OmniaScience

Journal of Industrial Engineering and Management
JIEM, 2020 – 13(2): 371-401 – Online ISSN: 2013-0953 – Print ISSN: 2013-8423
https://doi.org/10.3926/jiem.3099

Key Performance Indicators (KPIs) to Promote Building Developers Safety Performance in the Construction Industry

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Received: January 2020
Accepted: May 2020

Abstract:

Purpose: The aim of this study is to establish key performance indicators (KPIs) that can be deployed in the evaluation and promotion of safety performance of building developer's in Nigeria.

Design/methodology/approach: A thorough review of the literature was performed to generally identify sets of KPIs used to evaluate the safety performances of building developer's during construction. Interviews and focus group discussions were conducted with eleven (11) subject matter experts and professionals to ensure inclusion, validation and clarity of the indicators and to further provide agreement/disagreement, and importance ratings for the identified KPIs. The KPIs was grouped into appropriate categories, keeping out redundant KPIs, and ensuring KPIs are clear and measurable. The Relative Importance Index (RII) and Mean values were computed.

Findings: Results from the study consist of 137 KPIs, grouped into 9 categories including: Planning, design and procurement, communication on & maintenance of effective safety behaviour, construction safety policy, construction safety personnel, management effort and support, safety training and enlightenment, administration of safety processes, investigation and reporting of accidents, and rewards and sanctions for project stakeholders. These KPIs were observed to be at different levels of importance from the respondents. The following KPIs were considered based on their extreme importance judging from the respective RII values: communicating safety requirements to designer (98.18%), safety performance set as part of contractor selection criterion (96.36%), availability and accessibility of the relevant insurance policies (98.18%) and appropriate issuance of motivational directives by the top management (100%).

Originality/value: Many studies have been done in the past where KPIs as it relates to construction safety were identified. However, the specificity of these KPIs to countries other than Nigeria requires similar research be conducted to identify building developer safety performance KPIs for the Nigerian construction industry

Keywords: construction safety, key performance indicators KPIs, building developers, assessment, construction safety performance

To cite this article:

Mahmoud, A.S., Ahmad, M.H., Yatim, Y.M., & Dodo, Y.A. (2020). Key performance indicators (KPIs) to promote building developers safety performance in the construction industry. *Journal of Industrial Engineering and Management*, 13(2), 371-401. https://doi.org/10.3926/jiem.3099

1. Introduction

Nations all over the world consider the construction industry as a major stimulant to their economic growth and development (Okoye, Mbakwe & Igbo 2018). According to Alarcón, Acuña, Diethelm and Pellicer (2016) the construction industry is project-based with many stakeholders consisting of professionals such as designers, building developers, contractors, subcontractors and workers among others working as a team to achieve a common goal. In achieving such goal, however, the life of workers is always threatened by occupational hazards. The complex nature of the activities carried out in building construction as noted by Muiruri & Mulinge (2014); Suárez-Sánchez, Carvajal-Peláez and Catala-Alis (2017) lead to various impacts on the health and safety of workers with occupational risks during building production. Gambatese and Behm (2008) opine that despite the numerous ongoing research, accident still occurs.

Diugwu and Baba (2014) suggested that, successful delivery of the project depends on the level of compliance with safety regulations. This has led to the establishment of Occupational Safety and Health Administration (OSHA) to enforce safety laws and regulations (Jaselskis, Anderson & Russel 1996). Occupational safety forms part of operations on construction site as various skills and activities are required to be done in an environment that is safe (Wachter & Yorio, 2014). In addition, a number of research have been conducted globally in order to improve the safety performance of the construction industry (Alarcón et al., 2016; Choudhry, Fang & Mohamed, 2007; Jannadi & Almishari, 2003; Misiurek & Misiurek, 2017; Okoye, Ezeokonkwo & Ezeokoli, 2016). Many research efforts have been considered at several levels, such as design for safety", "safety culture", "safety climate", and "behaviour base safety BBS" (Choudhry, 2014; Choudhry, Fang & Mohammed, 2007; Fang & Wu, 2013; Toole & Gambatese, 2008). In spite of the wide recognition of the importance of safety in the construction industry, it appears there is rare research conducted to identify building developer's safety performance indicators. Thus, it becomes pertinent to have developed some KPIs which will guide the building developer's commitment to safety performance before and throughout the construction stages. Besides, these elements will give an enabling environment for the industry.

Key Performance Indicators (KPIs) are used as a marker, or sign to assess the level of a construction safety on site, and thus, determine its specific quality and performance (Lavy, Garcia & Dexit, 2014a,b). Also, the KPIs refers to a tool used to assess the efficiency of a facility either completed or under construction and are usually documented, which is a common construction industry approach (Preiser, Rabinowitz & White, 1987). Lavy, Garcia and Dixit (2014a,b) amongst other researchers that identified the effectiveness of KPIs in the assessment of building performance and highlighted the significance of establishing KPIs for effective performance evaluation. However, KPIs differs in relation to the reason of assessment and typology of facility being examined and the case study at hand (Kim, Yanq, Yeo & Kim, 2005). Previous research has sought to identify a set of causes of accidents and performance indicators to assess the safety performance of various construction stakeholders. But, there are only a few studies that have done toward building developer safety performance (Jensen, Laustsen & Jensen, 2016). Therefore, this paper seeks to establish KPIs ideal for building developer in Nigeria. Gambatese (2000) established six 6 criteria for safety program to be successful with low injury or accident rate, the six factors can be used as a guide by building developers to ensure safety responsibilities. These factors include: (1) indicate a clear position with regard to safety; (2) ensure that safety issues are considered during project planning and design phase; (3) consider contractor previous performance on safety during the selection process, contractual agreement should address safety issues; (4) designate safety duties during the construction process; (5) take part in all project safety process during construction. Also, Construction Industry Institute - CII (2015) identified many best practices that address construction safety on the project site, these include safety planning, participation by top management, safety training and education, recognition and rewards, accident investigation and reporting. Accordingly, this study adapted 5 criteria from the work (Construction Industry Institute - CII, 2015) and 4 other criteria from the work of Gambatese 2000 as dependent variables. Thus, nine performance elements for building developers were established to ensure safety during planning, design and construction phases. The elements include: (1) the Planning, design and procurement.; (2) Communication & maintenance of effective safety behaviour; (3) construction safety policy, (4) construction safety personnel; (5) management effort and support, (6) safety training and enlightenment, (7) administration of safety processes, (8) investigation and reporting of accidents, (9) rewards and sanctions for

project stakeholders. Thus, the objective of this paper is to establish a set of KPIs as a causal factor for each of the 9 elements for building developer to assess their safety performance.

