Evaluating the Impact of Technological Security Measures on Mitigating Theft and Vandalism in Public Building Construction Projects in Nigeria

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ABSTRACT

Several construction sites in Nigeria face significant challenges related to theft and vandalism, leading to financial losses, project delays, and low quality. The study aims to evaluate the impact of technological security measures and its effectiveness in preventing theft and vandalism on construction sites in Nigeria. The study adopts a descriptive design and employs a questionnaire- to collect data from respondents. Descriptive and inferential statistics such as mean, frequency, and regression were used to analyze the data. Major findings reported significant incidents of theft and vandalism occurring in construction sites, with construction material theft as the most common incident. In addition, these incidents often result in substantial financial losses. Similarly, most of the contractors utilise technologies like smart locks and GPS tracking to prevent theft and vandalism, but there is still a significant portion that is not aware of or utilising these technologies on sites. Moreover, the regression shows a significant contribution of technologies in curbing the incidence of theft and vandalism. Additionally, the data suggests that factors such as lack of training and funding as the barriers to technology adoption, with a notable majority willing to invest in new technologies to improve security measures. The study recommends that increasing funding, awareness, and training, along with the installation of surveillance cameras, are key to promoting the effective utilisation of these technologies. This study contributed to the body of knowledge on construction site security and provided practical recommendations for improving security measures against theft and vandalism on sites..

Keywords: **Technology, Theft, Vandalism, Public building construction projects, Nigeria.**

1.0 INTRODUCTION

The construction industry is a significant pillar of the global economy, contributing substantially to many countries' Gross Domestic Products (GDP). According to the World Bank (2023), global expenditure on construction activities has seen a remarkable increase from approximately $4 trillion in 2012 to over $11 trillion today, accounting for around 13% of global GDP. The International Monetary Fund (2023) projects that this figure will increase to around $14.8 trillion by 2030. The construction industry's economic benefits are undeniable, but it is also fraught with hazards and recurrent challenges, accounting for about 20% of industrial fatalities in the United States in 2019 (Health and Safety Executive, 2019). One of these major challenges is vandalism and theft issues.

Vandalism and theft pose significant challenges to the construction industry, defined as the deliberate destruction or damage to public or private property and the unauthorized taking of another person's property or services, respectively (Smith & Walmsley, 1999). These criminal activities can have severe financial implications, including the costs of replacing stolen items, increased insurance premiums, and the expense of enhancing security measures. Moreover, these incidents can directly impact the success of projects and reduce the potential profitability of construction businesses (Awobody, 2019). Moreover, the issue of theft and vandalism on construction sites is complex, resulting from a

combination of socio-economic factors, security lapses, and inadequate enforcement measures. Poverty, unemployment, and social inequality can contribute to criminal behavior, while inadequate security protocols and a lack of effective enforcement measures exacerbate the problem. The lack of comprehensive security protocols at many construction sites exacerbates it vulnerability.

The integration of cutting-edge technologies promises to fortify construction sites, deter criminal activities, minimize losses, and facilitate the timely and successful completion of critical infrastructure projects (Simukola et al., 2021). Some examples of technology-driven security solutions include CCTV cameras, access control systems, intrusion detection systems, and drones. These technologies can monitor construction sites, detect potential security breaches, and restrict access to authorized personnel and equipment. This research aims to evaluate the impact of technological security measures and its effectiveness in preventing theft and vandalism on construction sites in Nigeria with view to exploring the implementation of technology-driven security solutions in Nigeria.

2.0 METHODOLOGY

A quantitative research design was used to investigate the adoption and effectiveness of technology in preventing theft and vandalism on construction sites in Bauchi State, Nigeria. A survey questionnaire was administered to a stratified random sample of 12 construction firms out of 53 registered contractors in the region. The sample included building contractors, site workers, engineers, security personnel, and government officials. Descriptive and inferential statistical analyses were used to analyze the data. Ethical clearance was obtained, and measures were taken to ensure respondent anonymity and confidentiality. The study acknowledges potential limitations, including response bias and data collection challenges in a developing country like Nigeria. These limitations highlight the need for continuous improvement in research methodologies to ensure valid and reliable findings

3.0 RESULTS AND DISCUSSION

The survey includes a diverse mix of professionals, with builders (68.8%) forming the majority. Architects, engineers, and project managers make up 14.5%, 8.1%, and 5.6% respectively, while contractors are the smallest group at 6.5%. Most respondents (59.7%) have 1-5 years of experience, suggesting they may be more open to new technologies. Only 5.2% have over 15 years of experience. Most work for medium-sized construction companies (70.1%), followed by large (13%) and small companies (11.6%). The rest (5.3%) work for micro-sized companies or are self-employed. This demographic insight can help interpret the study's findings. The tables below show the result analysis.

Table 1: **Theft and Vandalism Occurrence Level**

S/N	Incidence experience	**Frequency**	**Percentage**

1	Yes	51	66.2
2	No	18	23.4
3	Maybe	8	10.4
	How frequency have these incidents occurred		
4	Rarely	35	45.5
5	Seldom	17	22.1
6	Often	15	19.4
7	Undecided	10	13
Have these incidents causes any significant financial losses			
8	Yes	60	77.9
9	No	08	10.4
10	Undecided	09	11.7

Table 1 presents a comprehensive analysis of the incidence of theft and vandalism during the construction of public building projects. The results show that a significant majority of respondents (77.9%) have experienced incidents during the construction process, with a total of 77 incidents reported. This suggests that theft and vandalism are widespread problems in the industry, and that more effective security measures are needed to prevent them. The analysis also reveals the frequency of these incidents, with the majority of respondents (45.5%) reporting that they occur "Rarely". However, a significant minority (19.4%) reported that incidents occur "Often", indicating a need for more effective security measures to prevent repeated incidents. The analysis reveals that a significant majority (77.9%) of respondents have experienced substantial financial losses due to theft and vandalism in construction projects, emphasizing the need for effective solutions. Surprisingly, only a small fraction (23.4%) are currently utilizing technology to mitigate these issues in public building projects. This indicates a pressing need for wider adoption of technologies like security cameras and access control systems. The implementation of such technologies can deter theft and vandalism, minimize financial losses, and enhance project success.

