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EARLY VIEW

BARRIERS TO INCIDENT REPORTING IN THE PAKISTANI CONSTRUCTION INDUSTRY: AN EXPLORATORY FACTOR ANALYSIS APPROACH

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ABSTRACT

The construction industry is amongst the most hazardous industries, with workers routinely involved in critical accidents. Following proper safety procedures can help to reduce these accidents. Incident reporting is widely regarded as an effective approach to improving worker safety on construction sites as it allows relevant stakeholders to learn from past events. Despite the acknowledged significance of incident reporting in reducing accident rates, several researchers have reported that the construction industry still lacks effective reporting and investigation practices. This study aims to explore the barriers that inhibit the reporting of incidents in the construction industry of Pakistan. Through a detailed literature review, 29 barriers that inhibit effective incident reporting were identified. A questionnaire survey was then carried out to include the perspective of construction industry professionals on the identified barriers. A total of 214 responses were collected. Further, for dimension reduction, exploratory factor analysis was utilized, resultantly four components were revealed and discussed. These components include organizational, individual, environmental, and technical. The findings of this study will help the relevant construction industry stakeholders in improving safety performance by mitigating these reporting challenges at the construction sites, resulting in a better working environment for workers with fewer risks and accidents.

Keywords: Barriers; Incident Reporting; Construction Industry; Exploratory Factor Analysis; Safety

1. INTRODUCTION

Safety records of the construction industry indicate poor performance worldwide owing to recurring accidents involving near-miss, work-induced health issues, injuries, and fatalities (Choudhry and Zahoor, 2016; Chigara and Moyo, 2022). Workplace safety has become a prominent issue for many organizations due to the consequences resulting in an unsafe environment, affecting productivity and harming the health of the workforce (Singh and Misra, 2021). According to the International Labor Organization (ILO), each year, approximately 2.78 million people lose their life due to work-related accidents and occupational diseases across the globe (ILO, 2018). Moreover, it has been estimated that the number of incidents and illnesses per year is 374 million, which results in employees being absent from work for extended durations (ILO, 2018). The situation is particularly severe in the construction industry, where accidents occur at a substantially higher rate than in other industries (Singh and Misra, 2021). The findings of Umar (2019) highlighted that the accidents are caused by a variety of reasons, including; the unique nature of the construction industry, inadequate understanding of safety regulations, failure to implement safety protocols, recruiting unskilled employees, construction machinery/equipment failure, stress including physical & emotional, and reckless human behaviors. Causes of accident in the construction industry have remained a popular topic for researchers working in the domain of construction management. One possible explanation for this growing trend in research is that this realm is perceived to significantly impact the reduction of accidents based on which the management develops effective strategies on how to avoid the reoccurrence of accidents in their future projects (Umar, 2019). To establish an accident prevention strategy for a construction project, it is required to first understand the prevailing underlying root causes of existing incidents and accidents (Cermelli *et al.*, 2019). Effective safety management is based on feedback from field experiences, a process by which knowledge about the

consequences of an action is communicated back to policymakers as new input to change and improve subsequent operations (Sandberg and Albrechtsen, 2018). In addition, it is believed that paying attention to the underlying factors will be required for long-term improvements in sustainable construction practices (Al-Aubaidy, Caldas and Mulva, 2022).

The approach of incident reporting has been extensively employed in various sectors, such as nuclear energy, aviation, and petrochemical industry. These sectors have developed a tradition of effective safety management, having numerous incident reporting systems established for advanced reporting of critical incidents (Jones, Kirchsteiger and Bjerke, 1999; Saurin *et al.*, 2015). Moreover, literature has also highlighted successful incident-reporting initiatives in other industries, including construction and healthcare (Cambraia, Saurin and Formoso, 2010; Saurin *et al.*, 2015; De Silva, Rathnayake and Kulasekera, 2018). These reporting systems are intended to gather, process, and distribute data from a wide variety of safety-related incidents, particularly those regarded as precursors to accidents, such as near-misses (Reason, 2016). The data collected helps in identifying the root causes of incidents and consequently strengthening the safety culture by taking necessary preventive measures (De Silva, Rathnayake and Kulasekera, 2018).

Incident reporting within an organization is the first step towards learning and critical analysis of events, ensuring that all necessary safety measures are in place to prevent their reoccurrence (Chigara and Moyo, 2022). Despite the acknowledged benefits of incident reporting in successfully eliminating the rate of critical occurrences, the under-reporting phenomenon has been amply highlighted in the empirical literature (Probst and Estrada, 2010; Probst and Graso, 2013; De Silva, Rathnayake and Kulasekera, 2018; Al-Aubaidy, Caldas and Mulva, 2022). It has been found that organizations with unsatisfactory safety culture failed to report more than 80% of accidents to the Occupational Safety

and Health Administration (OSHA), whereas companies with a favorable safety environment failed to report 47% of such incidents in the USA (Naji *et al.*, 2021). Similarly, it has also been reported that employees failed to report over half of all experienced accidents to their supervisors (De Silva, Rathnayake and Kulasekera, 2018). The under-reporting phenomenon is far worse in developing countries, where incident reporting in the construction industry is not taken seriously even though occupational exposure to hazards is very high. Most of the tasks are performed manually, and record-keeping is of poor quality when measured against international standards (Abukhashabah, Summan and Balkhyour, 2020).

