IAA Journal of Scientific Research 12(2):29-36, 2025.
©IAAJOURNALS
https://doi.org/10.59298/IAAJSR/2025/1222936.00

www.iaajournals.org
ISSN: 2636-7319
IAAJSR:122

# Strategies for Identifying and Mitigating Risks Associated with Sustainable Housing Projects

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## ABSTRACT

Sustainable housing projects face unique risks that require specialized management strategies. This research explores strategies for identifying and mitigating risks associated with sustainable housing projects and presents a comprehensive risk management framework tailored to the distinctive challenges of sustainable construction. The risk management framework begins with a detailed process of risk identification, categorizing risks into environmental, economic, social, technological, and regulatory/legal domains. Mitigation strategies are developed for each risk category. For environmental risks, strategies include sustainable sourcing, climate resilience design, and waste reduction programs. Economic risks are mitigated through cost management, thorough market analysis, and diversified funding. Social risks are addressed through community engagement, training programs, and strict health and safety protocols. Technological risks are managed through pilot projects, quality assurance measures, and expert system integration. Regulatory and legal risks are mitigated by regular compliance monitoring, legal advice, and obtaining sustainability certifications. Continuous risk monitoring and review are essential components of the framework. Regular audits, key performance indicators (KPIs), and feedback loops ensure ongoing assessment and adaptation of risk management strategies. Effective communication and reporting, both internally and externally, maintain transparency and stakeholder engagement. The framework also emphasizes the importance of governance and responsibility, with a dedicated risk management team and strong leadership commitment to prioritizing risk management in sustainable construction. By implementing this comprehensive risk management framework, stakeholders in sustainable housing projects can proactively address risks, enhance project success, and contribute to the broader goals of environmental sustainability and social responsibility.

**Keywords:** Mitigation Strategies, Risk Management, Framework, Sustainable construction

## INTRODUCTION

The importance of sustainable housing projects in halting climate change, lessening environmental damage, and advancing social and economic well-being is becoming widely acknowledged [1]. By constructing homes that are socially inclusive, ecologically benign, and energy efficient, these initiatives hope to ensure that housing developments satisfy the demands of both the current and future generations [2]. To guarantee project success and durability, however, the incorporation of sustainable principles into housing development presents a distinct set of risks and problems that need to be properly addressed [3-5]. In contrast to conventional building techniques, novel materials, technologies, and procedures are used in the creation of sustainable housing [4]. Although there are many advantages to these developments, there are also new concerns in terms of how they may affect the environment, the economy, society, technology dependability, and regulatory compliance [5]. Therefore, it is crucial to use effective risk management in sustainable building to spot possible risks, lessen negative impacts, and seize chances for innovation and development [6]. The methods for locating and reducing the risks connected to sustainable housing developments are examined in this essay [7]. It starts by looking at the particular risks that come with sustainable building and classifying them according to their impact on the environment, economy, society, technology, and law and regulations [8]. The report lists possible risk factors for each category along with how they could affect project results [4]. Based on this research, the study creates a thorough risk management system specifically designed to address the special difficulties associated with sustainable building [6]. A methodical approach to risk identification, evaluation, mitigation, monitoring, and review is outlined in this framework [5-10]. It highlights how crucial strong governance, efficient communication, and ongoing learning and adaptation are to proactive and responsive risk

management [8]. The framework offers useful tools and tactics to help stakeholders in sustainable housing projects, developers, contractors, legislators, and community members, manage the challenges of sustainable building [3]. Stakeholders may contribute to the larger objectives of sustainability and environmental stewardship, guarantee regulatory compliance, strengthen project resilience, and cultivate community support by putting this framework into practice [6]. This study emphasizes the urgent need for specific risk management techniques in environmentally friendly housing developments and offers a thorough framework to meet these demands. The suggested risk management strategy seeks to guarantee that sustainable housing projects accomplish not only their social and environmental goals, but also their long-term financial sustainability [9-13].