2. Research Methodology

To achieve the objective of this research, the following activities were undertaken:

- An extensive literature review was conducted to source for the broad and different KPIs appropriate to evaluate the building developers' safety performance.
- KPIs is grouped into appropriate categories, leaving out redundant KPIs, and ensuring the KPIs are unambiguous and measurable.
- Interviews and focus group discussions with eleven (11) member panel of experts and professionals were conducted to ensure inclusion, validation and clarity of the indicators and to further provide agreement/disagreement, and adequate ratings for the identified KPIs.
- Statistical analysis was performed on the results to derive the rate of agreement/disagreement with the identified KPIs, as well as the computed Relative Importance Index (RII) and the Mean Value and finally the level of importance.
- Panel member's main business includes: design, construction supervision and property development, and they all acknowledge the significance of safety on site. Details of panel members are presented in Table 1.

Profile	Subgroup	Number	Percentage of respondents
Gender			
	Male	3	27.3%
	Female	8	72.7%
Age			
	20-30	1	9.1%
	31-40	4	36.4%
	41-50	4	36.4%
	> 51	2	18.2%
Education level			
	PhD	0	0.0%
	Masters	10	90.9%
	Bachelors	1	9.1%
Work experience in construction industry in years			
	6-10	4	36.4%
	11-20	5	45.5%
	21-30	2	18.2%
Professional certification			
	FNIA	2	18.2%
	MNIA	3	27.3%
	CSP	2	18.2%
	COREN	1	9.1%
	Others	3	36.4%

Profile	Subgroup	Number	Percentage of respondents
Current engagement /designation			
	Representative ministry of labour	1	9.1%
	Former president NIA	1	9.1%
	Building development control (Public sector)	2	18.2%
	University lecturers	2	18.2%
	Others (private sector)	5	45.5%

Note: FNIA-Fellow Nigerian Institute of Architect, MNIA- Member, Nigerian Institute of Architect, CSP- Certified Safety Professional, COREN- Council for the Regulation of Engineering in Nigeria.

Table 1. Panel member's profile

3. Key Performance Indicators for Building Developer

Øien, Utne, Tinmannsvik and Massaiu (2011) maintain that performance indicator is considered to measure both qualitative and quantitative data, which seeks to generate information on a matter of concern with safety. They are used as indicators to assess the level of construction safety on site and it determines the quality of performance (Kim, Yanq, Yeo & Kim, 2005). Herrera (2012) also upholds that, performance indicators play a vital part in providing information on organizational performance, increasing organizational potential for safety and motivating people to work in safety. Performance indicators, however, are not universal, and may vary according to the evaluation purpose and the case study at hand (Kim, Yanq, Yeo & Kim, 2005). Thus, Hale (2009) state that the main function of the performance indicators is to direct the sociotechnical activity in the organization by motivating certain safety-related activities such as the practices, abilities, skills and motivation of the personnel, the organizational potential for safety. Hale also acknowledges that organizations will improve significantly if performance indicators are used for operations. However Okoro, Musonda and Agumba (2017) posit that understanding and managing organizational processes and practices is becoming a primary concern of safety management system. Herrera (2012) concludes that in order to be in controls of a site, it becomes necessary to have the required information such as safety performance indicators so as to avoid what may occur in the future like accidents. Though, many studies, like Reiman and Pietikäinen (2012), Shea, De Cieri, Donohue, Cooper and Sheehan (2016); Sinelnikov, Inouye and Kerper (2015) have been carried out to identify indicators such as "leading" and "lagging" indicators to evaluate the safety performance on site. However, lagging indicator is based on the premise of an accident occurring and taking action that is reactive. Thus, Hale (2009) argues that performance indicators are geared toward being proactive.

A number of research studies have pursued to identify the causes of construction accident and performance indicators (KPIs) for the various stakeholders in the construction industry (Chan & Chan, 2004; Lavy et al., 2014b; Takim & Akintoye, 2002). Thus, many studies have mentioned construction safety policy, planning, procurement and design, construction safety personnel, communication & maintenance of effective safety behavior, management effort and support, safety training and enlightenment as important factors in ensuring safety on construction sites (Ajayi, 2016; Alzahrani & Emsley, 2013; Dodo, 2012; Farooqui, 2011; Gambatese & Hinze, 1999; OSHA, 2015; Teo & Lin, 2005). In addition, administration of safety processes, accident reporting and investigation, rewards and sanctions for project stakeholders (Hinze & Gambatese, 2003; Karakhan & Gambatese, 2017; Umeokafor, Kostis, Lundy, Isaac, Stuart, Igwegbe et al., 2014; van der Molen, Basnet, Hoonakker, Lehtola, Lappalainen, Frings-Dresen et al., 2018) were acknowledged to influence the level of safety performance of a construction site. In summary, the 137 KPIs, grouped into 9 distinctive categories for this study were garnered from reviewing literature, design guidelines, published research papers, technical report and documents. These categories are summarized in Tables 2-9, along with their respective references. Descriptions of the 9 categories are presented in the sections that follows.

3.1. Construction Safety Policy

The American Society of Civil Engineers - ASCE (2012) established that policy statement outline developer's responsibility as the pillar for improving safety performance. The policy suggested that developer's should take an active role and consider safety based on the specific project. The policy should have provision for contractor's selection based on safety records (Construction Industry Institute - CII, 2015). Xinyu and Hinze (2006) also suggest that the contractor selection should be centered on the contractor that have established safety program. In addition, Gambatese (2000) also mentioned that building developer should be proactively engaged in all phases of project management in all issues relating to safety. The study by Xinyu and Hinze (2006) concluded that a building developer can positively impact project performance by active participation at the conceptual phase. Agwu (2012) identified that total safety management, when integrated in the policy of the organizations, has the potentials of enhancing safety practices on construction sites, it is recommended that for enhanced development of individuals and organizations, improved occupational safety policy is a paramount investment in terms of precautions and safety intelligence. Inuwa, Githae & Diang (2014) reported that comprehensive safety policy requires that safety be reflected at all project phases. It is obvious that the safety performance of workers has a strong link with safety policies of the building developer.