The investigation of the barriers that potentially inhibit the reporting of safety incidents in an organization is crucial for the successful implementation of safe working environments. Various studies have already established the importance of incident reporting systems to improve worker safety and the need to understand the resistance of potential users (Al-Rayes *et al.*, 2020; Maslen *et al.*, 2020; Abu Alrub *et al.*, 2022). However, the theoretical explanation of end-users resistance towards effective incident reporting in the construction industry of developing countries is in dire need of further exploration. To fill this research gap, the present study aims to explore and identify the barriers inhibiting the effective reporting of incidents at construction sites in the context of developing countries like Pakistan and to determine whether the identified barriers may be further classified into closely related components. The following research question will be investigated in this study: What are the primary barriers inhibiting the efficient usage of incident reporting systems at construction sites in developing countries? The outcomes of this study will guide the relevant stakeholders in taking necessary actions to mitigate the barriers to the effective reporting of incidents.

2. CONSTRUCTION INDUSTRY IN PAKISTAN

The construction industry in Pakistan has experienced rapid growth in the past decade, mainly attributable to the democratic setup and consistent government policies (Hasnain, 2018). However, compared to developed countries, such as the United States, the construction practices in Pakistan are deemed more labor-intensive (Choudhry and Zahoor, 2016; Khan *et al.*, 2019). Fluctuations in demand, the project base of construction, and the widespread use of multi-level sub-contracting arrangements all conspire to make it difficult for construction laborers to get a consistent flow of work that would allow them to provide continuity of employment (Kanaganayagam, Ogunlana and Fung, 2013). Consequently, with rising inflation and poor economic conditions, workers migrate within the country for better employment opportunities, thus forming a mix of diverse groups at construction sites with different languages and cultural backgrounds. Excavation labor is often supplied from the province of Khyber-Pakhtunkhwa, concrete laborers from the Punjab province, and carpenters from the Kashmir region (Choudhry and Zahoor, 2016). Since the construction sector is in the developing stage it requires the adoption of several standard practices to compete with the international market. In Pakistan, the prevailing occupational health and safety standards are regulated by the Factories Act of 1934, the Minimum Wage Ordinance of 1961, and the Workmen's Compensation Act of 1923 (Choudhry and Zahoor, 2016; Raheem and Issa, 2016). These state laws, which are not specific to the construction sector, are primarily concerned with the occupational health and safety of factory workers (Memon *et al.*, 2017). Subsequently, the magnitude and severity of accidents emerging on construction sites are rising at an alarming rate. The accurate documentation of incidents is deemed challenging due to insufficient reporting and further manipulation of work-related accidents and illnesses (Saqib *et al.*, 2023). However, the Pakistan Bureau of Statistics (2017-2018) reported that construction injuries and fatalities accounted for around 17.27% of total labor force injuries

and fatalities, although construction workers comprise only 7.61% of the overall labor force (Pakistan Bureau of Labor Statistics, 2017). Raheem and Issa (2016) observed that the majority of construction accidents are not reported to the Labor Department due to a lack of enforcement of existing labor laws and seriousness on the part of the construction organizations in dealing with the grave health and safety situation. Typically, only casualties or dangerous occurrences that garner media attention are documented. As a result, it appears unlikely that accessible occupational health and safety data would be trustworthy (Raheem and Hinze, 2012; Raheem and Issa, 2016; Abdul Momeet, Nafees Ahmed Memon, Saeed Nazeem and Jamali, 2022).

The construction industry contributes significantly to the gross domestic product (GDP) in both developed and developing countries; however, the negative impact of occupational safety and health performance on the working population is quite evident (Singh and Misra, 2021). Organizations dealing with safety and health, such as HSE (UK), OSHA (USA), and Safe Work (Australia), play a substantial role in driving a country's safety and health performance. These administrations become the primary source of health and safety statistics reflecting the industry's safety record. However, there are no such organizations in developing countries like Pakistan. Even if such groups exist, they are either not fully functional or are not functioning properly, thus making it one of the most pressing issues in this region, as emphasized by Umar and Wamuziri (2016). The only regulating authority, the Pakistan Engineering Council (PEC), has yet to issue regulatory standards for construction industry stakeholders to comply (Hasnain, 2018). Due to the presence of a weak administrative framework, the safety of workers is not the main objective of the construction industry (Raheem and Issa, 2016). Additionally, the private sector dominates the construction industry in Pakistan, and due to inadequate technical and financial resources, poor working environments are quite prevalent (Hinze, Devenport and Giang, 2006; Ejaz *et al.*, 2013; Farooq *et al.*, 2022). Likewise, the construction industry of

Pakistan has adopted a responsive strategy rather than a pre-emptive strategy toward the safety of millions of workers at construction sites (Khan *et al.*, 2019).

