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A mixed method approach to validating barriers to safety incentives implementation in the Nigerian construction industry

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The position of safety incentives in the construction industry emerged from the demands to align employees with organisational performance-related goals, improve workplace safety practices, and share risk between clients and contractors. This study identifies and validates barriers to safety incentives implementation in the construction industry using an exploratory sequential mixed-methods design. The study addresses this critical gap by delving into construction firms' challenges in implementing safety incentives. Twenty-three of thirty-two identified barriers to implementing safety incentives from the literature review were validated through a Delphi survey using expert panellists' opinions. This is followed by obtaining quantitative data from construction professionals (architects, builders, engineers, and quantity surveyors) using a structured questionnaire in Lagos, Nigeria, through a simple random sampling technique. Descriptive and exploratory factor analysis was conducted on the retrieved data and Cronbach's alpha test to determine data reliability and interrelatedness. The twenty-three validated barriers to safety incentives implementation in the construction industry were clustered into six factors: discrepancies in the incentive rewards process, lack of incentive budget planning, conflicting incentive performance indicators, absence of a national safety incentive policy, construction firms' governance systems, and lack of automation in the incentive implementation process. The practical implication of this study is to provide a better understanding of national safety policy, key performance indicators, and scheme selection approaches supporting the implementation of safety incentives. The study provides actionable recommendations for construction stakeholders, government agencies, professional institutions, safety managers, and policymakers to prioritise incentive budget planning, incentive reward approaches, automation processes, and key performance indicators to improve safety incentive implementation. The study concluded by calling on construction stakeholders' commitment to developing safety incentives and performance goals that will not conflict with health and safety practices or create workplace tension among workers.

KEYWORDS

barriers, construction firms, health and safety, safety incentives, mixed method, Nigeria

1 Introduction

The construction sector is crucial in providing infrastructural facilities that drive national economic growth and contribute to the gross domestic product (GDP) (Ogunde et al., 2017; Masoetsa et al., 2022). Due to high human involvement during construction, the sector significantly creates employment opportunities in developing countries, particularly Nigeria (Rao et al., 2015; Nyoni and Bonga, 2016; Ogunbayo et al., 2024). In Nigeria, the sector contributions are also reflected in the gross fixed capital formation of the national economy (Ofori-Kuragu et al., 2016; Adeshina, 2021; Bamgbose et al., 2024). The Nigerian construction sector contributed about 4.18% of GDP to the economy in the first quarter of 2022 (National Bureau of Statistics GDP Q1 report, 2022). Despite the contributions of this sector, the high incidence of accidents in the construction industry is often attributed to manual operations and exposure to hazardous working conditions (Kalatpour and Khavaji, 2016; Abukhashabah et al., 2020). However, the complexities of various activities in the construction industry are harmful and cause health hazards to workers' lives and safety (Ogundipe K. E. et al., 2018; Abdel-Hamid and Mohamed-Abdelhaleem, 2022). These results in thousands of unreported and reported occupational hazards, injuries, and deaths annually (Abukhashabah et al., 2020; Ogundipe et al., 2025). Mahmoud, Ahmad, and Yatim (2020) acknowledged that approximately 2% of accidents and 5% of injuries are reported among construction workers in Nigeria.

Furthermore, existing studies linked the challenges of health and safety (H&S) practices to ineffective H&S policies, lack of safety incentive policies, weak enforcement frameworks, shortage of skilled enforcement personnel, and underfunding of H&S programs (Ogundipe K. E. et al., 2018; Eyiah et al., 2019; Boadu et al., 2021). The non-enforcement of regulatory policies governing H&S practices negatively affects the industry standardisation and implementation of safety incentives (Awwad et al., 2016). Reactive approaches have traditionally been utilised to enhance safety practices and performance to address safety challenges (Alfandi and Alkahsawneh, 2014; Adekunle et al., 2023). Given the high construction-related accidents and fatalities rate, implementing safety incentive schemes could reduce these incidents, increase productivity, and lower costs associated with accidents and injuries. Ogwueleka, 2015 and Liu et al. (2022) maintained that safety incentives should be integral to the construction organisational policy to improve H&S practices and performance-related goals. This would offer a proactive approach to improving organisational H&S culture and practices rather than reactive approaches to H&S management (Karakhan and Gambatese, 2018; Ogundipe et al., 2024a).

In this study, safety incentives (SI) are defined as schemes to improve workplace H&S practices, share project risk between clients and contractors, and align workers' incentive drives with organisational performance-related goals (Karakhan and Gambatese, 2018; Liu et al., 2022; Ogundipe K. E. et al., 2024). This is because stakeholders in the construction industry often require economic, psychological and social measures of safety incentives to stimulate productivity and performance in the workplace (Nordgren-Selar, 2022). According to Hilmarsson and Rikhardsson (2011), safety incentives are often based on various motivation theories that explain what drives human behaviour. Gerhart (2017) maintained that safety incentives promote safety practices that can improve workers' behaviours and performance and reduce destructive behaviours that could hinder attaining projects, clients and organisational performance-related goals. Safety incentives also have various schemes that promote workplace safety and team spirit and increase employees' morale due to extrinsic rewards that motivate individuals to meet organisational goals and employee incentive drives (Alfandi and Alkahsawneh, 2014). Moreover, the application of safety incentives has transformed various construction industry operations. The safety incentives framework is rooted in the demands to align employees with organisation performance-related goals, improve workplace safety behaviour, and share risk between clients and contractors (Zulkefli et al., 2014; Ogundipe et al., 2024c). Safety incentives allow project risk sharing and align the activities of all parties in contractual arrangements with the objectives of the projects (Ogunde et al., 2017; Ogundipe K. E. et al., 2024). These arrangements in the conditions of contracts ensure the inclusion of penalties and rewards for all factors that affect project performance (Ogwueleka, 2015; Guo et al., 2015; Ogundipe et al., 2024a).

Despite construction firms' efforts using safety incentives to improve health and safety (H&S) practices and project performance, this is not without various barriers that significantly affect its effective implementation in the construction industry (Aina and Akinyemi, 2014; Liu et al., 2022). Researchers hold various views concerning the challenges facing the effective implementation of safety incentives in the construction industry (Del-Puerto et al., 2012; Ogwueleka, 2015; Liu et al., 2022). Sheppard et al. (2020) and Liu et al. (2022) maintained that making incentive rewards mutually beneficial to construction stakeholders remains a knowledge gap and requires identifying barriers to implementing reward and punishment schemes. Yang et al. (2021) established that contributing factors to safety incentives implementation in the construction sector are influenced by firm size, project type, construction methods, and occurrence of site accidents. Feng et al. (2023) maintained that it is imperative to understand the barriers to implementing safety incentives in the construction industry. While various studies have established the benefits, drivers, and approaches that influence the implementation of safety incentives in the construction industry, it is essential to address the specific gap of barriers (see Table 1) that significantly affect the effective implementation of safety incentives in the construction industry in developing countries, using Nigeria as a case study exemplar.

Hence, this study uses Lagos, Nigeria, as a case study to assess barriers to implementing safety incentives in the construction industry. The study's objective was achieved through a literature review to establish the barriers to implementing safety incentives in the construction industry. This is followed by adopting an exploratory sequential mixed method, starting with the qualitative design using the Delphi technique through expert panellists' opinions to pilot the identified barriers. The quantitative data obtained using the perspective of construction professionals in Lagos, Nigeria, explored the correlation and interrelatedness of each of the six components of the barriers to implementing SI through exploratory factor analysis. The study findings are intended to assist government policymakers, construction stakeholders, and industry professional institutions in understanding barriers that significantly

TABLE 1 Barriers to safety incentives implementation.

