

Assessing the Influence of Demographic Factors on Safety Climate in Construction Projects: Perspectives from Southern Africa

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Abstract

Background: Although construction projects are high risk in nature and associated with elevated levels of high severity accidents, there has been little research on how to improve construction safety performance especially in developing countries. Many studies have shown that demographic factors can influence the safety climate in construction settings. This study contributes to existing research by evaluating the influence of demographic factors on safety climate in a construction project in Southern Africa which consisted of workers predominantly from South Africa and Zimbabwe. **Methods:** The study adopted a quantitative approach in evaluating demographic factors influencing safety climate among construction workers. A total of 206 respondents were selected for the study from a population of 1000 construction workers using stratified random sampling. A questionnaire consisting of questions covering management and supervisor commitment, worker involvement, risk tolerance, procedures compliance, prioritisation of safety, communication and competence safety climate dimensions was utilised to compute the overall safety climate. The other part of the questionnaire consisted of demographic questions about the respondents. A Statistical Package for Social Sciences (SPSS) software was used to conduct statistical inference: independent sample t-test and Analysis of Variance - ANOVA of the demographic factors and their influence on the safety climate. **Results:** Independent sample t-test: Gender had a significance level ($p < 0.001$), which is lower than 0.05. Therefore, hypothesis (H1) suggesting that significant differences in the perception of safety climate between gender groups is accepted. Marital status had a p-value (0.081), hence, hypothesis (H2) indicating a significant difference in the perception of safety climate between marital status groups is rejected. ANOVA: The p-values for level of education (0.350) and age group (0.091) are higher than the significance level of 0.05. Hence hypotheses H3 and H4, proposing

that education and age differences significantly affect perceptions of the safety climate are rejected. Experience in company p value (0.019) is less than 0.05. Thus hypothesis H5 that more experienced employees have a better safety climate perception than newer employees is accepted. **Conclusion:** The study indicated that employee demographic characteristics namely age, marital status and education level did not significantly alter the safety climate. However, the other demographic factors, namely gender and work experience significantly influenced the climate, suggesting that these factors play a prominent role in shaping safety perceptions. The implication of this is that construction project managers may factor in demographic differences in the design and implementation of safety programmes.

Keywords

Safety Culture, Safety Climate, Demographic Factors, Construction Projects

1. Introduction

Many authors submit that safety performance in the construction sector in developed and emerging economies has plateaued despite an influx in safety initiatives [1] [2]. This is attributed to worsening accident experience in the construction sector as a result of poor safety climate [3]. Again considerable research has demonstrated a positive link between safety culture and accident trends [4] [5]. Safety culture refers to team beliefs, norms, attitudes, perceptions and behaviours relating to workplace safety. Safety climate is a sub-component of safety culture entailing the perceptions of employees towards safety culture. Hence, occupational health and safety improvements can be realised by improving the safety climate and culture.

Despite the current focus on safety climate across industries, there is little research on how organisations can enhance safety climate to attain the desired safety performance [6] [7]. Furthermore, [8]-[10] laments that occupational health and safety research in Africa lags behind developed countries, notwithstanding the region's undesirable construction industry accident trends. Hence, there is little construction safety climate research in developing economies. Therefore, this case study research focussing on the safety climate of construction projects in Southern Africa can bridge the gap in construction safety climate research in developing economies.

2. Research Aim and Objectives

This case study evaluates the demographic factors influencing the safety climate among construction projects with employees predominantly from South Africa and Zimbabwe (Southern Africa) and suggests strategies to improve the prevailing climate.

The objectives of the proposed safety climate study are to:

- 1) Develop a questionnaire for collating employee demographic information
- 2) Assess influence of demographic factors on safety climate using inferential statistics
- 3) Propose strategies to enhance the safety climate and contribute to the overall safety culture.

3. Literature review

3.1. Age

Age differences significantly affected safety climate across 54 Hong Kong construction sites, with older employees having more favourable views than younger workers [11]. Older employees may have a lower risk tolerance due to hazard awareness and near miss experiences than younger workers. Likewise, [12] concluded that age significantly affects the construction safety climate in Saudi Arabia. Both [11] [12] corroborate the critical role of ageing in shaping safety perceptions across different geographical locations. Conversely, a systematic literature review revealed insignificant differences in work performance between old and young workers [13]. These mixed results indicate the importance of considering potential differences in cognitive and cultural contextual factors contributing to the observed age-related discrepancies in safety climate.

3.2. Gender

It was concluded that gender differences influenced worker safety perceptions in Ghana [14]. Similarly, [15] found significant effects of gender differences on safety climate across nine construction sites in China. Another study concluded that gender impacted risk perception in Saudi Arabia [16]. These studies revealed that female workers in emerging economies have a better safety climate than their male counterparts. However, [17] concluded that gender did not affect worker safety behaviour among construction workers in China. This may indicate the presence of safety climate moderating factors such as personality traits, cognitive abilities, and organisational context. Therefore, further investigation across different regions and industries can provide a comprehensive insight into how gender affects safety climate.