3.2. Planning, Design and Procurement

The participation of building developer at all project phases is a fundamental requirement for zero accidents on the project site (Gambatese & Hinze, 1999; Hallowell & Hansen, 2016). The developer is the main party in the construction industry and the beneficiary of the end product, thus, play a very significant role during the construction project life circle (Biswas, Bhattacharya & Bhattacharya, 2017; Jazayeri, Liu & Dadi, 2017). Usually, the building developer request the services of the designer, contractor and other industry stakeholder in the delivery of the built facility (Bello, 2012; Haslam, Hide, Gibb, Gyi, Pavitt, Atkinson et al., 2005). In line with the developer's scope of work, the designer produce the construction drawings and the contractor implement it on the site to make it a reality. Many industry practitioners perceive that safety is the responsibility of the contractors neglecting the role of other stakeholder that play a vital role in preventing the menace of accident during project execution (Heinz, Hallowell & Baud, 2013; Toole & Gambatese, 2008). To achieve high safety performance Huang and Hinze (2006); opined that it is essential the inclusion of safety issues at the planning stage and also providing financial support to the contractor with site monitoring. A number of researchers clarify that architect and engineers have a leading impact on the much desired safety performance on site with zero injury tolerance (Tymvios & Gambatese, 2016). A study conducted by Gambatese, Behm and Hinze (2005) established that 42% of accident at construction site are linked to the safety design concept during the early stage. However, due to the lack of commitment from the stakeholders, designers produce working drawings without consideration to the safety during implementation. Also, according to European Foundation for the Improvement of Living and Working Conditions (Eurofound) (1991), 60% of project accident can be mitigated if safety decision is considered at the design stage. Sadeghi, Mathieu, Tricot and Al Bassit (2015), Zhou, Whyte and Sacks (2012) opined that safety during construction project site is best determined during the early stage of planning and design conceptualization. A research conducted by Szymberski (1997) reported that construction safety is significantly impacted when safety on site is considered at the conceptual level. As shown in Figure 1 adapted from Szymberski (1997), the time/safety influence curve, demonstrate the part at which safety can be impacted for most desirable. Additionally, Anumba (1999) reported that there is an economic benefit when safety is considered at the design stage. Construction Industry Institute - CII (2003), state that considering safety at the design stage demonstrate management effort and safety commitment, and firms that implement such strategies reported fewer accidents.

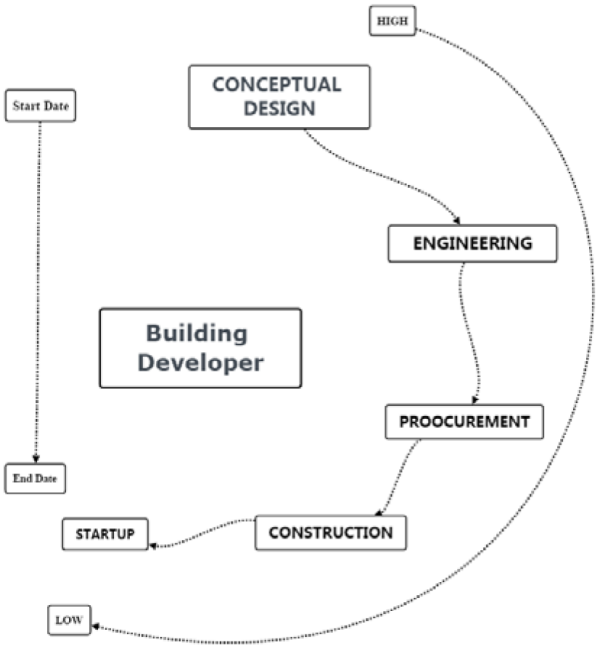

Figure 1. Time/safety influence curve (Szymberski, 1997)

3.3. Construction Safety Personnel and Safety Culture

Safety personnel relate to the safety and health officer who supervise the worker activities on a construction site (Gunduz, Birgonul & Ozdemir, 2017). These activities point to the safety performance and approaches of the workers and the management in the construction industry (Biggs & Biggs, 2013). Dingsdag, Biggs and Sheahan (2008) reported that there is a need for the engagement of safety personnel to handle the impediments to worker operations. In addition, Gunduz et al. (2017) revealed that, safety performance have proved to be positively impacted by the existence improvement in safety personnel on the project site. Zwetsloot, Kines, Ruotsala, Drupsteen, Merivirta and Bezemer (2017) recommended that safety culture covering specific factors like commitment of the management, involvement of safety personnel and adoption of safety regulations with enforcement without compromise impact significantly on the overall safety performance of a company. In a research aimed at reviewing accidents and violation of safety regulations on Nigerian construction sites, (Mahmoud, Sanni-Anibire Hassanain & Ahmed, 2019; Aniekwu, 2007) found professionals and workers on site responsible for most accidents occurring on a site which requires a zealous effort of safety managers for the coordination of personnel and materials on site. However, this view contradicts the view of Mudi, Bioku, & Kolawole (2015) that linked the occurrence of accidents on construction sites to indiscipline among workers, poor strategies of communication and conditions of the site.

3.4. Communication & Maintenance of Effective Safety Behaviour

An efficient communication between supervisor, construction workers and the management effectively provide a better and improve compliance to safety policies and standards (Ling, Liu & Woo, 2009). The efficiency of conveying such information is subject to the diverse ways, for example, everyday tool box meetings, posters and bulletin board (Park & Kim, 2013). The management efforts toward safety will establish a basis for the various means of communicating the needed information to all levels of workers on the project site (CPWR, 2008). Injuries and accidents on a construction site may happen due to poor behaviour and attitudes of workers (Vinodkumar & Bhasi, 2010). There is a direct correlation between workers' behaviour and performance of safety on construction site. Moreover, poor worker behaviour and attitudes and their negligence to safety has encourage more construction workers not to use safety gears (Idoro, 2008). In this respect, workers skills and knowledge must be translated into the commitment approach based on establishing procedures, policies or regulations and must stem out of motivation to work safely (Filstad, 2011).

3.5. Management Commitment and Support

According to Zwetsloot et al. (2017) safety commitment is the extent to which organizational leadership is represented by the willingness to prevent and promote safety as part of organizational goals, values and morale. Safety performance is a concept of commitment approach based on establishing safety program. Thus far, due to increased interest toward safety commitment, several studies have been undertaken to examine how commitment can improve safety performance globally (Huang, Verma, Chang, Courtney, Lombardi, Brennan et al., 2012; Zwetsloot, et al., 2017). While the significance of safety commitment in improving safety performance is widely accepted. Many literature demonstrate how commitment served as an effective tool in improving safety performance (Abudayyeh, Fredericks, Butt & Shaar, 2006; Barling & Hutchinson, 2009; Michael, Evans, Jansen & Haight, 2005; Zwetsloot et al., 2017) this has necessitated the construction industry to embrace the concept of commitment. Suraji, Duff and Peckitt (2001) shows a research conducted by the Health and Safety Executive (HSE) indicates that 75% of serious accident in the construction industry are mostly initiated by lack of management's commitment and effective support. De Silva and Walimalaratne (2012) established that the construction company with good safety performance is due to management support and commitment toward safety on the project site. Farooqui (2011) indicate that zero accident is achievable when management are committed to safety improvement and upholding to established industry standards.

