationship between corporate safety culture and accident occurrence in construction sites in Nakuru County

1.6. Hypothesis

- H<sub>0</sub>: There is no significant relationship between corporate safety culture and accident occurrence in construction sites in Nakuru County

2. Methodology

2.1. Study Design

The study was quantitative in nature in that it sought to quantify the safety culture in construction sites in relation to the safety in the sites. Assessment of the safety climate was quantified using the five point Likert scales. Descriptive research design was used to describe the safety climate on the basis of the study variables to capture information the way it is without manipulation.

2.2. Study Area

Location for this study was Nakuru County, Kenya involving construction sites.

2.3. Study Population

The study targeted safety officers in construction. In sites where there was no safety officer, the foreman or the site manager in charge of implementing safety was selected. According to NCA Nakuru (2015), there are 763 ongoing construction sites registered with the authority with a total site employment of 6867 staff. Thus the target population was 763 safety officers.

2.4. Sample Size Determination

To obtain the desired sample size for the study, Nassiuma (2002) formula was used. The formula was applied to calculate the sample size in each category Sample size calculations are as shown on equation 3.1 below:

$$n = (Nc_v^2) / (cv^2 + (N-1) e^2) \dots\dots\dots \text{Eq 3.1}$$

Where:

- n= Sample size
- N= Population

$C_v$  = Coefficient of variation (take 0.5)

$e$  = Tolerance at desired level of confidence, take 0.05 at 95% confidence level

The sample size for safety managers was determined as follows:

$$n = (Nc_v^2) / (cv^2 + (N - 1) e^2)$$

Therefore,  $n = (763 * 0.5^2) / (0.52 + (763 - 1) * 0.05^2)$

$n = 89$

### 2.5. Data Collection Instruments and Analysis

The study relied on both primary and secondary data. Primary data was elicited from the safety managers using a structured questionnaire. The instruments were piloted in ten (10) selected sites within Nakuru County. However, this was done on sites which had not been sampled to avoid contamination of study samples. Construct validity on the other hand was tested using the content validity index (C V I) basing on four (4) point scale of relevant, quite relevant, somewhat relevant, and not relevant. The instruments were then analyzed for reliability using the Cronbach reliability coefficient to determine the extent of reliability in which a reliability coefficient of 0.82 was obtained. Quantitative data was summarized using descriptive statistics which included mean, mode, standard deviations, frequencies and percentages.

## 3. Results and Discussions

### 3.1. Results

Out of the 89 questionnaires administered to safety managers in construction sites, 77 were filled and returned therefore giving a response rate of 86.51%. The demographic characteristics of interest to the researcher were: age, gender, designation in construction site, nature of contract, experience in managing safety in construction, duration of current construction site and the duration they have worked in the current site.

	N	Minimum	Maximum	Mean	Std. Deviation
Age	77	32.00	69.00	48.2468	9.17829
Valid N (listwise)	77				

Table 1: Age of Site managers

The age of construction safety managers varied between 32 years to as high as 69 years. The average age of safety managers however was 48 years. All construction safety managers (100%) were male.

On the job designation of persons charged with responsibility of safety management in the construction sites. The findings revealed that there was no dedicated safety officers in all construction sites visited. In 76.62% of the sites, safety management was the duty of the foremen while in 23.38% of the sites, the site managers were responsible for safety management. The nature of contract of site staff charged with the responsibility of safety management was as shown below.

		Nature of Job			Total
		Weekly casual	Permanent casual	Permanent Contract	
Job	Fore Man	Count	8	21	30
		% within Job	13.6%	35.6%	50.8%
	Site manager	Count	0	0	18
		% within Job	.0%	.0%	100.0%
Total		Count	8	21	48
		% within Job	10.4%	27.3%	62.3%

Table 2: Nature of Contracts of Construction Safety Mangers

All the site managers (100.0%) charged with the responsibility of managing safety were on permanent contract. However, for foremen in safety management, 50.8% were employed on permanent basis by construction companies while 35.6% were on temporary employment although on continuous basis, 13.6% were weekly casuals.

	Job	N	Mean	Std. Deviation	Std. Error Mean
Duration in safety	Fore Man	59	7.14	7.630	.993
	Site manager	17	7.88	2.058	.499

Table 3: Experience in Safety Management in the Construction Industry

$F(2,75) = 4.68, p = 0.034$

Site managers recorded higher experience in safety management of an average of 7.8 years compared to foremen with an average of 7.14. F- statistics shows that the duration of experience of site managers was significantly different from the foremen  $F(2,75) = 4.68, p = 0.034$ .

