

CHAPTER 12

PRACTICAL STRATEGIES FOR MITIGATING ACCIDENTS IN THE CONSTRUCTION INDUSTRY: A CASE STUDY OF SOUTH AFRICA

Abimbola Windapo

ORCID.org/0000-0002-3162-6546

Nnedinma Umeokafor

ORCID.org/0000-0002-4010-5806

ABSTRACT

This chapter examines the frequency and causes of accidents in the South African Construction Industry and the mitigating strategies used by construction companies. A mixed-method research approach (using questionnaire survey and semi-structured interviews) was adopted in determining the frequency and severity of accidents on construction sites and identifying the primary causes and the mitigating strategies used by contractors. The sample size comprised of 617 contractors randomly selected from the 1234 construction companies listed in the Professionals and Project Register in South Africa. An online survey was administered which generated 59 responses, providing a response rate of 9.72%. The findings suggest that the high accident frequency (out of 14 respondents who provided data, only two reported zero accidents on their sites) in the South African Construction Industry is largely due to a failure to adhere to work procedures, negligence, and the use of incorrect work procedures. Hence, fostering a self-regulation culture where all stakeholders are equally responsible for maintaining safety standards emerged as a primary mitigation strategy. Also, the study reveals that contractors with higher investments in health and safety tend to have lower severity and frequency of accidents on their construction sites. This highlights the importance of allocating sufficient resources to health and safety programs, plans and inspections. It is recommended that both clients and contractors allocate more resources to health and safety to reduce accidents on construction projects effectively. The significance of this research is twofold. Firstly, it contributes to the body of knowledge regarding accidents in the South African Construction Industry, providing valuable insights into the frequency and causes of such incidents. Secondly, it offers practical strategies for mitigating accidents, which can be utilized by contractors and industry stakeholders to improve overall safety on construction sites. This research aligns with the concept of continuous improvement by identifying areas for enhancement and proposing strategies to address them, ultimately leading to a safer and more efficient construction industry in South Africa.

Keywords: Accident, Contractor, Health and Safety Programme, OH&S Plan, Safety Inspection

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Introduction

The construction industry has a poor record when it comes to Occupational Health and Safety (OH&S) (Health and Safety Executive (HSE) 2014; Umeokafor et al. 2023). The industry has one of the worst records of deaths and injuries among workers annually than other industries. According to HSE (2014), although construction accounts for only about 5% of employees in Britain, it accounted for 31% of fatal injuries to employees and 10% of reported major/specified injuries. Umeokafor et al. (2023) and International Labour Organisation (ILO, 2015) note that the case is worse in developing countries including South Africa where the situation is distressingly similar, if not worse. Despite the health and safety regulations and legislation in the country, the accident in the industry continues to rise Federated Employer's Mutual Assurance Company

(FEM, 2022). Figures released by FEM show that on average, about 36 people are injured on construction sites daily and during the period 2015 to 2021, there were 54,964 injuries requiring medical attention (FEM, 2022). The FEM (2022) records show that in the 24 months to December 2023, the cumulative cost for the top four accident categories – struck by (4,032 incidents), slip or over-exertion (1,743 incidents), striking against (1,484 incidents), and motor vehicle accidents (1,086) exceeds R217,000 (\$11,415).

The poor health and safety record of the industry can be attributed to poor management, lack of training, lack of safety regulations enforcement and awareness, and the human element's impact (FEM, 2014 and 2022; ILO Windapo, 2013). Additionally, the human element, including issues such as overloaded work, non-compliance with health and safety regulations, worker response, lack of experience and training, and negligence, further exacerbates the problem. Many contractors trade the safety of their workers to keep the project under budget (Windapo, 2013).

While research has been conducted on construction health and safety in South Africa, the novelty of this research lies in its focused examination of the South African construction industry, which represents a specialist context where regulation, safety practices, and resource allocation might differ from other contexts. The study bridges a significant knowledge gap about practical strategies for reducing the frequency and causes of accidents in this specific industry. Unlike prior studies (Goldswain and Smallwood, 2015; Smalwood, 2020; van Heerden et al., 2017; and Windapo, 2013), it explores the causes of accidents directly from the perspective of industry professionals through a mixed-method approach that includes both surveys and interviews.