3.6. Administration of Safety Processes

Safety administration and processes denote management of work activities on the construction site that is detrimental to the well-being of workers (Tappura, Nenonen, & Kivistö-Rahnasto, 2017). The process of production in construction projects is evidently hampered by failure to comply with safety practice. Umoh and Torbira (2013) suggested that attitude of workers and how they behave towards the delivery of their works while minimizing accidents and increasing output is the major driver of safety practice. In his view, however, Smallwood (2002) opines that accidents cannot be avoided in the building industry and is more of a component in building production process due to the danger inherent in it; which negatively affects adherence to safety regulations. Mahmoud, Sanni-Anibire Hassanain and Ahmed (2019) found that professionals and workers on site are responsible for most accidents occurring on a site. However, this view contradicts the view of Mudi et al. (2015) that linked the occurrence of accidents on construction sites to indiscipline among workers, poor strategies of communication and conditions of the site. The main issues in managing construction site processes is the efficiency of control of many subcontractors, operating on the construction site due different specialization in trades, as such the chances of high accident occurrence will increase (Ali, Kamaruzzaman & Sing, 2010). Moreover, sometimes contractors transfer safety responsibility to the subcontractors, thus, workers operate with unsafe practice in an unsafe environment (Shen, Ju, Koh, Rowlinson & Bridge, 2017). Various method of construction on project site must meet different construction safety standards, policy, procedure and program. Accidents occur due to unsafe actions or unsafe conditions of work (Kadiri, Nden, Avre, Oladipo, Edom, Samuel & Ananso, 2014). Accidents occur when unskilled workers are tasked to undertake a work they are not skilled enough to handle like loading unsafely, arranging and placing, non-use of safety/protective equipments, and exposure to hazardous materials and stressed (Wu, Li & Fang, 2017).

3.7. Rewards and Sanctions for Project Stakeholders

Safety rewards are a method used in the construction industry to motivate workers to foster safety procedure and worker behaviour (Zhang, Zhou, Zhuang & Zhu, 2015). Though, expensive and appropriate for short term (Fass, Yousef, Liginlal & Vyas, 2017). Reward and sanction are introduce on site to signal a commitment to safety performance (Gu & Yang, 2015). The Construction Industry Institute - CII, indicated that the most effective method is having a written safety incentive program (Construction Industry Institute - CII, 2015). Appreciation, for demonstrating a good safety procedure should be acknowledged to motivate workers (Ghasemi, Mohammadfam, Soltanian, Mahmoudi & Zarei, 2015). However, Funso, Sammy and Gerryshom (2016) is of the view that financial reward may compromise worker's performance on safety, more so, economic reward may hinder workers to report all near misses, incident, or even accident. Thus, the study suggested a form of acknowledgement or written appreciation will boots significantly the morale of workers. Molenaar, Park and Washington (2009) identified that

social incentive is an influential index for worker safety performance. Accordingly, workers should be actively engaged in the policy formulation and review process that will empower them to consider the risk at all levels of project execution. Though Fass et al. (2017) research findings support the system of financial reward which they argued reduced construction accident. Other researchers illustrates that despite the introduction of safety incentive, the accident situations did not change much (El-Nagar, Hosny & Askar, 2015). Also, Alarcón et al. (2016) and Jaraiedi, Plummer and Aber (1995) debated that incentive do not significantly impact on the safety performance. Molenaar et al. (2009) indicated that incentive effectiveness depends on how they are being allocated. On the other hand, Aksorn and Hadikusumo (2008) opined that incentive and sanction on safety performance do not necessarily resulted in the anticipated output of improving safety, but rather depend on the relationship of the different stakeholders in a project. Therefore, evaluating the workers attitude and behaviour toward safety operation before engaging a contract will be able to produce a desired outcome. Building developer should identify policies, approached and strategies inculcate safety culture before and during the project implementation, though, the project completed within a time frame should be considered. (Choi & Kwak, 2012).

3.8. Investigation and Reporting of Accident

Accidents happen in all kinds of construction project, the majority of accidents on construction site are as a result of unsafe environment and unsafe act (Khosravi, Asilian-Mahabadi, Hajizadeh, Hassanzadeh-Rangi, Bastani & Behzadan, 2014; Alarcón et al., 2016). Identifying and eliminating construction accident on the project site is not always possible without identifying the causal factor through accident investigation. A number of preventive methods are acknowledged to protect workers from project site hazards or to reduce the severity of the accident. These methods involve the use of guardrail systems, safety harnessing systems, safety signs and housekeeping (Chi, Chang & Ting, 2005). The accident investigation is aimed at the determining of all root causes of accidents and suggesting that measure should be taken to prevent future recurrence. Wu, Gibb and Li (2010) establish that company that tract incident and near misses have improved safety performance, the research also discovered that companies having a sufficient record of near misses have lower accident and injury rates. Thus, addressing the causal factor would prevent the incident from happening again, hence it will strengthen the safety performance of the company.

3.9. Safety Training and Enlightenment

Choudhry and Fang (2008) established that construction workers that received formal safety training and orientation record lower injury rates compared to workers that received informal orientation. OSHA (2015), indicates that part of the features of a safer firm are providing workers on the project site with training and orientation before commencing work. The International Labour Organization - ILO (1995) also promoted safety and health on construction with emphasis on training by adopting the 1988 Safety and Health in Construction Convention (No. 167), and Recommendation (No. 175). Tackett, Goodrum and Maloney (2006) shows that significant safety enhancement can be achieved by application of construction site safety training on all projects, formalized supervisor training, hiring a full-time corporate training director, computerized tracking of worker training and increased evaluation of workers' skills and knowledge upon hiring. Nevertheless, the majority of the study indicate safety orientation and training have to be considered as a prerequisite before engaging constructors on a project. Safety passport training's modules should be introduced at every construction site.

4. Results and Findings

4.1. Assessment of the KPI Questionnaire Survey

The respondents' assessments of the questionnaire survey were analysed based on the Relative Importance Index (RII) calculated according to the following equation (Dominowski, 1980; Hassanain, Sanni-Anibire, Mahmoud & Hamida, 2019):

$$\mathrm{RII} = \frac{\sum_{i=0}^{5}(a_i)\,(x_i)}{5\sum x_i} \times 100\% \quad (1)$$

Where a_i is the constant representing the weight assigned to i; and x_i is the variable representing the frequency assigned to i. The response for i is 1, 2, 3, 4, 5, and is illustrated as follows:

- x_0 = frequency of "Extremely Important" response corresponding to $a_0 = 5$.
- x_1 = frequency of "Very Important" response corresponding to $a_1 = 4$.
- x_2 = frequency of "Important" response corresponding to $a_2 = 3$.
- x_3= frequency of "Somewhat Important" response corresponding to $a_3 = 2$.
- x_4 = frequency of "Not Important" response corresponding to $a_4 = 1$.

For the quantification of the level of importance for each of the KPIs, the following range was adopted:

- An RII value within (0 ≥ 12.5%) implies that, the respondents categorized the KPI as "not important".
- An RII value within (12.5 ≥ 37.5%) implies that, the respondents categorized the KPI as "somewhat important".
- An RII value within (37.5 ≥ 62.5%) implies that, the respondents categorized the KPI as "important".
- An RII value within (62.5 ≥ 87.5%) implies that, the respondents categorized the KPI as "very important".
- An RII value within (87.5 ≥ 100%) implies that, the respondents categorized the KPI as "extremely important".

Tables 1-9 is an illustration of the various KPIs in 9 categories, with their corresponding agreement levels, as well as their RII values, mean value and levels of importance. Also referred findings from similar authors that were reviewed.

