OCCUPATIONAL SAFETY CHALLENGES IN THE CONSTRUCTION INDUSTRY OF SINDH, PAKISTAN: AN ANALYSIS OF ACCIDENT DATA AND SAFETY IMPLEMENTATION

Mujtaba Hassan[*1], Rabia Soomro[2], Sohail Ahmed[3], Atiqa Aslam[4], Touqeer Ali Rind[5]

[*1]Department of Civil Engineering, Faculty of Architecture and Town Planning, the Aror University of Art, Architecture, Design & Heritage, Rohri, Sukkur, Sindh, Pakistan
[2]Department of Civil Engineering, Mehran University of Engineering Science and Technology (SZAB), Khairpur Mirs, Sindh, Pakistan
[3]Department of Civil Engineering, NED University of Engineering & Technology, Karachi, Sindh, Pakistan
[4]Foundation for Advancement of Science and Technology, National University of Computer and Emerging Sciences, Pakistan
[5]Ghulam Ishaque Khan Institute of Engineering Sciences and Technology, Topi, KPK, Pakistan

Abstract
This study investigates occupational safety in the construction industry of Sindh, Pakistan, highlighting the persistent issue of workplace accidents despite existing safety regulations. A review of the literature reveals a gap in empirical data focusing on accident count and state of safety practices in the construction industry of Sindh. The objectives of this research are to identify the frequency of occupational accidents and assess the level of implementation of safety measures in targeted construction companies. A quantitative research method was adopted for this research. The data was collected through a structured questionnaire, distributed among 386 construction companies in Sindh. The data collection process involved direct contact with safety managers and supervisors to ensure accurate reporting of accident statistics and safety practices. The data analysis was performed using SPSS, employing descriptive statistics to evaluate safety measure implementation and accident frequencies. The results indicate a total of 894 accidents over the past five years in 386 construction companies of Sindh, comprising 79 fatal, 231 non-fatal, and 584 property damage incidents. Key findings highlight inadequate safety training, insufficient personal protective equipment, and a prevalent culture of risk-taking. The study underscores the need for stringent safety protocols, improved training programs, and regulatory enforcement. This research emphasizes the urgent need for systematic safety interventions in Sindh's construction industry to foster a safer working environment.

INTRODUCTION

Occupational safety is a critical concern for workers in the construction industry. In recent years, the construction industry in the Sindh province of Pakistan has experienced a significant increase in the number of accidents, including fatal, non-fatal, and property damage incidents. These accidents not only result in human tragedies but also lead to significant financial losses for the companies involved.

According to a quantitative study conducted among 386 construction companies in the Sindh province of Pakistan, there exists a significant problem with the implementation of safety measures in the

construction industry. The study found that many of the companies surveyed lacked proper safety training for their employees and did not provide adequate personal protective equipment. Additionally, a prevalent culture of risk-taking and negligence towards safety further contributes to the high frequency of accidents.

The purpose of this research paper is to further explore the issue of occupational safety in the construction industry in Sindh. Specifically, this paper aims contribute to the existing literature on occupational safety in the construction industry in Sindh and provide valuable insights for policymakers and industry stakeholders to promote a safer working environment for construction workers in Sindh.

2. Literature Review

One of the largest and most significant industries in the world, the construction industry employs millions of people and considerably boosts the global economy. However, according to Oladinrin et al. (2012), the construction industry is also one of the most hazardous for worker safety. Construction industry workers frequently experience accidents and injuries, which can have catastrophic consequences for both the workers and their families as well as the companies involved (Rafindadi et al., 2020). The number of accidents in the construction industry has significantly increased in the Sindh province of Pakistan in recent years. It has been discovered that Sindh's construction industry lacks suitable safety measures, which contributes to a high incidence of accidents that result in fatal, non-fatal, and property damage accidents (Tarique, 2021).

The safety measures that are enforced in Sindh's construction industry have been the subject of several studies. For instance, Farooq et al. (2023) carried out research to assess the safety measures in the Karachi, Sindh, construction industry. The research revealed that there was a lack of understanding among employees about occupational safety and that the majority of Karachi's construction workers were not equipped with proper personal protection equipment. Accidents may have a huge negative impact on workers' and their families' well-being as well as the bottom lines of the companies involved.

The subject of occupational safety in the construction industry has also been the subject of several international studies. For instance, research on the variables affecting the adoption of safety management systems in the Chinese construction industry was undertaken by da Silva and Amaral in 2019. According to the study, better safety performance was positively correlated with the use of safety management systems.

In related research, Mansour and Sharour (2021) explored the factors affecting the way safety measures are implemented in Jordan's construction industry. According to the report, there are substantial obstacles to the adoption of safety measures in the construction industry, including a lack of safety training, insufficient protective equipment, and a lack of a safety culture.

