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(Review Article)

# Harnessing Modular and Prefabricated Structural Systems Integrated with Artificial Intelligence AI Automation and Renewable Energy to Accelerate Affordable Smart Housing in Africa

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## Abstract

Because of Africa's fast urbanisation, there is a big housing problem that needs creative solutions that go beyond traditional building methods. This study looks at how modular and prefabricated building methods, along with AI automation and renewable energy technologies, might affect the growth of affordable homes across the continent. This research looks at how advanced manufacturing methods, strategic change management, and design thought might help Africa build more homes. It looks at this through the eyes of management, engineering, materials science, industrial design, and new textile technologies. When textile and fashion design ideas are mixed, they lead to new ways of making housing elements that can be used by people from different countries. Simultaneously, advancements in materials engineering enable the development of solutions that can adjust to various climates. This comprehensive study demonstrates that the creation of scalable, sustainable housing ecosystems that enhance local economies and elevate the quality of life for millions of Africans necessitates the integration of technology, policy, and community involvement.

**Keywords:** Modular Construction; Prefabricated Housing; AI Automation; Renewable Energy; Strategic Change Management; Materials Engineering; Textile Design; Africa Housing Crisis

## 1. Introduction: The Housing Crisis in Africa and the Need for Paradigm Shift

### 1.1. Urbanization and Housing Demand

The fastest-growing continent in terms of cities is Africa, with 1.2 billion urban residents by 2050 (Onyango, 2018). This change in population and annual population growth rates of over 2.5% in certain nations have caused a 50-million-unit housing deficit (King et al., 2017). Daily rural migrants seeking work in Lagos, Kinshasa, and Nairobi strain the housing supply.

### 1.2. Socio-Economic Implications

Poor housing has a big effect on human development in many ways. Poor housing makes it easier for diseases to spread, makes it harder for kids to learn because there are too many people living there, and makes workers less productive because they must travel great distances to get to work (Sverdlik, 2011). The World Bank says that housing shortages

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cost African nations about 2–3% of GDP each year because they lower productivity and raise healthcare expenditures (Bah et al., 2018).

### 1.3. Limitations of Traditional Construction

In Africa, traditional building methods have serious problems, like long build times (18 to 36 months for basic housing), high material costs because they must be imported, inconsistent quality control, a lot of waste, and limited scalability (Bah et al., 2018). These methods cannot keep up with the speed and volume of demand, so new ones that use current technology and production principles are needed.

### 1.4. Strategic Change Management Imperative

Africa's housing dilemma requires a thorough overhaul of housing design, construction, and delivery (Bello and Khan, 2024). Strategic change management is needed to manage complex stakeholder ecosystems, overcome institutional resistance, and prepare people for new technologies and processes (Saliu et al., 2024). Moving from traditional to modular construction is a classic organisational change challenge that requires careful planning, stakeholder involvement, and flexible execution (Jerome and Ajakaiye, 2019). Modular building in Africa has failed because to regulatory issues, a lack of skilled labour, financial issues, and bad attitudes. Specialised change management initiatives must address each issue (Saliu et al., 2024).

## 2. Modular and Prefabricated Structural Systems: Engineering and Design Foundations

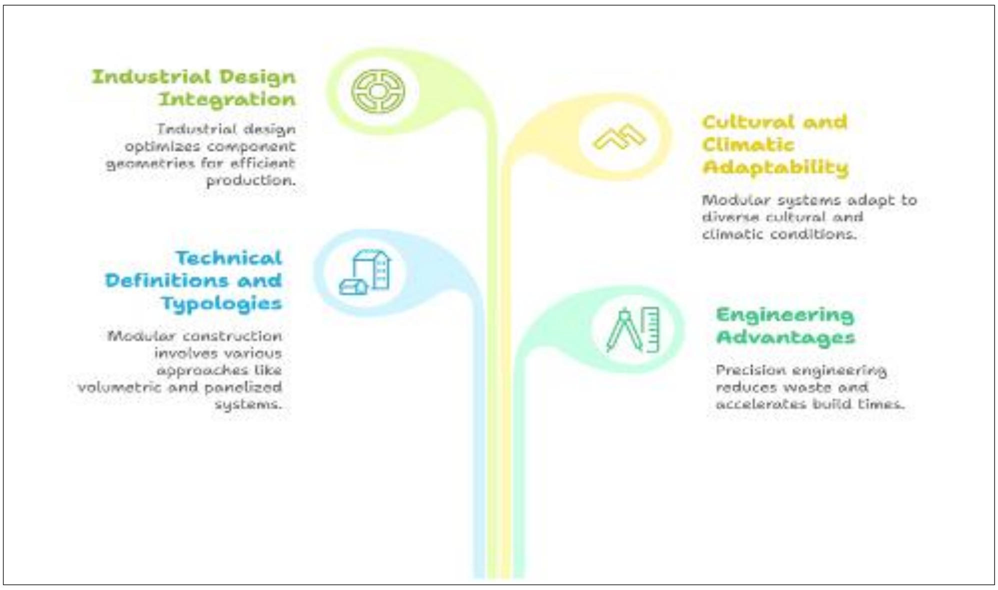


**Figure 1** Exploring Modular Construction in Africa

This diagram shows the most important parts of why modular building is important in Africa. It talks about four main ideas: "Industrial Design Integration which makes the shapes of parts better for efficient production; "Technical Definitions and Typologies" which talks about different types of systems, like volumetric and penalized systems; "Cultural and Climatic Adaptability," which talks about how modular systems can be changed to fit different environments; and "Engineering Advantages" which talks about how precision engineering cuts down on waste and speeds up building times (Akinradewo et al., 2023).