This is not to imply that Pakistan is not advancing in the field of infrastructure development. The country is now witnessing enormous infrastructure growth, with various development projects ongoing and several projects in the planning phase. Example of these infrastructure projects includes buildings, motorways, highways, dams, underpasses, flyovers, water supply systems, interchanges, and rapid mass transit systems (Hali, Shukui and Iqbal, 2015). Furthermore, the economic cooperation between China and Pakistan with Chinese investment in Pakistani infrastructural growth has further helped in bringing a new perspective to the Pakistani construction industry. These ventures provide Pakistan with a prospect for global recognition; however, concerns such as safety should first be addressed for the quality provision of construction projects (Khahro *et al.*, 2021).

3. INCIDENT REPORTING AND RELATED BARRIERS

Incident reporting is defined as an approach to preventing future hazardous incidents and accidents by learning from past events (Rossignol, 2015). In almost all countries, employees are required to report work-related injuries to their employers, for recording and processing incidents with relevant government authorities (De Silva, Rathnayake and Kulasekera, 2018). According to the "iceberg principle" on the correlation between various types of accidents and near misses, for every major accident that occurs, a large number of related minor injuries and near misses occur (De Silva, Rathnayake and Kulasekera, 2018). The benefits of collecting and analyzing near-misses are explicit because they provide free lessons (Reason, 2016). If the appropriate conclusions are reached and followed, they can operate as "vaccinations" to stimulate the system's defense against a more significant event in the future, and, just like effective vaccines, they are expected to do so without harming anything or anyone. Further, they offer qualitative acumen into how minor defensive

deficiencies might pile up to cause huge tragedies (Stanton *et al.*, 2009). Because they occur more frequently than adverse consequences, they provide the numbers needed for more in-depth quantitative evaluations. Moreover, they also serve as a strong warning of the system's flaws, slowing the process of acute calamity. As Gnoni and Saleh (2017) stated, learning from near-misses is less expensive than learning from well-grown more damaging analogs, such as accidents.

Several researchers have worked to mitigate the barriers to effective incident reporting. One of the challenges they observed with cognitive processing of accidents was that information might be filtered selectively before being transferred to higher echelons aimed at minimizing liabilities and blame concerns. The attribution of responsibility to the reporter was also cited as a factor hindering the sharing of information in the filter model proposed for incident reporting (Webb *et al.*, 1989). Similarly, Elwell (1995) argued that crew members of the flight might be too guilty to confess their faults or expect to be penalized, explaining his discovery that human errors, particularly when others have not noticed these, are miss reported in aviation reporting systems. Likewise, in his discourse of factors that could stimulate individuals' adoption of their organization's health and safety culture, and hence the desire to give to the organization's reporting system, O'Leary (1995) mentioned the fact that legal pronouncements have frequently ignored circumstances resulting in poor performance; that society puts pressure to level allegations and punishments; the military culture in the aviation industry; and the fact that many pilots feel responsible or even guilty for incidents. In line with this, Bridges (2000) claimed that fear of punitive action and teasing by fellow employees are among the key reasons for poor reporting, based on survey results conducted among safety managerial staff of chemical process plants. Furthermore, the firm expresses concern about potential accountability if the reporting systems are manipulated by outsiders as a possible deterrent against reporting of safety

incidents. When this anxiety is communicated to the workers, whether explicitly or implicitly, their willingness to participate suffers badly (Bridges, 2000).

It has been discovered that mishaps might be viewed as "part of the job" due to their frequent occurrence, and workers may have developed their interim guards against it (Powell, 1972). Moreover, according to Glendon (1991), the "macho" work climate observed in some industries, such as construction, impeded reporting. Dominant societal views on which certain dangerous occurrences are considered acceptable were also cited as an essential element in reporting behavior (Webb *et al.*, 1989).

Additionally, (Beale, Leather and Cox, 1994) indicated that management's alleged attitudes have a large impact on reporting levels, especially their lack of commitment to the reporting of safety incidents. In line with this, a study (Van der Schaaf, Lucas and Hale, 1991) claimed that organizational safety culture and related management approaches influence the forms of near misses being reported. Chemical plant safety personnel cited a lack of management commitment and an inability to follow through after incidents are reported as causes for inadequate reporting practices (Bridges, 2000). It is also found that people quickly become dissatisfied with incident reporting when they observe that management does not review and appreciate their reports; and that the reporting rate further suffers when those to whom one must report do not acknowledge the job of the people engaged in the occurrences (Powell, 1972). A recent study conducted in the Sri Lanka construction industry highlighted numerous organizational and individual barriers and stressed the need for training and resources for effective reporting of incidents (De Silva, Rathnayake and Kulasekera, 2018). Similarly, the latest research (Al-Aubaidy, Caldas and Mulva, 2022) identified various barriers, including fear of litigation, fear of negative publicity exposure, high insurance, and other effects of internal and external behaviors and practices.

