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The role of artificial intelligence in advancing green building projects in Nigeria

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Abstract

Disruptive innovation is presently occurring in Nigeria's construction industry through the green building projects which has a great role to play in enhancing climate resilience. According to the Green Building Council of Nigeria, the number of green building projects in the country is on the rise. The green building projects incorporate sustainable design, energy-efficient technologies, and eco-friendly construction materials, leading to reduced carbon emissions and resource conservation. However, the uniqueness and inherent complexities of Nigeria's construction industry require the use of Artificial Intelligence (AI) to improve its processes and enhance overall competitiveness and performance. This study examined the awareness level and application of AI to provide useful insights into the state of AI applications in the Nigerian construction industry in advancing the green building projects. Through literature review and participant observation, this study identifies the role of artificial intelligence in advancing the green building projects in Nigeria. This study recommends more awareness creation on the role of artificial intelligence in advancing the green building projects for climate resilience in Nigeria. It concludes with a clarion call for deeper research on the above subject matter.

Keywords: Artificial intelligence, climate resilience, disruptive innovation, green buildings, international development, sustainable development

Introduction

Climate change is one of the global issues which we must of necessity tackle with alacrity in order to prevent global warming too unbearable for the survival of mankind. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, 1992). Climate change is the most significant challenge to achieving sustainable development, not only because it affects the global physical environment directly, but also because it affects nearly all aspects of socio-economic development (World Bank, 2016) ^[36]. Climate change has been described as an existential threat to human well-being. Climate change impact is intensely felt on soil fertility in Nigeria (Anabaraonye, Okafor, Ewa, Anukwonke, 2021) ^[6] and also on her biodiversity which affects sustainable development and economic growth of the nation (Anabaraonye, Amaechi, Okolo, Adeniyi, & Nwobu, 2022) ^[8]. Climate change is recognized as a true global emergency that requires concerted efforts by all countries, businesses, and even individuals to achieve the Paris Agreement goals aimed at addressing the crisis. These goals include holding the rise of average global temperatures to well below 2 degrees Celsius (2 °C) above pre-industrial levels and pursuing actions to limit the temperature increase to 1.5 °C above pre-industrial levels. Climate change education is therefore very vital in order to enable individuals and communities to adapt and mitigate the impacts of climate towards sustainability in Nigeria (Anabaraonye, Okafor & Hope, 2020; Onnoghen, Ojong, Omang, Obibessong & Asor, 2020) ^[5, 25]. Recent floods, cyclones, monumental wildfires, attendant droughts and tsunamis across various countries in the world, call for global attention to issues of climate change. Climate change is a global challenge which must tackled with alacrity to achieve our sustainable development goals. Researchers have recently identified the role of eco-musicology and eco-theology in enhancing climate resilience for sustainable development in Nigeria (Onnoghen, Nwafor, Orji, Odoh & Anabaraonye, 2024; Onnoghen, Nwafor, Odoh, Ewa & Anabaraonye, 2024) ^[27, 28]. Researchers have also identified the role of artificial intelligence in enhancing climate resilience for sustainable development in

Nigeria (Oboti, Anabaraonye & Orji, 2024) ^[22]. Based on climate resilience theories advanced in recent times, Studies have shown that artificial intelligence (AI) has a great role to play in advancing green building projects thereby enhancing climate resilience in Nigeria. This study vividly defines the concept of artificial intelligence, climate resilience and green building projects.

Methodology

This study examined “the role of artificial intelligence (AI) in advancing the green building projects in Nigeria” through existing literature review and participant observation. The main purpose of this research work was to survey theoretical backgrounds and previous studies on “the role of artificial intelligence (AI) in advancing the green building projects in Nigeria” and the current progress with the implementation of green building projects in enhancing climate resilience and ensuring sustainable development in Nigeria.

