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Application of Sustainable Technology for Effective Risk Management Development

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Abstract

This study examined the application of sustainable technology for effective risk management development, using AXA Mansard Insurance Plc as a case study. The study adopted a descriptive survey research design. The target population comprised 134 professional staff of AXA Mansard Insurance Plc across its operational hubs in Lagos, Abuja, and Enugu. Data collection was executed using a structured 4-point Likert scale questionnaire Data were analyzed using descriptive statistics (frequencies and percentages), while hypotheses were tested using inferential statistics (Chi-Square). The empirical findings revealed that integration of sustainable technology has significantly improve risk identification, assessment, monitoring, and control processes. The study also identified high cost of implementation, lack of technical expertise, and poor infrastructure as challenges hindering the integration of sustainable technology for effective risk management. Based on these findings, the study recommends that organisations should allocate adequate resources to sustainable technologies such as artificial intelligence, Internet of Things (IoT), data analytics, automation, and other digital systems that can improve risk identification, monitoring, prediction, and response, also, insurance companies should transit to Software-as-a-Service (SaaS) models to lower initial capital barriers, implement structured socio-technical upskilling programs for staff to bridge the technology-human usage gap, develop hybrid parametric climate insurance products, and actively collaborate with regulatory bodies like NAICOM to establish standardized green underwriting policies.

Keywords: Sustainable Technology, Risk Management, AXA Mansard Insurance Plc, Chi-Square, and Socio-Technical Systems.

Introduction

The increasing complexity of environmental, economic, social, technological, and climate-related risks has made effective risk management essential for achieving sustainable development. Climate change, natural disasters, economic shocks, public-health emergencies, cyber threats, and infrastructure failures can undermine development gains and increase the vulnerability of communities and institutions. Consequently, contemporary risk management is increasingly shifting from reactive responses toward proactive approaches that emphasize risk identification, prevention, preparedness, mitigation, monitoring, and resilience (UNDP, 2022).

Sustainable technology provides important opportunities for strengthening this transition. Technologies such as artificial intelligence (AI), the Internet of Things (IoT), geographic information systems (GIS), remote sensing, big-data analytics, satellite technology, and digital early-warning systems can improve the collection and analysis of risk information, facilitate real-time monitoring, strengthen prediction, and support timely decision-making. Empirical evidence indicates that IoT and AI-based systems can substantially improve flood prediction and early-warning capacity, while smart-city technologies can strengthen emergency-management capabilities (Adeleye and Akindele, 2025; Waqar et al., 2025). Similarly, AI-driven risk-management applications have been associated with improved sustainable-development outcomes in construction projects (Al Qudah et al., 2025).

Despite these opportunities, the effectiveness of sustainable technology in risk management is not determined by technological capability alone. Its success depends on adequate infrastructure, data quality, institutional capacity, technical skills, stakeholder participation, affordability, and appropriate governance. UNDRR (2025) emphasizes that technological solutions must be integrated with socioeconomic, cultural, institutional, and infrastructural conditions. Furthermore, excessive dependence on digital systems can create new challenges, including cybersecurity threats, privacy concerns, technological exclusion, and unequal access to digital services (UNDP, 2024).

Although existing studies have established the usefulness of AI, IoT, GIS, and other digital technologies in specific areas of risk management, three important gaps remain. First, much of the existing empirical literature examines individual technologies or specific hazards, particularly floods and urban emergencies, rather than sustainable technology as a broader multidimensional concept. Second, existing studies tend to emphasize technological performance, such as prediction accuracy and monitoring efficiency, while giving less attention to institutional, social, and governance factors that determine whether technological information actually produces effective risk-management outcomes. Third, empirical evidence from developing countries, particularly sub-Saharan Africa, remains relatively limited compared with evidence from Asia and other regions. These gaps justify further investigation into how sustainable technology can be integrated with institutional and human capacities to produce effective and sustainable risk-management outcomes. Against this background, this study examines the application of sustainable technology for effective risk management and development, with emphasis on how technological innovation can support risk identification, prevention, preparedness, response, resilience, and sustainable development outcomes.