Barriers to safety incentives implementation	Authors
Inconsistent organisational policies	Karakhan and Gambatese (2018), Ogundipe et al. (2025)
Inflation and economic fluctuation	Abogun and Fagbemi (2012)
Insufficient information databases	Karakhan and Gambatese (2018). Naderi et al. (2023)
Inadequate organisation resources forecasting	Karakhan and Gambatese (2018)
Poor incentives budget administration	Musonda and Pretorius (2015), Boadu et al. (2021)
Lack of automation process for incentive design	Naderi et al. (2023)
Divergence of employees and organisational goals	Ghasemi et al. (2015), Abas et al. (2020)
Ineffective planning performance indicators	Laitinen et al. (2013), Haas and Yorio (2016)
Organisation financial incapability	Zulkefli et al. (2014), Naderi et al. (2023)
H&S programmes underfunding	Musonda and Pretorius (2015), Boadu et al. (2021)
Manual administration of incentive process	Chan et al. (2010), Naderi et al. (2023)
Incentive fairness preference	Ghasemi et al. (2015), Abas et al. (2020)
Inappropriate incentive selection approaches	Aina and Akinyemi (2014), Ghasemi et al. (2015)
Falsification of report	Chan et al. (2010), Naderi et al. (2023)
Falsification of data	Chan et al. (2010), Naderi et al. (2023)
Construction firms' systems of governance	Aina and Akinyemi's (2014), Ogundipe et al. (2024c)
Ineffective work measurement standardisation	Aina and Akinyemi (2014), Jiang et al. (2019)
Employees' loss of confidence	Ghasemi et al. (2015), Abas et al. (2020)
Performance goals conflicting with workplace safety	Karakhan and Gambatese (2018), Brandhorst and Kluge (2021)
Employees' inequity perception of incentives	Ghasemi et al. (2015), Abas et al. (2020)
Lack of automation reporting systems	Naderi et al. (2023)
Ineffective H&S policies	Kheni and Braimah (2014), Boadu et al. (2021)
Weak OSH enforcement framework	Kheni and Braimah (2014), Boadu et al. (2021)
Lack of safety incentive regulations	Chan et al. (2010), Boadu et al. (2021)
Organisations lacking H&S programmes	Goodrum and Gangwar (2004), Shui et al. (2014)
Lack of incentive budget for H&S	Choi et al. (2012), Boadu et al. (2021)
Problematic organisational policies	Kheni and Braimah (2014), Boadu et al. (2021)
Inappropriate incentive designs	Aina and Akinyemi (2014)
Employees high turnover rate	Kheni (2018), Choi et al. (2012)
Unsatisfactory safety awareness	Ghasemi et al. (2015), Abas et al. (2020)
Absence of organisation incentive budgets	Chan et al. (2010), Ogundipe et al. (2024c)
High rate of construction workers' mobility	Kheni (2018), Choi et al. (2012)

Source: Authors Literature Review (2024).

affect the implementation of safety incentives. The study's findings are significant initiatives towards attaining pillar one of Africa Agenda 2063 and sustainable development goals (SDGs), goals three and eleven of which are to provide a high standard of living, quality of life, and wellbeing.

2 Literature review

This section of the literature review provides a theoretical understanding supporting the implementation of safety incentives in the construction industry and contextualising knowledge of safety incentives (SI) in enhancing productivity, performance efficiency, workplace safety and aligning workers' incentive drives with the organisational goals. The section further reviewed and identified the barriers to safety incentives implementation from existing literature on the subject matter. This was discussed in two sub-sections to give further credence to the study.

2.1 Theoretical background explaining safety incentives implementation in the construction industry

This study utilised the employee incentive system model to provide a theoretical understanding of the barriers to safety incentive implementation in the construction industry. The employee incentive system model, advanced by Jakovljevic et al. (2018), is a theoretical framework for understanding the safety incentive mechanisms in the manufacturing sector to improve employee safety practices and productivity. The model started with the factors of the organisational policy required to incentivise workers, including internal and external goals alignment and rewards that improve workplace safety and encourage innovation. According to Cherry (2017), internal and external motivation factors influence employees' actions or behaviours. The model shows that the organisation needs education and learning that can be systematic, team learning, shared vision, and personal skills development to improve workplace safety and achieve performance goals. The model further shows that the organisational dimension of employee incentives could be directional, intense and persistent. Jakovljevic et al. (2018) admitted that financial or non-financial incentives could stimulate employees depending on the level of improvement or productivity required within the organisations. The model explains that effective incentives implementation include requirements, movements, and reward mechanisms. Thus, Jakovljevic et al. (2018) postulated that efficient incentive schemes should be guided by organisation policy, safety programme rules, human resource management, opportunities, internal benefits, rewards and sanctions towards improving workers' safety and productivity. The structural base of the organisation towards employee productivity, as highlighted in the employee incentives system model, should be guided through the formulation of incentive mechanisms for workplace safety practices, promote awareness, employee preference, mutual trust and creative system thinking, skills development and enhanced performance (Jakovljevic et al., 2018). This will help understand how safety incentive mechanisms influence productivity, efficiency, workplace safety practices, and align workers' incentive drives.

2.2 Safety incentive implementation mechanisms in the construction industry

Safety incentives are applied in the construction industry to achieve project objectives by setting measurable performance-related goals using elements that impact the project schedule, quality, or cost. Ahmed and Faheem (2020) admitted that reward and penalty schemes are used in construction contracts to align employees with organisation performance-related goals, improve workplace safety practices, and share risk between clients and contractors. Previous studies have established techniques to improve the implementation of safety incentives to benefit construction stakeholders in mutual contractual arrangements. Imhof and Kräkel (2014) assessed the principles of moral hazard problems in contracts and that implementing bonus contracts provides individual stakeholders with incentives for meeting a particular performance threshold. Wang and Zhou, (2023) noted that the effective implementation of safety incentives is supported by the integration of technology applications in incentive mechanisms and the design process of optimal incentive contracts under various performance indicators. Naderi et al. (2023) developed an automation process: Fungible Tokens and Non-Fungible Tokens for automated incentive mechanisms in incentive contracts, offering a decentralised, transparent, traceable, and immutable incentive mechanism that improves stakeholder trust. Bao et al. (2024) noted that integrating web and blockchain-based incentives improves the implementation of safety incentives using a native token incentive mechanism. The study established that linking workplace safety requirements with web and blockchain-based incentives could motivate users to participate in safety training regularly and improve their safety awareness and knowledge, cultivating new safety culture (Bao et al. (2024). Ji, Liu and Zhang (2021) and Zhu et al. (2022) explore evolutionary game analysis and tournament mechanism dimensions in safety incentives implementation in the construction industry. However, Ji et al. (2021) noted that the challenges of individual workers' fairness preference, risk preference and ability level in safety incentive implementation could be overcome by integrating the competition tournament rewards mechanism. Moreover, Zhu et al. (2022) explore an evolutionary game model in developing incentive and punishment mechanisms to improve the effectiveness of workplace safety practices between contractors and construction workers. The study of Zhu et al. (2022) established the impact of the evolutionary game analysis model as a mechanism for promoting mutual trust, benefits allocation, and setting incentives, punishment and reward indicators mutually beneficial to contractors and workers.

Various studies have established mechanisms for efficiently implementing safety incentives within the construction industry (Ji et al., 2021; Zhu et al., 2022; Bao et al., 2024; Wang and Zhou, 2023). Unfortunately, various barriers significantly affect the choice of incentive schemes and innovative approaches to safety incentives implementation in the construction industry in developing countries, including Nigeria.

2.3 Barriers to safety incentive implementation in the construction industry

While numerous researchers have focused on mechanisms and methods for designing safety incentives in the construction industry, a dearth of studies comprehensively address the barriers to implementing these processes. This lack of consolidated information limits the implementation of safety incentives in the construction industry, particularly in developing countries like Nigeria, Ghana, and South Africa. According to Aina and Akinyemi (2014), barriers to safety incentive implementation could be attributed to the methods and process of selecting appropriate schemes. Aina and Adesanya (2015) noted that construction organisations often base the selection of safety incentives mainly on safety manager discretion, traditional methods, and performance-based measurement. These SI selection approaches often neglect to investigate the relationship between job performance and employee incentive drives, job complexities, adequacy of work and cost-benefit analysis, and availability of standardised work measurement techniques (Aina and Akinyemi, 2014). Kim et al. (2023) establish that traditional methods for incentivising safe behaviours often face barriers such as excessive manual documentation, delayed recognition and awards, and resource allocation challenges.

