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THE USE OF EARLY WARNING SYSTEM IN REDUCING COST OF ACCIDENT IN BUILDING CONSTRUCTION SITES

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Abstract
Early warning systems aim to mitigate the risk produced by disasters, by providing advanced notice of potential risk, it enable individuals, communities, and organisations to take appropriate measures to minimize the potential impact of disasters. Early warning systems a techniques that have been used in many industries to reduce risk in areas that are prone to accidents and disasters. This is a method by which the occupants that are prone to risk and disaster were informed and steps in protecting against disaster were considered and applied. This usually enables them to prepare for any eventuality that may occur as a result of the forecasted disaster. This method has been proposed as the best way to prevent accidents on construction sites. This study therefore surveys the benefits of using EWS on construction sites. 150 questionnaires were designed and distributed purposively to safety experts in ten (10) construction firms in Abuja Nigeria. 120 questionnaires were retrieved given an 80% level of response. The respondents agreed that the use of EWS would reduce the cost of accidents in construction sites by more than 60%. Considering the overwhelming acceptance of the EWS by the safety experts. The study recommends that a framework for the implementation of EWS is a necessity in every site to reduce the cost of accidents.

Keywords: Accident, Construction, Early, Sites, System, Warning.

Introduction
Despite developments in the prevention of accident fatalities in the construction industry, fatalities resulting from preventable accidents continue at an unacceptable rate in construction sites (Selleck *et al*. 2023). In dynamic construction project environments early warnings system techniques have been ignored despite serious and fatal accident on site (Kui, 2019). The industry has been afflicted by a relatively high proportion of accidents because of low intensity, short duration of works, ignorant of workers and supervisors and lack of subtle signals (Ijaola *et al.,* 2021). When coupled with high time pressures, this would ensure that any action which could potentially precipitate an accident is rapidly buried in, and obscured by, a labyrinth of subsequent and interdependent activities. A group of people who are deemed to be at risk can have their harm and losses reduced by receiving and sharing warning information about potential dangers and vulnerabilities through the use of an Early Warning System (EWS). Considering the vulnerability of construction sites to accidents, any solution that will mitigate this vulnerability is a welcome solution. That is while this study is very important and necessary at this time.

Literature Review

Element of Early Warning System

A brief section on the four elements of Early Warning System EWS will help in given a highlight on the use and approach in construction industry. According to McBride et al. (2022), the components of EWS are risk knowledge, monitoring and warning services, communication and warning distribution, and community reaction capabilities. There is need to

discuss these element of early warning system EWS to highlight the importance of each element as related to construction sites.

Risk Knowledge

It is very important for the construction workers to have adequate knowledge of the risk involve in their work this will enable them to protect themselves from all the risk involve (Selleck *et al*., 2023). Instead of forcing them to wear protective clothing and taken other safety measures if the information on the risk is clear to them they will charge for the risk and protect themselves in order to save their own cost (McBride *et al*., 2022). Figure 1 highlighted the element of the EWS and the necessary details that are required to consider to achieve protection against accident or disaster.

Monitoring and Warning Services

Monitoring and Warning services is the sole responsibility of the management, management must established a sound scientific knowledge of accident occurrence on site to enable a reliable prediction of likelihood of accident and their preventions (McBride *et al.*, 2022).

To provide precise warnings in a timely manner, it is imperative to maintain constant observation of accident factors and antecedents. Warning services for different accident on construction site should be coordinated where possible to gain the benefit of shared institutional, procedural and communication networks (Selleck, 2023).

Dissemination and Communication

Onyiyechi *et al.* (2023) observed that for communication to be effective warnings must reach those at workers at risk, and also, there should be a clear messages containing simple, useful information to the workers on site on the risk behind a particular operation. It important to have a proper analysis of the risk involve in every operations and how to protect the workers from accident that may arise. Communication systems must be pre-identified disseminate appropriate. In order to ensure that the greatest number of people are warned, to prevent any one channel from failing, and to reaffirm the warning message to the workers on site both prior to and during operations, it is imperative that multiple communication channels be used (Hallegatte, 2012; McBride et al., 2022).

Response Capability

Okorie and Adindu (2020) highlighted that it is essential that workers on site understand the risks involved at every stages of operations; respect the warning service and know how to react and protect themselves. Programmes for education and readiness are important, and having established, tested, and rehearsed accident management procedures is also crucial. The workers should be well informed on options for safe behaviour, available escape routes, and how best to avoid damage and loss to life (Yi *et al.*, 2016; Kui, 2019; Wei *et al.*, 2021).