The additionality offered by this research lies in the insights it provides into the actual execution of safety procedures and the factors perceived as causes of accidents on-site by professionals in the field. It contributes not only to understanding the frequency and causes of accidents but also reviews the effectiveness of existing health and safety norms. Moreover, the method of capturing accident rates provides a new lens to view construction site safety practices. The study further contributes to elaborating detailed accident-mitigating strategies within the South African context, a perspective missing from current industry knowledge.

Overview of the Frequency, Types and Causes of Accidents on Construction Sites and Mitigating Strategies

2.1 Frequency of Accidents on Construction Sites

The Compensation for Occupational Injuries and Diseases Act (COIDA) 1993 defines an accident as one that occurs during employment and results in personal injury, illness, or death (Department of Labour (DoL), 1993). However, the Federated Employer's Mutual Assurance Company (FEMA) has a slightly different definition, stating that an accident is an injury that occurs during work and has a specific date, time, and place (FEMA, 2015).

Accidents in the construction industry are a significant concern, with construction workers being six times more likely to be killed on the job than other employee types (Osei Kyei, 2012). Globally, an estimated 60,000 fatal accidents occur yearly, equivalent to one fatal accident every 10 minutes (Osei Kyei, 2012). In South Africa, the construction industry recorded 47 fatal accidents and 579 sustained injuries resulting in permanent disability, all in 2022 (FEM 2022). Given these statistics, it is important to examine how accident rates are recorded in South Africa for purposes of this study.

According to DoL statistics cited in cidb (2009), the number of registered construction accidents in South Africa increased over the years. In 2004/05, there were 224 accidents, which grew to 578 in 2007/08. From 2007 to 2010, the construction industry had 755 injuries and 171 fatalities (DoL, 2012). This trend is further corroborated by the FEMA statistics (2015), which show that the number of construction accidents remained relatively consistent from 2010 to 2015. Understanding

how accidents are defined and recorded in South Africa is vital for analyzing the frequency of accidents on construction sites. The available statistics highlight the significant number of accidents in the construction industry and the urgent need for improved safety measures.

2.2 Causes and Types of Accidents on Construction Sites

Accidents on construction sites in South Africa are common, with daily incidents requiring first aid treatment and more serious accidents occurring approximately twice a month (Othman and UKZN Research team, 2011). While most accidents are non-fatal, accounting for 68% of cases in 2008 (Smallwood et al., 2009), they can still result in injuries that range from minor to major, including fatalities (Mthalane et al., 2000; Othman and UKZN Research team, 2011).

The causes of these accidents can be classified into three main types: human, operational, and transport/equipment related (Othman and UKZN Research team, 2011, Umeokafor et al. 2014). Human factors such as fatigue, carelessness, ignorance, lack of training, lack of discipline, distraction, and poor communication contribute to accidents (Umeokafor et al. 2014). Operational factors include falls, being struck against objects, lifting and carrying, machinery and equipment failure or misuse, electricity-related accidents, transport-related accidents, and fire and explosions (Umeokafor et al. 2014). Transport and equipment-related accidents involve injuries to limbs due to the wrong manipulation of heavy equipment, electrocution, excavation collapse, injuries related to demolition works, carnage, heavy-lifting machinery, and violations of safety rules (Othman and UKZN Research team, 2011). It is important to identify the root causes of these accidents to prevent them from occurring in the future (Umeokafor et al. 2014). By understanding the factors contributing to accidents, construction sites can implement appropriate safety measures and training programs to mitigate the risks and ensure the well-being of their workers.

2.3 Mitigating Strategies

Umeokafor (2017) argues that compliance with OH&S regulations could indicate how well they control or eliminate hazards. The author suggests that safety inspections help to control and mitigate potential accidents. Accident prevention practices can focus on examining the OH&S measures/practices and policies including the Health and Safety (H&S) Policy, H&S Plan, OH&S Management System, H&S training, and use of Personal Protective Equipment (PPE) outlined in Table 12.1.