Additionally, the lack of an incentive budget affects the implementation of effective safety incentives to meet the employees' incentive drives and improve workplace H&S practices (Hedley, 2023). Ogundipe K. E. et al. (2024) affirmed that the significant barriers to safety incentive implementation include lack of supporting incentive policy, employees' inadequate knowledge of SI, construction firms' systems of governance, and lack of incentive funding planning. Liu et al. (2022) noted that conflict income-sharing could affect the implementation of safety incentives to be mutually beneficial to construction stakeholders. According to Ji, Liu, and Zhang (2021), the effectiveness of implementing safety incentives depends on individual employees' ability levels, fairness preferences, and risk preferences to understand competitive mechanisms aligning their incentive drives to organisational performance goals. Goodrum and Gangwar (2004) added that employee loss of confidence and employee perception of inequity towards incentive rewards also influence SI implementation in the construction industry. Feng et al. (2023) added that firmness preference, uneven professional qualities and construction workers' mobility affect safety incentive implementation in the construction industry. Shui et al. (2014) further attributed the barriers to SI implementation among construction organisations to the absence of existing H&S programmes and policies that address training, culture, financial plans, and inadequate record-keeping. Chan et al. (2010) and Choi et al. (2012) admitted that most construction organisations operate as small and medium enterprises, making it challenging to implement safety incentives.

Furthermore, Choi et al. (2012) and Ogundipe et al. (2024c) stated that construction SMEs have limited budgets, poor human resources practices, and a lack of commitment from top management to implement safety incentives. The prevailing barrier to safety incentives in the construction industry is the absence of regulatory policies to standardise incentive implementation (Yik and Lai, 2007; Chan et al., 2010; Choi et al., 2012). Choi et al. (2012) argued that the three significant barriers to implementing safety incentives in the construction industry are associated with workers, barriers related to organisations' governance systems, and the prevailing barriers to subcontracting practices. Choi et al. (2012) and Ogundipe et al. (2024c) highlighted that the high turnover rate of workers, increased mobility of workers, and less familiarity of workers with the workplace environment significantly affect the construction industry implementation of effective safety incentive schemes. Brandhorst and Kluge (2021) noted the difficulties of implementing safety incentives when the performance goals conflict with safety and create workplace tension. Haas and Yorio (2016), Jiang et al. (2019), and Naderi, Shojaei and Ly (2023) maintained that inadequate employee awareness, unclear goal setting, complex manual incentives administration, lack of automation process for incentive design and inconsistent KPI standards constitute barriers to SI implementation in the construction industry. Bao et al. (2024) admitted that improving workplace safety culture and climate requires the integration of blockchain-incentives-based safety incentives in construction organisations. Karakhan and Gambatese (2018) and Abas, Nurahim, Yasin, and Rahmat (2020) added that inadequate communication between workers and managers and unsatisfactory safety awareness are barriers to implementing safety incentives in the construction industry.

3 Research methodology

This study rigorously employed an exploratory sequential mixed method. The research method adopted supports a pragmatic ontological stance and emphasises the practical application of knowledge and generalisation of research findings using mixed methods rather than being committed to a single view of reality (Maarouf, 2019). According to Caruth (2013), a mixed method emerged by using quantitative and qualitative designs in the same research study in response to the observed limitations of using quantitative or qualitative designs separately. Aigbavboa (2014) and Apuke (2017) maintained that using a mixed method increases the generalisability of research results by providing concrete evidence for a conclusion based on convergence and verification of findings. In addition, Jonker and Pennink (2010) and Aigbavboa (2014) added that a mixed-method approach to research allows deductive and inductive thinking in solving a research problem. To begin with, a review of extant literature (see section 2) provides a theoretical understanding of existing knowledge of various barriers to implementing safety incentives in the construction industry. Hence, "Construction" AND "Safety incentives," AND "Barriers" AND "Incentives Implementation," AND Barriers" were used as keywords to search online databases before the Delphi iteration.

3.1 Ethics consideration

To give further credence to this study, a certificate of ethics approval clearance was obtained from the Ethics and Plagiarism Committee (FEPC) of the Faculty of Engineering and the Built Environment at the University of Johannesburg, South Africa. The researcher complied with research ethics by ensuring respondents' anonymity in the survey. Hence, the respondents' names and other information that may reveal their identity were regarded as confidential. Likewise, none of the respondents was compelled to participate in the study. Their participation was based on self-free will. They were informed of their rights not to participate in the survey or to walk away from participating if they desired. Also, they were told the purpose of the study and how and why they had been selected.

3.2 Qualitative design

This study adopted the Delphi technique as a qualitative design because of its philosophical stance and ability to deduce a constructive perspective in research to validate barriers to designing and implementing safety incentives in the construction industry (Ikuabe et al., 2023). The Delphi study involved a group of experts selected based on established rigorous criteria, pooling their experiences and intelligence to improve individual judgment views on the subject matter. The Delphi technique was adopted in this study as a qualitative method for achieving expert consensus on barriers to implementing safety incentives identified from the literature review conducted based on their practical involvement in different construction contractual arrangements. Adom et al. (2016), Mahmoud et al. (2020), and Ikuabe et al. (2023) described the Delphi technique as the formation of distinctive knowledge and understanding of the world emanating from experiences. This anonymous and iterative Delphi process ensures the validity and reliability of the study's findings, a common practice in research within the engineering, architecture, and construction domain (Shariff, 2015; Tilakasiri, 2015; Tengan and Aigbavboa, 2021; Ogunbayo et al., 2022; Ikuabe et al., 2023). The outcome of the Delphi study was used to develop a quantitative research design *via* a structured questionnaire to obtain field survey data from construction professionals in Lagos, Nigeria.

The expert selection process, a crucial aspect of the Delphi technique, was meticulously carried out in this study. Existing literature suggests that no general rule applies to the Delphi study's sample selection (Howell and Kemp, 2005; Ameyaw et al., 2016). Hence, a purposive non-probability sampling method is often adopted based on the researcher's knowledge, experience, and respondents' desirable characteristics in selecting expert panellists for this study (Ogunbayo et al., 2022; Tengan and Aigbavboa, 2021; Somiah et al. (2020) maintained that the representative sample size is often based on bringing together experts in the area of study to share their knowledge and experience until consensus is reached rather than based on statistical sample sizes. The selection criteria of the expert panellists were based on academic qualifications, practical experience, theoretical knowledge, and professional registrations, coupled with their published works and involvement in H&S policy development. Hence, the criteria for selecting respondents for this study were based on experts who have practical experiences and demonstrate theoretical knowledge of safety incentives and H&S practices from academic and professional practices as recommended by (Aigbavboa, 2014; Evans and Farrell, 2021; Ogunbayo et al., 2023). Nonetheless, in this study, a master degree holder was considered the minimum academic qualification for the selected experts in the construction industry (Giel and Issa, 2016; Evans and Farrell, 2021); a minimum of 10 years of working experience was considered for the participating experts (Chan et al., 2010; Aghimien et al., 2020; Ikuabe et al., 2023); experts with professional registration and having conference or journal article publications in subject area were considered (Ogunbayo et al., 2023). Therefore, the selected expert panellists in this study met a minimum of 50% of the selection criteria, ensuring a high level of expertise and insight into the study (Tilakasiri, 2015; Aghimien et al., 2020; Ikuabe et al., 2023; Ogunbayo et al., 2023).

Likewise, a brief concept and relevant ethical considerations guiding the Delphi technique were included in the invitation email sent to the expert panellists individually to ensure participants' confidentiality, data protection, anonymity and consent (Fisher, 2021). These assumptions guided this study in arriving at a representative sample size. Twenty-five experts were invited *via* e-mails to participate in the Delphi study, and a copy of their curriculum vitae was requested. As Somiah et al. (2020), Ikuabe et al. (2023), and Ogunbayo et al. (2023) noted that the considerable sample size in previous Delphi studies ranged from 10 to 15. However, only twenty-one of the twenty-five invited experts met the selection criteria adopted in this study, and they individually received the first round of the Delphi questionnaire. Nonetheless, 15 experts completed and returned the first round of the Delphi questionnaire within the set time frame and were involved in the entire Delphi study process.