In addition to the research already mentioned, a number of other studies have looked at the topic of occupational safety in the global construction industry. For instance, Wang et al.'s study from 2022 looked into the causes and mitigation of construction accidents in China. According to the report, there are several factors that contribute to the high incidence of accidents in China's construction sector, including poor safety management, insufficient safety training, and a lack of safety legislation.

Similar to this, Maliha et al.'s study from 2021 looked into the safety management procedures used in India's construction industry. According to the report, there are considerable obstacles to the adoption of efficient safety measures in the Indian construction industry, including a lack of safety awareness among workers, insufficient safety training, and a lack of safety legislation.

In research published in 2023 by Ali et al., the authors focused on Pakistan's construction industry's safety performance and culture. According to the report, one of the biggest obstacles to the adoption of practical safety measures in Pakistan's construction industry is a lack of a safety culture.

The material emphasizes the value of working with many stakeholders to promote workplace safety in the construction industry. For instance, Yang et al. (2022) investigated the functions of owners, contractors, and employees in promoting safety in the Chinese construction sector. According to the

study, successful implementation of safety measures in the construction sector requires collaboration among many stakeholders.

In order to minimize accidents and lower related human and financial costs, the literature as a whole highlight the urgent need for adequate safety measures in the construction industry. Effective safety measures may help the construction industry thrive and be sustainable overall, in addition to protecting the workers. The existing literature provides valuable insights for policymakers, industry stakeholders, and researchers to develop effective strategies to improve occupational safety in the construction industry in Sindh and other parts of the world.

3. Research Methodology

The research employed a quantitative research method to collect data, and a structured questionnaire was distributed among 386 construction companies executing project in the Sindh province of Pakistan and registered with Pakistan Engineering Council (PEC). The data obtained from this survey aimed to address the research questions. The subsequent section gives a detailed description of sample and sampling technique, data collection, data analysis and demographic details of the respondents.

3.1 Sample Size

The total number of registered construction firms in Sindh province are 5452 till December 2024 records

available at Pakistan Engineering Council's (PEC) official website. The criterion for selecting these companies was their registration with the PEC, as this is the official legalizing body for construction companies in Pakistan. The Pakistan Engineering Council (PEC) classifies construction companies into various categories, primarily denoted by the letter's 'C' for Constructors, followed by a numerical designation (e.g., C-1). These categories define the scope and scale of projects that firms are eligible to undertake, based on factors such as the firm's financial capacity, technical expertise, and the qualifications of employed engineers. The construction companies are classified into categories as C6, C5, C4, C3, C2, C1, CB and CA, where the C6 is a lower category company, and it is suited for smaller projects with less stringent requirements Whereas CA being a higher category company permit to undertake larger projects and necessitate more experienced personnel, strong financial turnover and technical expertise.

Keeping in view, the population of registered companies in the construction industry of Sindh the sample size calculated using Cochran's Formula for finite population presented in equation 1. This approach was selected because it allows for the calculation of a representative sample size when the population is known and finite. A 95% confidence level and a 5% margin of error were used in the calculation, ensuring that the findings are statistically robust.

$$n = \frac{z^2 \times p \times (1-p)}{e^2} \tag{1}$$

Where:
- n = required sample size
- z = z-value (from the confidence level)
- p = population proportion (use 0.5 if unknown)
- e = margin of error

$$n_{adjusted} = \frac{n}{1 + \frac{(n-1)}{N}} \tag{2}$$

Where:
- n = Adjusted sample size for finite population
- n_o = Initial sample size for Cochran's formula

- N = population size

Step 1: Calculate Initial Sample Size (n)

$$n = \frac{1.96^2 \times 0.5 \times (1 - 0.5)}{0.05^2} = 384.16$$

Step 2: Adjust for the Population Size

$$n_{adjusted} = \frac{384}{1 + \frac{(384 - 1)}{5452}} = 359$$

Hence the total responses required for this research were 359. To account for a potential non-response rate, it was anticipated that approximately 20% of the firms contacted might not respond. Therefore, the questionnaires were distributed to 600 construction companies. This adjustment was made to ensure that the final number of usable responses would meet the originally calculated sample size requirements. This sampling methodology is consistent with guidelines outlined by William (1997)

3.2 Data Collection

The data collection for this research was conducted using a structured survey instrument aimed at collecting data related to the frequency of work-related accidents over the past five years and the extent of adherence to safety practices within construction companies. The questionnaire was divided into three sections: the first section gathered demographic information of the company, the second section focused on the frequency of work-related accidents within the last five years, and the third section assessed the level of company's safety practices, including safety training, use of personal protective equipment (PPE), and employee behavior regarding safety.