### 2.1. Modular Construction Systems

Different parts of a house are built in a controlled workshop and then brought to the construction site to be put together. Prefabricated systems come in a lot of different types, such as penalized (wall/floor/roof panels), hybrid systems that use both methods, and component-based systems that focus on standard building elements (Smith, 2010; Lawson et al., 2014). Each type has its own benefits for varied sizes and situations in Africa's wide range of housing needs.

### 2.2. Engineering Advantages for African Contexts

Factory-controlled manufacturing makes it possible to do precision engineering with consistent quality standards, less material waste (usually 15–20% less than traditional construction), and faster build times (60–80% faster than old methods) (Goodier and Gibb, 2007). Climate-controlled manufacturing facilities make sure that concrete and other materials cure in the best possible way. This is especially crucial in Africa, where the weather can change quickly. Standardized connecting systems and quality assurance processes reduce the number of construction problems that happen with traditional building methods (Windapo and Cattell, 2013). Building construction mishaps are a significant concern in Africa, especially in Nigeria which has the highest number (Ede, 2010). 21.4% due to structural failure, 8.9% due to substandard materials, 5.3% due to faulty design and 5.3 % due to violation of planning approval.

### 2.3. Industrial Design Integration

Industrial Design Integration involves combining architectural design principles, modular design and fabrication techniques to create efficient, sustainable and cost-effective buildings. Industrial design concepts turn modular houses from simple shelters into well-planned places to live putting into consideration modularization, design for manufacturing and assembly which helps optimize efficiency and reduce costs (Bertram et al., 2019) and structural design which involves the integrity of prefabricated units during transportation, lifting and installation (Gunawardena et al., 2022). Design for manufacturing (DFM) methods improve the shapes of parts so that they can be made and shipped more easily while still looking good (Lessing et al., 2015). Design standardization helps modular systems by making production easier and allowing customisation through different components and flexible configurations (Kamar et al., 2010).

### 2.4. Cultural and Climatic Adaptability

Modular systems that work in Africa need to be able to handle different cultural preferences, family patterns, and weather conditions. Design versatility makes it possible to create rooms that can support large families, small businesses, and community gatherings. Standardized modules can include climate-responsive design characteristics like optimizing orientation, natural ventilation systems, and managing thermal mass while still being efficient to make (Hachem-Vermette, 2024).

## 3. Materials Engineering: Advanced Solutions for African Environments

### 3.1. Climate-Responsive Material Selection

Africa's climate zones range from the hot, dry deserts of the Sahara to the wet, tropical rainforests. Materials engineering solutions must work well in all these conditions, as well as in high temperatures, humidity changes, and seasonal weather patterns. Compared to traditional materials, advanced composite materials, engineered lumber products, and high-performance concrete formulations are more durable and allow for less weight, which makes transportation more efficient (Ajayi et al., 2024; Alganehi, 2025; Nwachukwu et al., 2025).

### 3.2. Local Material Integration

Sustainable modular systems use materials that are sourced locally to lower shipping costs and help local economies. New ways of working with bamboo, compressed earth blocks, and agricultural waste composites make it possible to combine old materials with new ways of making things. These mixed methods keep cultural authenticity while meeting modern performance criteria (Faludi et al., 2012).

### 3.3. Smart Materials and Adaptive Systems

Phase-change materials (PCMs) built into wall panels help keep the temperature stable without using any energy, which cuts down on the amount of energy needed to heat and cool. In tough environmental circumstances, self-healing concrete technology can make structures last longer. Smart glass systems can automatically change how clear and warm they are based on the weather outside. This makes the inside more comfortable and uses less energy (Sun et al., 2022).

### 3.4. Textile Integration in Building Systems

Textile can be integrated into building systems through the following ways

- Textile-reinforced components: Textiles like carbon or glass fibers can be embedded in concrete (Textile-reinforced concrete) to enhance strength, resistance to heat and durability in building components such as walls, roofs, sandwich panels, domes etc. (Wu et al., 2023). Also, textiles can be combined with polymers (Textile-reinforced polymer) to create lightweight, high strength building components.

- Fashion-inspired architecture: Fashion design principles such as flexibility and modularity can influence architectural design.
- Modular textile structures: Inflatable, light weight, portable or tensile structures can be used for temporary and permanent buildings. (Venigalla et al., 2022).
- Smart Textiles: smart textiles such as self-cleaning or temperature regulating fabrics can be incorporated into building design.
- Sustainable Materials: Textile waste or recycled materials can be repurposed for building insulation, acoustic panels and other components.