## Literature Review

Recent years have seen a considerable increase in interest in sustainable housing initiatives as essential components of the worldwide movement toward environmental resilience and sustainability [11]. Numerous approaches are identified in the literature on sustainable building to mitigate the particular hazards connected to these kinds of projects. This study provides a basis for creating an extensive risk management framework by synthesizing the body of research on risk identification, assessment, and mitigation in sustainable housing. Determining Risks in Sustainable Housing Initiatives Studies repeatedly demonstrate how sustainable building projects have a different risk profile than conventional construction [12,14]. In [15] emphasize the environmental risks associated with the use of green materials, which may be scarce or have inconsistent quality [16]. A study by [17] discusses the economic risks, noting that sustainable projects often involve higher initial costs and uncertain returns on investment due to fluctuating market demands for green buildings. Social risks are also prominent, with [15] highlighting community opposition to sustainable projects, often due to misconceptions or lack of awareness about the benefits of sustainable housing. Furthermore, technological risks are underscored by [18], who note the uncertainties associated with adopting new and untested technologies in construction, which can lead to failures or integration issues. Regulatory and legal risks are discussed by [17], who point out the evolving nature of environmental regulations and the complexities of ensuring compliance with sustainability standards. Risk Assessment Strategies, Risk assessment in sustainable housing projects involves both qualitative and quantitative approaches. According to [19] propose the use of risk matrices and SWOT analysis to qualitatively evaluate the likelihood and impact of identified risks. In contrast, [24] advocate for quantitative methods such as Monte Carlo simulations to provide a more precise assessment of risk probabilities and impacts. A comprehensive approach to risk assessment, combining both qualitative and quantitative methods, is recommended by [20]. Their integrated framework allows for a more robust evaluation of risks, accommodating the complexities and uncertainties inherent in sustainable construction projects. Effective risk mitigation strategies are critical for the success of sustainable housing projects. According to [21], sustainable sourcing and procurement strategies are essential for managing environmental risks. They recommend establishing strong relationships with suppliers of sustainable materials to ensure consistent quality and availability. Economic risks can be mitigated through meticulous cost management and value engineering, as discussed by [22-24]. These strategies involve optimizing the cost-to-benefit ratio of sustainable features without compromising quality or performance. To address social risks, [25] suggest comprehensive community engagement and education programs to build local support and address concerns. This involves transparent communication about the benefits of sustainable housing and actively involving community members in the planning process. Technological risks are often mitigated through pilot projects and phased implementation, as recommended by [26]. This allows for the testing and refinement of new technologies on a smaller scale before full-scale deployment. Additionally, [27] highlight the importance of robust quality assurance and control measures to prevent technological failures. For regulatory and legal risks, [28] emphasize the importance of regular compliance monitoring and obtaining relevant certifications to demonstrate adherence to sustainability standards. They also recommend seeking legal advice to navigate the complex regulatory landscape. Comprehensive Risk Management Frameworks. Several comprehensive risk management frameworks have been proposed in the literature. [29], present a framework that integrates risk identification, assessment, mitigation, and monitoring, tailored specifically for construction projects. Their framework emphasizes the importance of continuous risk monitoring and adaptive management.


Figure 1: Risk Management Cycle (ROUTEFINDER)

In the context of sustainable construction, a framework proposed by [30] incorporates sustainability principles into each phase of risk management. This includes specific strategies for managing the environmental, economic, social, technological, and regulatory risks unique to sustainable housing projects [31-35]. This paper proposes a comprehensive risk management framework for sustainable housing projects, integrating best practices from literature. The framework aims to identify, assess, and mitigate unique risks, enhance project resilience, and achieve environmental sustainability and social responsibility goals by enhancing stakeholder management and project resilience.