Objectives of the Study

The broad objective of the study is to evaluate the application of sustainable technology for effective risk management development. Other specific objectives include:

i. To examine the relationship between sustainable technology and effective risk management.
ii. To examine the role of sustainable technology integration in risk identification, assessment, monitoring, and control processes.
iii. Identify challenges facing sustainable technology adoption.
iv. To suggest appropriate strategies for integration and application of sustainable technologies.

Statement of Hypotheses

H_{o1}: There is no significant relationship between the application of sustainable technology and effective risk management development.

H_{o2}: The integration of sustainable technology does not significantly improve risk identification, assessment, monitoring, and control processes.

Sustainable Technology

Sustainable technology refers to the development and application of technological innovations that meet present economic and social needs while minimizing negative impacts on the environment and preserving resources and opportunities for future generations. It involves the use of technology to improve efficiency, productivity, resilience, and quality of life while reducing resource depletion, pollution, greenhouse-gas emissions, waste, and other environmental consequences. According to the United Nations, technology and innovation are important enablers of sustainable development because they can support more efficient use of resources, promote clean production, and contribute to solutions to environmental and socioeconomic challenges (United Nations, 2015).

Sustainable technology encompasses a broad range of applications, including renewable-energy systems, energy-efficient technologies, smart infrastructure, sustainable agricultural technologies, waste-management technologies, green transportation, digital technologies, artificial intelligence, Internet of Things (IoT) systems, remote sensing, and technologies for climate and disaster-risk management. The European Commission (2022) emphasizes that digital technologies can contribute to sustainability by improving resource efficiency, enabling better monitoring, and supporting the transition toward more sustainable economic systems. Similarly, the World Bank (2025) identifies digital technologies as important tools for climate action, particularly through early-warning systems, geospatial technologies, environmental monitoring, and climate-smart applications.

The concept also extends beyond environmental protection to include economic and social sustainability. A technology may be considered sustainable when it is economically viable, socially inclusive, accessible to users, and capable of generating long-term benefits without creating unacceptable environmental or social costs. This perspective is particularly important in developing economies, where technological solutions must take account of affordability, institutional capacity, infrastructure, digital inclusion, and local conditions. UNDP (2024) notes that digital technologies can promote development and improve governance, but their benefits depend on appropriate policies and governance mechanisms that address associated risks.

For the purpose of this study, sustainable technology is defined as the purposeful application of environmentally responsible, economically viable, socially inclusive, and innovative technological tools to improve resource efficiency, strengthen resilience, reduce risks, and support long-term sustainable development. This definition is particularly relevant to risk management because technologies such as GIS, remote sensing, artificial intelligence, big-data analytics, IoT, and digital early-warning systems can improve the identification, assessment, monitoring, prediction, and management of risks (UNDRR, 2025).

Risk Management

Risk management is a systematic and continuous process through which individuals, organizations, institutions, and governments identify, assess, evaluate, treat, monitor, and communicate risks that may affect the achievement of their objectives. The International Organization for Standardization (ISO) defines risk management as "coordinated activities to direct and control an organization with regard to risk" (ISO, 2018). Under ISO 31000, risk is understood as the effect of uncertainty on objectives, meaning that uncertainty may produce either negative consequences or positive opportunities. Consequently, risk management is not limited to preventing losses; it also involves identifying opportunities and making informed decisions that improve the likelihood of achieving desired objectives.

Risk management involves several interconnected activities, including establishing the context, identifying risks, analysing their likelihood and consequences, evaluating their significance, selecting appropriate risk-treatment measures, monitoring changes, and communicating relevant information to stakeholders. ISO 31000 emphasizes that these activities should be integrated into organizational governance, strategy, planning, decision-making, and operational processes rather than treated as a separate activity. This integrated approach enables organizations to anticipate potential problems, allocate resources efficiently, strengthen decision-making, and improve resilience.