3.3 Delphi data collection and consensus

Consequently, the data analysis of the Delphi technique requires the panellists to reach a consensus on the identified barriers to implementing safety incentives. Aigbavboa (2014) and Nasa et al. (2021) maintained no agreement on the number of rounds required to conduct a Delphi study. However, consensus is often reached in the Delphi study within two or three rounds in most cases in the construction management, facility management, and maintenance management studies (Ameyaw et al., 2016; Ikuabe et al., 2023; Ogunbayo et al., 2023). In this study, the selected experts were given 35 days during each of the rounds of the Delphi study, which allowed for their quality contributions to the study. The first round of the Delphi questionnaire was designed as closed questions based on the findings of the literature reviewed and as open-ended questions to enable the expert panel to make new suggestions on barriers to implementing safety incentives. Likewise, the second-round questionnaire was developed as a closed-ended question based on the brainstorming engagement and analysed experts' feedback from the first round of the Delphi study. Thus, a consensus was achieved when stability occurred in the data collected and analysed after the second round. Median (M), mean ($\bar{x}$), standard deviation (σx), and interquartile deviation (IQD) were adopted to calculate and analyse each round of the Delphi process as the criteria for reaching consensus in this study:

- Weak consensus - median ≤6.99, mean ≤ 5.99, and IQD≥2.1 ≤ 3 and ≤59% (5.99).
- Good consensus - median 7–8.99, mean 6–7.99, IQD≥1.1 ≤ 2 and ≥60% ≤ 79% (6–7.99); and
- Strong consensus - median 9–10, mean 8–10, IQD ≤1 and ≥80% (8–10).

The decision for reaching consensus is based on a 10-point impact scale in which 1 to 2 represents no impact (NI), 3-4 represents low impact (LI), 5-6 represents medium impact (MI), 7-8 represents high impact (HI), and 9–10 represents very high impact (VHI). The scale derivation method adopted influences the articulation of experts' consensus on the identified barriers. However, the reliability and interrelatedness of the obtained data were checked using Cronbach's alpha test to determine the validity and reliability of the Delphi data collection instrument (Tavakol and Dennick, 2011; Taber, 2018). The acceptable reliability scale of Cronbach's alpha adopted for this study is 0.70 (Tavakol and Dennick, 2011; Taber, 2018). Likewise, the Mann-Whitney U test was adopted to compare the opinions of the two groups of expert panellists in academic and professional practices. According to Rousseaux and Gad (2013), the Mann-Whitney *U* test is non-parametric and often used to compare differences between two groups in the value of an interval, ordinal, or ratio variable.

3.4 Quantitative design

After expert panellists' validation and consensus of twenty-three of the identified thirty-two barriers to safety incentives implementation in the construction industry. The outcome of the Delphi study on the 23 validated barriers to safety incentives implementation in the construction industry was developed as a quantitative survey questionnaire using a five-point Likert scale of 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree. The study population comprises construction professionals in the Nigerian construction-built environment. The sample frame comprises 958 registered members of the Nigeria Institute of Architects (NIA), 610 registered members of the Nigerian Institute of Building (NIOB), 2,670 registered members of the Nigeria Society of Engineers (NSE), 870 registered members of the Nigeria Institution of Quantity Surveyors (NIQS), and 300 registered members of the Nigerian Institution of Builders in Facilities Management (NIBIFM), in Lagos Chapter, Nigeria respectively. In determining the sample, the Yamane (1967) equation, as cited by Agrasuta and Nelson (2013), was adopted to establish the sample size representing the total population of construction professionals and stakeholders within the study area. Equation 1 illustrates the calculation of the sample size for this study. Yamane (1967) noted that the level of precision is set at a 95% (p = 0.05) confidence level, which was adopted for calculating sample size in this study.

$$n = N/1 + N(e)^2 \tag{1}$$

where n = the random sample size, N = the population size, and e = the margin of error. Hence, the sample size, n, for this study was established as follows: $n = 5408/1 + 5408\ (0.05)^2 = 372.4$.

From Equation 1, the sample size required in this study is 372.45 respondents from the sample frame, representing 6.88% of the total population of 5408. However, the survey questionnaire was developed using Google Forms and emailed to the respondents through their respective state chapter offices of the NIOB, NIA, NIQS, and NSE Lagos Chapter, Nigeria. Three hundred seventy-nine (379) responded to the survey questionnaire used for data analysis for this study. Exploratory factor analysis (EFA) was conducted on the data obtained using IBM SPSS Statistic V28. Ezennia (2022) describes EFA as a statistical analysis tool that eliminates the high tendency of interrelatedness within the variable factors to produce orthogonal findings that are reliable and stable. The EFA allows determining correlation patterns within the dataset to extract the variables into the different cluster components (Yong and Pearce, 2013). Hence, the data reliability was checked using Cronbach's alpha because it measures the scale interrelatedness of variables in a test by considering the same construct of the variables. Pallant (2016) noted that a value of 0.6 is required for the coefficient of a scale using Cronbach's alpha. The data collected returned Cronbach's alpha value of 0.923, justifying that the data collection instrument is reliable and that the responses obtained are valid. Figure 1 presents the mixed-method framework research adopted for the study.

4 Results and discussion of findings

4.1 Qualitative data analysis

4.1.1 Demographic profiles of the delphi respondents'

As presented in Table 2, the study findings indicate experts' highest academic qualifications, which include 7 (46.66%) with doctorate holders and 8 (53.66%) who are master's degree holders who completed the Delphi study process in the first and second rounds. The panellist's designations in the construction industry (see Table 2) include 7 (46.66%) lecturers in the public and private HEI and 8 (53.66%) construction industry professionals with designations such as contractors 20.00%, consultants 13.33%, government agency 13.33% and director of physical planning 6.66% (comprising architect, builders, engineers, and quantity surveyors). The study findings further reveal that only one expert panel member had 6–10 years of experience, nine had 10–15 years of experience, four had 16–20 years of experience, and one had 21–25 years of experience. The demographic information set minimum criteria upon which panellists were drawn for the Delphi study met a minimum of five points criteria for inclusion of experts and were deemed fit for the study.

4.1.2 Delphi first-round result

Table 3 presents findings from the first round of the Delphi study. The data obtained was checked for reliability and interrelatedness using Cronbach's alpha test, which returned a 0.952 more than minimum value recommended for a good reliability according to Tavakol and Dennick (2011). Hence, the experts validated the thirty-two identified barriers to safety incentive implementation in the Nigerian construction industry according using mean (x̄), median (M), standard deviation (σx), and interquartile deviation (IQD). The 10-point impact scale adopted in this study, ranging from no impact (NI) to very high impact (VHI). Four of the thirty-two identified barriers to safety incentive implementation recorded (VHI: 9.00–10.00) with nine median scores. In contrast, the remaining twenty-eight identified barriers recorded a high impact (HI: 7.00–8.99). Furthermore,

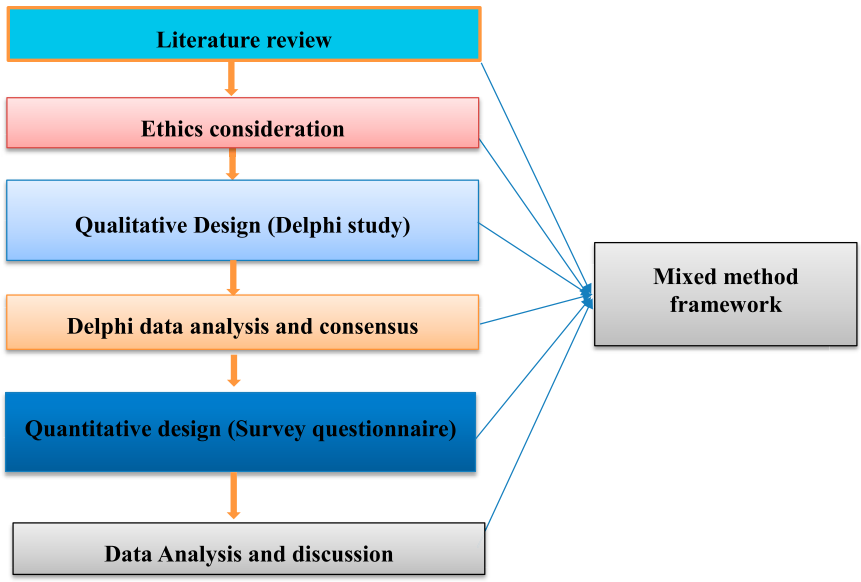

FIGURE 1
A exploratory sequential mixed method framework adopted for the study.