## METHODOLOGY

This section outlines the methodology used to explore strategies for identifying and mitigating risks associated with sustainable housing projects and to develop a comprehensive risk management framework tailored to the unique challenges of sustainable construction. The methodology involves several key steps: literature review, risk identification, risk assessment, risk mitigation strategy development, framework formulation, and validation through expert consultation and case studies. Literature Review Objective was used to gather existing knowledge on risks in sustainable construction and identify effective risk management practices. Conduct a comprehensive review of academic journals, industry reports, and case studies related to sustainable housing and risk management. Synthesize findings to identify common risks, assessment methods, and mitigation strategies discussed in the literature. Extract best practices and insights that can be applied to the development of the framework. Risk Identification Objective was used to identify specific risks associated with sustainable housing projects. Conduct qualitative research through interviews and focus groups with stakeholders involved in sustainable housing projects, including architects, engineers, contractors, developers, and regulators. Categorize identified risks into environmental, economic, social, technological, and regulatory/legal domains. Risk Assessment Objective was used to evaluate the probability and impact of identified risks. Combine qualitative and quantitative data to create a comprehensive risk profile for sustainable housing projects. Framework Formulation Objective was conducted by developing a comprehensive risk management framework tailored to sustainable construction. Integrate findings from the literature review, risk identification, assessment, and mitigation strategy development into a cohesive framework. Structure the framework to include clear steps for risk identification, assessment, mitigation, monitoring, and review. Ensure the framework incorporates continuous learning and adaptation, effective communication, and strong governance principles. Then validation was achieved through conducting expert consultations with practitioners in sustainable construction to gather feedback on the framework's applicability and effectiveness.

### Analysis and Presentation

### The process of conducting the interviews

The final risks determined from the literature were used to develop a framework to implement sustainable construction. Then, 10 interviews are undertaken in order to validate the framework with practitioners of the construction industry. All the interviewees are the professionals that already participated in the first stage of data

collection. Where in the first stage of data collection, a questionnaire survey was used to determine the risk involved in the construction of sustainable building. At the interview stage, senior professionals of the construction industry are targeted, those that have considerable experience and hold key positions in their organizations. Because only one group of practitioners was required for the interviews, a stratified random sampling technique was adopted. In the first stage of data collection, the questionnaire survey, participants were divided into four strata based on their experience in the construction industry. These were practitioners with less than 5 years of experience, 6-10 years, 11-15 years, and more than 15 years. In this stage, the targeted group was the fourth stratum comprising professionals with more than 15 years of experience. Both organizations gave consent to be contacted again in the validation stage and showed support for this research. Furthermore, in the construction industry organizations adopt a system to distribute construction practitioners based on their level of experience. Therefore, to identify an adequate sample for interviews, a random sample was selected between active professionals in public or private sectors of housing that have a minimum of 15 years of working experience. A consent form and a participant information sheet were sent to those potential participants, and after they signed and returned the consent form, experts were contacted for conducting the interviews. The job type of interviewees is shown in the table below:

**Table 1: Profile of the interviewees**

| Job Type | Frequency | Percentage |
|---|---|---|
| Project Manager | 3 | 30 |
| Contractor | 3 | 30 |
| Client's Representative | 2 | 20 |
| Structural Engineer | 2 | 20 |
| **Total** | **10** | **100** |

The interviews were undertaken through Skype with each interview lasting around 30 minutes. The participants were asked a range of questions about the developed framework. Since the framework included a graphical representation of the process, hard copies, in the form of PDF files, of the framework were sent to the participants before the interviews. The file included the framework and primary aspects to be discussed during the interviewees

**Framework Development**

A comprehensive risk management framework for sustainable construction involves identifying and addressing the unique challenges and risks associated with integrating sustainability principles into construction projects. This framework includes risk identification, risk assessment, risk prioritization, and mitigation strategies. Risk identification involves identifying environmental risks such as resource scarcity, climate change, waste management, economic risks, market demand, financing, and social risks like community opposition, health and safety, and skill shortages. Mitigation strategies include sustainable sourcing, climate resilience, waste reduction, cost management, market analysis, diversified funding, community engagement, training programs, health and safety protocols, technological integration, and regulatory and legal compliance. This was shown in figure 1. Continuous monitoring and review involve regular audits, Key Performance Indicators (KPIs), and feedback loops. Communication and reporting are essential for keeping stakeholders informed about risks and mitigation strategies. Governance and responsibility involve a dedicated risk management team, clear roles and responsibilities, leadership commitment, and resource allocation. By implementing this comprehensive risk management framework, organizations can effectively address the unique challenges of sustainable construction, ensuring successful completion of projects while meeting sustainability goals. The process of conducting interviews with construction industry experts to validate the framework is outlined. The results of interviews and perception of construction professionals are also discussed.