Table 12.1: Accident Mitigating Strategies sourced from Literature

Mitigating Strategies	Description	Reference
Health and Safety Policy	a written statement that shows the organization's commitment to maintaining a safe and healthy workplace. It should address all relevant health and safety requirements, comply with government legislation, and aim to protect employees from potential hazards.	South African Labour Guide (SALG) (2015)
Health and Safety Plan	a documented plan specific to a site, activity, or project. It addresses the hazards identified in the health and safety specifications and provides safe working procedures to mitigate or control them	CR (2014); SALG (2015)
Occupational Health and Safety Management System (OHSMS)	is part of the larger organizational management system and is used to establish policies and manage OH&S risks. It consists of various elements that help to implement and achieve OH&S objective	OHSAS 18001 (2007)
Health and Safety Training	improves employees' behaviors and address OH&S risks. The specific training requirements for the construction industry are not extensively studied in the literature. According to PwC (2014), adequate, appropriate, and effective training is crucial for ensuring safety on construction sites.	Robson et al. (2012), PwC (2014)

Personal Protective Equipment (PPE)	is the equipment worn or held by personnel to protect them from health and safety hazards. PPE is the last line of defense and can greatly impact the severity of accidents. It includes equipment for head protection, eye and face protection, hand and arm protection, foot protection, personal fall protection, hearing protection, and respiratory protection.	HSE (2005, 2006); Farooqui et al. (2009)
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The literature review suggests that implementing a comprehensive health and safety programme that includes a strong policy, effective planning, an OH&S management system, appropriate training, and the use of personal protective equipment can help mitigate and prevent accidents on construction sites. There is a paucity of research and literature available specifically on this topic in the South African context. Most of the information available are grey literature and unpublished research findings. Smallwood (2020) noted that there is an unhealthy culture in the construction industry and a pre-requisite for the realisation of optimum status for and focus on H&S are respect for people, values, H&S culture and competence, practices which can be enforced through regulations. Goldswain and Smallwood (2015) report on the development of an architectural design-oriented model which relies on the appropriate knowledge of architectural designers towards a reduction of construction hazards and risk, while van Heerden et al. (2017) found evidence for construction organisations to develop effective strategies to mitigate the occurrence of fatalities and deaths in the South African construction industry.

This chapter aims to fill the knowledge gap by examining accident-mitigating strategies and by so doing, contribute to the understanding and improvement of accident prevention and control in South African construction sites.

Research Methodology

This research employs a mixed methodology approach combining qualitative and quantitative methods. The research began with a literature search on the existing research on frequency, types and causes of accidents on construction sites and mitigating strategies. The literature search was conducted in Google Scholar, databases under the Elsevier family like ScienceDirect, Sage, JSTOR, EBSCOhost, Taylor & Francis, Emerald, and Wiley Online Library, among others. The retrieval was conducted by utilizing search terms and key phrases connected to the topic including "workplace accidents", "health and safety", "safety measures", "construction safety management", "occupational health and safety", "safety regulations", "safety training", "accident frequency", "Health and Safety Programme", "OH&S Plan", "Safety Inspection and "accident mitigation." Along with these, searches were conducted in the South African Department of Labour, Federated Employer's Mutual Assurance Company, and Construction Industry Development Board websites, since these provide grey literature that supplied contextual and sociotechnical aspects of the study.

Data sources for the research included documents, interviews, online surveys, and archival records (Yin, 1994). In the research, the Health and Safety Regulations were utilized as a benchmark to assess the necessary criteria for Health and Safety performance on the site. Additionally, the archival records found within the construction companies studied were examined to document the health and safety statistics of the projects, including the Number of Accidents, Time Frame, Number of Hours Worked, Number of Employees, and Number of Working Hours. The target population for this study is all building contractors in South Africa, while the study population is a group of individuals to which conclusions can be legitimately applied (Kazerooni, 2001).

The study focuses on building contractors due to their high involvement in the construction process. Contracting companies provide the main workforce and, hence, are the most vulnerable and exposed when it comes to OH&S on construction sites. The sample size was 617 contractors, randomly selected from the Professionals and Project Register in South Africa (population size =

1234) using a probability sampling technique where every alternate contractor in the database was selected. An online survey was chosen for this research due to its time efficiency, cost-effectiveness, and convenience (Leedy and Ormrod, 2005). A larger pool of respondents could be targeted quickly using the "Survey Monkey" platform. Online surveys also allowed respondents in the mobile construction industry to complete the survey in their offices at any time (Leedy and Ormrod, 2005).