## 4. Digital Technologies and AI-Enabled Manufacturing

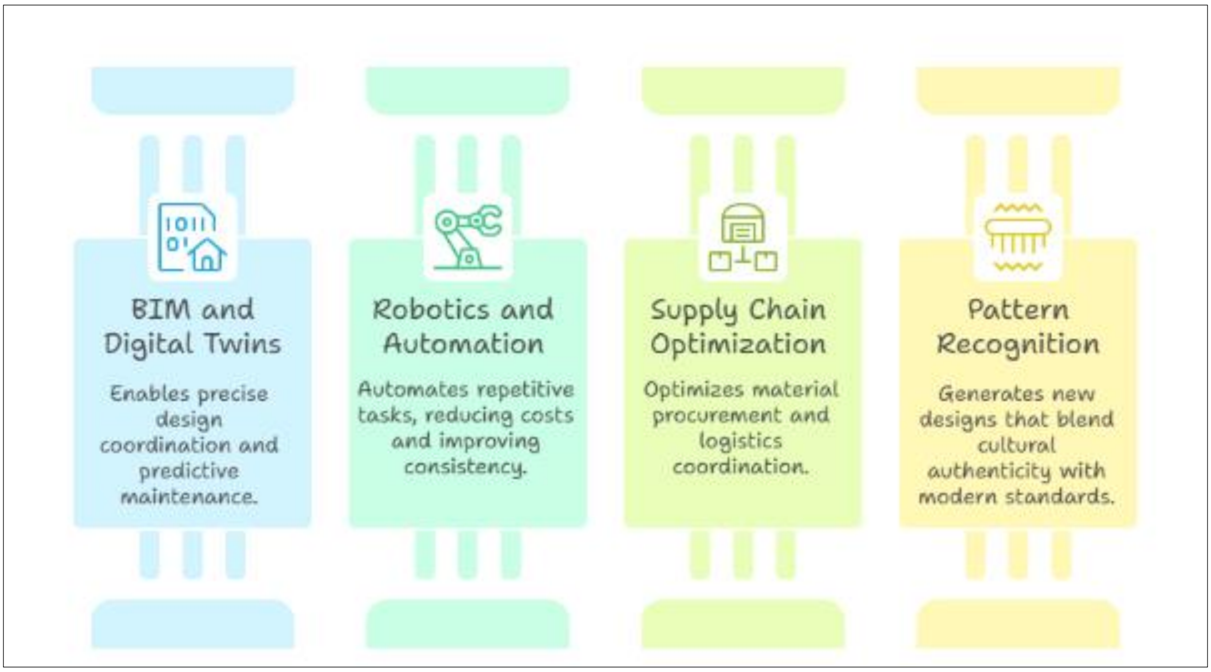


**Figure 2** AI in Modular Construction

This diagram illustrates the various applications of Artificial Intelligence (AI) in the modular construction process. It highlights four key areas: 'BIM and Digital Twins' for precise design coordination and predictive maintenance; 'Robotics and Automation' to automate repetitive tasks, reduce costs, and improve consistency; 'Supply Chain Optimization' for efficient material procurement and logistics coordination; and 'Pattern Recognition' for generating new designs that blend cultural authenticity with modern standards (Liu et al., 2024).

### 4.1. Building Information Modelling (BIM) and Digital Twins

BIM tools help coordinate designs, find conflicts, and make it easier to make modular parts. Digital twin technology creates digital copies of both finished buildings and the steps that were used to build them. This makes it possible to keep improving and plan for upkeep. Because they make it easy to put things together and use them, these tools are especially helpful in Africa, where people may not have a lot of building experience (Olaseni, 2020).

### 4.2. Robotics and Automated Assembly

The same production tasks can be done repeatedly by robots that are driven by AI. This saves money on labour and makes things more consistent. Built-in sensing systems in automated assembly lines speed up production, cut down on the amount of material that needs to be moved, and make sure that quality control is always in place. There may not be a lot of skilled building workers in Africa. Automation can help speed up work and give people the chance to learn new skills and get technical training (Ammar et al., 2021).

### 4.3. Supply Chain Optimization

Supply chain management tools that use AI make it easier to buy things, keep track of stock, and plan logistics. Nweje and Taiwo (2025) say that predictive analytics can help Africa's complicated infrastructure networks by figuring out patterns of demand, making the best use of factory schedules, and coordinating logistics for transportation. It is very important to have these systems in place so that modular building supply chains stay simple and costs and delivery times stay cheap.

### 4.4. Pattern Recognition and Design Automation

Machine learning programs can look at old African building styles and come up with new designs that are true to the culture but also make the structure work better and the production process more efficient. This method takes old design knowledge and combines it with new engineering skills to make homes that meet current performance standards and are popular with people in the area (Chitkeshwar, 2024).