All the research studies mentioned above have assessed barriers to incident reporting in various regional settings and industry sectors; it is, therefore, vital to identify the barriers to effective incident reporting concerning the construction industry of Pakistan. This study's methodology is a quantitative research design, which will be detailed further in the subsequent section.

4. METHODS

This study employs a quantitative approach to determine the most crucial barriers/hindrances to effective incident reporting in the Pakistani construction industry. The research data was gathered in two stages: in the first stage, a detailed literature review was carried out followed by a survey questionnaire. At the literature review stage, the barriers influencing the effective reporting of incidents in the construction industry were identified. A systematic literature review process was undertaken to use articles with high quality and relevance to this study. The literature review was conducted using several search engines, including Google Scholar, Web of Science, and the HEC Digital Library, which proved to be highly beneficial. As part of the initial search criteria, no restrictions on the year of publication were applied. The keywords used were: “reporting barriers”, “reporting behavior”, “reporting tendencies”, “reporting biases”, “near-miss report”, and “incident reporting”. The search yielded 57 studies, which included journal articles, conference papers, and reports. However, following the exclusion of irrelevant and low-quality studies, a set of 27 publications were chosen for barrier identification. The investigation of these research publications led to the identification of 29 barriers inhibiting the effective reporting of incidents (see **Table 1** for details).

Table 1: List of variables affecting the incident reporting used in the questionnaire.

Variable no.	Variable Name	References
BIR 01	Existence of strict disciplinary action	(Mitropoulos, Abdelhamid and Howell, 2005; Riege, 2005; Saurin <i>et al.</i> , 2015; Viby Indrayana <i>et al.</i> , 2020; Abu

		Alrub <i>et al.</i> , 2022)
BIR 02	Acceptance of some hazards as part of routine work	(O'Leary, 1995; Van Der Schaaf and Kanse, 2004; Haslam <i>et al.</i> , 2005; Mitropoulos, Abdelhamid and Howell, 2005; Sanne, 2008; Saurin <i>et al.</i> , 2015) (Riege, 2005; Storgård <i>et al.</i> , 2012; Gnoni and Saleh, 2017; Maslen <i>et al.</i> , 2020; Umeokafor, Evangelinos and Windapo, 2020; Al-Aubaidy, Caldas and Mulva, 2022)
BIR 03	Job insecurity and fear of job loss	(Ortega, 2000; Van Der Schaaf and Kanse, 2004; Rossignol, 2015; Saqib <i>et al.</i> , 2023)
BIR 04	Lack of management commitment to report incidents	(O'Leary, 1995; Bridges, 2000; Umeokafor, Evangelinos and Windapo, 2020; Abu Alrub <i>et al.</i> , 2022)
BIR 05	Lack of trust in the anonymity of the reporting system	(Mitropoulos, Abdelhamid and Howell, 2005; Storgård <i>et al.</i> , 2012; Gnoni and Saleh, 2017; Viby Indrayana <i>et al.</i> , 2020)
BIR 06	Lack of knowledge about reporting requirements	(Pransky <i>et al.</i> , 1999; Azaroff, Levenstein and Wegman, 2002)
BIR 07	Focus on keeping the company's "accident-free record"	(Pransky <i>et al.</i> , 1999; Van Der Schaaf and Kanse, 2004; Umeokafor, Evangelinos and Windapo, 2020)
BIR 08	Fear of separation from co-workers	(Probst and Graso, 2013; Saurin <i>et al.</i> , 2015; Gnoni and Saleh, 2017; Sandberg and Albrechtsen, 2018; Viby Indrayana <i>et al.</i> , 2020; Al-Aubaidy, Caldas and Mulva, 2022)
BIR 09	Incentives to achieve zero-accident targets	(O'Leary, 1995; Haslam <i>et al.</i> , 2005; Mitropoulos, Abdelhamid and Howell, 2005; Saurin <i>et al.</i> , 2015; Oswald, Sherratt and Smith, 2018; Sandberg and Albrechtsen, 2018; Abu Alrub <i>et al.</i> , 2022)
BIR 10	Reporting Procedure is not appropriate and time-consuming	(Probst and Estrada, 2010; De Silva, Rathnayake and Kulasekera, 2018)
BIR 11	Production pressure	(Ortega, 2000; Winsvold Prang and Jelsness-Jørgensen, 2014; Saurin <i>et al.</i> , 2015; Umeokafor, Evangelinos and Windapo, 2020; Abu Alrub <i>et al.</i> , 2022)
BIR 12	Lack of feedback on how information reported has been used	(Bridges, 2000; Haslam <i>et al.</i> , 2005; Mitropoulos, Abdelhamid and Howell, 2005; Umeokafor, Evangelinos and Windapo, 2020; Al-Aubaidy, Caldas and Mulva, 2022)
BIR 13	Fear of legal consequences and investigations	(Haslam <i>et al.</i> , 2005; Mitropoulos, Abdelhamid and Howell, 2005)
BIR 14	Fear of negative publicity exposure	(Bridges, 2000; Gnoni and Saleh, 2017; Sandberg and Albrechtsen, 2018; Al-Aubaidy, Caldas and Mulva, 2022)
BIR 15	Short-term contract engagement including subcontracting	