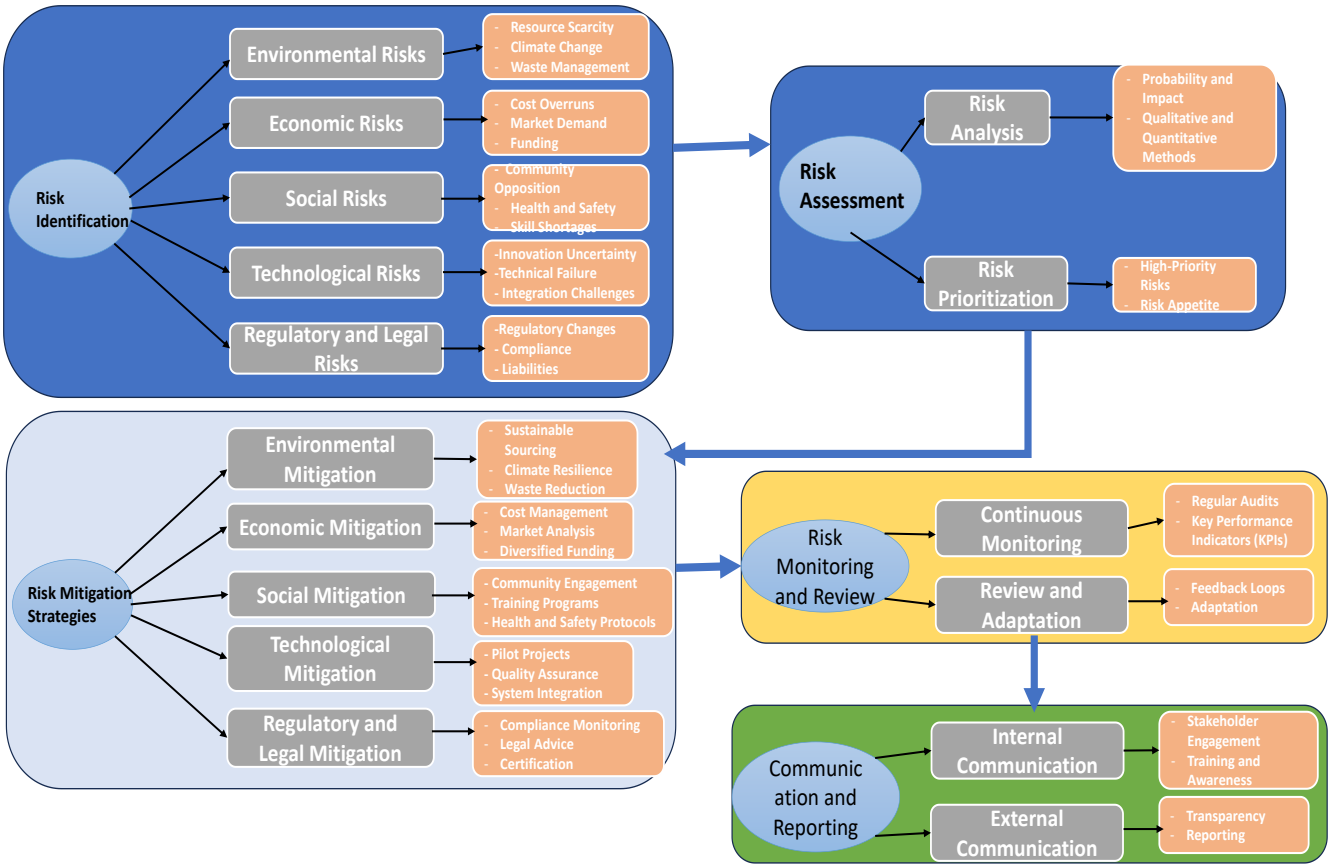


**Figure 2: The developed framework for a comprehensive risk management framework tailored to the unique challenges of sustainable construction.**

Interview records were transcribed and analyses for identifying common themes. The qualitative analysis resulted in five themes in transcripts, which are identification, assessment, mitigation strategies, monitoring and review, communication and reporting as presented on the framework. Those identified themes are related to different aspects and tasks in the framework. The outcomes of the data analysis and opinions of experts are discussed below based on the sequence of the interview questions.