Mann–Whitney U test was conducted to determine the significant difference in the experts' opinions based on their designation. According to Pallant (2016), a p-value >0.05 indicates a not statistical difference in group opinion; in contrast, a p-value ≤0.05 indicates an imbalance or statistical difference in the group opinion. A p-value obtained >0.05, indicating no statistical difference in the experts' opinions of the thirty-two identified barriers to safety incentive implementation in the Nigerian construction industry. Hence, the study findings from the Delphi study's first round indicated no variability in the experts' opinions.

4.1.3 Delphi second round result

Table 4 presents the outcome of the second round of the Delphi study. A 0.732 Cronbach's alpha value was obtained for the data analysis, indicating a good reliability according to Tavakol and Dennick (2011). Likewise, a Mann–Whitney U test indicated no significant difference in the experts' opinions regarding thirty-one out of the thirty-two identified barriers to implementing safety incentives in the Nigerian construction industry. Only the divergence of employees and organisational goals with p-value 0.030 ≤ 0.05 is statistically significant and recorded a very high impact (VHI: 9.00–10.00). They include inconsistent organisational policies with (M = 10; $\bar{x}$ = 9.27; IQD = 1.00), ineffective work measurement standardisation (M = 9; $\bar{x}$ = 8.73; IQD = 1.00), manual administration of incentive process (M = 9; $\bar{x}$ = 8.73; IQD = 1.00), absence of organisation incentive budgets (M = 9; $\bar{x}$ = 8.60; IQD = 1.00), lack of safety incentive regulations (M = 9; $\bar{x}$ = 8.60; IQD = 1.00), ineffective H&S policies (M = 9; $\bar{x}$ = 8.53; IQD = 1.00), inadequate organisation resources forecasting (M = 9; $\bar{x}$ = 8.53; IQD = 1.00), organisation financial incapability (M = 9; $\bar{x}$ = 8.47; IQD = 1.00), falsification of performance report (M = 9; $\bar{x}$ = 8.47; IQD = 1.00), lack of incentive budget for H&S (M = 9; $\bar{x}$ = 8.40; IQD = 1.00), ineffective planning performance indicators (M = 9; $\bar{x}$ = 8.33; IQD = 1.00), performance goals conflicting workplace safety (M = 9; $\bar{x}$ = 8.33; IQD = 1.00), and inflation and economic fluctuation (M = 9; $\bar{x}$ = 8.33; IQD = 1.00).

The results also indicate that eleven identified barriers recorded high impact (HI: 7.00–8.99) with eight median scores. These include weak OSH enforcement framework (M = 8; $\bar{x}$ = 8.47; IQD = 1.00), poor incentives budget administration (M = 8; $\bar{x}$ = 8.40; IQD = 1.00), lack of automation process for incentive design (M = 8; $\bar{x}$ = 8.27; IQD = 1.00), lack of automation reporting systems (M = 8; $\bar{x}$ = 8.27; IQD = 1.00), falsification of performance data (M = 8; $\bar{x}$ = 8.27; IQD = 1.00), problematic organisational policies (M = 8; $\bar{x}$ = 8.27; IQD = 1.00), inappropriate incentive designs (M = 8; $\bar{x}$ = 8.20; IQD = 1.00), organisations lacking H&S programmes (M = 8; $\bar{x}$ = 8.20; IQD = 1.00), construction firms systems of governance (M = 8; $\bar{x}$ = 8.20; IQD = 1.00), inappropriate incentives selection approaches (M = 8; $\bar{x}$ = 8.20; IQD = 1.00), and H&S programmes underfunding (M = 8; $\bar{x}$ = 8.07; IQD = 1.00).

Similarly, employees' inequity perception of incentives (M = 6; $\bar{x}$ = 6.33; IQD = 2.50), insufficient information databases (M = 6; $\bar{x}$ = 6.13; IQD = 3.00), divergence of employees and organisational goals (M = 5; $\bar{x}$ = 5.53; IQD = 3.00), high rate of construction workers' mobility (M = 5; $\bar{x}$ = 5.20; IQD = 4.00), employees high turnover rate (M = 5; $\bar{x}$ = 5.07; IQD = 3.50), incentive fairness preference (M = 5; $\bar{x}$ = 5.07; IQD = 4.000), unsatisfactory safety awareness (M = 5; $\bar{x}$ = 4.80; IQD = 1.50), employees' loss of confidence (M = 5; $\bar{x}$ = 4.60; IQD = 2.00), had a medium impact (MI: 5.00–6.99). However, the recorded standard deviation scores suggest strong consistency but a little variability in the panellists' opinions on the significant contribution of the barriers to effective safety incentive implementation in the Nigerian construction industry.

TABLE 2 Respondents' demographic information.

Respondent demographic information	Frequency (n = 15)	Percentage (%)
Highest academic qualification		
Doctor of Philosophy (Ph.D.)	7	46.66%
Master of Science degree	8	53.66%
Total	15	100%
Designation		
Lecturers	7	46.66%
Consultants	2	13.33%
Government agency	2	13.33%
Contractors	3	20.00%
Director of Physical Planning	1	6.67%
Total	15	100%
Years of experience		
1–5	-	-
6–10	1	6.66%
11–15	9	60.00%
16–20	4	26.66%
21–25	1	6.67%
Above 25 years	-	-
Total	15	100%
Professional Affiliations		
Nigerian Institute of Architects	4	26.66%
Nigerian Institute of Building	6	40.00%
Nigerian Institute Of Engineers	3	20.00%
Nigerian Institute of Quantity Surveyors	2	13.34%
Total	15	

4.2 Quantitative data analysis

4.2.1 Demographic profiles of the respondents

Table 5 presents the study findings about the respondents' highest qualifications. A significant number of the respondents had bachelor's degrees (n = 112; 29.6%), postgraduate diplomas (n = 100; 26.4%), master's (n = 84; 22.2%), higher national diplomas (n = 71; 18.7%), doctoral degree (n = 9; 2.2%), and national diplomas (n = 3; 1%). The results of the respondents' years of working in the Nigerian construction industry, as indicated in Table 5, show that 42.2%; n = 160 of the respondents had between 11–15 years of working experience, 34.8%; n = 132 had 6–10 years of working experience, 14.5%; n = 55 had 16–20 years of working experience, 5.5%; n = 21 had one to 5 years of working experience, and 2.9%; n = 11 had above 21 years of working experience. Table 5 presents the respondents' professional designation in the Nigerian construction industry. The study findings indicate that 23.3% (n = 88) architects, 32.45% (n = 123) builders, 24.27% (n = 92) engineers, and 20.05% (n = 76) quantity surveyors were involved in the survey. Table 5 further reveals the respondents' professional affiliations within the Nigerian construction industry. The study findings indicate that 23.3% (n = 88) of the respondents are members of the Nigerian Institutes of Architects (NIA), 32.45% (n = 123) are members of the Nigerian Institute of Building (NIOB), 24.27% (n = 92) are members of the Nigerian Society of Engineers (NSE) and 20.05% (n = 76) are members of the Nigerian Institute of Quantity Surveyors (NIQS).

4.2.2 Explorative factor analysis of barriers to safety incentives implementation

According to the information presented in Table 6, the results of the KMO test measure sampling adequacy, and Bartlett's test of sphericity measures the equality of variance on the barriers to safety incentives (BSI) variables to determine its adequacy for EFA. A 0.908 value above an acceptable 0.70 cut-off value of KMO and a 0.001 < p-value 0.50 for Bartlett's test were obtained, which signifies data adequacy for EFA (Pallant, 2016; Lloret et al., 2017; Watkins, 2018). As noted by Pallant (2016), Lloret et al. (2017), and Watkins (2018), the value obtained for the KMO test is appropriate for EFA, as KMO's acceptable value for EFA must be above 0.70. Moreover, Bartlett's test returned 0.001 < p-value 0.05, indicating a measure of the multivariate normality of the dataset of distributions. A significant 0.001 < p-value 0.05 demonstrates that the BSI variables in the dataset do not yield an identity matrix, which makes the data acceptable for EFA (Pallant, 2016; Lloret et al., 2017; Watkins, 2018).