4.2. Planning, Design and Procurement

Results in Table 2, which shares similar findings with other researchers, indicate that respondents unanimously agreed on the inclusion of 24 KPIs in the Planning, design phase and procurement. except in 7 places where about 22 respondents differed in opinion. Also, 16 KPIs in this group (preconstruction) were ranked "extremely important" with RII values above 87.5%. These include: Safety related issues considered in the feasibility study (RII of 96%), communicating a safety requirement to the designer (RII of 98%), and Safety performance set as part of contractor selection criterion (RII of 96%). Contractor accident and injury rates (RII of 100%), availability of insurance policy (RII of 100%), safety requirements are outlined in the contract document for preselected contractors (RII of 100%), available plan for report of injury and incidents on site by the contractor (RII of 100%) were among the KPIs ranked with RII values at 100%. Availability of plan on accidents mitigation to be submitted by the contractor (RII of 98%), meeting up the benchmark for "extremely important" KPIs. Although 3 KPIs were rated "important" in this category.

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
	Design Firm Engagement							
1	Safety related issues considered in the feasibility study during the design conceptualization phase	11		96.36	4.72	0.47	EI	(Bello, 2012; Luo & Van Den Brand, 2016; van der Molen et al., 2018)
2	Responsiveness of design firms towards safety to forms the bases for their selection	3	8	80.00	3.91	0.70	VI	(Umeokafor 2017; Weidman, Dickerson & Koebel, 2015)

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
3	Construction safety constructability considered by designers	11		94.55	4.64	0.67	EI	(Gambatese et al., 2008)
4	Engaging safety professionals to review the design.	11		92.73	4.55	0.69	EI	(Weinstein, Gambatese, Asce & Hecker, 2005)
5	Design decisions that impact safety on construction worker	11		81.82	4.45	0.52	VI	(Gambatese et al., 2005)
6	Communicating safety requirement to designer.	11		98.18	4.82	0.40	EI	(Saifullah & Ismail, 2012)
7	Building developers safety professionals are engaged in reviewing the design along with the designers to ensure safety during the construction phase.	11		92.73	4.64	0.50	EI	(Gambatese, Asce, Toole, Asce, Abowitz, Asce et al., 2017)
	Contractor Selection							
8	Safety performance sets as part of contractor selection criterion	11		96.36	4.72	0.47	EI	(Construction Industry Institute - CII, 2015)
9	Safety forms a criterion for prequalifying contractors	9	2	89.09	4.18	0.75	EI	(Construction Industry Institute CII, 2015)
10	Contractor accident and injury rates.	11		94.55	4,73	0.46	EI	(Xinyu & Hinze, 2006)
11	Considering safety awards received by the contractor.	8	3	56.36	2.82	1.08	I	(Hinze 2002; Dodo, 2012)
12	Safety programs applicable to the services to be performed	10	1	72.73	3.55	0.52	VI	
13	Contractor designated safety supervisor	8	4	60.00	3.00	0.45	I	
14	Availability of contractor safety management/program	9	2	60.00	3.00	0.77	I	
15	Established accident reporting and mitigating program	11		96.36	4.82	0.40	EI	(Umeokafor, et al., 2014)
16	Availability of insurance policy	11		100	5.00	0.00	EI	(Odeyinka, 2000)
	Contractual Arrangement							
17	Contractor to comply with all applicable safety rules & regulation	9	2	70.00	3.50	0.82	VI	(Ayob, Shaari, Zaki & Munaaim, 2018)

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
18	Safety requirements are outlined in the contract document for preselected contractors	11		100	4.73	0.46	EI	(Wu, Wang, Zou & Fang, 2016)
19	Written safety program to be submitted before work commences	11		98.18	4.55	0.52	EI	(Mustapha, Aigbavboa & Thwala, 2017)
20	Availability of plan on accidents mitigation to be submitted by the contractor	11		98.18	4.55	0.69	EI	(Asanka & Ranasinghe, 2016; Hallowell & Gambatese, 2009)
21	Available plan for report of injury and incidents on site by the contractor	11		96.36	4.64	0.50	EI	
22	Contractor to establish the applicable site safety plan	11		83.64	4.18	0.60	VI	
23	Preconstruction meeting with the contractors on safety matters prior to the commencement of construction	11		90.91	3.91	0.70	EI	(Hare, Cameron & Duff, 2006)
24	Involvement of the building developer at all project phases with regard to safety.	11		93.33	4.64	0.50	EI	(Fang & Wu, 2013)

Table 2. Key Performance Indicators for Planning, design and procurement

4.3. Communication on & Maintenance of Effective Safety Behaviour

As shown in Table 3 respondents unanimously agreed with the inclusion of the KPIs in this group except in two KPIs where one or two respondents differed. Meanwhile, respondents ranked all the KPIs "extremely important" except in 6 places, these include: contractor is provided with support for safety on site, defined responsibilities of site safety personnel, all project participant/stakeholders are made to understand safety plan of the project clearly, safety, commitment are communicated to contractors, health and safety implementation plan effectively communicated to all are ranked with RII of 72%, 85%, 78%, 81%, 87% and 80% respectively which were perceived by respondents to be "very important". Table 3 also shares similar findings with other researchers.

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
	Maintenance of Effective Safety Behaviour							
1	Prioritizing safety in the selection of contractors	11		98.18	4.91	0.30	EI	(Choe & Leite, 2017)
2	Targets accident-free project completion	11		96.36	4.81	0.40	EI	(Hinze, 2000)
3	Set appropriate procedure for preventing accidents	11		92.73	4.73	0.46	EI	(Charehzehi & Ahankoob, 2012)

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
4	Promotion of safety performance forms the basis for the engagement of construction personnel	11		100.00	5.00	0.00	EI	(Fang & Wu, 2013)
5	The contractor is provided with support for safety on site	10	1	72.00	3.45	0.82	VI	(International Labour Organization - ILO, 1995)
6	The contractor bears responsibility for the safety of his workers	11		100.00	5.00	0.00	EI	(Manu, Ankrah, Proverbs & Suresh, 2013)
7	The contractor is provided with a safety manual which must be complied with	11		98.18	4.91	0.30	EI	(Dodo, 2012)
8	A minimum of one safety personnel is appointed to a project	11		92.73	4.64	0.67	EI	
9	Established unit to check the safety performance of contractors	11		89.09	4.45	0.52	EI	
10	Defined responsibilities of site safety personnel	11		85.45	4.27	0.64	VI	
	Communication of Effective Safety Behaviour							
11	All project participant/stakeholders are made to understand the safety plan of the project clearly	11		78.18	3.91	0.53	VI	(Choudhry, Fang, & Rowlinson, 2008; Ulang, 2005).
12	Safety commitment is communicated to contractors	9	2	81.82	4.09	0.53	VI	
13	Communicate practically anticipated hazards associated with the nature of the work	11		98.18	4.90	0.30	EI	
14	Health and safety implementation plan effectively communicated to all contractor and subcontractor workers within their respective companies.	11		87.27	4.36	0.50	VI	
15	Lessons learned from accidents are communicated to workers with a view to enhancing positive safety performance	11		94.55	4.73	0.64	EI	

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
16	Communications procedures for safety are established by the safety program	11		80.00	4.00	0.44	VI	(Ulang, 2005)

Table 3. Key Performance Indicators for the communication & maintenance of effective safety behaviour

4.4. Construction Safety Policy

As indicated in Table 4, respondents agreed to all KPIs in this category except for 5 KPIs of which 2 KPIs has 16 respondents disagreed with the inclusion of these KPIs. Meanwhile, all the respondents ranked all the KPIs between "very important" and "extremely important" excluding 2 KPIs which were perceived as "important", including: "SMS implementation" (RII of 58%), "Inclusion of safety basis like training on safety or experience among the criteria of recruiting workers" (RII of 51%). This might be connected to the lack of formal safety regulation in the industry that stakeholders consider the KPIs less important. Table 4 also shows similar findings from other researchers.