The survey instrument was developed through a comprehensive literature review to ensure that the key components relevant to construction safety were covered. These components included safety training programs, the availability and use of PPE, employee behavior concerning safety, occupational accidents reduction level, and overall safety performance within the company. A 5-point Likert scale was utilized for the questionnaire, as shown in Table 1, ranging from 'Strongly Disagree' to 'Strongly Agree' (Soomro et al., 2024). This scale facilitated the measurement of varying degrees of agreement or disagreement from the respondents.

Table 1 Mean interval of 5-Point Likert Scale

Mean Interval	Opinion
1 – 1.80	Strongly Disagree
1.81 – 2.60	Disagree
2.61 – 3.40	Neutral
3.41 – 4.20	Agree
4.21 – 5.00	Strongly Agree

A pilot test was conducted to validate the questionnaire, involving an industrial expert with over 15 years of experience in construction safety in Sindh. The expert recommended adding questions related to the effectiveness of safety training and PPE within the company. Additionally, an English language expert proofread the questionnaire to correct grammatical errors and enhance clarity, while a statistician suggested the use of mean values for data analysis aligned with the research objectives.

The target respondents for the survey were company owners, safety officers, project managers, or designated representatives responsible for providing information on safety practices and accident counts.

Companies were selected based on their registration with the Pakistan Engineering Council (PEC) and whether they implemented safety measures or had experienced construction-related accidents.

The data collection period spanned from July 3, 2023, to September 28, 2024. Companies were contacted via email and telephone using contact information obtained from the PEC website (*Pakistan Engineering Council - PEC*, n.d.). Out of 1200 contacted companies, 187 responded and scheduled appointments, while an additional 184 responses were gathered through references from company representatives and owners, resulting in a total of 371 responses and a response rate of 30%.

The questionnaire was administered in-person by the researcher to ensure accurate and reliable data collection. Each survey took approximately 20 minutes, with 10 minutes allocated to explaining the study's objectives and 10 minutes for respondents to answer the questions, which were marked by the researcher during the session. Confidentiality and anonymity were maintained throughout the study, with informed consent obtained from all participants, ensuring adherence to ethical guidelines.

3.3 Data Analysis

The collected data was subjected to analysis in Microsoft Excel and Statistical Package of Social Sciences (SPSS). The sum of all accidents was identified in Microsoft Excel in order to determine the cumulative number of accidents that occurred in the last five years in 386 construction companies in Sindh. Meanwhile, descriptive analysis was conducted using SPSS to ascertain the mean value of the data with respect to the level of implementation of safety measures among construction companies. The demographic characteristics of the companies involved in the survey are presented in table 2:

Table 2 Demographic characteristics of respondent construction companies

Character	Component	Result
Location of Company Head Office	Karachi	134
	Hyderabad	73
	Sukkur	68
	Larkana	62
	Other	34
Years of Operation in the Construction Industry	Less than 5 years	113
	5–10 years	162
	11–20 years	64
	More than 20 years	32
Size of the Company (Number of Employees)	Less than 50	193
	50–100	117
	101–500	40
	More than 500	21
Type of Construction Projects Focused On	Government	221
	Private	131
	Autonomous	18
	International	1
Category under the company is registered with PEC	C6	92
	C5	67
	C4	63
	C3	52
	C2	44
	C1	32
	CB	18

	CA	3

The present study conducted a thorough data analysis to present a comprehensive overview of the current status of occupational safety in the construction industry in Sindh.

4. Results

The tables presented below shows the results of a study conducted among 386 construction companies in the Sindh province of Pakistan. The study aimed to identify the number of occupational accidents that occurred in the last 5 years as well as the level of implementation of safety measures in the construction industry in Sindh. The response for Q1 represents the total number of occupational accidents reported by the 386 construction companies surveyed in the Sindh region of Pakistan over the last 5 years. The responses for Q2 represent the average rating (on a Likert scale of 1–5) given to the corresponding statements about the level of implementation of safety measures by the surveyed companies. A lower rating indicates a lower level of implementation of that particular safety measure.

Table 1 Results of question 1

Question 1 : Number of occupational accidents in last 5 years	Responses in Number
Fatal	79
Non-Fatal	231
Disability	
Property Damages	584
Total	894

The first question (Q1) asked about the number of occupational accidents that occurred in the last 5 years. The response was 894, indicating that there were 79 fatal accidents in the last five years, 231 non-fatal accidents, and 584 property damages in the construction industry in Sindh during this period. However, it is worth mentioning here that the number of accidents was not mentioned on any official document of the company, and the response was purely based on verbal communication with the respondents.