From a development perspective, risk management extends beyond organizational protection to include the prevention and reduction of risks that can undermine economic, social, and environmental development. The United Nations Office for Disaster Risk Reduction (UNDRR) defines disaster risk management as the application of policies and strategies to prevent new disaster risks, reduce existing risks, and manage residual risks, thereby strengthening resilience and reducing disaster losses. This perspective links risk management directly with sustainable development because effective risk management helps protect livelihoods, infrastructure, institutions, and development investments from potential shocks.

Risk management is therefore increasingly viewed as a proactive rather than purely reactive process. Instead of waiting for adverse events to occur, effective risk management seeks to anticipate potential threats, assess vulnerabilities, implement preventive measures, and continuously monitor changing conditions. The integration of technology can strengthen this process through real-time monitoring, predictive analytics, digital early-warning systems, geographic information systems, remote sensing, and artificial intelligence. Such technologies can improve the availability of information and support timely evidence-based decisions.

For the purpose of this study, risk management is defined as the systematic and continuous application of policies, processes, information, and technological tools to identify, assess, prevent, mitigate, monitor, and respond to potential risks while strengthening resilience and supporting the achievement of sustainable development objectives. This definition is particularly appropriate for examining the application of sustainable technology because technological innovations can enhance several stages of the risk-management process, from early identification and prediction to monitoring, communication, preparedness, and response.

Theoretical Framework

This study is anchored on the theory of Socio-Technical Systems. The Socio-Technical Systems (STS) Theory is an approach to understanding organizations and development systems as the interaction of two interdependent components: the social system and the technical system. The social system includes people, institutions, organizational structures, skills, values, relationships, leadership, and patterns of

behaviour, while the technical system consists of technologies, tools, machines, processes, information systems, and infrastructure. The central argument of the theory is that organizational effectiveness cannot be achieved by optimizing technology alone; rather, the technical and social components must be designed and managed together.

The theory originated from the work of researchers at the Tavistock Institute in the United Kingdom, particularly Trist and Bamforth (1951), who demonstrated that changes in mining technology affected not only production processes but also workers' relationships, responsibilities, communication, and organizational structures. Their work established the principle that technological systems and social systems are mutually dependent. Later contributions by Emery and Trist (1960) further developed the idea that organizations operate within complex environments and must adapt their technical and social arrangements to changing environmental conditions.

The fundamental principle of STS Theory is therefore joint optimization. This means that a technological innovation is most effective when it is compatible with the needs, capabilities, values, institutional arrangements, and working practices of the people who use it. A technologically sophisticated system may fail to achieve its objectives when users lack the skills to operate it, institutions are unable to maintain it, infrastructure is inadequate, or stakeholders do not accept the technology. Conversely, a well-designed social system may be constrained when appropriate technologies are unavailable or poorly integrated.

STS Theory provides a useful theoretical foundation for understanding the application of sustainable technology because sustainable technological development is not simply a question of introducing new technological tools. It involves the interaction between technology, people, institutions, economic systems, and the environment. For example, the introduction of artificial intelligence, Internet of Things (IoT) devices, geographic information systems (GIS), remote sensing, digital early-warning systems, or automated monitoring systems can improve sustainability and risk management, but their effectiveness depends on human capacity, institutional support, infrastructure, governance, and user participation.

The theory therefore suggests that sustainable technology should be designed around both technological efficiency and human and institutional requirements. This is particularly important in developing economies where technological projects may encounter constraints such as inadequate infrastructure, limited technical skills, weak institutions, financing problems, and unequal access to technology.

STS Theory is particularly relevant to risk management because risks frequently emerge from interactions between technological systems and human or organizational systems. For example, an automated early-warning system may accurately detect a flood risk, but the technology will not effectively reduce disaster losses if the warning does not reach vulnerable populations, responsible institutions do not respond promptly, or communities lack the resources and knowledge required to take protective action.