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
	Construction Safety Policy							
1	Implementation of available safety rules and regulations	7	4	69.09	3.45	0.82	VI	(Mustapha, Aigbavboa & Thwala, 2017)
2	Understanding of company sets down rules and regulations	11		92.73	4.64	0.50	EI	
3	SMS implementation	3	8	58.18	2.91	0.83	I	
4	Understanding of Factories Act and other applicable regulations	11		81.82	4.09	0.30	VI	(Ezenwa, 2001)
5	Understanding of permit-to-work system	11		96.36	4.82	0.40	EI	(Helix ESG, 2003)
6	Application of the permit-to-work system	11		80.00	4.00	0.44	VI	
7	Availability and accessibility of relevant insurance policies	11		98.18	4.91	0.30	EI	(Odeyinka, 2000)
8	Inclusion of subcontractors in the safety program	11		100	5.00	0.00	EI	(Diugwu & Baba, 2014)
9	Specified the roles and responsibility of the management team in the improvement of health and safety	11		96.36	4.82	0.40	EI	(Boyd, 2014; Choudhry et al., 2008)

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
10	Inclusion of safety basis like training on safety or experience among the criteria of recruiting workers	3	8	50.91	2.63	0.81	I	
11	Documented program for safety procedures	11		83.64	4.18	0.60	VI	
12	Inclusion of safety issues among the criteria for engaging supervisory and management personnel	11		96.36	4.82	0.40	EI	
13	Properly planned procedure for the review of policy on health and safety at least once annually.	11		80.00	4.00	0.45	VI	(Vitharana & De Silva, De Silva, 2015)
14	The policy sets achievable goals in terms of health and safety performance, which includes effort to encourage improvement	9	2	92.73	4.64	0.67	EI	(Hare et al., 2006)
15	Effective procedure for the implementation of safety plan	8	3	76.36	3.82	0.75	VI	(Choudhry et al., 2007)
16	Documented policy on personal protective equipment (PPE)	11		96.36	4.82	0.40	EI	(Tam, Zeng & Deng, 2004)
17	Ensures that all stakeholders on a project comply with all legislative requirements related to health and safety	11		76.36	3.82	0.40	VI	(Hare & Cameron, 2012)
18	Establishing relevant policies, standards and safe work practices necessary to address worker safety	11		100	5.00	0.00	EI	(Hare & Cameron, 2012)

Table 4. Key Performance Indicators for construction safety policy

4.5. Construction Safety Workers

Two or three respondents in this category disagreed with 3 out of the 9 KPIs as shown in Table 5. However, all the KPIs in this category was ranked between "very important" and "extremely important" with factors such as "demonstration of safety culture by the management", "availability of health and safety training", "language and communication challenges by workers are adequately resolved before work started" having an RII value of 100%. Also, similar findings by other authors is shown in Table 5.

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
	Construction Workers Safety							
1	Implementation of safe working attitude and behaviour of workers and supervisors	8	3	76.36	3.82	0.40	VI	(Teo & Lin, 2005)
2	Demonstration of safety culture by the management	11		100	5.00	0.00	EI	(Agwu & Olele, 2014)
3	Availability of health and safety training	11		100	5.00	0.00	EI	(van der Molen et al., 2018)
4	Define the roles and responsibilities of safety committees	9	2	67.27	3.36	0.80	VI	(Williams, 2008; Williams, Adul-Hamid & Misnan, 2018)
5	Workers understand the goals and objectives of the safety committee	8	3	63.64	3.36	0.92	VI	(Teo & Lin, 2005)
6	Language and communication challenges by workers are adequately resolved before work started	11		100	5.00	0.00	EI	(Cheng & Wu, 2013)
7	Adaptation of the working environment by workers	11		72.73	3.64	0.50	VI	(Teo & Lin, 2005)
8	Cultural background of the workers are considered	11		68.00	3.27	0.90	VI	(Chuks & Uchenna, 2012)
9	Consideration of educational level of workers	11		94.55	5.00	0.00	EI	

Table 5. Key Performance Indicators for Construction Safety Workers

4.6. Management Effort and Support

Results presented in Table 6 indicate that respondents were in complete agreement with all the 17 KPIs except in two or three respondents differed in opinion on 9 KPIs. It is also acknowledged that 29 respondents disagreed with the inclusion of 5 out of the 9 KPIs. These are: provision for review of injury reports by top management (RII of 58%), direct involvement of top management in the activities of safety committees (RII of 56%), accident cases reported on a site influence the number of safety personnel deployed to the site (RII of 51%). Top management directly takes part in the enforcement of safety on sites (RII of 36%), and corporate safety targets are set by the management (RII of 56%). Moreover, all other KPIs are ranked between "very important" and extremely important' with RII values above 63%. Table 6 also shows similar findings by other authors.

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev		
	Management Effort and Support							
1	Management emphasis on the establishment of safety committees for all projects	8	3	63.64	3.18	0.406	VI	(Choudhry & Fang, 2008)
2	Monitoring of contractor's performance in terms of safety on the construction projects	11		98.18	4.90	0.302	EI	(Idoro, 2012)
3	Safety makes a major criterion for evaluating the performance of a supervisor	9	2	76.36	3.81	0.603	VI	(Choudhry & Fang, 2008)
4	Availability of proper procedure for receiving and reviewing feedback of workers on health and safety related issues	10	1	76.36	3.81	0.404	VI	(Hinze, Asce, Hallowell, Asce & Baud, 2013)
5	Provision for review of injury reports by top management	5	6	58.18	2.90	0.700	I	(Haslam et al., 2005)
6	Appropriate issuance of motivational directives by the top management to enhance safety	11		100	5.00	0.00	EI	(Delegach, Kark, Katz-Navon & van Dijk, 2017)
7	Involvement of top management in the establishment of reward system to enhance adherence to safety plan by all personnel	9	2	83.64	4.18	0.751	VI	(Hu, Chan, Le, Jiang, Xie & Hon, 2012)
8	Direct involvement of top management in the activities of safety committees	2	9	56.36	2.63	0.809	I	(Choudhry & Fang, 2008)
9	Obvious emphasis on the management on safe work above output	10	1	72.73	3.81	0.603	VI	(Alarcón et al., 2016)
10	Accident cases reported on a site influence the number of safety personnel deployed to the site	8	3	50.91	2.54	0.934	I	(Fonseca, Lima & Duarte, 2014)
11	Top management directly takes part in the enforcement of safety on sites.	3	8	36.36	2.09	1.04	SI	(Alarcón et al., 2016)
12	Corporate safety targets are set by the management	8	3	56.36	2.81	0.404	I	
13	Availability of personnel specifically responsible for handling and implementation of safety policy	11		78.18	3.90	0.539	VI	