Likewise, as indicated in Table 7, the extraction of the BSI variables containing values above 0.1 and all the BSI variables with the extraction above 0.1 indicate data suitability for EFA (Pallant, 2016). Pallant (2016) noted that all the variables listed under the barriers to safety incentives implementation fit well within the components.

Table 8 presents the latent Kaiser's criterion for retaining factors with eigenvalues >1.0 for the total variance explained in the six factors clustered for the barriers to implementing safety incentives, as Watkins (2018) recommended. The study finding explores the six factors with eigenvalues >1.0 as follows: 7.099, 3.097, 1.809, 1.629, 1.449, and 1.190, which explained 30.867%, 13.465%, 7.864%, 7.083%, 6.299%, and 5.173%, respectively. These three factors explained a cumulative percentage of 70.751% of the total variance, emphasising the significance of all the 15th variables of the barriers to safety incentive implementation.

Table 9 presents the pattern matrix of the BSI variables, highlighting how the twenty-three variables clustered into six factors. As observed in Table 9, the EFA returned six factors, and

TABLE 3 Delphi first-round outcome.

Barriers to safety incentives implementation	Median (M)	Mean ($\bar{x}$)	SD (σx)	IQD	Mann-Whiteny	
					Z	*P-value*
Inconsistent organisational policies	8	8.40	1.30	2.00	0.000	1.000
Inflation and economic fluctuation	8	8.07	1.33	2.00	−0.417	0.677
Insufficient information databases	8	8.07	1.39	1.50	8.390	0.060
Inadequate organisation resources forecasting	9	8.27	1.39	1.50	8.149	1.000
Poor incentives budget administration	8	8.40	0.91	1.00	−0.679	0.497
Lack of automation process for incentive design	8	7.73	1.53	2.00	−0.301	0.764
Divergence of employees and organisational goals	8	8.00	1.56	2.00	0.178	0.858
Ineffective planning performance indicators	8	7.93	1.10	2.00	0.061	0.952
Organisation financial incapability	8	7.93	1.22	2.00	−1.381	0.167
H&S programmes underfunding	8	8.07	1.39	1.00	−1.098	0.272
Manual administration of incentive process	8	7.40	1.72	1.50	−0829	0.407
Incentive fairness preference	8	7.60	1.06	1.00	−1.162	0.245
Inappropriate incentive selection approaches	8	7.80	1.32	2.00	−0.121	0.903
Falsification of report	8	8.07	0.96	2.00	−1.334	0.182
Falsification of data	8	7.93	1.22	2.00	0.000	1.000
Construction firm's systems of governance	8	8.00	1.07	2.00	0.540	0.589
Ineffective work measurement standardisation	8	7.93	0.96	2.00	0.424	0.671
Employees' loss of confidence	8	8.00	1.13	1.50	−0.302	0.762
Performance goals conflicting with workplace safety	8	7.67	1.18	1.50	−1.381	0.167
Employees' inequity perception of incentives	8	7.93	1.33	2.00	0.000	1.000
Lack of automation reporting systems	8	7.40	2.13	1.50	−0.119	0.905
Ineffective H&S policies	8	8.27	1.44	2.00	−0.359	0.720
Weak OSH enforcement framework	9	8.60	0.99	1.00	−1.026	0.305
Lack of safety incentive regulations	9	8.40	1.06	1.50	−1.152	0.249
Organisations lacking H&S programmes	8	8.20	1.26	1.50	−0.596	0.551
Lack of incentive budget for H&S	9	8.27	1.03	2.00	−0.561	0.575
Problematic organisational policies	8	8.13	0.92	1.50	0.427	0.670
Inappropriate incentive designs	8	8.07	0.96	2.00	−0.182	0.856
Employees high turnover rate	7	7.20	2.14	2.00	−0.732	0.464
Unsatisfactory safety awareness	8	8.07	1.22	2.00	−0.717	0.473
Absence of organisation incentive budgets	8	8.27	1.16	1.50	−0.657	0.511
High rate of construction workers' mobility	7	6.73	2.15	1.50	0.475	0.635

TABLE 4 Delphi second-round outcome.

Barriers to safety incentives design	Median (M)	Mean ($\bar{x}$)	Mean ranking	SD (σx)	IQD	Mann-Whitney	
						Z	*P-value*
Inconsistent organisational policies	10	9.27	1	0.96	1.00	0.253	0.801
Ineffective work measurement standardisation	9	8.73	2	0.88	1.00	−0.422	0.673
Manual administration of incentive process	9	8.67	3	0.90	1.00	−2.019	0.054
Absence of organisation incentive budgets	9	8.60	4	0.83	1.00	−0.657	0.511
Lack of safety incentive regulations	9	8.60	4	0.91	1.00	−1.152	0.249
Ineffective H&S policies	9	8.53	6	0.92	1.00	−0.359	0.720
Inadequate organisation resources forecasting	9	8.53	6	1.06	1.00	0.000	1.000
Organisation financial incapability	9	8.47	8	1.25	1.00	−1.480	0.139
Weak OSH enforcement framework	8	8.47	8	0.92	1.00	−1.026	0.305
Falsification of performance report	9	8.47	8	0.83	1.00	−1.334	0.182
Poor incentives budget administration	8	8.40	11	0.91	1.00	−0.679	0.497
Lack of incentive budget for H&S	9	8.40	11	0.83	1.00	−0.561	0.575
Ineffective planning performance indicators	9	8.33	13	1.05	1.00	−0.493	0.622
Performance goals conflicting with workplace safety	9	8.33	13	1.45	1.00	−1.075	0.283
Inflation and economic fluctuation	9	8.33	13	1.29	1.00	−0.423	0.672
Lack of automation process for incentive design	8	8.27	16	0.80	1.00	−0.301	0.764
Lack of automation reporting systems	8	8.27	16	0.59	1.00	−0.119	0.905
Falsification of performance data	8	8.27	16	0.88	1.00	0.000	1.000
Problematic organisational policies	8	8.27	16	0.88	1.00	0.427	0.670
Inappropriate incentive designs	8	8.20	20	0.86	1.00	−0.182	0.856
Organisations lacking H&S programmes	8	8.20	20	0.94	1.00	−0.596	0.551
Construction firm's systems of governance	8	8.20	20	1.01	1.00	0.540	0.589
Inappropriate incentive selection approaches	8	8.20	20	0.77	1.00	0.121	0.903
H&S programmes underfunding	8	8.07	24	1.39	1.00	−1.098	0.272
Employees' inequity perception of incentives	6	6.33	25	1.76	2.50	−0.059	0.953
Insufficient information databases	6	6.13	26	2.42	2.50	0.701	0.484
Divergence of employees and organisational goals	5	5.53	27	2.13	3.00	2.172	0.030
High rate of construction workers' mobility	5	5.20	28	2.21	4.00	0.000	1.000
Employees high turnover rate	5	5.07	29	1.75	3.50	0.299	0.765
Incentive fairness preference	5	5.07	29	1.98	4.00	1.194	0.232
Unsatisfactory safety awareness	5	4.80	31	1.90	1.50	1.142	0.253
Employees' loss of confidence	5	4.60	32	1.68	2.00	−0.478	0.633

TABLE 5 Respondents' background information.

Respondents highest qualifications	Frequency	Percentage
Bachelor's degree	112	29.6
Postgraduate Diploma	100	26.4
Master's degree	84	22.2
Higher national diploma	71	18.7
Doctoral Degree	9	2.2
National Diploma	3	1
Total	379	100
Years of working experience	Frequency	Percentage
11–15 years	160	42.2
6–10 years	132	34.8
16–20 years	55	14.5
1–5 years	21	5.5
More than 21 years	11	2.9
Total	379	100
Respondents Highest Qualifications	Frequency	Percentage
Architects	88	23.3
Builders	123	32.45
Engineers	92	24.27
Quality surveyors	76	20.05
Total	379	100
Respondents professional affiliations	Frequency	Percentage
NIA	88	23.3
NIOB	123	32.45
NSE	92	24.27
NIQS	76	20.05
Total	100	379

TABLE 6 KMO and Bartlett's test of barriers to safety incentives.