Understanding disruptive innovation

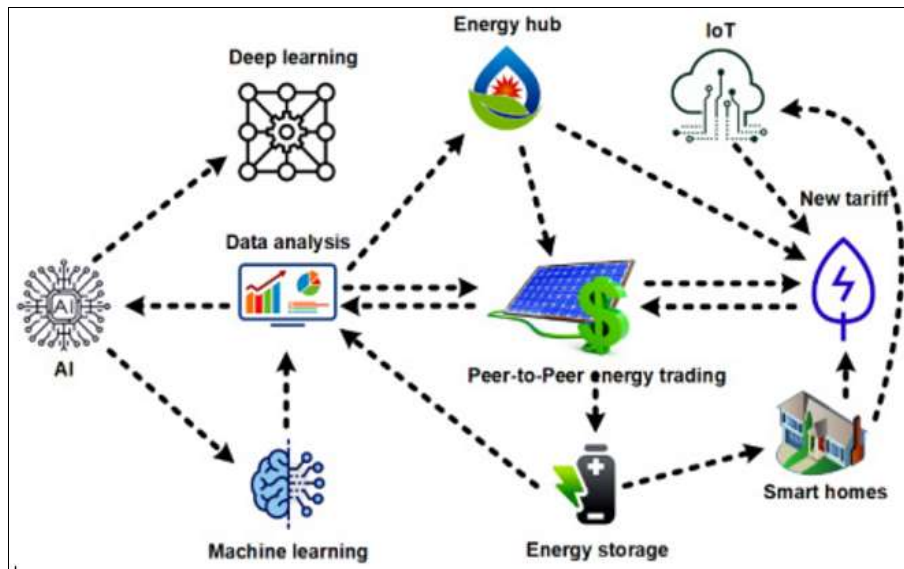
In business, a disruptive innovation is an innovation that creates a new and value market and eventually disrupts an existing market and value network, displacing established market-leading firms, products, and alliances. Innovation can be sustaining, evolutionary, revolutionary or disruptive. A disruptive process can take longer to develop than by the conventional approach and the risk associated with it is higher than the other more incremental or evolutionary forms of innovations, but once it is deployed in the market, it achieves a much faster penetration and a higher degree of impact on the established markets (Assink, 2006) ^[10]. Christensen (1997) ^[13] defined a disruptive innovation as a product or service targeted at a new set of customers. Generally, disruptive innovations were technologically straightforward, consisting of off-the-shelf components put together in a product architecture that was often simpler than prior approaches. (Christensen, 1997) ^[13]. Thus, disruptive innovation brings about a new set of customers for green products in Nigeria which are eco-friendly and inevitably appreciate the climate change adaptation and mitigation capacities and opportunities in green entrepreneurship (Anabaraonye, Okafor. & Hope, 2019) ^[4]. Disruptive innovation in the construction industry in Nigeria has created the emergence of the green building projects which comes with numerous socio-economic, environmental and psychological benefits. Disruptive innovation in Nigeria’s construction industry in Nigeria furthermore implies that big companies which relied heavily on excessive burning of fossil fuels, and deforestation which are the major contributors to climate change, air pollution and global warming will have to innovatively and creatively change their market and mode of operation in order to continue to be relevant for environmental sustainability and sustainable economic growth in the 21st century in Nigeria and beyond.

Understanding artificial intelligence

Artificial intelligence (AI) is the ability of a

digital computer to perform tasks commonly associated with intelligent beings (Britannica, 2024) ^[12]. Artificial Intelligence (AI) can also be defined as the development, deployment, and maintenance of computational systems that can replicate certain types of human intelligence (Rouse, 2024) ^[32]. Artificial intelligence can further be defined as using computers to do most of what humans would ordinarily do (Robeiro, 2021) ^[31]. Rebeiro (2021) ^[31] also defines AI as the field of computer science that enables machines to perform tasks requiring human-like intelligence. It involves creating intelligent agents that can sense, comprehend, learn, and act in a way that extends human capabilities (Robeiro, 2021; Nils, 2010) ^[31, 20]. Nils (2010) ^[20] opines that Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment (Nils, 2010; Tehrani, 2023) ^[20, 30]. Artificial intelligence (AI) has become a global revolution in the last decade. Almost every sector in the developed countries of the world has utilized artificial intelligence to deepen their technological efficiency as well as escalate progress and development which in turn entrenches their global relevance (Nwoye, 2023) ^[21]. The utilization of artificial intelligence (AI) to enhance eco-theology and climate resilience for sustainable development in Nigeria should be given priority. AI holds the potential to bring about transformative advancements in environmental data monitoring, resource management optimization, and the enhancement of climate resilience strategies (UNDP, 2024) ^[34]. There is therefore need to explore the innovative use of AI in green entrepreneurship education towards enhancing green building projects and climate resilience in Nigeria (Anabaraonye, Okon, Ewa, Adeniyi. & Nwobu, 2022) ^[7].

In the pursuit of addressing the climate crisis, data becomes an indispensable tool for tracking climate progress, anticipating environmental challenges, and directing resources effectively. When leveraged correctly, data acts as a catalyst for driving climate action (UNDP, 2024) ^[34]. For solar energy, which is abundant across much of Africa, AI-driven systems can enhance the efficiency of photovoltaic installations. Machine learning models can predict solar irradiance with remarkable accuracy, allowing for better planning and operation of solar farms. These models take into account a multitude of factors including weather patterns, atmospheric conditions, and historical data to optimize the positioning of solar panels and adjust their angles in real time, maximizing energy capture throughout the day. Additionally, AI-driven technologies such as drones, sensors, and predictive analytics can help mitigate risks associated with climate change and market volatility, enabling youth to adapt and thrive in a rapidly changing environment (Olagunju, 2024) ^[24]. The role of artificial intelligence in advancing green building projects in Nigeria is a vital aspect of green entrepreneurship education for enhancing climate resilience (Onnoghen, Onwuzurike, & Anabaraonye, 2024) ^[26].



(Source: Ahmad *et al.*, 2022) ^[1]

Fig 1: Energetics Systems and Artificial Intelligence: Applications of Industry 4.0

Enhancing green building projects through artificial intelligence

Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building (EPA, 2016). The evolution and principles of green building represent a pivotal aspect of modern architecture, addressing the urgent need for environmental sustainability in the construction sector (Umoh, Nwasike, Tula, Adekoya & Gidiagba, 2024) ^[33]. Guribie *et al.* (2022) ^[17] underscore the increasing public demand for green building, a response to the ecological impact of traditional construction methods. Their research highlights green architectural design as a strategy to minimize resource use and environmental damage, advocating for sustainable development within the construction industry.