The duration in which the site has been in operation and that which foremen and site managers have been in the current site were also analyzed as shown on Table 4.

	N	Minimum	Maximum	Mean	Std. Deviation
Duration of current site	77	4	26	12.40	6.570
How long in the current site	77	4	26	11.44	6.105
Valid N (listwise)	77				

Table 4: Experience in Current Site in Months

On average, the construction sites included in this study had been in operation for a duration between 4 to 26 months; the average duration was 12 months. The site managers and foremen in charge of safety have been in the current construction sites for a duration between 4 and 26 months too but on average 11 months. A comparison on the experience in safety management in the current sites is shown on Table 4.5.

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Duration of current site - How long in the current site	.961	2.877	.328	.308	1.614	2.932	76	.004

Table 5: Comparison between Age of site and Duration in Safety management

Although there was a statistically significant difference between the duration of the site and the duration in which safety managers had worked ( $t(76) = 2.932, p = 0.04$ ). However, the gap in duration was small since on average sites were  $12.44 \pm 0.96$  months and the duration of work in the current site  $11.44 \pm 0.96$ . This shows that the selected respondents had been in the current site from the onset therefore had the knowledge on accident statistics and the safety culture in the site.

### 3.2. Accidents Reported to Safety managers in Construction Sites

Incidences were categorized as: fatal accidents, moderate damage accidents, minor accidents and near misses. This information was obtained from construction site supervisors in charge of safety. The findings are shown on Table 6.

Incidences	Fatal Accidents		Moderate Accidents		Minor Accidents		Near Misses	
	F	%	F	%	F	%	F	%
None	71	92.2%	35	45.5%	5	6.5%	3	3.9%
1 - 5	6	7.8%	36	46.8%	40	51.9%	4	5.2%
6 - 10	0	0.0%	6	7.8%	19	24.7%	25	32.5%
11 - 15	0	0.0%	0	0.0%	8	10.4%	17	22.1%
16 - 20	0	0.0%	0	0.0%	5	6.5%	13	16.9%
Above 20	0	0.0%	0	0.0%	0	0.0%	15	19.5%

Table 6: Accidents Reported to Safety managers in Construction Sites

The findings on Table 6 show that at least 7.8% of the construction sites experienced 1 – 5 accidents with fatal injuries in the last one year, 46.8% have experienced 1 - 5 accidents with moderate injury while 7.8% have experienced 6 -10 accidents with moderate injuries. A majority 93.5% of sites have experienced accidents with minor injuries while 96.1% have experienced near misses. This shows that construction sites in Nakuru County experience a high number of safety incidences evident from 96.1% sites reporting near misses, 93.5% minor injuries, 54.5% moderate injuries and 7.8% fatal accidents in one year.

### 3.3. Corporate Safety Culture Measures in Place in Construction Sites

Corporate safety practices establish a platform or framework on which safety practices are based. They also indicate commitment by the top executive to implementing safety. Cooper (1993) terms corporate safety culture as the glue that holds safety function together. Corporate safety culture in construction sites was determined by assessing the safety policies, standards, safe operating procedures, safety management systems, control systems, communication flows and workflow systems put in place by contractors. The findings from the opinions of designated safety officers were presented on Table 7.

	N	Min	Max	Mean	$\sigma$
There is a well elaborate safety policy on this site	77	2.00	5.00	3.73	0.74
The project has enough budget set aside for implementing safety in the construction site	77	2.00	5.00	3.92	0.64
All necessary safety feature were taken into account during the planning phase of this project	77	3.00	5.00	3.69	0.63
There are adequate systems in place to ensure smooth and safe flow of work	77	2.00	5.00	3.23	0.71
There are well elaborate standard operating procedures in this site	77	2.00	5.00	3.35	0.79
There are clear channels for relaying safety information	77	2.00	4.00	2.74	0.55
The management attaches importance to safety equally as productivity	77	2.00	5.00	3.35	0.76
Managers and supervisors provide good examples to the other site staff on best practices in safety	77	2.00	5.00	3.27	0.81
There is a well organized channel of command in dealing with safety	77	2.00	4.00	3.03	0.68
There is an active safety committee for the site	77	1.00	4.00	1.97	0.63

Table 7: Corporate Safety Culture

Mean = 3.23,  $\sigma$  = 0.46.