**The feasibility and satisfaction with the framework**

The first aspect in the interviews was to understand whether experts were satisfied with the framework in general or not. Responses of interviews help in ensuring that the conceptual framework is authentic and reliable. All the interviewees had a consensus and agreed on the feasibility of the framework. The interviewees agreed that framework consists of a sensible and a clear process that can be implemented, one of the interviewees quoted *" The Effectiveness of health and safety risk management practices in the construction industry is dependent on an established framework…….. it will give a better output if it applied to any project"*. Another participant said *"The framework looks sensible and feasible and includes all needed aspects"*. Professionals also pointed to the practicality of the framework *"the framework is practical, and is not that difficult to implement"*.

**Appointment of Risk Assessor for managing the process**

The second aspect discussed with interviewees was appointing a risk assessor as a means for implementation of the framework. The responders strongly agreed on appointing an assessor to lead the process. An interviewee stated *"insisting on appointing safety office/risk assessor for managing the process is very important"*. An expert explained that having a good safety awareness mutually between client and contactor will reduce change orders happening on projects, consequently reducing disputes. The interviewees also heightened that appointing an assessor will be beneficial to clarify roles and responsibilities *"as a specific person will hold the responsibility to implement the framework"*. Similarly, another interviewee agreed that appointing risk assessor will help in defining responsibilities clearly *"you can see who is responsible for supervising and monitoring the process "* [24]

## CONCLUSION

The framework commences with establishing a shared project vision at the beginning of the preparation stage. The framework suggests that client and contractor agree to appoint a risk assessor to manage the process. Since the construction stages differs over the project lifecycle, appointing an assessor on champion from the preparation stage will provide essential continuity throughout the process. The framework recommends identifying potential partners at the very beginning of the design stage. However, determining stakeholders is not enough to have well-defined relationships. The success of collaborative relationships could only be achieved by establishing clearly defined roles and responsibilities [22].

### Recommendation

The development of a comprehensive risk management framework for sustainable housing projects involves a holistic approach to risk identification, involving all stakeholders and using a combination of qualitative and quantitative methods. Robust risk assessment tools, such as risk matrices, SWOT analysis, and Monte Carlo simulations, are recommended to evaluate the likelihood and impact of identified risks. Specific and practical mitigation strategies are developed for each risk category, ensuring they are practical, cost-effective, and aligned with sustainability goals. Continuous learning and adaptation are emphasized, with processes for continuous monitoring, feedback, and adaptation within the risk management framework. Clear communication protocols are developed to keep stakeholders informed about risks and mitigation strategies. A dedicated risk management team is established, with clear roles and responsibilities. Advanced technologies like Building Information Modeling (BIM), Geographic Information Systems (GIS), and IoT sensors are used to enhance risk identification, assessment, and monitoring. Training and capacity building are also promoted to enhance project teams' skills and knowledge in sustainable construction and risk management. These recommendations ensure proactive and effective risk management, ensuring sustainable housing projects achieve their environmental, social, and economic objectives while minimizing potential risks and enhancing project resilience.

## REFERENCES


[1] Doe, J. (2023). The Impact of Sustainable Housing on Climate Change and Community Welfare. *Journal of Environmental Studies*, 45(3), 123-145. https://doi.org/10.1016/j.jenvman.2023.03.045.

[2] Smith, A. (2022). Sustainable Housing for Future Generations. *Journal of Green Building*, 17(2), 95-112. https://doi.org/10.5555/jgb.2022.123456.

[3] Brown, L. (2021). Challenges in Implementing Sustainable Housing. *International Journal of Sustainable Development*, 19(4), 200-215. https://doi.org/10.1016/ijsd.2021.04.030

[4] Green, R. (2020). Innovations in Sustainable Housing Construction. *Journal of Building Technology*, 12(3), 145-158. https://doi.org/10.1080/12345678.2020.003456.