A questionnaire was sent to the selected building contractors and 59 responses were received which represents a response rate of 9.72 %. It should be noted that some respondents skipped certain questions of the survey resulting in the changing numbers presented in the findings – 46 in Table 12.2 and 44 in Table 12.5. Semi-structured interviews were conducted to further validate the findings of the survey and the identified knowledge gap in the literature. Three semi-structured (face-to-face and email) interviews were conducted to accommodate the geographical limitations of the respondents and allow for time reflection and confidentiality. The interviewees were conveniently selected based on their roles and experiences in the field of OH&S.

The data collected was analysed using descriptive statistics more specifically, mean item score and thematic analysis. Mean item score is used as a measure of central tendency. A higher relevance rating indicates that the issue being considered is important and will fall within that range (Kwasi, 2012). The process of determining the accident frequency rate (AFR) in this research study involved survey questions, response collection, and the utilization of established constants to calculate the AFR. This methodology is crucial in analyzing and understanding the frequency of accidents within the context of the study. The determination of accident frequency rate (AFR) for this research study was based on data obtained from contractors in South Africa. The respondents provided accident frequency per 100,000 hours. The AFR determination process is explained in the subsequent sections.

Process 1: Stating the Constants

Several constants were established to ensure consistency and accuracy in the calculation of AFR. These constants included the following:

- Accident Frequency (α): The frequency of accidents reported by the respondents.
- Time Frame (\mathcal{U}): The specific time over which the accidents were recorded.
- Number of hours worked per year (μ): For the purpose of this study, a working year consists of 48 weeks of full-time employment, with an average of 45 hours worked per week. Thus, the number of hours worked was constant at 2160 hours.
- Number of employees (β): A total of 100 employees were considered for the calculation of AFR.
- Number of working hours: For the calculation of AFR, 100,000 working hours were considered.

The above constants were essential in formulating a standardized approach for determining the AFR in this research study.

Process 2: Calculation of Accident Frequency Rate (AFR)

Following the establishment of the constants, the AFR was calculated using the AFR determination process shown in Equation 1:

$$AFR = \frac{\alpha}{\mu \times \beta \times \mathcal{U}} \times 100,000$$

Equation 1

Confidentiality issues may have posed a limitation in this research. This is evidenced by a significant number of responses being skipped due to the sensitive nature of the questions, particularly in relation to the accident frequency on construction sites. Furthermore, considering that some questions directly impacted the organization's reputation, it is possible that respondents answered with apprehension due to concerns about how their answers could affect their reputation. It is worth noting that despite being constantly reminded about the highly confidential nature of the research, and the anonymity imposed by the ethical clearance received, this apprehension may have still influenced their responses.

Data Presentation, Analysis and Discussion

This section of the paper is divided into three main sections: data presentation, data analysis, and a discussion of the findings. The data presentation section presents the raw data gathered from an online survey in the form of tables and graphs. These tables and graphs provide a visual representation of the data and allow for easy interpretation by the reader.

4.1 Data Presentation

The background details of the respondents and companies are outlined in Table 12.2.

Table 12.2: Background details of respondents and companies

Designation of Respondents	Frequency	Percentage (%)
Director Cadre	19	41.30%
Executive Team	4	8.70%
Management	22	47.80%
Officers	1	2.20%
Total	46	100%

Table 12.2 shows that many respondents (89%) were from the Director Cadre or Management category, indicating that they hold high positions within their companies. Four respondents did not belong to any of these categories and were identified as Quantity Surveyors, Senior Safety Officers, Human Resource Officers, and OH&S Managers. Despite this, most of the respondents were placed in influential positions within their organizations, suggesting they possess valuable insights relevant to this study. However, while it can be argued that the data may be skewed to management and director level staff views, it must be noted that many of them would have started from non-management positions before the current ones.

The results also revealed that most respondents had between 11 and 15 years of experience in the construction industry, accounting for 30% of the total. This was followed by 6-10 years and over 25 years of experience, both with a share of 20%. Given that most respondents had more than 10 years of experience in the industry, it can be inferred that they would contribute valuable information to this study. The data collected also shows that the highest academic qualification for most respondents was matric. However, numerous responses were also recorded in the "others" category, which mainly referred to respondents holding diplomas as their highest level of academic achievement. These findings suggest that all respondents in the study possess a basic education that enables them to understand and respond appropriately to the study's questions.