## 5. Renewable Energy Integration and Smart Home Technologies

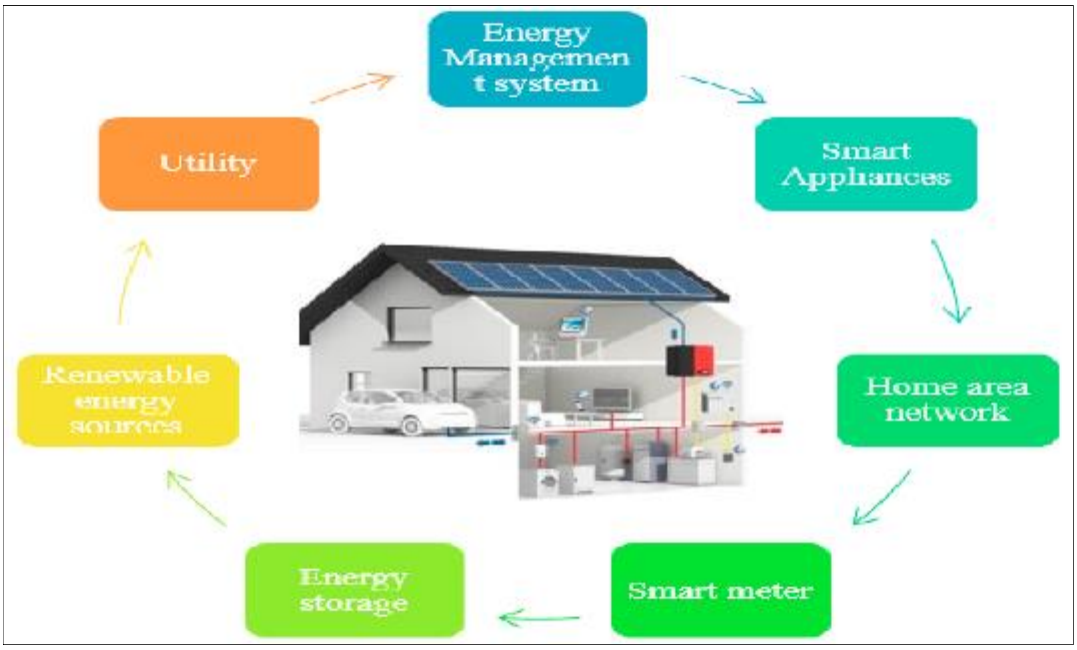


**Figure 3** Smart Home System

This picture shows how the parts of a smart home energy control system are linked to each other. The main part is the house itself, which has solar screens built in. It is shown in the flow chart how a "Energy Management system" manages "Smart Appliances" and a "Home area network." A "Smart meter" is linked to this network, and it works with "Energy storage" and "Renewable energy sources." When energy is handled from the "Utility" company back to the central system, the cycle is complete. This shows that energy flows completely and efficiently in a smart home (Gunawan et al., 2016).

### 5.1. Solar Integration and Energy Independence

Because Africa has a lot of sun resources, photovoltaics must be used in modular buildings that are meant to last. It is easier and cheaper to add solar panels, battery storage systems, and energy management controls if they are built into the factory. Communities can get more reliable energy from microgrids that connect several modular units. Each system can also cost less because of economies of scale (Mathies, 2016).

### 5.2. Energy-Efficient Building Systems

With modular construction, it is easy to add energy-saving features like LED lights, smart HVAC controls, and tools that use less power. Setting up the system in the factory makes sure it is set up correctly and makes it easy to set up in the field. Energy modelling helps with the design process to find the best system size and layout for the area and how people use it (Pless et al., 2022).

### 5.3. IoT Integration and Smart Home Features

Adding energy-saving features like LED lights, smart HVAC controls, and energy-efficient appliances is easy with modular building. Factory installation makes sure the system is set up correctly and makes it easy to install in the field. Modelling energy use helps designers figure out the best system size and layout for the area's weather and how people will be using it (Pless et al., 2022).

### 5.4. Water and Waste Management

Some modular plans include ways to clean water, collect rainwater, and take care of trash (Nwachukwu et al., 2025). They can help many African towns fill in important infrastructure gaps. Rodrigues et al. (2023) say that these systems can work on their own or connect to bigger community infrastructure when it is ready.

## 6. Strategic Change Management and Implementation Frameworks

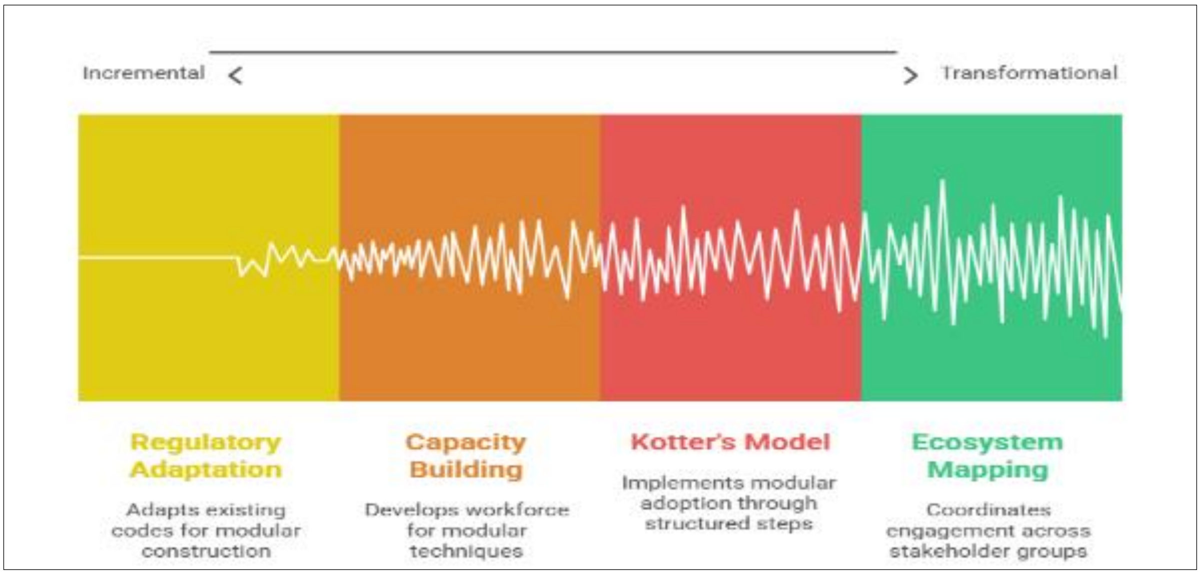


**Figure 4** Modular Construction Adoption

This diagram shows the different levels of change that are needed to adopt modular building, from small steps to big changes. It describes four main steps: "Regulatory Adaptation," which means changing existing rules; "Capacity Building," which means creating a skilled work force; "Kotter's Model," which suggests a planned way to put the plan into action; and "Ecosystem Mapping," which makes sure that everyone involved works together. The picture shows a development from easier, more stable changes to harder, more transformative ones (Shin et al., 2022).