This perspective is consistent with contemporary risk-management approaches that emphasize that technological solutions cannot independently eliminate risk. The United Nations Office for Disaster Risk Reduction (UNDRR) stresses that technological applications for disaster-risk reduction need to be considered alongside socioeconomic, cultural, institutional, and infrastructural conditions.

For a study on “Application of Sustainable Technology for Effective Risk Management and Development,” STS Theory provides a strong theoretical explanation of how sustainable technology can contribute to improved risk-management outcomes. The theory assumes that the effectiveness of sustainable technology depends on the interaction between technological capabilities and the social and institutional environment in which the technology is deployed.

For instance, technologies such as AI and IoT can provide real-time information about environmental hazards. However, their contribution to effective risk management will depend on whether institutions possess the skills and resources to interpret the information, whether communication channels are available to transmit warnings, and whether communities trust and respond to the information. Thus, the theory helps explain why the mere availability of advanced technology may not necessarily translate into effective risk reduction.

The theory can also explain the relationship between sustainable technology and development outcomes. When technology is appropriately aligned with social needs and institutional capacities, it can improve resource efficiency, strengthen resilience, support informed decision-making, reduce vulnerability, and protect development investments. Conversely, poor integration between technological and social systems can create new vulnerabilities, such as technological dependence, cybersecurity risks, exclusion, unemployment, or unequal access to technological benefits.

Socio-Technical Systems Theory is highly relevant to this study because it emphasizes that technology and society must function as an integrated system. It provides a theoretical basis for arguing that the success of sustainable technology in risk management depends not only on technological sophistication but also on human capabilities, institutional arrangements, infrastructure, governance, and stakeholder participation. The theory therefore supports the proposition that effective risk management and sustainable development are more likely to be achieved when technological innovations are appropriately integrated with the social and institutional systems in which they operate.

Empirical Review

Gbran H. (2026) investigated AI-enabled IoT systems for urban flood resilience using a validated case study in Dubai. The system combined AI, sensor data, and GIS-based alerts to support flood-risk detection and warning. The prototype achieved a precision-recall area under the curve of 0.86, with recall of 0.88, and provided an operational warning lead time of approximately 30–45 minutes. The results demonstrate the potential of integrating AI, IoT, and geospatial technologies to provide actionable information for urban flood-risk management.

Adeleye and Akindele (2025) empirically examined the application of Internet of Things (IoT) and artificial intelligence (AI) for real-time flood early warning and resilience management in Ibadan Metropolitan Area, Nigeria. The researchers deployed rainfall and water-level sensors and combined real-time observations with historical data to train an artificial neural-network model. The integrated IoT–AI system achieved prediction accuracy above 90% and increased average warning lead time by almost three times compared with conventional monitoring. The study demonstrates that locally developed digital technologies can improve flood prediction, preparedness, and resilience, particularly in developing-country urban environments.

Al Qudah et al. (2025) investigated AI-driven risk management and sustainable development in Jordan's construction sector using survey data from 240 respondents collected between March and May 2024. Using Partial Least Squares Structural Equation Modelling (PLS-SEM), the study found that AI-supported risk management significantly contributed to sustainable development outcomes. Risk management also mediated the relationship between AI adoption and sustainable development. The findings suggest that AI can improve project planning, implementation, control, risk reduction, and sustainability across the construction project life cycle.

Waqar et al. (2025) examined the role of IoT in smart and sustainable city development. Their study considered IoT-enabled real-time monitoring, disaster management, energy management, and waste management as mechanisms through which smart-city technologies can support sustainable urban

development. The findings provide evidence that IoT-based monitoring and connected urban systems can strengthen the capacity of cities to manage environmental and operational risks while improving sustainability outcomes.