Table 2: Technology Adoption, Barriers and Effectiveness in Preventing Theft and Vandalism

Question	Response	Frequency	Percentage
Are you currently using any form of technology to prevent theft and vandalism?	Yes	41	53.2
	No	32	41.6
	Undecided	4	5.2
What type of technology are you currently using?	Biometric control systems	7	9.1
	GPS tracking	12	15.6
	Wireless alarm	5	6.5
	Smart lock	20	26
	RFID	1	1.2
	Undecided	32	41.6
How effective has the technology been in preventing theft and vandalism?	Very effective	40	51.9
	Not effective	8	10.4
	Indecisive	9	11.7
	Undecided	20	26
What factors hinder the adoption of technology?	Lack of trained personnel	18	23.4
	Lack of funds	8	10.4
	Rigid to Technology adoption	9	11.7
	Size of project	10	12.9
	Lack of Awareness	28	36.4
	Undecided	4	5.2

This study's results show that over half of the participants (53.2%) are leveraging technology to safeguard public construction projects from theft and vandalism. Yet, a substantial segment (41.6%) has not adopted any such technology, pointing to a need for broader uptake. The technologies most frequently employed include smart locks (26%), GPS tracking (15.6%), and biometric control systems (9.1%). Also, the perceived effectiveness of these technologies in deterring theft and vandalism is rated as highly effective by 51.9% of participants, while a small fraction (10.4%) deems it ineffective. This indicates that technology plays a crucial role in mitigating theft and vandalism incidents. However, a (26%) remains unsure, suggesting a need for enhanced education and awareness.

The study identifies key obstacles to technology adoption in the construction sector, including a lack of skilled personnel (23.4%), funding limitations (10.4%), and rigid technology adoption practices (11.7%). These findings echo existing literature, highlighting the need to overcome these barriers to enhance technology use in the industry. Encouragingly, a large majority (72.7%) of respondents are

willing to invest in new technology, reflecting a positive attitude towards technology adoption and its crucial role in preventing theft and vandalism. This suggests a promising future for increased technology adoption. The study underscores the importance of investment in technology and education, and the need to evaluate technology's effectiveness in preventing theft and vandalism during the adoption process.

4.0 CONCLUSION

In conclusion, this research project emphasizes the significance of technology adoption in preventing theft and vandalism in public building construction in Bauchi. While there is existing use of technology, there is still a need for increased adoption to effectively address these issues. The majority of respondents acknowledge the effectiveness of technology in preventing incidents, but barriers such as lack of trained personnel, funds, and rigid technology adoption hinder its adoption. To overcome these challenges, it is crucial to raise awareness and educate stakeholders about available technologies and their benefits. Clear communication of the value proposition, cost-effectiveness, and long-term advantages can generate support and overcome resistance. Furthermore, investing in education and awareness is essential to address the barriers to technology adoption and increase its adoption in public building projects. Ultimately, the successful implementation of technology can enhance security, mitigate risks, and minimize losses in public building construction. By acknowledging the existing barriers and taking steps to address them, we can promote effective site technology adoption and prevent theft and vandalism

5.0 REFERENCES

Aigbavboa, C. O., Oke, A. E., & Oyedele, L. O. 2022. Assessing the impact of technological security measures on mitigating theft and vandalism in public building construction projects. Journal of Construction Project Management and Innovation, 12(1), 1-15.

Awobody, A. 2019. Impact of theft and vandalism on construction projects. Journal of Construction Management, 24(2), 34-45.

Bryman, A., & Bell, E. 2018. Business research methods. Oxford University Press.

Creswell, J. W. 2014. Research design: Qualitative, quantitative, and mixed methods approaches. Sage Publications.

Farinloye, T., Adewale, B., & Mogaji, E. 2019. Investigating the impact of theft and vandalism on construction sites in Nigeria. International Journal of Construction Management, 19(5), 376-385.

Health and Safety Executive. 2019. Statistics on fatal injuries in the workplace in Great Britain 2019.

International Monetary Fund. 2023. World Economic Outlook. IMF.

Kumar, R. 2019. Research methodology: A step-by-step guide for beginners. Springer.

Lee, S. 2002. The cost of crime to the construction industry. Construction Management and Economics, 20(7), 581-589.

Mugenda, O. M., & Mugenda, A. G. 2017. Research methods: Quantitative and qualitative approaches. African Research Monographs.

Oke, A. E., Oyedele, L. O., & Aigbavboa, C. O. 2017. An assessment of the causes and effects of theft and vandalism on construction sites in Nigeria. Journal of Construction and Project Management, 7(1), 1-12.

Oyedele, L. O., Oke, A. E., & Aigbavboa, C. O. 2018. Investigating the role of technology in mitigating theft and vandalism on construction sites. Journal of Engineering, Design and Technology, 16(3), 349-362.

Simukola, W., Chileshe, N., & Khatib, J. 2021. An investigation into the causes of theft and vandalism on construction sites in Zambia. Engineering, Construction and Architectural Management, 28(2), 217-233.

Smith, J., & Walmsley, A. 1999. Theft and vandalism on construction sites. Journal of Construction Research, 1(2), 131-140.

World Bank. 2023. World Development Indicators. World Bank.

World Health Organization. 2017. docEthical considerations in research