### 6.1. Stakeholder Ecosystem Mapping

A lot of different groups need to work together to make modular homes work. These groups include banks that lend money for projects, traditional construction companies that need to learn new ways to do things, community groups that speak for end users, and tech companies that make the tools and systems that factories need to make things. Adeyemi et al. (2024) say that different groups of stakeholders have different needs, skills, and worries that need to be addressed with different change management methods (Ibe et al., 2025).

### 6.2. Organizational Change Models

Kotter's 8-Step Change Model supports modular construction. It makes people feel like housing shortages are urgent, brings stakeholders together, makes clear plans for changing housing, talks about benefits and concerns, empowers them to act through policy and financing support, gets short-term wins through pilot projects, keeps momentum going through continuous improvement, and makes changes stick through institutional support and cultural change (Ziataki, 2023).

### 6.3. Capacity Building and Skills Development

Modular construction requires training for manufacturing technicians for running factories, quality control specialists for overseeing production, logistics coordinators for moving and assembling things, and maintenance technicians for keeping things running. Training programs must teach technical skills and change management to enable organisations transform (Thurairajah et al., 2023).

### 6.4. Policy and Regulatory Adaptation

Most building codes and rules do not have rules for modular construction, which makes it harder to use. Part of managing strategic change is making sure that attempts to change regulations set the right standards while keeping safety and quality standards. People from all sides need to be involved in this process and it needs to be carried out in stages so that people can get used to the new technology and ways of doing things (Wuni and Shen, 2020).

## 7. Textile and Fashion Design Applications in Modular Housing

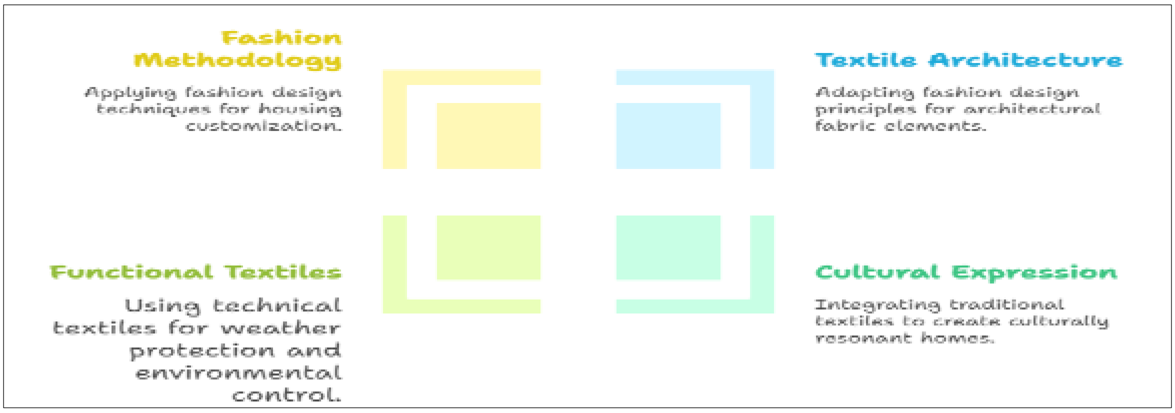


**Figure 5** Integrating Fashion into Modular Housing

This diagram illustrates how principles from the fashion industry can be applied to modular housing. It highlights four key areas of integration: 'Fashion Methodology' which involves applying design techniques for housing customization; 'Textile Architecture' which adapts fashion design principles for architectural fabric elements; 'Functional Textiles' which uses technical fabrics for weather protection and environmental control; and 'Cultural Expression' which integrates traditional textiles to create culturally resonant homes (Casciani, 2023).

### 7.1. Textile Architecture Principles

Textile architecture principles in modular housing involve incorporating textile materials and design strategies to enhance sustainability efficiency and aesthetic appeal. This includes designing buildings from independent prefabricated modules that can easily be combined, allowing flexibility and scalability (Bertram et al., 2019); using eco-friendly materials like natural fibers or recycled textile wastes to minimize environmental impact; using textile-reinforced building components to enhance durability and strength; integrating smart textiles such as electrochromic materials (change color or opacity in response to electrical signals allowing for dynamic shading and light control) or thermochromic materials (change color in response to temperature changes , providing visual indicators of temperature fluctuations) to provide dynamic shading and optimize energy efficiency and lastly, design flexibility which allows adaptable and customizable designs that meet changing preferences and needs similar to how fashion designs can be updated or repurposed (Kolarevic, 2003). The way movable housing parts work might be changed by ideas from fashion design about built-in textiles. Pattern drawing techniques that can be used on a bigger scale allow for very accurate making of cloth building parts. Tensioned membrane systems that keep out the weather while letting air move naturally are made with draping principles. Drawing fashion designs on clothes can help many people understand how fabrics can be put together and how designs work (Chilton, 2010).