Jain (2024) examined the application of geo-computational technologies to sustainable disaster management and flood resilience. The study integrated remote sensing, GIS, LiDAR, unmanned aerial vehicles, and machine learning into a framework for flood monitoring, risk assessment, and mitigation. The evidence indicates that combining geospatial technologies with machine learning can improve hazard identification and support more effective disaster-preparedness and resilience strategies

The recent empirical literature generally indicates a positive relationship between sustainable technology and effective risk management. The evidence shows that AI can improve prediction and risk assessment, IoT can facilitate real-time monitoring, GIS and remote sensing can improve spatial identification of vulnerable areas, while smart-city technologies can strengthen institutional emergency-management capacity. The findings from Ibadan are particularly relevant to Nigeria because they demonstrate that relatively low-cost IoT and AI systems can produce substantial improvements in flood-warning performance.

However, the literature also indicates that technology alone is insufficient. Effective risk management depends on data quality, institutional capacity, infrastructure, stakeholder participation, communication, and the ability of decision-makers and communities to act on technological information. Recent evidence from AI-based disaster forecasting similarly shows that accurate prediction does not automatically prevent losses when warnings are not effectively communicated or translated into preparedness and protective action.

Three important gaps emerge from the literature. First, many recent studies concentrate on specific technologies or specific hazards, particularly AI, IoT, and flood management, rather than examining sustainable technology as a broader multidimensional concept. Second, much of the empirical evidence comes from China, the Middle East, and individual urban case studies, while evidence from sub-Saharan Africa remains comparatively limited. Third, existing studies often measure technological performance—such as prediction accuracy or warning lead time—without sufficiently examining how technology affects broader dimensions of effective risk management, including prevention, preparedness, institutional response, resilience, and sustainable development.

Therefore, a study examining the application of sustainable technology for effective risk management and development can contribute to the literature by integrating technological, institutional, environmental, and developmental dimensions rather than focusing on a single technology. This would provide a broader understanding of whether and how sustainable technology translates into improved risk-management outcomes.

METHODOLOGY

This study adopts a survey research design. A survey design is highly effective for this investigation because it allows the researcher to collect quantitative and qualitative data on the perceptions, attitudes, adoption levels, and practical challenges of sustainable technology directly from industry professionals. The institutional focus of this study is AXA Mansard Insurance Plc, one of Nigeria's leading insurance providers pioneering digital underwriting, climate risk indexing, and corporate sustainability. The study is concentrated on the company’s key operational hubs located in Lagos (the corporate headquarters), Abuja, and Enugu. These urban centers host the administrative, risk evaluation, and IT infrastructure departments of the organization. Focusing on these locations provides a comprehensive view of how

sustainable technological tools are integrated into both high-level risk policy decisions and everyday field operations.

The target population consists of the professional staff of AXA Mansard Insurance Plc who are directly involved in risk assessment, technical operations, and digital infrastructure. The total population for this study is 134 employees across the selected regional hubs. Because this population is highly specialized and relatively small, it ensures that the collected data is technically precise and highly relevant to sustainable technology applications.

The study utilizes primary data gotten from the respondents through the use of well-structured close-ended Likert-scale questionnaire. The data were analysed using descriptive statistics such as frequency and percentage while Chi-square statistic was used to test the hypotheses at 5% level of significance using Statistical Package for Social Sciences (SPSS) version 2026.

Results and Discussion

A total of 134 questionnaires were distributed, out of which 100 were properly completed and returned, representing a response rate of 74.63%.

Table 1: Gender Distribution

Gender	Frequency	Percentage (%)
Male	**58**	**58%**
Female	**42**	**42%**
Total	**100**	**100%**

Source: field survey 2026

The table shows that the majority of respondents were male (58%), while females accounted for 42%, indicating a fairly balanced gender representation.