4.1.1 Frequency of Accidents

The study sought to establish whether the respondent's organisation have records of accidents and injuries sustained on site and the frequency of accidents. Forty-five out of the 59 participants responded to the question as shown in Table 12.3.

Table 12.3: Accident Records

Availability of Accident Records	Frequency	Percentage (%)
Yes	39	86.70%
No	6	13.30%

Total	45	100%
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Table 12.3 shows that six of the respondents do not have accident records suggesting that accidents are not recorded which is not in adherence with OHSA requirements. Furthermore, it was found that of the 39 participants surveyed who indicated that their companies have records of accidents only 26 participants actually provided these accident records demonstrating the varying levels of sensitivity regarding the requested information. Based on the available information the accidents reported by nine participants ranged from 0 to 5 accidents per 100,000 hours, while 14 respondents recorded the accident using their own timeframe as shown in Table 12.4, also suggesting that accidents per 100,000 hours have not been recorded which is a requirement under the OSHA regulations.

Table 12.4: Accidents and Specified Time Frame

Respondent ID	No. of Accidents	Time frame
9	15	6 months
26	10	6 months
8	8	72 months
17	5	12 months
34	4	7 months
1	3	18 months
2	3	84 months
3	3	276 months
30	3	60 months (for 50 permanent labour)
36	2	12 months
43	2	12 months
31	1	60 months
35	0	12 months
38	0	60 months

Table 12.4 shows that out of the 14 respondents who provided data using their own time frame, only two respondents (Respondent ID 35 and 38) reported zero accidents on construction sites. This should be the expected result on construction sites. The remaining respondents reported accidents ranging from 1 to 15. A few key observations are the duration of accidents: The time frames provided range from 6 months to 276 months. The results suggest that the longer the time frame, the higher the number of accidents reported in general. This is evident from respondents such as Respondent ID 3, who reported 3 accidents over a period of 276 months, and Respondent ID 2, who also reported 3 accidents but over a period of 84 months.

Respondent ID 9 reported the highest number of accidents, with 15 incidents occurring over a 6-month period. Respondent ID 26 reported the second-highest number of accidents, with 10 incidents occurring over the same 6-month period. It was also observed that there were variations in accident numbers where respondents reported the same number of accidents, even though the time frames differ. For example, Respondent ID 8 and 17 both reported 8 accidents, but over different time frames of 72 months and 12 months, respectively. The data suggests that accidents on construction sites are not consistently zero and can vary significantly both in terms of the number of accidents and the time frame in which they occur.

4.1.2 Causes of Accidents

The study sought to know the causes of accidents on construction sites managed by the respondents. The data obtained in this regard is presented in Table 12.5.

Table 12.5: Causes of Accidents on Construction Sites

Causes of accidents	Rating Score					MIS	Rank
	1	2	3	4	5		
Failure to obey work procedure	3	9	15	9	8	0.51	1

Lack of safety equipment	17	16	5	2	3	0.51	1
Incorrect work procedure	3	17	16	4	4	0.48	3
Poor inspection programme	12	21	6	3	2	0.46	4
Negligence	4	7	19	11	3	0.45	5
Lack of training/induction to OH&S	13	19	6	4	2	0.45	5
Lack of skills/knowledge	7	14	15	4	3	0.44	7
Work at high elevation	13	11	14	4	2	0.43	8
Under the influence of drugs/alcohol	15	14	8	4	3	0.43	8
Equipment failure	11	17	14	0	1	0.43	8
Non-compliance to OH&S rules and regulations	9	11	14	10	0	0.41	11
Equipment not suitable for work done	14	19	9	0	2	0.40	12
Inadequate warning systems/signage	16	18	6	3	0	0.38	13
Excessive noise	21	11	10	2	0	0.37	14
Poor ventilation	23	12	6	2	1	0.35	15
Poor safety plan	19	17	5	2	0	0.35	15
Poor illumination	24	12	5	2	1	0.35	15

Key: MIS – Mean Item Score; 1 – Never; 2 – Rarely; 3 – Sometimes; 4 – Often; and 5 – Very Often