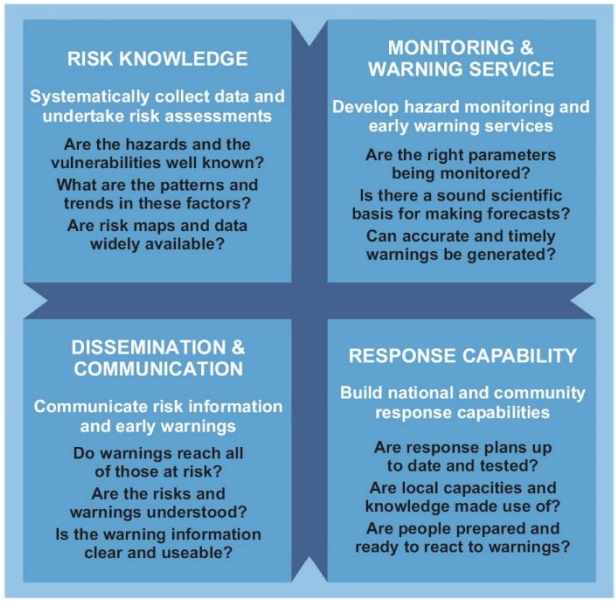


Figure 1. The Element of Early Warning System
Source: UN/ISDR Platform for the Promotion of Early Warning

Managerial actions

In addition to the nature of accident warning signals determining an organisation's sensitivity to them, there is also the influence of managerial actions (McBride *et al*., 2022). Management can help the workers to manage the rate of accident occurrence on sites by making policies that reduce their own receptivity to bad-news. Managers inadvertently reduced the sensitivity of operatives to potential problems and their willingness to report those that they detected. In the longer-term, managers also allowed a

culture of sensitivity of workers to their environment (Dansadau & Abubakar, 2020).

The Accident Detection Process

Detecting a potential accident is a process which involves three steps, namely; intelligence gathering, assessing the impact of intelligence information by establishing its potential impact upon the attainment of predefined goals, and deciding whether a response is justified and if so what that response should be (Ijaola *et al.*, 2021). At each of these stages, people in an organisation can choose to ignore advance warning signs and continue along their existing path.

Self-interest and ambiguity have been identified as problems to accident detection. This has a negative influence on all the three processes. However, there were also other problems which are discussed herein, Centralization of decision-making responsibility - One problem related to the hierarchical distance of the decision-making authority from the point of problem detection. During the aftermath of a serious accident, when reference to high authority is justified or in highly centralized organizations where the necessary decision-making authority exists at higher organizational levels, this is a particular problem. This is because it slows down the speed of response. Therefore, managers should aim to structure their organization so that people performing the roles of monitoring, assessing and decision-making are as autonomous as possible. Autonomy minimizes communication interfaces and is one way of maximising the speed of response (Dansadau & Abubakar 2020; Okorie & Adindu, 2020).

Lack of resolve - A lack of resolve was discovered which was reflected in peoples' tendency to lower performance standards by accepting damage to goals rather than attempting to mitigate it. The matrix structure of construction project organizations is a likely contributory factor in producing this behaviour because it separated people's personal interests from those of the client's. This meant that they were defending goals to which were not necessarily in their interests, even though they may have had formal responsibility for them. This behaviour is more likely to occur in relation to health and safety standards since they are less overt than those relating to costs, time and quality. This means that they can be lowered less conspicuously. To resolve this problem, project managers must make safety a high priority and avoid matrix structures by pursuing procurement arrangements which minimize conflicting objectives (Ding & Zhou, 2013; Yuan *et al.,* 2017).

Partnering arrangements are a possible solution to this problem as is a shortening of the supply chain, by reducing the number of firms involved in the procurement process. While partnering seeks to build trust and converge interests, shortening the supply chain, is a structural measure which reduces fragmentation and thereby the number of problematical interfaces within a construction project organization (Wei *et al.,* 2021: Onyiyechi *et al.,* 2023)

Methodology

The study employed exploratory and quantitative research because the study was only interested in determining the opinion of the respondents on the use of EWS as accident reduction on construction sites. The respondents were professional in construction firms in Abuja who have adequate knowledge of health and safety and also those who are working directly in construction sites in Abuja. The questionnaire was closed-ended and structured according to the questions generated from the literature on whether accident and other related issues on site could be reduced by the use of EWS techniques; also the awareness of EWS techniques and effectiveness of EWS techniques these questions were scaled using the 5 – point Likert scale of 1 – 5 (where: 1 strongly disagree, 2 disagree, 3 Neutral 4 agree and 5 strongly agree). The questionnaire was structured into 2 sections: Section A covered respondents' profiles and questions related to the respondents' backgrounds and organisations while section B, C, and D covered queries drawn out for the objective using the findings from the literature. Section A, B and C of the questionnaire were analysed using percentiles while section D was analysis using mean index scores.

Results and Discussion

One hundred and fifty (150) questionnaires were distributed based on the sample size calculated. Out of this number, one hundred and twenty (120) questionnaires were retrieved. This showed an 80% response rate which is high and adequate for the research. Table 1 shows the presentation and analysis of Section A of the questionnaire; this was the profile of the respondents and some basic questions concerning the organisations.