Table 2: Educational Qualification

Qualification	Frequency	Percentage (%)
Secondary Education	**15**	**15%**
Undergraduate	**45**	**45%**
Graduate	**30**	**30%**
Post graduate	**10**	**10%**
Total	**100**	**100%**

Source: field survey 2026

Most respondents (45%) hold undergraduate qualifications, followed by Graduate holders (30%), suggesting that respondents are well-educated and capable of informed responses and (10%) post graduate.

Table 3: Awareness of Sustainable Technology

Response	Frequency	Percentage (%)
Highly Aware	**40**	**40%**
Moderately Aware	**35**	**35%**
Slightly Aware	**15**	**15%**

Response	Frequency	Percentage (%)
Not Aware	10	10%
Total	100	100%

Source: field survey 2026

A large proportion (75%) of respondents are either highly or moderately aware of sustainable technology, indicating strong awareness levels.

Table 4: Challenges Identified

Challenge	Frequency	Percentage (%)
High Cost of Implementation	35	35%
Lack of Technical Expertise	25	25%
Poor Infrastructure	20	20%
Resistance to Change	20	20%
Total	100	100%

Source: field survey 2026

The most prominent challenge is the high cost of implementation (35%), followed by lack of expertise (25%), indicating financial and skill barriers.

Table 5: Suggested Strategies

Strategy	Frequency	Percentage (%)
Government Support/Policies	30	30%
Training and Capacity Building	25	25%
Investment in Infrastructure	25	25%
Public Awareness Campaigns	20	20%
Total	100	100%

Source: field survey 2026

Government support (30%) is seen as the most critical strategy, followed closely by training and infrastructure investment.

Hypothesis One

Table 6: There is no significant relationship between the application of sustainable technology and effective risk management development.

Sex	Very Significant	Significant	Slightly Significant	Not Significant	Total
Male	35	27	8	4	74
Female	15	3	4	4	26
Total	50	30	12	8	100

Source: field survey 2026

Pearson chi-square value = 44.32; df = 3, Asymp. (2-sided) = .000 and critical value = 7.815

The Chi-square test result shows calculated value of 44.32 with degree of freedom df.3 and at 0.05 level of significance. Given that the calculated value of 44.32 is greater than the tabulated value of 7.815, we

reject H_0 and concluded that there is a significant relationship between sustainable technology and effective risk management development.

Hypothesis Two

Table 7: The integration of sustainable technology does not significantly improve risk identification, assessment, monitoring, and control processes.

Sex	Very Significant	Significant	Slightly Significant	Not Significant	Total
Male	**26**	**50**	**4**	**1**	**81**
Female	**12**	**4**	**2**	**1**	**19**
Total	**38**	**54**	**6**	**2**	**100**

Source: field survey 2026

Pearson chi-square value = 10.67, df = 3, Asymp. (2-sided) = .000 and critical value = 7.815

The Chi-square test result shows calculated value of 10.67 with degree of freedom df.3 and at 0.05 level of significance. Given that the calculated value of 10.67 is greater than the tabulated value of 7.815, we reject H_0 and concluded that integration of sustainable technology has significantly improve risk identification, assessment, monitoring, and control processes.

The findings indicate a significant positive relationship between sustainable technology and risk management development, suggesting that greater adoption and effective use of sustainable technologies contribute meaningfully to improved risk-management capabilities, this finding is in line with the findings of Al Qudah et al. (2025). This relationship can be explained by the ability of technologies such as artificial intelligence (AI), Internet of Things (IoT) devices, remote sensing, geographic information systems (GIS), cloud computing, and data analytics to provide timely and reliable information for identifying and responding to emerging risks.

The finding further suggests that sustainable technology moves risk management from a largely reactive approach toward a more proactive and preventive approach. By continuously collecting and processing information, technological systems can identify abnormal conditions and early warning signals before risks develop into major disruptions. For example, IoT sensors can monitor environmental and infrastructural conditions in real time, while AI and predictive analytics can analyse historical and current data to forecast the likelihood of future risks. Consequently, organisations and communities can take preventive measures and allocate resources before the effects of a risk become severe.