BIR 16	Confusion regarding what is reportable	(Elwell, 1995; Saurin <i>et al.</i> , 2015)
BIR 17	Lack of training and instruction	(Azaroff, Levenstein and Wegman, 2002; Lingard, 2013)
BIR 18	Feelings of being misunderstood or undervalued	(O'Leary, 1995; Van Der Schaaf and Kanse, 2004; Riege, 2005)
BIR 19	Resistance in future employment or career progression opportunities	(Saurin <i>et al.</i> , 2015; Viby Indrayana <i>et al.</i> , 2020)
BIR 20	Fear of being assigned to lighter jobs that workers disliked	(Azaroff, Levenstein and Wegman, 2002; Lingard, 2013)
BIR 21	Insufficient information to complete the required formalities	(Pransky <i>et al.</i> , 1999; Van Der Schaaf and Kanse, 2004; Riege, 2005)
BIR 22	Different cultural, ethnic, and language background	(O'Leary, 1995; Riege, 2005)
BIR 23	Lack of safety communication in the organization	(Bridges, 2000; Lingard, 2013; Rossignol, 2015; Sandberg and Albrechtsen, 2018; Al-Aubaidy, Caldas and Mulva, 2022)
BIR 24	Considering reporting an incident a sign of weakness - Men perspective	(Azaroff, Levenstein and Wegman, 2002; Lingard, 2013)
BIR 25	Lack of rewards for effective reporting of incidents	(Ortega, 2000; Van Der Schaaf and Kanse, 2004; Lingard, 2013; Saqib <i>et al.</i> , 2023)
BIR 26	High insurance costs	(Mitropoulos, Abdelhamid and Howell, 2005; Gnoni and Saleh, 2017; Al-Aubaidy, Caldas and Mulva, 2022)
BIR 27	Fear of teasing by co-workers	(Elwell, 1995; Bridges, 2000)
BIR 28	Unwarranted surveillance	(Elwell, 1995; Lingard, 2013)
BIR 29	Individuals wish not to appear incompetent	(Bridges, 2000)

Based on the barriers identified, a questionnaire was developed and distributed to consultants, project managers, employers, and contractors actively involved in the construction practices to include input based on their experience. The questionnaire was divided into three sections. In the first section, gratitude was expressed for the participants' willingness to take part in the experiment, and information about the study was briefly presented. The respondents were ensured that personal details would be kept in the strictest confidence and individual names or job descriptions would not be disclosed in the study. In the second section, demographic-related questions were asked regarding participants' age, work sector, education level, and work experience. In the third section, respondents were asked to rate the influence of identified barriers.

A five-point Likert-type scale anchored from “1 = not influential at all” to “5 = very influential” was used in the questionnaire. The study targeted experts working in diverse domains including clients, contractors, and consultants through online means whereby a questionnaire was sent to them in English. Professionals were identified via simple random sampling. Moreover, there are no limitations on the size or type of construction organization. A total of 214 survey responses were gathered. Among these responses, only 197 were found suitable, whereas the remaining 17 were excluded due to incomplete or repetitive response patterns. In total, 92% of the responses (197/214) were eligible for further analysis. The demographic profile of the study respondents is shown in **Table 2**. A total of 83% of the respondents had more than six years of work experience; the majority of the respondents (49%) had bachelor's degrees and around 53% of respondents were from the private sector.

Table 2: Respondents' demographic characteristics.