KMO and Bartlett's test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.908
Bartlett's Test of Sphericity	Approx. Chi-Square	3874.948
	Df	210
	Sig	0.000

the arrangement of their variables in each factor suggests the significance of the clustered BSI measuring variables. Likewise, the naming of the factors is guided by the inherent relationship between the variables loaded in each factor (Kothari, 2004; Bell and Bryman, 2007). A familiar name was allocated to each of the six factors as follows: Factor 1 was named "***Discrepancies in the incentive rewards process***," Factor 2 was named "***Lack of incentive budget planning***," Factor 3 was named "***Conflicting incentive performance indicators***," Factor 4 was named "***Absence of a national safety incentive policy,***" Factor 5 was named "***Construction organisations governance systems***", and Factor 6 was named "***Lack of automation in incentive implementation process***". According to Yong and Pearce (2013), a 0.40 loading cut-off was adopted based on pragmatic reasons as the minimum criterion for retaining the loading value and variables significant for the EFA factors.

4.2.2.1 First factor: discrepancies in the incentive rewards process

The five variables clustered into the first factor comprised 30.867% of the total variance, with the highest factor loading value. The loading variables include construction firms' systems of governance (79%), falsification of performance data (77%), falsification of performance reports (77%), organisation financial incapability (77%), and ineffective standard of work measurement (64%). The study findings explain barriers associated with discrepancies in the incentive rewards process in the Nigerian construction industry. This is consistent with Aina and Akinyemi (2014), Ogwueleka (2015), and Oloke et al. (2017), who admitted that the implementation of safety incentives in the construction industry is low and lacks incentives standard of measurement. Likewise, these findings were supported by Chan et al. (2010) and Naderi et al. (2023), who reported that construction organisations relying on massive administrative paperwork and intermediaries' processes and procedures are significant barriers to implementing safety incentives. The study findings align with Aina and Akinyemi's (2014) submission, which stated that uncertainty and a limited understanding of selection approaches affect the safety incentive of construction organisations. Therefore, effective safety incentive implementation requires understanding selection approaches to prevent discrepancies in the incentive rewards processes and enrich its application in the construction industry. Safety incentives are reward-based schemes encouraging employees to meet and exceed safety standards, which imply managerial implications to promote existing workplace safety procedures and highlight effective safety processes.

4.2.2.2 Second factor: lack of incentive budget planning

Furthermore, as observed in Table 9, the three variables clustered into the second factor include organisations' lack of incentive budgets (94%), problematic organisational policies (92%), and inappropriate incentive designs (87%). This factor explained a cumulative percentage of 13.465 of the total variance. Moreover, the study findings emphasise the construction industry's lack of incentive funding planning to support the implementation of safety

TABLE 7 Communalities of barriers to safety incentives.

Codes	BSI variables	Initial	Extraction
BSI1	Inconsistent organisational policies	1.000	0.646
BSI2	Inflation and economic fluctuation	1.000	0.795
BSI3	Inadequate organisation resources forecasting	1.000	0.760
BSI4	Poor incentives budget administration	1.000	0.645
BSI5	Lack of automation process in incentive design	1.000	0.752
BSI6	Ineffective planning performance indicators	1.000	0.615
BSI7	Organisation financial incapability	1.000	0.633
BSI8	H&S programmes underfunding	1.000	0.400
BSI9	Manual administration of incentive process	1.000	0.694
BSI10	Inappropriate incentive selection approaches	1.000	0.612
BSI11	Falsification of performance report	1.000	0.725
BSI12	Falsification of performance data	1.000	0.734
BSI13	Construction firms' systems of governance	1.000	0.743
BSI14	Ineffective standard of work measurement	1.000	0.676
BSI15	Performance goals conflicting with workplace safety	1.000	0.742
BSI16	Lack of automation reporting systems	1.000	0.730
BSI17	Ineffective H&S policies	1.000	0.809
BSI18	Weak OSH enforcement framework	1.000	0.770
BSI19	Lack of safety incentive regulations	1.000	0.724
BSI20	Organisations lacking H&S programmes	1.000	0.645
BSI21	Organisations lack incentive budgets	1.000	0.851
BSI22	Problematic organisational policies	1.000	0.829
BSI23	Inappropriate incentive designs	1.000	0.741

Extraction Method: Principal Component Analysis.

incentives. The findings are consistent with the view of Choi et al. (2012) and Yang et al. (2021), who attributed barriers to safety incentives implementation among construction SMEs to a lack of incentive budget and poor attitude of top managers towards safety practices. In addition, organisational financial incapability significantly affects the implementation of safety incentives. This supported the submission of Yang et al. (2021) and Zulkefli et al. (2014), who affirmed the barriers of inadequate financial resources due to the nature and size of construction organisations. Furthermore, the study findings align with Boadu et al. (2021) and Musonda and Pretorius (2015), who attributed barriers to SI implementation to a lack of construction firms' incentive budget planning and allocation to meet employees' motivation drives and improve H&S programmes. In collaboration with Abogun and Fagbemi (2012) and Ogundipe et al. (2024a), Ogundipe et al. (2024days), this study's findings show that implementing SI in the construction industry often failed due to barriers like inconsistent organisational policies, economic fluctuation or inflations, and non-available or inadequate information databases. Nonetheless, construction organisations prioritising incentive budget planning is essential for understanding and improving safety incentives implementation to meet employees' incentive drives. It will also require the firms' managerial process to align incentive budget planning with goal setting and incentive periods (short or long-term schemes). By ensuring emergency procedures are in place for all potential emergencies, training to ensure the safety of

TABLE 8 Total variance explained by barriers to safety incentives.

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings[a]
	Total	% Of variance	Cumulative %	Total	% Of variance	Cumulative %	Total
BSI1	7.099	30.867	30.867	7.099	30.867	30.867	5.325
BSI2	3.097	13.465	44.332	3.097	13.465	44.332	3.169
BSI3	1.809	7.864	52.196	1.809	7.864	52.196	2.369
BSI4	1.629	7.083	59.279	1.629	7.083	59.279	5.089
BSI5	1.449	6.299	65.579	1.449	6.299	65.579	2.820
BSI6	1.190	5.173	70.751	1.190	5.173	70.751	2.451
BSI7	0.916	3.982	74.733				
BSI8	0.709	3.081	77.814				
BSI9	0.572	2.488	80.302				
BSI10	0.523	2.276	82.577				
BSI11	0.487	2.118	84.695				
BSI12	0.454	1.975	86.670				
BSI13	0.385	1.676	88.346				
BSI14	0.371	1.612	89.957				
BSI15	0.349	1.516	91.473				
BSI16	0.332	1.442	92.915				
BSI17	0.308	1.341	94.255				
BSI18	0.271	1.176	95.432				
BSI19	0.247	1.075	96.507				
BSI20	0.217	0.943	97.450				
BSI21	0.212	0.922	98.372				
BSI22	0.203	0.882	99.254				
BSI23	0.172	0.746	100.000				

Extraction Method: Principal Component Analysis.
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

workers, and controlling risks and hazards through elimination and minimization.

4.2.2.3 Third factor: conflicting incentive performance indicators

The four variables loaded into the third factor explained 7.864% of the total variance. The variables are organisations lacking H&S programmes (78%), ineffective planning performance indicators (59%), H&S programmes underfunded (58%), and poor incentives budget administration (50%). The component barriers are associated with conflicting incentives, performance indicators, and evaluation. Moreover, ineffective planning incentives performance indicators supported the view of Laitinen et al. (2013) and Haas and Yorio (2016) that not prioritising performance indicators (KPIs) for safety incentives constitutes a challenge in the construction industry. The study findings further identified

TABLE 9 Pattern Matrix[a] of barriers to safety incentives implementation.