Table 1 shows that most of the respondents work in an organisation involved in contracting and consulting; the figure was as high as 66%, while those who are either for contracting and consulting were 28% and 5%, respectively. These findings are in line with Ibidunni *et al.* (2022), which found that most of the construction organisations practising in Nigeria are into both contracting and consulting. The respondents used for this research were of great experience; this is shown in Table 1; the respondents with twenty years above have a high percentage

of 62%. This gave them confidence that most of the respondents were eligible because it was delivered from their wealth of experience of over 20 years.

Table 1. Demography of Respondents and Organisations

	Frequency	Percentage
Type of the Organisation of the Respondents		
Contracting	19	16
Consulting	16	13
Both	85	71
Total	120	100
Professional Qualification of the Respondents		
QSRBN	15	13
CORBON	32	27
ARCON	23	18
CORREN	29	24
ICA/ANA	3	3
NIM	12	10
Others	6	5
Total	120	100
Respondents' Years of Experience in the Construction Industry		
≤ 5 Years	5	4
6 - 10 Years	15	13
11 - 15 Years	80	66
16 - 20 Years	12	10
Above 20 Years	8	7
Total	120	100

Source: Researcher's Analysis of Data (2024)

The respondent's designation was also check by the questionnaire to know how knowledgeable they are on the subject of the study. The result presented in Table 2 shows that the respondent spread across the entire profession in the construction industry and the safety officers and supervisors are had higher respondents of 20% each. This is higher percentage than the other professions. This indicated that the findings of the study is from the view of experts and those who are involve in site management.

Table 2. Designation of the Respondents

Designation	Number of respondents	% of respondents
Architect	15	13
Builder	10	8
Civil engineer	10	8
Formen	25	13
Safety officers	20	21
Supervisors	20	21
Quantity surveying	15	12
others	5	4
Total	120	100

Researcher's Analysis of Data (2024)

Table 3. Reduction of Cost of Accident Using Early Warning System Techniques

	% of Cost Reduction	Number of Respondents	Percentage of The Respondents
1	Below 10%	5	4
2	10 – 20%	4	3
3	20 – 30%	15	13
4	30 – 40%	7	6
5	40 – 50%	8	7

6	50 – 60%	12	10
7	60 – 70%	43	36
8	70 – 80%	12	10
9	Above 80%	14	11
	Total	120	100

Source: Researcher's Analysis of Data (2024)

Table 4 presented the result of awareness of early warning system techniques by the respondents, 45% and 40% strongly agreed and agreed to the question on awareness of EWS techniques this showed that 85% of the respondents are aware of the techniques.

Table 4. Awareness of Early Warning System Techniques.

Level of Awareness	Number of respondents	% of respondents
Strongly Aware	45	37
Aware	40	33
Rarely Aware	20	17
Not Aware	15	13
Total	120	100

Source: Researcher's Analysis of Data (2024)

The respondents were also asked to determine the effectiveness of each of the techniques when use in construction sites. All the techniques has a high mean index score more (MIS) than 1.5 . The range was 3.10 – 3.52. Response capability was ranked 1st MIS of 3.52 that indicated that if the knowledge is give and there were no response to the implementation of the knowledge the techniques cannot be effective. Also dissemination and effective communication of information is rank 2nd this shows that there is need to focus on the way the information of the accidents and the need for the preventions is passed to the workers on sites.

Table 5. Effectiveness of the EWS Techniques

Effectiveness	N	1	2	3	4	5	Sum	MIS	Rank
Response Capability	120	3	16	135	208	60	422	3.52	1
Dissemination and Communication	120	16	12	105	232	25	390	3.25	2
Monitoring and Warning Services	120	12	40	90	204	35	381	3.18	3
Risk Knowledge	120	10	48	99	176	45	372	3.10	4

Researcher's Analysis of Data (2024)

Conclusion

The purpose of this study was to explore the forces in construction projects which reduce receptivity to the early warning signals of potential accidents. Ultimately, the aim was to suggest managerial measures which could be taken to counter them. To this end, construction project managers should; identify and protect potential losers in a situation; make safety a priority, clarify safety performance standards; train managers in safety and appraise their safety record; reduce time- pressures; keep contractual arrangements as simple as possible; avoid matrix structures; create a specific MIS for health and safety information; avoid unnecessary changes in team membership; employ people with a concern for safety; create supportive not penal environments.

While historically implementing an effective early warning system in construction projects has been challenging due to legacy workflows and technologies, new and innovative technologies are now being developed to address this issue. These technologies offer opportunities for contractors to leverage data and analytics to inform decision-making, proactively mitigate risks, and optimize project performance. With the advancements in construction project controls software and data-driven tools, contractors now have the potential to overcome the limitations of traditional approaches and implement robust early warning systems that enable them to achieve better project outcomes. Embracing these emerging technologies can revolutionize the way contractors operate on a day-to-day basis and drive improved project delivery in the construction industry.

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