Table 2 Results of question 2

Question 1 Level of safety measures implementation	Response in Mean Value
- Safety training for employees	2.2
- Provision of personal protective equipment	2.8
- Safety regulations compliance	2.1
- Safety culture within the organization	1.9

The response for Q1 represents the total number of occupational accidents reported by the 386 construction companies surveyed in the Sindh region of Pakistan over the last 5 years. The responses for Q2 represent the average rating (on a Likert scale of 1–5) given to the corresponding statements about the level of implementation of safety measures by the surveyed companies. A lower rating indicates a lower level of implementation of that particular safety measure.

5. Discussion

The first question (Q1) asked about the number of occupational accidents that occurred in the last 5 years. The response was 894, indicating that there were a significant number of accidents in the construction industry in Sindh during this period. This result highlights the urgent need for improved safety measures to prevent accidents and reduce the associated human and financial costs.

The second question (Q2) asked about the level of implementation of safety measures in the construction industry in Sindh. Four different safety

measures were assessed: safety training for employees, provision of personal protective equipment, compliance with safety regulations, and safety culture within the organization. The responses were given on a Likert scale ranging from 1 to 5, with a lower rating indicating a lower level of implementation of that particular safety measure.

The results show that there is significant room for improvement in the implementation of safety measures in the construction industry in Sindh. The average rating for safety training for employees was 2.2, indicating that many companies surveyed lacked proper safety training for their employees. The average rating for the provision of personal protective equipment was 2.8, indicating that many companies also did not provide adequate personal protective equipment for their employees. The average rating for compliance with safety regulations was 2.1, indicating that many companies were not fully compliant with safety regulations. The average rating for safety culture within the organization was 1.9, indicating a prevalent culture of risk-taking and negligence towards safety in the construction industry in Sindh.

These findings suggest that urgent action is needed to improve the implementation of safety measures in the construction industry in Sindh. This could include measures such as improved safety training for employees, increased provision of personal protective equipment, and stronger enforcement of safety regulations. By prioritizing safety initiatives and promoting a safer working environment, policymakers and industry stakeholders can help prevent accidents and reduce the associated human and financial costs in the construction industry in Sindh.

5. Conclusions

In conclusion, this study highlights a significant problem with the implementation of safety measures in the construction industry in the Sindh region of Pakistan (Memon et al., 2023). The high number of occupational accidents in the last 5 years and the low level of implementation of safety measures demonstrate the urgent need for improved safety measures to prevent accidents and reduce the associated human and financial costs.

The study provides valuable insights for policymakers and industry stakeholders to prioritize safety initiatives and promote a safer working environment for construction workers in Sindh. The findings suggest that improving safety training for employees, increasing the provision of personal protective equipment, and strengthening enforcement of safety regulations are crucial steps towards reducing occupational accidents and creating a safer working environment (Shahar et al., 2023).

Future research could focus on exploring the reasons behind the low level of implementation of safety measures in the construction industry in Sindh as well as assessing the effectiveness of specific safety initiatives. Additionally, research could be conducted to explore the experiences and perspectives of construction workers and their families affected by occupational accidents in order to gain a deeper understanding of the human impact of these incidents.

Overall, this study emphasizes the importance of prioritizing safety measures in the construction industry in Sindh and the need for collaborative efforts from policymakers, industry stakeholders, and workers to create a safer working environment .

6. Limitation and Challenges

Despite the significance of this study in identifying the frequency of accidents in the construction industry of Sindh, several challenges and limitations were encountered during the research process.

One of the primary limitations was related to the accuracy and reliability of the accident data. The figures provided by company representatives were based on verbal or unofficial records, without any supporting documentation or verifiable evidence. As a result, there remains a possibility of underreporting or overestimation due to the lack of standardized and transparent record-keeping within the organizations. This limitation affects the overall precision of the findings and underscores the need for a more structured and systematic accident reporting mechanism within the construction sector.

In terms of challenges, communication and coordination with company representatives proved to be difficult. Organizing meetings and follow-up discussions required considerable time and effort due to the busy schedules of the respondents.

Furthermore, there was noticeable hesitancy among some company officials to disclose accident-related data, as they feared potential reputational risks or data leakage. To address these concerns, the researcher made it explicitly clear that all shared information would be treated with strict confidentiality and used solely for academic purposes. Additionally, no identifiable company names or sensitive details were recorded during the data collection process to ensure anonymity and build trust with the participants.

Another constraint was the reliance on random sampling within a specified population, which, while beneficial for generalizability, may have led to the exclusion of certain key players or high-risk construction sites whose inclusion could have provided a more comprehensive view of the accident trends.

In summary, while this research provides valuable insights into the frequency and nature of construction accidents in Sindh, the findings must be interpreted with caution, keeping in view the data limitations and the operational challenges encountered during the research process.

Acknowledgement

Conflicts of Interest

The authors declare no conflicts of interest.

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