Variables	Frequency	Percentage (%)
Gender		
Male	168	85.3
Female	29	14.7
Age Group		
20-29	45	22.8
30-39	62	31.5
40-49	76	38.6
50 years and above	14	7.1
Education Level		
Diploma	35	17.7
Bachelors	97	49.3
Masters	54	27.4
Doctorate	11	5.6
Work Experience		
1-5	34	17.3

6–15	65	33.0
16–25	59	30.0
>25	39	19.7
Work sector		
Public	73	37.1
Private	105	53.3
Other	19	9.6

5. STATISTICAL DATA ANALYSIS

To summarize the number of barriers inhibiting the effective reporting of safety incidents in the Pakistani construction industry and to extract the related components, the statistical technique of exploratory factor analysis (EFA) had been used. The reason behind employing EFA is that it reduces the size of a data set to improve interpretability and uncover hidden data structures while maintaining the highest amount of original information (Mosly, 2020). When a scholar is uncertain about which, or how many, latent constructs can explain the initial collection of data, the term “exploratory factor analysis” is employed (Hinton, McMurray and Brownlow, 2014). SPSS version 26 was used to perform the analysis. To check the internal consistency of the responses obtained through the questionnaire survey, Cronbach’s coefficient alpha method was adopted. The recommended threshold value of Cronbach’s alpha must be greater than 0.7 to be considered acceptable (Cronbach, 1951). The collected data had a value of 0.912, which indicated the data was reliable and consistent. Before running the EFA, two key tests were performed: the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett’s test of sphericity as indicated in **Table 3**. The value for KMO is 0.873, which is well above the recommended threshold of 0.5 (Babalola and Harinarain, 2022). Furthermore, Bartlett’s test of sphericity was also observed to be 2737.429, with a significance level of 0.000. Hence, indicating the suitability of data for further factor analysis.

Table 3: KMO and Bartlett's test.

Kaiser-Meyer-Olkin measure of sampling adequacy.		0.873
Bartlett's test of sphericity	Approx. Chi-square	2737.429
	df	406
	Sig.	0.000

The communality of the variables post-extraction can be observed in **Table 4**, demonstrating that none of the retrieved items have eigenvalues below the cut-off mark of 0.50, confirming that all variables are eligible for further analysis and processing (Babalola and Harinarain, 2022).

Table 4: Communalities.

Communalities	Initial	Extraction
BIR 01 Existence of strict disciplinary action	1.000	0.806
BIR 02 Acceptance of some hazards as part of routine work	1.000	0.810
BIR 03 Job insecurity and fear of job loss	1.000	0.699
BIR 04 Lack of management commitment to report incidents	1.000	0.775
BIR 05 Lack of trust in the anonymity of the reporting system	1.000	0.792
BIR 06 Lack of knowledge about reporting requirements	1.000	0.743
BIR 07 Focus on keeping the company's "accident-free record"	1.000	0.778
BIR 08 Fear of separation from co-workers	1.000	0.844
BIR 09 Incentives to achieve zero-accident targets	1.000	0.565
BIR 10 Reporting Procedure is not appropriate and time-consuming	1.000	0.786
BIR 11 Production pressure	1.000	0.798
BIR 12 Lack of feedback on how information reported has been used	1.000	0.722
BIR 13 Legal consequences and investigations	1.000	0.760
BIR 14 Fear of negative publicity exposure	1.000	0.561
BIR 15 Short-term contract engagement including subcontracting	1.000	0.681
BIR 16 Confusion regarding what is reportable	1.000	0.879
BIR 17 Lack of training and instruction	1.000	0.810
BIR 18 Feelings of being misunderstood or undervalued	1.000	0.833
BIR 19 Resistance in future employment or career progression opportunities	1.000	0.800
BIR 20 Fear of being assigned to lighter jobs that workers disliked	1.000	0.853
BIR 21 Insufficient information to complete the required formalities	1.000	0.859
BIR 22 Different cultural, ethnic, and language background	1.000	0.827
BIR 23 Lack of safety communication in the organization	1.000	0.694

BIR 24	Considering reporting an incident a sign of weakness – Men perspective	1.000	0.779
BIR 25	Lack of rewards for effective reporting of incidents	1.000	0.718
BIR 26	High insurance costs	1.000	0.638
BIR 27	Fear of teasing by co-workers	1.000	0.743
BIR 28	Unwarranted surveillance	1.000	0.794
BIR 29	Individuals wish not to appear incompetent	1.000	0.798

Note: Extraction Method: Principal Component Analysis.

Principal component analysis with varimax rotation was used to extract the components. This strategy can aid in the formation of a simple structure by reducing the likelihood of a 'general' component in the solution (Chan, 2012). The number of factors to be extracted from the data set was calculated using Eigenvalues ≥ 1 and an absolute factor loading value ≥ 0.6 (jadidoleslami, Saghatforoush and Zare Ravasan, 2021). The variables demonstrating cross-loading capabilities, however, were removed from further analysis because they are not uniquely identified under a noted component.

6. DISCUSSION

The exploratory factor analysis formed four components that emerged as dominating factors inhibiting the effective reporting of incidents at construction sites in Pakistan. A total of 68.15% of the total variation was explained by this four-factor component solution. The first component accounted for 29.92% of the total variance, whereas the second component accounted for 18.12% variance. Moreover, the third and fourth components explained 10.64% and 9.46% variance respectively. The results can be seen in **Table 5**. The total variation explained is greater than the minimum suggested percentage of 50% (Pallant, 2013; Babalola and Harinarain, 2022). Finally, the components have been given short labels to reflect the correlation of all the variables contained within. Referring to the opinions of the academic experts, the labels assigned to the four components were as; 'organizational', 'individual', 'environmental', and 'technical' (**Table 6** displays the final results with specified labels).