3.3. Marital Status

Marital status was found to influence the safety climate in construction projects in Hong Kong [18]. Also, [19] concluded that married workers had a favourable safety climate across 22 construction projects in Hong Kong. Workers with family responsibilities may comprehend potential risks better and exhibit voluntary behaviour to maintain job security, leading to better attitudes and behaviours towards safety. However, these findings are specific to the Hong Kong context and may not be universally applicable. The cultural and social dynamics associated with the construction industry in Hong Kong could influence the relationship between marital status and the safety climate. Hence, further research incorporating

diverse geographical and cultural contexts can provide important insights.

3.4. Work Experience

Work experience was observed to significantly affect the safety climate in Saudi Arabia construction projects [12]. This finding could be attributed to more appreciation of safety risk with experience, thus shaping safety behaviour. In contrast, [20] demonstrated that work experience had little influence on the safety climate in a Chinese construction company. Recently, [17] also found that years worked in a particular occupation did not affect worker safety behaviour among Chinese construction workers. The literature review above shows inconsistent conclusions. Hence, there is a need to explore the underlying reasons for these discrepancies further, including the country-specific characteristics of the construction industry. These inconsistencies underscore the importance of considering contextual influences when implementing safety programmes to enhance the safety climate in construction settings.

3.5. Education Level

A comprehensive systematic review of construction literature and a quantitative study in a construction environment in the United States of America showed that education significantly influenced safety risk perceptions [21]. Likewise, [12] found that the education level of construction workers influenced the safety climate in Saudi Arabia. Similarly, [22] showed a positive association between education level and the safety climate of industrial workers in Ghana. The evidence by [12] [21] [22] indicates a positive link between the level of education and safety climate among construction workers across North America, Asia, and Africa. This suggests that highly educated workers may have better occupational hazard awareness and risk mitigation knowledge. This finding implies that managers could consider developing targeted safety training and awareness programmes to enhance safety understanding among less educated workers.

On the basis of the literature review above, the following research hypotheses have been formulated as follows:

H1: There is a significant difference in the perception of safety climate between gender (male and female) groups.

H2: There is a significant difference in the perception of safety climate between marital status (married and single) groups.

H3: Education is significantly related to perceptions of the safety climate, with more educated employees having a more positive perception than less educated employees.

H4: Age is significantly related to the perception of the safety climate, with older employees having a more positive perception than younger employees.

H5: More experienced employees have a more favourable safety climate perception than less experienced ones.

4. Materials and Methods

4.1. Materials

4.1.1. Questionnaire

The first portion of the questionnaire comprised demographic questions relating to the respondents, including their age, gender, marital status, education level, and work experience. This information was used to assess the influence of these personal characteristics on safety climate. Part two of the questionnaire consisted of 31 questions relating to safety climate dimensions namely management commitment, supervision commitment, worker involvement, safety commitment, rules compliance, tolerance to risk, communication and competence. The 31 sample questions were created from Fang's 87 questions [11]. Employees marked the appropriate responses in the Likert scale that ranged from strong disagreement to agreement. A pilot study of 22 safety practitioners reviewed and improved the questionnaire.

4.1.2. Statistical Tools

The Statistical Package for the Social Sciences (SPSS) software was used to perform inferential statistics namely t-test and Analysis of Variance (ANOVA).

4.2. Methods

This quantitative research examined demographic factors influencing safety climate in construction projects in the case study organisation using a survey questionnaire.

4.2.1. Sample Size Selection

The project construction population was 1000 employees. A total of 206 employees participated in the study and were selected through stratified random sampling to represent the employment roles equally. This 206 sample is above 169 samples to allow for generalisation from a random sample assuming a 7% sampling error [23].

4.2.2. Data Collection and Ethical Considerations

The study participants were given blank questionnaires before commencing the work shift and requested to return completed forms at the start of the next shift. The respondents confidentiality was safeguarded by ensuring that they completed the questionnaire anonymously. The study participants provided verbal consent prior to data collection.

4.2.3. Statistical Analysis

A t-test was performed to evaluate the influence of gender and marital status (demographic variables) on safety climate. The t-test is essential for testing differences in mean scores among diverse groups [24]. The hypothesis was accepted for values less than 0.05. Furthermore, the ANOVA statistical method was applied to determine if the level of education, age, and working experience (demographic variables) affected safety climate. The t-test is suitable for comparing statistical

significance between means of two groups e.g married and single while ANOVA is ideal for measuring statistical significance between means of more than two groups e.g diverse years of work experience.

5. Results

5.1. T-Test

A t-test was undertaken to determine if the differences in mean scores for gender and marital status were statistically significant (See **Table 1**).

Table 1. T-test - Gender and Marital status.

| Demographic factor | t | Degrees of freedom | Test for differences in Means | |
|--------------------|--------|--------------------|-------------------------------|-------------|
| | | | One-sided p | Two-sided p |
| Gender | -3.363 | 204 | <0.001 | <0.001 |
| Marital status | -1.404 | 204 | <0.081 | <0.162 |

Source: SPSS.