### 7.2. Cultural Expression Through Textile Integration

The integration of textiles into African modular housing is a fantastic way of expressing cultural identity, preserving cultural heritage and promoting sustainable development. According to a study by Wu et al., 2023 on textile-reinforced concrete (TRC), textiles can be used to create building components that are not only durable but also culturally relevant. Textiles have always been an integral part of the African culture having traditional patterns and motifs that convey meanings and symbolism (Renne, 2018). People who build houses using modular systems can use traditional African textile patterns and methods to make homes that are culturally appropriate and help local artisans. Oladepo-Ajagbe (2024) says that digital printing makes it cheap to add designs and colours that are unique to an area to textile building parts. The standard modular parts are used in this way to make housing solutions that fit a culture and keep the community's identity while still meeting modern performance standards.

### 7.3. Functional Textile Systems

Modular homes can do many things with technical textiles to enhance sustainability and performance. Examples are smart textiles such as thermochromic textiles and electrochromic textiles , insulating textiles which provide thermal insulation, reducing heat loss and energy consumption (Gunawardena et al., 2022), phase change materials that absorb and release heat, regulating indoor temperature and also reducing energy consumption (Wu et al., 2023), air-purifying textiles which capture pollutants and allergens improving indoor air quality (Navaratnam et al., 2019), antimicrobial textiles which inhibit growth of microorganisms, reducing the risk of infections and promoting a healthy indoor environment (Venigalla et al., 2022), acoustic textiles which absorb sound waves, reducing noise levels and improving acoustic comfort (Gelbrich et al., 2018) and lastly sustainable textiles such as recycled materials that are eco-friendly, reducing waste, minimizing environmental impact and promoting sustainability (Fletcher, 2014). Outside, they keep the weather out, and inside, they split rooms, protect privacy, and control sound. They can also be used to control the surroundings by using smart fabric technologies to control temperature and humidity (Firoozi et al., 2024). Some of the benefits of textile-based systems are that they are easy to install easy to repair, are of low maintenance and they can be repurposed.

### 7.4. Fashion Design Methodology in Housing Customization

Fashion design ideas concerning customisation, sizing, and fit can make modular housing more user-friendly. Clothing manufacturing techniques like modular assembly, changeable parts, and standardised size can be employed in home design (Yeung et al., 2010). Mass customisation enables consumers design their own living spaces while lowering production costs.

## 8. Case studies: implementation experiences

### 8.1. African Modular Housing Initiatives

South African emergency housing projects have used prefabricated solutions to reduce building time from 6 to 12 months to 4 to 6 weeks (Moghayedi and Awuzie, 2023). Transportation, talent, and money issues have slowed scaling. Kenya uses solar and water harvesting to produce cheap houses. These initiatives demonstrate how integrated utility systems can work and the importance of community involvement and upkeep (Obunga, 2023).

### 8.2. Global Parallels and Technology Transfer

India's prefabricated housing projects show us how to use local materials and make things larger in Africa (Anderson, 2019). Brazil's social housing programs demonstrate how to engage communities and make little adjustments that could benefit Africa. These worldwide examples demonstrate the importance of adapting global technologies to local demands rather than just relocating them (Cubillos-González and Tiberio Cardoso, 2020).

### 8.3. Supply Chain and Logistics Challenges

African infrastructure issues complicate modular building logistics. Designers may need to adjust module sizes and weights to meet local transport networks (Peiris et al., 2022). Strong inventory management and local suppliers are needed due to supply chain reliability issues. These issues demonstrate the need for value chain-wide systems, from product development to consumer delivery (Samson and Gloet, 2018).

### 8.4. Financial Innovation and Access

Microfinance integration, community ownership models, and government subsidy programs can make modular homes affordable for low-income people (Bhanye et al., 2024). Financial transactions can be simplified and cheaper with blockchain and mobile payment solutions. New financial mechanisms help Africa's housing scarcity by getting to the right size (Ogundu, 2025).

## 9. Future vision: integrated smart manufacturing ecosystems

### 9.1. AI-Driven Production Optimization

Advanced AI systems will manage logistics, quality control, material acquisition, and production scheduling to optimise manufacturing ecosystems. Machine learning algorithms will keep growing better at manufacturing things based on performance data, weather conditions, and patterns of demand (Mawson and Hughes, 2020). Predictive analytics will forecast when maintenance will be needed and improve system performance during the life of the building (de Brito and Silva, 2020).

### 9.2. Distributed Manufacturing Networks

Instead of mega factories, modular housing systems may leverage distributed production networks. Regional strengths and lower transit needs would benefit these networks (Ben-Ner and Siemsen, 2017). Mobile factories may work in hard-to-reach regions, while city factories can make several things at once. Distributed methods can boost local economies while reducing environmental impact (Mora et al., 2019).

### 9.3. Circular Economy Integration

Future systems will incorporate circular economy principles like disassembly and component reuse. AI systems will monitor building items throughout their lifespans to reuse them and save waste (Sikander, 2024). This strategy is useful in Africa, where limited resources require effective material use to protect the environment.

### 9.4. Community-Centred Smart Cities

Smart communities will be built using modular housing systems that integrate transportation, utilities, and social infrastructure. IoT will help communities use resources better and provide data to improve (Li et al., 2024). This combination approach can help cities flourish while improving people's lives by minimising environmental impact.