BSI variables	Component					
	1	2	3	4	5	6
Construction firms' systems of governance	0.806					
Falsification of performance data	0.757					
Falsification of performance reports	0.739					
Organisation financial incapability	0.725					
Ineffective standard of work measurement	0.638					
Organisations' lack incentive budget		0.939				
Problematic organisational policies		0.921				
Inappropriate incentive designs		0.865				
Organisations lacking H&S programmes			0.778			
Ineffective planning performance indicators			0.587			
H&S programmes underfunded			0.578			
Poor incentives budget administration			0.499			
Ineffective H&S policies				0.902		
Weak OSH enforcement framework				0.841		
Performance goals conflicting with workplace safety				0.804		
Lack of automation reporting systems				0.786		
Lack of safety incentive regulations				0.634		
Inflation and economic fluctuation					0.826	
Inconsistent organisational policies					0.806	
Inadequate organisation resources forecasting					0.796	
Manual administration of incentive process						0.778
Inappropriate incentive selection approaches						0.734
Lack of automation process in incentive design						0.568

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization. a. Rotation converged in 19 iterations.

performance goals conflicting with workplace safety. This agrees with Karakhan and Gambatese (2018) and Brandhorst and Kluge (2021), who state that safety incentive schemes could become ineffective if the performance goals conflict with workplace safety and create tension. In addition, the study aligns with Aina and Akinyemi (2014) and Jiang et al. (2019) that the non-availability of standardised work measurement techniques and inconsistent performance indicators standards influence the effective implementation of safety incentives. Therefore, effective implementation of safety incentives requires prioritising precise goal setting, regularly reviewing performance evaluation, aligning incentive goals and rewards, and standardising work measurement to overcome conflicting performance indicators when implementing SI in the construction industry.

4.2.2.4 Fourth factor: absence of a national safety incentive policy

In addition, the five variables clustered into the fourth factor include ineffective H&S policies (90%), weak OSH enforcement framework (84%), performance goals conflicting with workplace

TABLE 10 Factor correlation matrix of barriers to safety incentives implementation.

Component correlation matrix						
Component	1	2	3	4	5	6
Discrepancies in the incentive rewards process	1.000	0.178	0.145	0.456	0.159	0.200
Lack of incentive budget planning	0.178	1.000	0.133	0.174	0.274	0.091
Conflicting incentive performance indicators	0.145	0.133	1.000	0.123	0.199	0.072
Absence of a national safety incentive policy	0.456	0.174	0.123	1.000	0.162	0.201
Organisational policies and resource fluctuation	0.159	0.274	0.199	0.162	1.000	0.010
Lack of automation in the incentive implementation process	0.200	0.091	0.072	0.201	0.010	1.000

Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.

safety (80%), lack of automation reporting systems (79%), and lack of safety incentive regulations (63%). The five variables clustered in the fourth factor represented 7.083% of the total variance. Equally, a lack of safety incentive regulations and ineffective H&S policies significantly impacted identified safety incentive implementation barriers. This agrees with the conclusion of Boadu et al. (2021) and Kheni and Braimah (2014), who affirmed that the absence of H&S legislation and lack of safety incentive regulations invariably defeats the purpose of implementing H&S standards on construction sites. Furthermore, these agree with Kheni and Braimah (2014) and Boadu et al. (2021), who attributed barriers to safety incentives in the construction industry to a lack of appropriate incentive schemes, ineffective OHS regulations, standards and policies, and problematic organisational policies. Also, it aligns with Goodrum and Gangwar (2004) and Shui et al. (2014), who affirmed that safety incentives implementation would be ineffective with organisations lacking H&S programmes that address culture, record keeping, training and management commitments, among others. This underscores the maturity of the construction industry in developing countries, particularly Nigeria, as the absence and non-enforcement of H&S policy affects the development policy supporting incentives implementation in the construction industry. Thus, an effective national incentives policy is essential for implementing safety incentives in the construction industry. Furthermore, a national incentives policy will also guide the construction industry on safety incentive templates and performance indicators.

4.2.2.5 Fifth factor: construction organisations' governance systems

Also, as observed in Table 9, three variables are in the fifth factor, which explains 6.299% of the total variance. These variables include inflation and economic fluctuation (83%), inconsistent organisational policies (81%), and inadequate organisation resources forecasting (80%). The study findings also aligned barriers to safety incentive implementation to the construction organisations' governance systems. The study findings align with Aina and Akinyemi (2014), who affirm that construction organisations' governance systems and strategies often affect the effective implementation of safety incentives. These findings were in contrast with Kheni (2018) and Choi et al. (2012), the construction industry has difficulty implementing effective safety incentive schemes because of the high turnover rate of workers, high mobility of workers, and workers who are less familiar with the workplace environment. Therefore, understanding construction industry governance systems is essential for stakeholders to implement safety incentives effectively.

4.2.2.6 Sixth factor: Lack of automation in the incentive implementation process

The three variables clustered in the sixth factor had the most minor loading factors, explaining 5.173% of the total variance. The variables are manual administration of incentive process (78%), inappropriate incentive selection approaches (73%), and lack of automation process in incentive design (57%). The study findings highlight barriers associated with inadequate innovative knowledge of safety incentives. These barriers aligned with the view advanced by Sheppard et al. (2020) and Naderi et al. (2023) that the lack of automated systems that accurately measure performance indicators of safety incentives constitutes a significant barrier to safety incentives implementation. Likewise, it agrees with Naderi et al. (2023), who attributed manual administration of incentive processes as one of the significant barriers to safety incentive implementation in the construction industry. The stakeholders in the construction industry need to understand how safety incentives work for their organisations and increase their knowledge of integrating automation processes into safety incentives implementation.

Likewise, Table 10 shows the relationship of the BSI variables clustered in the component correlation matrix, with values above 0.300, indicating the relationship between the variables of these factors as recommended (Field, 2005; Pallant, 2016).

5 Conclusion and recommendations

Through an exploratory sequential mixed method, this study examines barriers to implementing safety incentives to enrich its application among construction firms within the Nigerian construction industry. Thirty-two barriers to implementing safety incentives were identified from the literature review and validated using the exploratory sequential mixed method. Nonetheless, twenty-four out of the thirty-two identified barriers were established through the expert panellists to significantly prevent construction firms in the Nigerian construction industry from implementing safety incentives. The twenty-four barriers to safety incentives implementation established by the Delphi survey were clustered into six factors as follows using EFA: discrepancies in the incentive rewards process, lack of incentive budget planning, conflicting incentive performance indicators, absence of a national safety incentive policy, construction firms' governance systems, and lack of automation in the incentive implementation process. Understanding these six cluster barriers is required to guide construction firms in effectively implementing safety incentives. Therefore, the study findings provide construction firms, stakeholders, government, safety managers, and policymakers with the knowledge and strategies to develop a national safety incentive policy, integrate automation process, and budget planning to improve safety incentives implementation in the construction industry. It also provides proactive approaches to improve construction H&S practices and initiatives towards attaining pillar one of Africa Agenda 2063 and sustainable development goals (SDGs) three and eleven to offer a high standard of living, quality of life, and wellbeing.

This study's findings provide theoretical and practical implications for improving the application of safety incentives in the construction industry. Theoretically establishes twenty-three barriers to implementing safety incentives in the Nigerian construction industry. It also provides a solid theoretical base for future studies on the safety incentives framework in the construction industry. The practical implication of this study implies that construction stakeholders, government agencies, professional institutions, safety managers, and policymakers should develop a national safety policy to promote the implementation of safety incentives. The study provides actionable recommendations for construction stakeholders and firms to adopt findings when implementing safety incentives. These actionable strategies include prioritising incentive budget planning, scheme selection approaches, and key performance indicators to improve safety incentive implementation. Likewise, the study calls for construction stakeholders' commitment to developing safety incentives and performance goals that will not conflict with workplace safety and create workplace tension among workers. It also requires integrating automation processes into implementing safety incentives in the construction industry.

The study focuses on the barriers to safety incentives implementation in the construction industry, and the data analysed is limited to the perspective of construction professionals who are architects, builders, engineers, and quantity surveyors with academic and professional practice experience in Lagos, Nigeria. The study informs future research to explore the identified gaps to improve the safety incentives framework in the construction industry. In addition, further study could examine the perspectives of construction site operatives on identified barriers to safety incentives implementation in the construction industry.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material; further inquiries can be directed to the corresponding author.

Author contributions

KO: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Resources, Validation, Writing – original draft, Writing – review and editing. CA: Conceptualization, Methodology, Project administration, Supervision, Visualization, Writing – review and editing. BO: Conceptualization, Investigation, Methodology, Project administration, Supervision, Visualization, Writing – review and editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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