For gender, t statistic (204) = -3.363 and significance level ($p < 0.001$), suggests a statistically significant difference in safety climate perceptions between the two groups. Hence, the hypothesis (H1) suggesting significant differences in the perception of safety climate between gender groups is accepted. Furthermore, marital groups had the following results: t (204) = -1.404 and ($p < 0.081$) for the one tailed test and ($p < 0.162$) for the two-tailed. The p-values for marital status are greater than 0.05, suggesting insignificant differences in means between the two groups. Hence, hypothesis (H2) indicating significant difference in the perception of safety climate between marital status groups is rejected.

5.2. Analysis of Variance

The ANOVA test examined the interaction between safety climate and demographic variables namely education, age, and work experience (See **Table 2**).

Table 2. Analysis of Variance - Demographic factors.

| Demographic factor | Variability | Sum of Squares | Degrees of Freedom | Mean Square | Significance level |
|--------------------|----------------|----------------|--------------------|-------------|--------------------|
| Level of Education | Between Groups | 2.169 | 5 | 0.434 | 0.350 |
| Age | Between Groups | 3.098 | 4 | 0.774 | 0.091 |
| Work experience | Between Groups | 4.519 | 4 | 1.130 | 0.019 |

Source: SPSS.

The significance level (p-value) for level of education (0.350) and age (0.091) are higher than the significance level of 0.05, indicating statistically insignificant

differences in safety climate scores amongst the various levels of education and age groups respectively. Hence hypotheses H3 and H4 suggesting that education and age differences significantly affect perceptions of the safety climate, are rejected. The associated significance level for work experience of 0.019 is less than 0.05, suggesting that the interaction effect among the different work experience groups is statistically significant. Hence hypothesis H5 that more experienced employees have a better safety climate perception than newer employees is accepted.

6. Discussion

The safety climate research sought to understand the role of age, education status, employee experience, marital status, and gender on safety climate perceptions.

6.1. Age

The ANOVA analysis showed that age did not significantly impact opinions of safety climate. These results contrast past and recent research, which suggests that age differences significantly affect safety climate perceptions, with older employees having a positive view compared to younger workforce [11] [12] [17]. Young workers may underestimate safety risks more than old employees [15]. The insignificant differences between perceptions of safety climate among the different age groups may point to older employees influencing the younger workforce's safety culture. This could also reflect an organisational culture creating similar employee behaviours which can be confirmed qualitatively.

6.2. Level of Education

The ANOVA test showed that age had a statistically insignificant impact on safety climate. These results are inconsistent with most safety climate research suggesting that more educated construction workers exhibited positive safety behaviour [12] [21] [22]. Therefore, context-specific and other factors could be influencing the significance of education level on the safety climate. Thus, future research could focus on understanding these contextual issues.

6.3. Work Experience

The ANOVA results showed that years of experience in the organisation significantly influenced the safety climate. This suggests that years of experience in the company significantly shape these perceptions. These statistical findings are consistent with [12] assertion that years of experience significantly affect the perception of the safety climate amongst the construction workforce. The practical implication of this finding is that work experience needs consideration when designing and implementing safety initiatives. For example, more experienced employees can be assigned to high-risk workstations, while the inexperienced workforce can be transferred to low-risk areas. Again the more experienced workers can be appointed as mentors, coaches and role models for the inexperienced employees to assist them in attaining the desired safety maturity.

6.4. Gender

The t-test proved that gender has a considerable role in worker perceptions of the safety climate, with females having a better perception than males. These findings are consistent with historical and recent research indicating that gender differences influence worker safety perception in construction projects [14]-[16]. This highlights the need for gender-specific safety interventions such as tailoring safety programmes to address the specific needs and perceptions of different gender groups. Again this finding supports the call for deliberate inclusion of females into a construction sector predominantly dominated by males.

6.5. Marital Status

The t-test revealed insignificant mean differences between married and single employees. The t-test results contrast research findings demonstrating that marital status influences the construction safety climate [18] [19]. A qualitative deep-dive analysis of the reasons behind these perceptions can provide more insight into the findings.

6.6. Research Limitations and Future Research Recommendations

The study was conducted in a specific time frame and hence future studies could be longitudinal to assess changes in perceptions over time. Secondly, while the sample size was adequate to generalise at 7% level of error, future research could further reduce the error level to below 5% by further increasing the sample size.

7. Conclusion

The research evaluated the influence of demographic factors on the overall safety climate of the case study organisation. The study revealed that demographic factors, namely gender and employee work experience, seemed to influence perceptions of safety climate. Therefore, demographic factors should be considered when shaping safety climate and by extension safety culture. Thus, safety professionals can consider gender and years of experience when developing and implementing safety programmes. For example, tailoring safety improvement interventions to address specific needs and perceptions of different gender groups can enhance the overall safety climate. This finding calls for deliberate strategy to increase the proportion of women in a construction sector predominantly dominated by men. Moreover, the company can assign more experienced workers to high-risk workstations and inexperienced workforce to less risky areas. Furthermore, less experienced employees could be assigned under experienced workers to infuse the desired safety culture with coaching and mentoring.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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