## 10. Conclusion

We need modular building, AI, renewable energy, and strategic change management to solve Africa's housing crisis. These new ideas can quickly build inexpensive, culturally appropriate homes on a wide scale to encourage energy independence and economic growth. We need to invest in infrastructure, train workers, develop helpful legislation, and cooperate with businesses to achieve this. Everyone must collaborate rapidly to turn Africa's urbanisation crisis into long-term growth.

## Compliance with ethical standards

*Disclosure of conflict of interest*

The authors declare no conflicts of interest related to this work

## References


[1] Adeyemi, A. B., Ohakawa, T. C., Okwandu, A. C., Iwuanyanwu, O., and Ifechukwu, G. O. (2024). Integrating modular and prefabricated construction techniques in affordable housing: Architectural design considerations and benefits. J. Constr. Innov, 18, 67-82.

[2] Akinradewo, O., Aigbavboa, C., Aghimien, D., Oke, A., and Ogunbayo, B. (2023). Modular method of construction in developing countries: the underlying challenges. International Journal of Construction Management, 23(8), 1344-1354.

[3] Alganehi, S. M. (2025). Green Building Materials and Technologies for Sustainable Construction (master’s thesis, Hamad Bin Khalifa University (Qatar)).

[4] Ammar, M., Haleem, A., Javaid, M., Walia, R., and Bahl, S. (2021). Improving material quality management and manufacturing organizations system through Industry 4.0 technologies. Materials Today: Proceedings, 45, 5089-5096.

[5] Anderson, A. M. (2019). Fabrication and construction methods for low-cost, low-carbon structural components for housing in India (Doctoral dissertation, Massachusetts Institute of Technology).

[6] Ajayi, M. B., Fadipe, Y. W., Wright, D. T., Talabi, A., and Durodola, R. L. (2024). Electronic waste and environmental toxicology: Assessing health and ecological risks in Nigeria and Sub-Saharan Africa.

[7] Bah, E. H. M., Faye, I., and Geh, Z. F. (2018). The housing sector in Africa: setting the scene. In Housing market dynamics in Africa (pp. 1-21). London: Palgrave Macmillan UK.

[8] Bello, A. O., and Khan, A. A. (2024, April 17). Implementing modular construction systems in developing countries. Emerald Publishing.

[9] Ben-Ner, A., and Siemsen, E. (2017). Decentralization and localization of production: The organizational and economic consequences of additive manufacturing (3D printing). California Management Review, 59(2), 5-23.

[10] Bhanye, J., Lehobo, M. T., Mocwagae, K., and Shayamunda, R. (2024). Strategies for Sustainable Innovative Affordable Housing (SIAH) for low-income families in Africa: A rapid review study. Discover Sustainability, 5(1), 157.

[11] Casciani, D. (2023). Fashion and modular design–Modularity as a design strategy for sustainability. AGATHÓN| International Journal of Architecture, Art and Design, 14, 326-337.

[12] Chilton, J. (2010). Tensile structures–textiles for architecture and design. In Textiles, polymers and composites for buildings (pp. 229-257). Woodhead Publishing.

[13] Chitkeshwar, A. (2024). Revolutionizing structural engineering: applications of machine learning for enhanced performance and safety. Archives of Computational Methods in Engineering, 31(8), 4617-4632.

[14] Civerchia, F., Bocchino, S., Salvadori, C., Rossi, E., Maggiani, L., and Petracca, M. (2017). Industrial Internet of Things monitoring solution for advanced predictive maintenance applications. Journal of Industrial Information Integration, 7, 4-12.

[15] Cubillos-González, R. A., and Tiberio Cardoso, G. (2020). Clean technology transfer and innovation in social housing production in Brazil and Colombia. A framework from a systematic review. Sustainability, 12(4), 1335.

[16] de Brito, J., and Silva, A. (2020). Life cycle prediction and maintenance of buildings. Buildings, 10(6), 112.

[17] Ede, A. N. (2010). Building collapse in Nigeria: The trend of casualties in the last decade (2000-2010). International Journal of Civil and Environmental Engineering, 10(6), 32-42.

[18] Faludi, J., Lepech, M. D., and Loisos, G. (2012). Using life cycle assessment methods to guide architectural decision-making for sustainable prefabricated modular buildings. Journal of green building, 7(3), 151-170.

[19] Firoozi, A. A., Firoozi, A. A., Oyejobi, D. O., Avudaiappan, S., and Flores, E. S. (2024). Emerging trends in sustainable building materials: Technological innovations, enhanced performance, and future directions. Results in Engineering, 24, 103521.

[20] Fletcher, K. (2014). Sustainable Fashion and Textiles: Design Journeys. Routledge.

[21] Gelbrich, S., Funke, H., and Kroll, L. (2018). Function-Integrative Textile Reinforced Concrete Shells. Open Journal of Composite Materials, 8, 161-174.

[22] Goodier, C., and Gibb, A. G. F. (2007). Future opportunities for offsite in the UK. Construction Management and Economics, 25(6), 585–595.

[23] Gunawan, T. S., Yaldi, I. R. H., Kartiwi, M., Ismail, N., Za'bah, N. F., Mansor, H., and Nordin, A. N. (2017). Prototype design of smart home system using internet of things. Indonesian Journal of Electrical Engineering and Computer Science, 7(1), 107-115.