The corporate safety culture was rated average in most of the areas assessed overall mean score was (Mean = 3.23,  $\sigma$  = 0.46). The highest rated corporate safety practice was financing the implementation of safety in the construction sites (Mean = 3.92,  $\sigma$  = 0.64). Majority of the safety officers also indicated the presence of a safety policy on site (Mean = 3.73,  $\sigma$  = 0.74) as well as incorporating safety in the design and planning phase of the construction projects (Mean = 3.69,  $\sigma$  = 0.63).

Site safety officers rated average the importance management attached to safety in relation to productivity (Mean = 3.35,  $\sigma$  = 0.76) as well as standard operating procedures in the sites (Mean = 3.35,  $\sigma$  = 0.79), the presence of systems to ensure smooth and safe flow of work (Mean = 3.23,  $\sigma$  = 0.71) as well as leadership by the top managers (Mean = 3.27,  $\sigma$  = 0.81). However, there was very low scores on the presence of functional safety committees on site (Mean = 1.97,  $\sigma$  = 0.63) and communication channels were also not clear (Mean = 2.74,  $\sigma$  = 0.55)

In determining whether the corporate safety culture contributed to the number of incidents experienced in construction sites, the study tested the hypothesis that:

- $H_0$ : There is no significant relationship between corporate safety culture and accident occurrence in construction sites in Nakuru County

Hypothesis test was done by computing the Pearson correlation between corporate safety culture and the number of incidents reported in construction sites. The test was done at a significance level of 0.05. The test results are as shown on Table 8.

		Safety Climate	Corporate Safety Culture
Corporate safety culture	Pearson Correlation	1	-0.287*
	Sig. (2-tailed)		.023
	N	77	77
Accident occurrence	Pearson Correlation	-0.287**	1
	Sig. (2-tailed)	.023	
	N	77	77

\*, Correlation is significant at the 0.05 level (2-tailed).

Table 8: Correlation between Corporate safety culture and Accident Occurrence

Results of the correlation analysis revealed a significantly negative correlation between corporate safety culture and accident occurrence in construction sites ( $r = -0.287$ ,  $p < 0.05$ ). This implies that construction sites where contractors had in place corporate safety practices recorded less incidents compared to those without. Therefore the study rejected  $H_0$  and accepted  $H_1$ .

#### 4. Discussions

The occupational safety situation in construction sites in Nakuru County is very critical owing to the high number of safety incidences specifically 96.1% sites reporting near misses, 93.5% minor injuries, 54.5% moderate injuries and 7.8% fatal accidents in one year. This finding conforms with that of Mitullah and Wachira (2013) in Nairobi and Smallwood and Haupt, (2008) and Similarly Sohail (1999) which terms construction sites as dangerous or highly hazardous owing to the disproportionately high incidence of accidents and fatalities that occur. Thus construction industry in Nakuru County was not exceptional on poor safety.

In regard to the organization of the safety management in construction it emerged that there was no dedicated safety officers in all construction sites visited. Which implies that contractors in construction industry in Nakuru did not prioritize safety as key in their works. Instead, safety was a secondary responsibility of site managers and foremen. This finding collaborate with that of Mitullah and Wachira (2013) in Nairobi which found out that safety of the workers was highly compromised in that 96% of the sites did not have safety measures of any kind in place while only 9% had protective clothing.

It however emerged that contractors put in place budgets for provision of safety equipments and safety supervision in construction sites as well as incorporating safety features in building plans and having a safety policy in place. These are features that did not involve the employees in their establishment. On the contrary, communication between the managers and other site workers in regard to safety was poor. This was evident from the lack of clear and organized channels of relaying safety information from workers to management. HSC (2001) identify clear and decisive leadership as prerequisite for safe work environment and so were communication channels. They opine that communications should be, a two-way process, and hence provided essential feedback to management on safety matters. These two parameters are at the heart of corporate safety culture that in the current study has been closely associated with the number of incidents in construction sites.

## 5. Conclusions

Corporate safety culture was ranked above average in construction sites in Nakuru County. However, key significant safety aspects were missing or were inadequate among most of the contractors. The failure to have dedicated safety officers and treatment of safety as a secondary activity was of great concern. Secondly there were poor communication channels between workers and the management on safety. It was found that the level of corporate safety culture has a significant influence on the number of accidents reported in the site. Sites with higher corporate safety culture recorded significantly less incidents. Thus implementing safety culture is key in minimizing accidents significantly in construction sites. The study recommends for intensive training of contractors on safety in construction sites.

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