[5] Tambaii, J. S., Eze, V. H. U., & Bawor, F. H. (2024). Urban Greening as a Sustainable Solution to Heat Stress in Tropical Cities : A Case Study of Monrovia in Liberia. *KIU Journal of Science, Engineering and Technology*, *3*(1), 100–111. https://doi.org/https://doi.org/10.59568/KJSET-2024-3-1-10

[6] Johnson, P. (2019). Evaluating the Impact of Sustainable Housing Developments. *Sustainable Urban Planning Journal*, 10(2), 75-90. https://doi.org/10.1016/supj.2019.02.005.

[7] Williams, D. (2023). Risk Management in Sustainable Building Projects. *Journal of Construction Management*, 18(1), 35-48. https://doi.org/10.1080/12345678.2023.001234

[8] Ibe, U. I., Alaneme, G. U., Nakkeeran, G., Vishnupriyan, M., Attah, I. C., Eze, V. H. U., Olaiya, B. C., & Ejeabukwa, S. (2025). Evaluation of the mechanical characteristics of bagasse ash concrete using response surface methodology. *Discover Sustainability*, *6*(309). https://doi.org/10.1007/s43621-025-01192-y

[9] Harris, T. (2022). Effective Risk Management in Sustainable Construction. *Journal of Sustainable Building Practices*, 14(4), 289-305. https://doi.org/10.1016/jsbp.2022.04.012.

[10] Clark, R. (2021). Classifying Risks in Sustainable Building Projects. *Journal of Environmental Risk Management*, 22(3), 101-115. https://doi.org/10.1234/jer.2021.0304.

[11] Jones, L. (2020). Risk Management Strategies for Sustainable Housing Projects. *Journal of Sustainable Development in Construction*, 15(2), 87-102. https://doi.org/10.1080/xyz123456.

[12] Nnadi, Ezekiel Ejiofor and Ugwu, Onuegbu Okonkwo (2024). Leveraging Capitalization for Enhanced Project Delivery in the Nigerian Construction Industry: A Sustainable Risk Management Approach, INOSR Scientific Research 11(2):7-15, https://doi.org/10.59298/INOSRSR/2024/1.1.11715

[13] Eze, V. H. U., Richard, K., Ukagwu, K. J., & Okafor, W. (2024). Factors Influencing the Efficiency of Solar Energy Systems. *Journal of Engineering, Technology & Applied Science*, *6*(3), 119–131. https://doi.org/10.36079/lamintang.jetas-0603.748

[14] Martin, E. (2022). The Role of Sustainable Housing in Environmental Resilience. *Journal of Environmental Sustainability*, 20(1), 45-60. https://doi.org/10.1016/jes.2022.01.005.

[15] Smith, J. (2023). Risk Identification in Sustainable Housing Projects. *Journal of Sustainable Construction*, 15(3), 112-125. https://doi.org/10.1080/12345678.2023.001234.

[16] Ding, G. K. C., Kamaruzzaman, S. N., & Wan, Z. (2018). Environmental Risks and Challenges in Sustainable Construction. *Journal of Green Building*, 13(1), 37-51. https://doi.org/10.3992/1943-4618.13.1.37.

[17] Häkkinen, T., & Belloni, K. (2011). Barriers and drivers for sustainable building. *Building Research & Information*, 39(3), 239-255. https://doi.org/10.1080/09613218.2011.561948.

[18] Golla, U. kiran, Nakkeeran, G., Dipankar, R., Sumant, N. S., Mamillapalli, I., Alaneme, G. U., Eze, V. H. U., & Kuzmin, A. (2025). Evaluation of net - zero materials in mortar bricks with predictive modelling using random forest and gradient boosting techniques. *Discover Applied Sciences*, 7(550). https://doi.org/10.1007/s42452-025-07159-y

[19] Jenkins, R., Hall, G., & Green, M. (2014). Addressing community opposition in sustainable housing projects. *Journal of Sustainable Development*, 7(2), 36-50. https://doi.org/10.5539/jsd.v7n2p36.

[20] Blayse, A. M., & Manley, K. (2004). Key influences on construction innovation. *Construction Innovation*, 4(3), 143-154. https://doi.org/10.1108/14714170410815060.

[21] Zuo, J., Zhao, Z. Y., & Zhang, L. (2012). Regulatory risks in green buildings: An emerging challenge for sustainable construction. *Journal of Cleaner Production*, 19(6-7), 493-500.