Table 5: Summary of exploratory factor analysis results.

	Component			
	1	2	3	4
Lack of management commitment to report incidents	0.87			
Lack of feedback on how information reported has been used	0.85			
Existence of strict disciplinary action	0.83			
Lack of safety communication in the organization	0.79			
Focus on keeping the company's "accident-free record"	0.75			
Lack of training and instruction	0.71			
Resistance in future employment or career progression opportunities	0.68			
Lack of rewards for effective reporting of incidents	0.65			
Unwarranted surveillance	0.62			
Acceptance of some hazards as part of routine work		0.83		
Job insecurity and fear of job loss		0.81		
Lack of knowledge about reporting requirements		0.75		
Fear of negative publicity exposure		0.72		
Confusion regarding what is reportable		0.68		
Fear of separation from co-workers		0.66		
Feelings of being misunderstood or undervalued		0.65		
Fear of being assigned to lighter jobs that workers disliked		0.61		
Legal consequences and investigations			0.75	
Short-term contract engagement including subcontracting			0.74	
Incentives to achieve zero-accident targets			0.72	
Different cultural, ethnic, and language background			0.67	
High insurance costs			0.63	
Production pressure			0.62	
Lack of trust in the anonymity of the reporting system				0.82
Reporting Procedure is not appropriate and time-consuming				0.78
Insufficient information to complete the required formalities				0.71
% of Variance	29.9	18.1	10.6	9.46
Cumulative %		48.0	58.6	68.1

Table 6: Extracted components and their related variables.

Component Name	Variables
Organizational	Lack of management commitment to report incidents Lack of feedback on how information reported has been used Existence of strict disciplinary action Lack of safety communication in the organization Focus on keeping the company's "accident-free record" Lack of training and instruction Resistance in future employment or career progression opportunities Lack of rewards for effective reporting of incidents Unwarranted surveillance
Individual	Acceptance of some hazards as part of routine work Job insecurity and fear of job loss Lack of knowledge about reporting requirements Fear of negative publicity exposure Confusion regarding what is reportable Fear of separation from co-workers Feelings of being misunderstood or undervalued Fear of being assigned to lighter jobs that workers disliked
Environmental	Legal consequences and investigations Short-term contract engagement including subcontracting Incentives to achieve zero-accident targets Different cultural, ethnic, and language background High insurance costs Production pressure
Technical	Lack of trust in the anonymity of the reporting system Reporting Procedure is not appropriate and time-consuming Insufficient information to complete the required formalities

6.1. Component 1 – Organizational

The nine barriers extracted for component 1 were; *Lack of management commitment to report incidents (87%), Lack of feedback on how information reported has been used (85%), Existence of strict disciplinary action (83%), Lack of safety communication in the organization (79%), Focus on keeping the company's "accident-free record" (75%), Lack of training and instruction (71%),*

Resistance in future employment or career progression opportunities (68%), Lack of rewards for effective reporting of incidents (65%), Unwarranted surveillance (62%). The factor loadings are denoted by the numbers in parentheses. This component accounted for 29.92% of the total variance and is regarded as the most prominent of all four identified components. Resolving organizational barriers requires a shift in the existing methodologies, organizational culture, and an understanding of the managerial capabilities concerning the issues of incident reporting at the organizational and project levels. As Wu *et al.* (2008) asserted, the management should strive to enact policies and incentives that positively inspire attitude towards the reporting of safety incidents to maintain favorable acceptance and use of the reporting systems in the industry. Additionally, several studies have highlighted the need for effective feedback on incident reports to motivate the user's participation in such incident reporting systems (Wu *et al.*, 2008; Saurin *et al.*, 2015; Abu Alrub *et al.*, 2022). For employees to continue to participate in the incident reporting process, they must see something positive coming out of it (Saurin *et al.*, 2015). The cluster of barriers reported in this component emphasizes the need for organizations to take mitigating steps and inculcate confidence among the employees through effective policies and sound commitment toward the reporting culture. Management should also ensure that reporting should not have any negative consequences. Therefore, promoting a non-punitive reporting culture is a vital consideration for worker safety to eliminate the tendency of the under-reporting of incidents.