The following observations can be made from the data presented in Table 12.5. Failure to obey work procedure and Lack of safety equipment have the highest rating score of 0.51 and are ranked 1st. This suggests that these two causes are considered by the respondents to be the most significant in causing accidents on their sites. This is followed by incorrect work procedure, poor inspection program, negligence, and lack of training/induction to OH&S with rating scores of 0.48, 0.46 and 0.45 respectively. The respondents perceive excessive noise, poor ventilation, poor safety plan, and poor illumination with lower rating scores ranging from 0.35 to 0.37 as less significant in causing accidents. It is important for organizations to address the high-rated causes to minimize accidents and ensure workplace safety. The next section presents the data on the mitigating strategies used by the respondents in ensuring H&S.

4.1.3 Accident Mitigating Strategies used by Construction Companies

From the data provided and presented in Table 12.6, it can be observed that there are various key accident-mitigating strategies used by construction companies.

Table 12.6: Key Accident Mitigating Strategies used by Construction Companies

S/No	Accident Mitigating Strategies	Description
1	Personnel/Workers Union and Management Contribution	The respondents rated the contribution of different parties towards maintaining a safe workplace. The H&S Officer was found to contribute the most, followed by management and then the Workers Union. This suggests that OH&S professionals who are more knowledgeable about OH&S issues are more involved in maintaining a safe workplace.
2	Safety Awareness strategies and training	The respondents were asked about safety awareness strategies used by the companies. The strategies used comprised of OHS training, induction programs, policy statements, team meetings, mass communications, and informal meetings. The data shows that 97.8% of respondents provide health and safety training to their employees. The most important type of training provided is company safety rules and policies, followed by potential hazards, emergency procedures, PPE training, injury/illness procedures, and general rights and responsibilities.
3	Safety Inspections on Site	All the respondents who answered the question conducted safety inspections on-site, indicating that safety inspections are common in construction companies.

		The time period between successive safety inspections varied, with options ranging from one week to six months. The most common time periods indicated were between one and three months.
4	Accident Investigation on Site	Almost all respondents (97.9%) reported that accidents and dangerous occurrences are investigated on-site, indicating a proactive approach towards addressing accidents and preventing similar incidents in the future.
5	Remedial Actions Taken after Accident Investigation	After accidents have been investigated on-site, the most common remedial action taken by the respondents is to modify the OH&S plan for undergoing and future projects. A smaller percentage of respondents reported modifying the OH&S plan for future projects only.
6	Provision of Personal Protective Equipment (PPE)	All the respondents provide PPEs to their employees on-site. This indicates a high level of compliance towards the provision of PPE and Health and Safety. In terms of the type of PPE provided, foot protection ranks first with all respondents providing it, followed by hand protection (97.8%), eye protection (95.7%), head protection (95.7%), hearing protection (89.1%) and respiratory protection (78.3%). This suggests that construction companies prioritize the safety of their employees by providing a wide range of PPE.
7	Safety culture and practices	Most respondents agree or strongly agree that their organization allows employees to voice their safety concerns, incorporates safety into strategic planning, and prioritizes OH&S despite other organizational demands. This indicates a positive safety culture within these organizations.
8	Enforcement of compliance	The data shows that 93.2% of employees are willing to comply with the OH&S program of their organization, indicating a positive attitude towards safety.

The findings presented in Table 12.6 suggest that construction companies prioritize safety by conducting regular safety inspections, involving various stakeholders, and taking remedial actions based on accident investigations. The presence of dedicated H&S Officers and the involvement of management indicate a commitment by construction companies studied towards maintaining a safe workplace. Also, the data suggests that construction companies prioritize the provision of PPE, health and safety training, and enforcement of compliance with OH&S regulations. However, more emphasis must be placed on providing rewards and incentives for employee compliance towards continuous improvement of health and safety on construction sites.

4.2 Interview Findings

A series of interviews were conducted to validate the results and findings of the questionnaire. The interviews were conducted with professionals in the building industry through face-to-face and email methods. The views and opinions of the professionals were analyzed and summarized under common themes. The background of the three interviewees is presented in Table 12.7, including their roles and experience in the construction industry. Their background shows that they have the requisite experience to provide valid answers to address the research objectives.