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev		
14	Emphasis on open discussion between workers and supervisors on safety related matters	11		83.64	4.81	0.404	VI	(Choudhry & Fang, 2008)
15	Encourages involvement of workers on decisions that affect safety on site	11		98.18	4.90	0.301	EI	(Park & Kim, 2013; Choudhry & Fang, 2008)
16	Involvement of workers in preparation of safety programs for the site	11		100	5.00	0.00	EI	
17	Subcontractors are involved in all aspects of site safety issues	11		94.55	4.72	0.467	EI	

Table 6. Key Performance Indicators for Management Effort and Support

4.7. Safety Training and Orientation

Respondents unanimously agreed with the inclusion of the KPIs in this group except in six KPIs where one or two respondents differed or disagreed. Perceived levels of importance are "very important", as shown in Table 7 that shares similar findings with other researchers. 5 KPIs is rated as "extremely important" with RII values between 96%-100%, indicating appreciation for inclusion of the KPIs. However, the KPI that is rated the lowest in this category is "a training meeting for all supervisors is required by the safety program" with RII of 70.91% which shows disagreement with the KPIs.

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
	Safety Training and Orientation							
1	Workers to undergo orientation on safety before work commences on site	11		98.18	5.00	0.00	EI	(Choudhry & Fang, 2008)
2	Supervisors are trained and oriented to health and safety	9	2	76.36	3.27	0.78	VI	(Sacks, Perlman & Barak, 2013)
3	Safety program covers the training of workers on the field	10	1	74.55	3.73	0.46	VI	(Tackett et al., 2006)
4	Provision is made in the budget for safety training/education	11		98.18	4.91	0.30	EI	
5	The management staff is trained on health and safety	11		96.36	4.82	0.40	EI	
6	Discussion of safety on site activities and possible incidents is required by the safety program	11		98.18	4.91	0.30	EI	(Elliott, 2016)

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
7	Conduct safety orientation for all site visitors is required by the safety program	9	2	78.18	3.00	0.63	VI	(Sacks et al., 2013; OSHA, 2015)
8	New skills are checked to monitor impact of training on health and safety	10	1	83.64	4.18	0.05	VI	
9	The safety plan arranges for formal orientation of subcontractors	11		83.64	5.00	0.00	VI	
10	Define level of safety and awareness required of all workers	10	1	75.00	4.18	0.40	VI	
11	Safety program requires a safety orientation plan for all new individuals to the site	9	2	72.00	3.60	0.80	VI	
12	A training meeting for all supervisors is required by the safety program	11		70.91	3.54	0.52	VI	
13	A well-written policy for health and safety training in the safety program	11		100.00	5.00	0.00	EI	(Sacks et al., 2013; OSHA, 2015)
14	Safety program inspires active participation of workers in training sessions	11		78.18	4.90	0.30	VI	
15	Safety program requires training certifications for operation of equipment.	11		74.55	3.81	0.40	VI	
16	Training is provided to workers at a minimum for new site work	11		78.18	3.91	0.53	VI	

Table 7. Key Performance Indicators for Safety Training and Orientation

4.8. Administration of Safety and Processes

A total of 18 KPIs has been represented in this category as shown in Table 8. All respondents unanimously agreed on the inclusion of the KPIs except 2 with 11 respondents disagreed. Furthermore, about 16 KPIs are perceived as "very important" while 1 KPI is perceived as "extremely important" which represent the highest level of importance in this category "workers' commitment to safe work practice are rewarded" with an RII value of 100%. The KPI with the lowest perceived rating is "safety program requires emergency response drills" which has an RII value of 45.45%, which indicate a lack of significant value for response drills in eliminating accident on the site, also 9 respondents disagreed with this KPI. Similarly, other researchers share similar findings as shown in Table 8.

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
	Administration of Safety and Processes							
1	Established procedure to measure safety achievements	11		76.36	4.90	0.30	VI	(Arezes & Sérgio-Miguel, 2003)
2	Investigate non-compliance for proper use of personal protective equipment (PPE)	11		82.27	4.36	0.67	VI	(Chi, et al., 2005)
3	Workers commitment to safe work practice are rewarded	11		100	5.00	0.00	EI	(Zahoor, Chan, Utama, Gao & Zafar, 2017)
4	Rules of work are routinely reviewed	11		81.82	4.09	0.53	VI	(Hale & Borys, 2013)
5	Provision for the monitoring of safety inspection to understand its impact and coverage	11		83.64	4.18	0.60	VI	(Saurin, 2016)
6	Proper planning towards retrieval and analysis of safety inspection reports	11		81.82	4.00	0.89	VI	
7	Proper planning to ensure actions are taken based on the analysed reports of inspection	9	2	74.55	3.72	0.78	VI	
8	Safety site layout is made before the commencement of the project	11		78.18	3,81	0.60	VI	(Huang & Wong, 2015)
9	Safety issues are discussed at preconstruction and progress meetings	11		85.45	4.27	0.46	VI	
10	Procedures for identifying safety risk and its management are established in the safety program	11		80.00	4.00	0.63	VI	(Arezes & Sérgio-Miguel, 2003)
11	Safety program requires emergency response drills	2	9	45.45	2.27	0.90	I	(Hallowell & Gambatese, 2009)
12	Provision is made for safety bulletin boards accessible to workers during working hours	11		78.18	3.91	0.30	VI	
13	Maintenance of a site accident record book to document accidents, impact and preventive safety measures.	11		94.55	5.00	0.00	VI	(Hallowell & Gambatese, 2009)
14	Posters and signs for site safety are obviously displayed on the project site	11		80.00	4.00	0.44	VI	

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
15	Safe operational procedures for all contractors and subcontractor are documented.	11		81.82	4.09	0.30	VI	
16	Procedures for checking the appropriate utilization of PPE as well as inspection and training are established.	11		83.64	4.18	0.40	VI	(Haslam et al., 2005)
17	Available/appropriate PPEs on project sites.	11		83.64	4.18	0.40	VI	
18	Adequate provision of First Aid and CPR facilities on project sites	11		80.00	4.00	0.63	VI	(Findley, Smith, Kress, Petty & Enoch, 2004)

Table 8. Key Performance Indicators for Administration of Safety and Processes

4.9. Investigation and Reporting of Accident

All participants unanimously agreed the inclusions to all KPIs in this group and the perceived level of importance to be "very important", as shown in Table 9, except one KPI "near misses are reported in the incident logs" which is perceived to be "extremely important". The KPI with the lowest RII was "utilization of safety reports for the improvement of safety performance" (RII of 69.09%) which shows respondents perceived level of importance in reducing accidents on sites. Also, Table 9 shows similar research outcome by other authors.