Badawy *et al.* (2021) ^[11] discusses the key principles of sustainable green building, including strategies and guidelines for sustainable design and the use of green building materials. Their study focuses on the Palestinian context, suggesting a checklist to assess buildings' adherence to sustainable green building principles. This approach is crucial for transforming new and existing buildings towards sustainability, thereby saving energy, reducing waste, and improving overall environmental quality. Mahdavinejad and Bitaab (2017) ^[18] investigate the concept of Smart-Eco buildings, an architectural approach that integrates sustainable architecture with advanced intelligent technologies. Their study focuses on enhancing the technical performance of Smart-Eco buildings, particularly in energy efficiency. The research thoroughly examined elements like facades, windows, and shading systems, assessing their capability to fulfill rigorous energy standards. This highlights the essential role of smart building systems in not only improving building performance but also maintaining environmental integrity. Ramesh (2019) ^[29] explores the integration of participatory

approaches, systems, and solutions using IoT and AI for designing smart communities, with a focus on case studies from India. The study emphasizes the transformation of communities into smart communities by addressing the needs of inhabitants through the application of IoT and AI. This approach encompasses key verticals such as smart governance, energy, building, mobility, infrastructure, technology, healthcare, and citizen engagement. The research demonstrates how IoT and AI contribute to smartness in these areas, involving different stakeholders and leading to improved quality of life, enhanced resilience, optimal resource utilization, and empowerment of the community. Franco (2020) ^[16] investigates the integration of Information and Communication Technologies (ICT) in the design of smart buildings, focusing on balancing user comfort with energy efficiency. The research underscores the importance of ICT in enhancing the living experience, ensuring health and safety, and promoting efficient resource utilization. Smart buildings, as described in the study, are not only technologically advanced but also economically viable, contributing to reduced operational costs and fostering environments that are both healthy and environmentally sustainable. Meena *et al.* (2022) ^[19] explores innovations in the green building sector, emphasizing their potential to contribute to sustainable development, particularly in relation to climate change. The study underscores the importance of using energy, water, and other resources in a balanced manner to improve environmental conditions. Green buildings, characterized by their energy-efficient designs and low operational costs, not only reduce energy consumption and emissions but also boost health and productivity, offering a holistic approach to sustainability. Almalki *et al.* (2023) ^[2] discuss the concept of Green IoT and its application in creating eco-friendly and sustainable smart cities. Their research focuses on the integration of IoT technologies in smart city applications, addressing challenges such as energy consumption, pollution, and waste management. The study highlights the potential of Green IoT in reducing environmental hazards, optimizing resource usage, and enhancing public safety and life quality in urban environments. D'Apuzzo *et al.* (2022) ^[14] explore the Smart Urban Mobility Management project,

which aims to design and test highly innovative tools such as drones, High Definition (HD) smart cameras, IoT sensors on 5G networks, and AI tools. The project integrates environmental datasets, information systems, and local databases, taking into account the mobility of traffic flows, energy efficiency, and control of environmental parameters. This approach represents a concrete step towards more sustainable and connected communities, demonstrating the potential of IoT and AI in urban planning and management.

Recommendations

- Poetry is one of the tools which can be used to educate communities, cities, campuses and companies in Nigeria on the role of artificial intelligence in enhancing green building projects for sustainable development in Nigeria (Anabaraonye, Nji &, Hope, 2018) ^[3].
- Music with its therapeutic benefits can also be employed in awareness creation on the role of artificial intelligence in enhancing green building projects for sustainable development in Nigeria (Onnoghen, Nwafor, Odoh, Ewa & Anabaraonye, 2024) ^[26].
- Green entrepreneurial opportunities in environmental photography can also be employed in awareness creation on the role of artificial intelligence in enhancing green building projects for sustainable development in Nigeria (Okolo, Orji & Anabaraonye, 2024) ^[23].
- Green financing from multilateral organizations such as the World Bank Group can provide financial support needed for the youths engage in the dynamics of artificial intelligence in enhancing climate resilience for sustainable development in Nigeria (Anabaraonye, Ezuma, Emone, Olisah & Ewa, 2023) ^[9].
- International Development Co-operation towards enhancing science, technology and capacity building in artificial intelligence and green building projects in Nigeria is highly recommended.
- Relevant policies should be enacted by the Nigerian government and the International Community towards enhancing the role of artificial intelligence in advancing green building projects for sustainable development.

Conclusion

Green entrepreneurship education and youth empowerment for climate resilience through the innovative use of artificial intelligence (AI) is vital for sustainable development in Nigeria. Seminars and youth programs targeted at climate change education towards enhancing green building projects and climate resilience should be well encouraged and sponsored at various communities and cities in Nigeria. Researchers, Architects and Educationists need to delve further into deeper research on the role of artificial intelligence in enhancing green building projects for sustainable development in Nigeria. By embracing AI, Nigeria can enhance green building projects, climate resilience and promote sustainable development.

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