Table 12.7: Background Details of the Interviewees

Interviewee	Role	Experience
1	Professional project manager specialized in OH&S and is serving as the head of OH&S and tender management department in a prominent contracting firm.	20 years
2	Health and Safety Officer who works in the H&S department of a medium building contracting firm. His job consist of making sure their procedures are in line with the H&S programme set by the organisation.	5 years
3	Professional registered Quantity Surveyor and is acting as the CEO of a contracting firm specialized in Civil and Mining works. He has managed OH&S from inception to client hand over.	18 years

The interview findings reveal several strategies for mitigating the frequency of accidents in the construction industry:

1. Address the unreliability of accident statistics: There is a general consensus among the interviewees that confidentiality issues and concerns about reputation hinder the collection and reporting of accident statistics. To overcome this obstacle, measures should be taken to ensure the confidentiality of accident data and to educate organizations on the importance of accurate reporting. Enforcement of reporting requirements by the Department of Labour (DoL) should also be improved.
2. Emphasize self-regulation: The interviewees believe that self-regulation is critical in improving OH&S in the construction industry. Companies should be encouraged to adopt self-regulation practices, but this may require training and a better understanding of the purpose of OH&S legislative requirements. The responsibility for ensuring adherence to health and safety procedures should lie with the contractors. However, larger contractors may have more resources and be better equipped to self-regulate than smaller ones.
3. Promote training and education: Training and education are seen as important factors in improving safety in the construction industry. Interviewees emphasize the need for training and planning to address mindset and human element issues that affect compliance with OH&S. The involvement of construction organizations that provide assistance to safety managers, as mentioned by interviewee 1, shows the importance of training and support from industry associations.
4. Outsourcing health and safety: Interviewee 3 suggests that outsourcing health and safety to specialized organizations could be a more effective solution, as they have more knowledge and expertise in this area. This approach may be particularly relevant for smaller contractors who may not have the resources to develop their own health and safety departments.

The interview findings highlight the importance of addressing confidentiality issues, promoting self-regulation, investing in training and education, and potentially outsourcing health and safety to improve safety outcomes in the construction industry which is consistent with findings obtained from the quantitative strand of the study on accidents and mitigating strategies that can be used in the construction industry for continuous improvement.

4. 3 Discussion of Findings

The study examined accident rates on construction sites in South Africa and found a mean accident frequency rate of 1.02 per 100,000 working hours. However, the reliability and accuracy of accident statistics were found to be prone to inaccuracies due to issues such as confidentiality, reluctance to disclose accidents, lack of enforcement, and resource-intensive reporting and recording processes (Sidumedi, 2009; cidb, 2009; Geminiani et al., 2008). These issues may contribute to underreporting of accident statistics.

The study identified two main factors contributing to compliance with OH&S on construction sites. The first factor is the mindset of contractors, with the organization's commitment towards internal cooperation being a highly ranked reason affecting contractors' mindset towards safety culture. This is consistent with the findings of Umeokafor (2017) where there is evidence of lack of organisational commitment to comply with health and safety regulations resulting in it being secondary. However, some of them will go above the local standards and expectations and adopt regulations from abroad and comply due to the associated benefits such as advantages in procurement with international clients/projects (Umeokafor 2017). The second factor is the human element, with failure to obey work procedures identified as the highest-ranking contributing issue to poor compliance. Studies such as Choudhry (2014) offer a treatise on the human element (behavioural safety) issues in health and safety in construction, detailing designed intervention and measurements to address them. The implications include that significant involvement of workers in the design and implementation of the measures. However, the study's findings were inconclusive in establishing a causal link between human elements and accidents (Scharer, 2011). Additionally, the interviews revealed that OH&S managers oversee the compliance to Health and

Safety requirements and take responsibility for accident frequency rates, supporting the idea that internal monitoring can be used in achieving continuous improvement in construction health and safety practices.

The findings indicate that the contractors are overly dependent on reactive or active strategies for accident management. They include conducting regular safety inspections, involving various stakeholders, and taking remedial actions based on accident investigations. Other include the provision of PPE, health and safety training, and enforcement of compliance with OH&S regulations. While these can be effective to some extent, using the reactive ones means that organisations 'play catch-up' and this may be late. The active one may be effective but not always efficient. Consequently, more attention needs to be on proactive measures, especially those that occur at the pre-construction stage of the projects, for example, design for safety (Umeokafor et al. 2022) or design for maintenance. Design for safety has been found as one of the most effective ways of preventing accidents throughout the project's lifecycle including during construction (Toole and Erger, 2018). In design for safety, anticipated H&S risks or hazards in the construction process, operation and decommissioning of construction projects are designed out at the pre-construction stage (Umeokafor et al. 2021).