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
	Investigation and Reporting of accident							
1	Utilization of safety reports for improvement of safety performance	11		69.09	3.45	0.69	VI	(Wu et al., 2016)
2	Near misses are investigated to prevent future site incidents	11		80.00	4.18	0.98	VI	(Asanka & Ranasinghe, 2016; Umeokafor et al., 2014)
3	Near misses are reported in the incident logs	11		100	5.00	0.00	EI	
4	Appropriate procedures to prevent recurrence of accidents	11		80.00	4.00	1.09	VI	
5	Record keeping of accident and incident logs have ease of access	11		78.18	3.91	0.94	VI	(Hallowell & Gambatese, 2009; Kartam, Flood & Koushki, 2000)
6	Keep a record of accidents and incidents of the contractors and subcontractors.	11		74.55	3.73	0.46	VI	

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
7	Review and audit safety procedures used by the contractor	11		81.82	4.36	0.67	VI	(Khosravi et al., 2014)
8	Occasionally audits contractor safety procedures and operations.	11		80.00	4.00	0.44	VI	

Table 9. Key Performance Indicators for Investigation and Reporting of accident

4.10. Rewards and Sanctions for Project Stakeholders

Results in Table 10 indicate that respondents agree to the inclusion of all the KPIs except two or three respondents that disagreed. However, the KPI "appropriate penalty in the form of reporting to relevant law enforcement authorities" and "provision of penalty in the form of rank demotion" had almost all the respondents disagreed, which were perceived as "somewhat important" (with RII values 53.33% and 32.73% respectively) this clearly indicate the non-inclusion of the KPIs in reducing construction accidents. Furthermore, two of the KPIs were perceived as "extremely important' "provision of rewards for good safety performance" with RII of 96.36% and "availability of reward in the form of certificate of corporate recognition" with RII of 98.18%. Table 10 also shows similar findings by other researchers.

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
	Rewards and Sanctions for Project Stakeholders							
1	Penalties are spelt out for dissatisfactory safety performance	8	3	70.91	3.64	0.92	VI	(Teo, Ling & Ong, 2005)
2	Provision of rewards for good safety performance	11		96.36	4.81	0.40	EI	(Alarcón et al., 2016; Arditi, Yasamis & Member, 1998; Ashworth, 2013; Choi & Kwak, 2012; Hu et al., 2012; Rose & Manley, 2011)
3	Provision of sanctions and penalties	8	3	74.55	3.73	1.10	VI	
4	Provision of penalty in form of work stoppage	10	1	76.36	3.62	0.92	VI	
5	Provision of reward in form monetary bonus	8	3	70.91	3.55	0.82	VI	
6	Availability of reward in form of certificate of corporate recognition	11		98.18	4.91	0.30	EI	
7	Provision of reward in the form of rank elevation	11		80.00	4.00	0.44	VI	
8	The appropriate penalty in the form of reporting to relevant law enforcement authorities	2	9	53.33	3.00	0.89	SI	
9	Provision of penalty in form of rank demotion	3	8	32.73	1.64	0.92	SI	

S/No	Performance Indicators	Agree	Disagree	Importance Rating			Level of Importance	Ref. (Similar findings by other authors)
				RII 100%	Mean value	StDev.		
10	Established penalty in form of disengagement from work	9	2	69.09	3.45	0.68	VI	
11	Availability of monetary fines and penalty	11		81.82	4.09	0.70	VI	

Table 10. Key Performance Indicators for Rewards and Sanctions for project stakeholders

5. Discussions and Conclusions

Key performance indicators refer to a tool used to assess the efficiency of construction facilities. Such KPIs differ in relation to the reason of the assessment and typology of facility being examined. Kylili, Fokaides and López-Jiménez (2016) among other researchers also identified their effectiveness in the assessment of building construction performance. Despite existing research in the area of construction safety, there is no established KPIs that could be used to reliably assess or promote building developer safety performance.

This study, established 137 KPIs that can be deployed for promoting or assessing building developer's safety performance in the construction industry in Nigeria. In-depth review of the literature supported by evaluation from 11 subject matter experts and professionals that validated and ensure clarity and inclusion. The KPIs were further categorized into 9 categories that include: Planning, design and procurement. Construction safety policy, construction safety personnel, communication & maintenance of effective safety behavior, management effort and support, safety training and orientation, administration of safety processes, accident reporting and investigation, rewards and sanctions for project stakeholders. The categorization was used as a basis of presenting the KPIs to show the response of survey conducted on 11 respondents. The survey required the respondents to either agree/disagree with statements and rank the KPIs by their perceived relevance.

Results from the focus group discussion revealed that the respondents consider all the KPIs important, even as some of the KPIs are rated less important, compared to the ones perceived to be "extremely important". Thus, factors such as "Near misses are reported in the incident logs", "Availability of reward in form of certificate of corporate recognition" "Involvement of the building developer at all project phases" with RII value of 100%, 98%, and 93% respectively to be extremely important. Also, "language and communication challenges by workers are adequately resolved before work start" with an RII value of 100%, "establishing relevant policies, standards and safe work practices necessary to address worker safety" with an RII value of 100% are among the KPIs considered extremely important. Some KPIs is perceived to be "important" by the respondents include: "SMS implementation", "accident cases reported on a site influence the number of safety personnel deployed to the site" (RII of 51%), "conduct safety orientation for all site visitors is required by the safety program", (RII of 51%). Moreover, "safety program requires emergency response drills" (RII of 45%), is among the KPIs considered "important". Also, other KPIs perceived to be as "somewhat not important" such as "top management directly takes part in the enforcement of safety on sites" RII of 35%, "appropriate penalty in the form of reporting to relevant law enforcement authorities" RII of 53%.

The established KPIs therefore, presents a guideline to ensure safety performance of construction stakeholders in the construction industry in Nigeria. The guideline would be of much use to building developers, research institutions, Architects, Contractors and professionals involved in building construction in Nigeria. The study would also encourage further research into the KPIs of other construction types. It is worthy of note that much care was taken to establish all possible KPIs for building developer, however, citation of some relevant literature may have been omitted, or some KPIs may still look uncaptured to the perception of the reader. Finally, implementation of the established KPIs in the form of measurement tool on real-life case studies would be the target of future research work to show the application of the KPIs in assessment of construction safety performance of building developers in Nigeria.

Declaration of Conflicting Interests

The authors have declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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