The significant relationship is also consistent with the socio-technical systems perspective, which emphasises the interaction between technological systems and human and organisational systems. Technology alone does not automatically produce effective risk management; its benefits depend on how effectively people, institutions, processes, skills and technological infrastructure are integrated. Thus, the finding implies that sustainable technology is most valuable when supported by competent personnel, appropriate organisational structures, effective communication and institutional capacity.

Furthermore, the finding that integration of sustainable technology improves risk detection, prediction and management, is in tandem with the findings of Adeleye and Akindele (2025). This demonstrates the importance of technological integration rather than the isolated adoption of individual technologies. Integrated systems enable information from different sources to be combined, analysed and communicated to decision-makers. This improves the ability to detect risks at an early stage, predict their potential consequences and coordinate appropriate responses. For instance, combining IoT-

generated data with AI and GIS can provide decision-makers with real-time information about the location, intensity and likely development of environmental hazards.

The improvement in risk detection may result from the continuous monitoring capability of digital technologies. Instead of relying exclusively on periodic assessments or manual observations, organisations can receive real-time information about changes in risk conditions. Similarly, improvements in risk prediction arise from the capacity of AI, machine learning and data analytics to identify patterns and relationships within large datasets. This enables organisations to estimate the probability and potential severity of future risks and consequently develop appropriate preparedness measures.

The findings therefore have important practical implications. Organisations seeking to strengthen risk management should not view sustainable technology merely as an investment in modern equipment. Rather, it should be considered an integrated risk-management resource requiring investment in digital infrastructure, staff capacity, data quality, cybersecurity, maintenance and institutional coordination. Effective integration can improve early warning systems, emergency preparedness, resource allocation and decision-making while potentially reducing the economic and social consequences of risks.

Overall, the findings demonstrate that sustainable technology can serve as an important driver of modern risk management development. The significant relationship indicates that technological adoption is associated with stronger risk-management capacity, while technological integration enhances the ability to detect, predict and manage risks. The implication is that organisations and policymakers should promote integrated, sustainable and human-centred technological systems as part of broader strategies for building resilient institutions and communities.

Conclusion and Recommendations

The integration of sustainable technology is no longer an optional green public relations campaign; it has become an operational necessity for the modern insurance industry.

As demonstrated by this empirical investigation, sustainable technology plays a vital role in transforming the risk management lifecycle-improving how risks are identified, assessed, and controlled. By leveraging digital platforms, AI diagnostics, and remote sensing tools, the insurance company can effectively insulate itself and its clients from volatile climate, operational, and system risks. However, to unlock the full potential of these green innovations, the company must proactively address high capital costs, commit to the continuous upskilling of its workforce, and actively participate in shaping the surrounding regulatory environment. Taking these steps will ensure long-term corporate resilience, environmental sustainability, and competitive market positioning.

To optimize the application of sustainable technologies for effective risk management development, the following recommendations are proposed:

- Organizations should increase investment in sustainable technologies. Management should allocate adequate resources to technologies such as artificial intelligence, Internet of Things (IoT), data analytics, automation, and other digital systems that can improve risk identification, monitoring, prediction, and response.
- Governments should provide supportive policies and relevant incentives. Relevant government agencies should develop policies, tax incentives, grant, and other support mechanisms that encourage organizations to adopt sustainable technologies for effective risk management.

- Organizations should strengthen technological infrastructure. Adequate digital infrastructure, reliable internet connectivity, secure data systems, and appropriate technological equipment should be provided to ensure that sustainable technologies can function effectively
- Following the principles of Socio-Technical Systems (STS) theory, the organization must pair technical acquisitions with human training. Intensive, continuous training programs on GIS mapping, AI risk forecasting, and data privacy should be established. Underwriters and claims administrators must be actively involved in the design and customization of these digital platforms to prevent technological friction.

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