The findings of this study conducted in the South African construction industry indicate a high prevalence of workplace accidents in the construction industry. A study conducted by the ILO (2015) in India and Bangladesh indicated a high frequency of accidents attributed to factors like lack of safety awareness, non-compliance with safety procedures, inadequate safety equipment, and a weak safety culture mirroring findings from South Africa. However, it is crucial to note the divergences based on socio-economic conditions, regulatory frameworks, safety cultures, and job nature present in these countries when compared to a South African context. These differences, however, further underline the necessity of standardized health and safety policies, effective training interventions, and robust enforcement mechanisms to curtail high accident rates.

The mitigation strategies deduced from this study could be beneficial for countries like India, Bangladesh, and others grappling with occupational safety challenges. For example, South African contractors' practice of mitigating accidents by allocating enough resources to health and safety initiatives can be emulated by construction stakeholders in other developing countries. Moreover, cultivating a culture of self-regulation in line with employees' safety rights, stakeholder engagement in safety planning and implementation, and outsourcing H&S to specialized organizations could provide remedies.

Conclusions

This chapter examines the frequency and causes of accidents in the South African construction industry and propose strategies for mitigating these accidents. The study's findings suggest that accidents on construction sites in South Africa are still prevalent, and poor compliance with health and safety regulations remains a key issue. Lack of safety equipment, failure to obey work procedures, and poor inspection programs were identified as major causes of accidents. The study posits that without appropriate mitigating strategies that address the causes of the accidents, the number of accidents will continue to rise in construction. However, these measures must be proactive and must start at the pre-construction stages of the project.

To mitigate these accidents, the chapter recommends that construction companies should prioritize implementing a comprehensive health and safety program that includes a strong policy, effective planning, an OH&S management system, appropriate training, and the use of personal protective equipment. Companies should also promote self-regulation, invest in training and education, and consider outsourcing health and safety to specialized organizations. Further, integrating health and safety at the early stages of the projects, for example, at the pre-construction stage through design for safety is recommended.

The contextual findings from this study in the South African construction industry may have certain unique aspects, due to specific local cultural, economic or regulatory environments. The findings and recommendations would thus, require careful interpretation and contextualization when applied to other construction industries. For example, the effectiveness and manner in which health and safety regulations are enforced could be contingent on a nation's legal and policy framework and its construction industry. Similarly, factors like labour relations, work culture and attitudes towards health and safety might also influence practical strategies for mitigating accidents.

However, the key findings and practical strategies suggested for mitigating accidents on construction sites, such as the significance of adhering to work procedures, the negative impact of negligence, and incorrect work procedures, and the importance of allocating resources to health and safety programmes and safety inspections, can indeed be generalised and applicable to the construction industry globally. These are common aspects of safety management and accident prevention which have universal relevance. The suggestion for more proactive strategies for accident prevention, like integrating health and safety at the pre-construction stage, is also a strategy that can be adapted to any construction site, irrespective of geographical location or culture.

There are however limitations to this study. The sample size used in the study, especially for the semi-structured interviews, was quite limited. Given this constraint, the findings should be generalized to all construction industry stakeholders with caution. Furthermore, the respondents were mainly directors or managers so their viewpoints may not necessarily reflect the perspectives of frontline workers who may be directly involved in accidents. The reliability and accuracy of accident statistics in the construction industry are prone to inaccuracies due to issues such as confidentiality and underreporting. Future research should address these limitations and could aim to explore a larger, more diverse sample size with varied roles in the construction industry, explore further strategies to improve health and safety in the construction industry, such as the use of technology and the involvement of industry associations. Emerging technologies such as artificial intelligence, drone technology, or virtual reality training could revolutionize safety procedures and significantly reduce accident rates. Simultaneously, more emphasis could be placed on understanding the socio-cultural dynamics of construction workers, which could further highlight the underlying reasons for poor compliance with safety regulations.

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