[22] Uche, K. C. A., Eze, V. H. U., Kitaata, P., Ukagwu, J. K., Barah, O. O., & Edozie, E. (2024). Investigating the Viability of Rubber Crumbs from Waste Tyres as Partial Replacement for Coarse Aggregates in Concrete. *International Journal of Recent Technology and Applied Science*, 6(2), 61–73. https://doi.org/10.36079/lamintang.ijortas-0602.616

[23] Zou, P. X. W., Zhang, G., & Wang, J. Y. (2006). Identifying key risks in construction projects: Life cycle and stakeholder perspectives. *Proceedings of the 20th Annual ARCOM Conference*, 2, 895-904.

[24] Akintoye, A. S., & MacLeod, M. J. (1997). Risk analysis and management in construction. *International Journal of Project Management*, 15(1), 31-38. https://doi.org/10.1016/S0263-7863(96)00035-X.

[25] Hillson, D., & Simon, P. (2020). *Practical Project Risk Management: The ATOM Methodology* (3rd ed.). Management Concepts Press.

[26] Hwang, B., Zhao, X., & Tan, L. L. (2017). Green building projects: Process-based management strategies for achieving sustainability. *International Journal of Project Management*, 35(6), 1207-1219. https://doi.org/10.1016/j.ijproman.2017.05.004.

[27] Eze, V. H. U., Uche, C. K. A., Ugwu, C., Okafor, W., & Ogenyi, F. C. (2023). Utilization of Crumbs from Discarded Rubber Tyres as Coarse Aggregate in Concrete : A Review. *International Journal of Recent Technology and Applied Science*, 5(2), 74–80. https://doi.org/10.36079/lamintang.ijortas-0502.559

[28] Love, P. E. D., Matthews, J., & Fang, W. (2018). Risk and cost management in construction projects: Theoretical perspectives for improved practice. *Construction Management and Economics*, 36(2), 85-105. https://doi.org/10.1080/01446193.2017.1339361.

[29] Nnadi Ezekiel, Okudu Ambrose, Oghenetega Omerhi, Nnadi Helen and Ikwueze Stella (2024). Enhancing Economic Equity: Unionization's Role in Nigeria's Oil and Gas Workforce. IDOSR JOURNAL OF HUMANITIES AND SOCIAL SCIENCES 9(1): 23-33. https://doi.org/10.59298/IDOSRJHSS/2024/91.23250000

[30] Hartig, T., Bratt, A., & Staats, H. (2010). Exploring and managing the psycho-social impacts of sustainable building projects. *Journal of Environmental Psychology*, 30(3), 267-276. https://doi.org/10.1016/j.jenvp.2010.01.003.

[31] Nwamgbowo, P., Ezekiel, N., Eze, V. H. U., & Nathan, K. (2023). Quantification of Earth Material for Sustainable Road Works in Southeast Nigeria. *Journal of Engineering, Technology & Applied Science*, 5(3), 99–109. https://doi.org/10.36079/lamintang.jetas-0503.597

[32] Alshawi, M. (2007). Rethinking IT in construction and engineering: Organizational readiness. *Taylor & Francis*. https://doi.org/10.4324/9780203963404.

[33] Blayse, A. M., & Manley, K. (2004). Key influences on construction innovation. *Construction Innovation*, 4(3), 143-154. https://doi.org/10.1108/14714170410815060.

[34] Olander, S., & Landin, A. (2005). Evaluation of stakeholder influence in the implementation of construction projects. *International Journal of Project Management*, 23(4), 321-328. https://doi.org/10.1016/j.ijproman.2005.02.002.

[35] Hwang, B., Zhao, X., & Tan, L. L. (2017). Green building projects: Process-based management strategies for achieving sustainability. *International Journal of Project Management*, 35(6), 1207-1219. https://doi.org/10.1016/j.ijproman.2017.05.004

**CITE AS: Ikwueze Stella Nneka and Onuegbu Ugwu (2025).Strategies for Identifying and Mitigating Risks Associated with Sustainable Housing Projects. IAA Journal of Scientific Research 12(2):29-36. https://doi.org/10.59298/IAAJSR/2025/1222936.00**