6.2. Component 2 – Individual

The eight barriers extracted for component 2 were; *Acceptance of some hazards as part of routine work (83%), Job insecurity and fear of job loss (81%), Lack of knowledge about reporting requirements (75%), Fear of negative publicity exposure (72%), Confusion regarding what is reportable (68%), Fear of*

separation from co-workers (66%), Feelings of being misunderstood or undervalued (65%), Fear of being assigned to lighter jobs that workers disliked (61%). The numbers in parentheses are the factor loadings. This component accounted for 18.12% of the total variance and is regarded as the second most prominent of all four identified components. The study conducted by De Silva, Rathnayake and Kulasekera (2018) reasoned that individuals sometimes make their judgment of the seriousness of an incident, which will then lead to their decision on whether or not to report it. Further, if they perceive that they were at fault too, then they are hesitant to report the incident (De Silva, Rathnayake and Kulasekera, 2018). Underreporting is encouraged further when individuals are apprehensive about the reporting procedures and perceive them to be risky and detrimental to their jobs. Therefore, as suggested by Su (2014), it is essential to consider the privacy requirements of the employees and to assure them that they will not face any penalty or retaliation from others as a result of incident reporting. The purpose of incident reporting should be to learn lessons and to prevent its reoccurrence instead of leveling allegations against human beings for their mistakes (Probst and Graso, 2013). It is thus vital for the management to promote the significance of incident reporting, as well as its key components, to enhance their level of knowledge and trust, which could lead to increased reporting in the future.

6.3. Component 3 – Environmental

The six barriers extracted for component 3 were; *Legal consequences and investigations (75%), Short-term contract engagement including subcontracting (74%), Incentives to achieve zero-accident targets (72%), Different cultural, ethnic, and language backgrounds (67%), High insurance costs (63%), Production pressure (62%).* The numbers in parentheses are the factor loadings and the component accounted for 10.64% of the total variance. Environmental factors are caused by significant environmental impacts, such as economic

situations, technological developments, etc., that are beyond our control to a large extent (jadidoleslami, Saghatforoush and Zare Ravasan, 2021). Government policies also play a critical role in forming such environments. It has also been observed that these environmental barriers often overlap with managerial obstacles, indicating that focusing on enhancing management or changing managerial procedures can provide appropriate direction for studies to identify solutions to these challenges (jadidoleslami, Saghatforoush and Zare Ravasan, 2021).

6.4. Component 4 – Technical

The three barriers extracted for component 4 were; *Lack of trust in the anonymity of the reporting system (82%)*, *Reporting Procedure is not appropriate and time-consuming (78%)*, and *Insufficient information to complete the required formalities (71%)*. The numbers in parentheses are the factor loadings, and the component accounted for 9.46% of the total variance. The advancements in traditional reporting procedures and the shift towards electronic incident reporting practices have brought about significant complications in the reporting of safety incidents (Winsvold Prang and Jelsness-Jørgensen, 2014). It is also observed that lack of technical skill and knowledge further exacerbates the experience to a point where individuals no longer see the significance of the reporting process. Therefore, it is important to provide technical skills and basic computing training to workers lacking such resources and expertise, given that technological self-efficacy facilitates the use and adoption of reporting systems. Moreover, the concern of privacy has always dominated and various measures have been taken to cater to this concern. Despite all these measures, individuals have shown a growing degree of dissatisfaction (Qureshi *et al.*, 2021). It is suggested to ensure anonymity and confidentiality and to give confidence that reported information will not be used against them. The employees should be allowed to report the incident

anonymously. When participants are more confident about using the system, the system is more likely to be accepted in ~~the industry~~industry. In contrast, reporters may be less likely to report due to scarce trust and negative publicity by others (Wu *et al.*, 2008). Decision-makers and technology staff should collaborate to identify and address users' needs and complaints to facilitate incident reporting. These aspects should be taken into account not only during the development phase but also during the implementation phase and even in the potential future upgradation of the system.

7. CONCLUSION

The barriers to successful incident reporting on construction sites are multifaceted, with various contributing factors for which stakeholders are to be blamed. Many studies have emphasized the importance of incident reporting, although little research has explored and discussed the potential barriers in the context of the Pakistani construction industry. This research concludes the barriers inhibiting the reporting of safety incidents in the construction industry of Pakistan. At first, using a systematic literature review, the list of barriers to incident reporting was advanced in the form of a questionnaire. Following that, a survey of construction industry professionals was carried out. The collected data was analyzed using the EFA approach. The barriers identified were then classified into four clusters: organizational, individual, environmental, and technical. It has been found that the most significant cluster hindering the successful incident reporting implementation in Pakistan is organizational-related barriers. The findings of this study contribute to the existing body of knowledge about the awareness and implementation of incident reporting practices and also provide a theoretical basis to take adequate measures to encourage incident reporting in the construction sector of Pakistan and similar emerging construction industries, thereby providing a safer working environment for workers and reducing the likelihood of construction-related incidents.

Future research should concentrate on how the drivers of incident reporting can be harnessed to overcome the existing barriers, considering the conditions governing the Pakistani construction industry and applying expert perspectives. Researchers may also use qualitative research methods such as case studies in the future to study barriers to successful incident reporting implementation in similar or some other settings.

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