[24] Gunawardena, T., and Mendis, P. (2022). Prefabricated Building Systems—Design and Construction. Encyclopedia, 2(1), 70-95.

[25] Hachem-Vermette, C. (2024). Enhancing urban climate resistance through the application of selected strategies and technologies. Discover Cities, 1(1), 17.

[26] Ibe, G. A., Rosaline, D. O., Erimife, J., Ehiabhi, T. A., and Adebayo, A. (2025). Adaptive program management in complex development ecosystems: Evidence from cross-sectoral interventions in Sub-Saharan Africa.

[27] Jerome, A., and Ajakaiye, O. (2019). Drivers and barriers to industrialized construction adoption in Africa: A policy and economic analysis.

[28] Kamar, K. A. M., Alshawi, M., and Hamid, Z. A. (2011). Industrialized Building System (IBS): Revisiting issues of definition and classification. International Journal of Emerging Sciences, 1(2), 120–132.

[29] King, R., Orloff, M., Virsilas, T., and Pande, T. (2017). Confronting the urban housing crisis in the global south: adequate, secure, and affordable housing. Washington, DC: World Resources Institute.

[30] Kolarevic, B. (2003). Architecture in the Digital Age: Design and Manufacturing. Taylor and Francis.

[31] Lawson, R. M., Ogden, R. G., and Bergin, R. (2012). Application of modular construction in high-rise buildings. Journal of Architectural Engineering, 18(2), 148–154.

[32] Lessing, J., Stehn, L., and Ekholm, A. (2005). Industrialised housing: Definition and categorization of the concept. Construction Management and Economics, 23(3), 221–229.

[33] Li, C. Z., Chen, Z., Xue, F., Kong, X. T., Xiao, B., Lai, X., and Zhao, Y. (2021). A blockchain-and IoT-based smart product-service system for the sustainability of prefabricated housing construction. Journal of Cleaner Production, 286, 125391.

[34] Liu, Q., Ma, Y., Chen, L., Pedrycz, W., Skibniewski, M. J., and Chen, Z. S. (2024). Artificial intelligence for production, operations and logistics management in modular construction industry: A systematic literature review. Information Fusion, 109, 102423.

[35] Mathies, U. (2016). Panasonic: a case study on constant change and reinvention of a world brand. In Multinational management: a casebook on Asia's global market leaders (pp. 173-202). Cham: Springer International Publishing.

[36] Mawson, V. J., and Hughes, B. R. (2020). Deep learning techniques for energy forecasting and condition monitoring in the manufacturing sector. Energy and Buildings, 217, 109966.

[37] Moghayedi, A., and Awuzie, B. (2023). Towards a net-zero carbon economy: A sustainability performance assessment of innovative prefabricated construction methods for affordable housing in Southern Africa. Sustainable Cities and Society, 99, 104907.

[38] Mora, H., Peral, J., Ferrandez, A., Gil, D., and Szymanski, J. (2019). Distributed architectures for intensive urban computing: a case study on smart lighting for sustainable cities. IEEE Access, 7, 58449-58465.

[39] Navaratnam, S., Ngo, T., Gunawardena, T., and Henderson, D. (2019). Performance Review of Prefabricated Building Systems and Future Research in Australia. Buildings, 9(2), 38.

[40] Nwachukwu, G., Okigwe, K., Nwachukwu, R. S., Immaculata, E. C., and Ebimami, P. C. (2025). The role of GIS in monitoring and mitigating chemical pollution in aquatic ecosystems: A case study of Nigeria and Africa.

[41] Nwachukwu, G., Okigwe, K., Nwachukwu, R. S., Immaculata, E. C., and Christianah, O. (2025). Application of satellite imagery and artificial intelligence (AI) for PFAS contamination mapping in African aquatic systems: Advancing data-driven environmental and public health risk assessment. World Journal of Biology Pharmacy and Health Sciences, 23(1), 395–413. https://doi.org/10.30574/wjbphs.2025.23.1.0696

[42] Nweje, U., and Taiwo, M. (2025). Leveraging Artificial Intelligence for predictive supply chain management, focus on how AI-driven tools are revolutionizing demand forecasting and inventory optimization. International Journal of Science and Research Archive, 14(1), 230-250.

[43] Obunga, P. O. (2023). Assessing Deployment of Emerging Innovations and Technologies in Catalysing Sustainable Water Services Provision in Nairobi City County, Kenya: Case of Soweto Kayole Jisomee Mita (Doctoral dissertation, University of Nairobi).

[44] Ogundu, P. G. (2025). Decentralized housing finance models: Blockchain-based mortgage systems and crowdfunded real estate investment for affordability. International Research Journal of Modernization in Engineering, Technology and Science, 7(2), 1916.

[45] Oladepo-Ajagbe, M. (2024). Exploring the Synergy of Traditional Textile Techniques and Digital Technology in Contemporary Clothing and Textile Design (Doctoral dissertation, PhD Thesis, Southern Illinois University Edwardsville).

[46] Olaseni, I. O. (2020). Digital Twin and BIM synergy for predictive maintenance in smart building engineering systems development. World J Adv Res Rev, 8(2), 406-21.

[47] Onyango, A. O. (2018). Global and regional trends of urbanization: A critical review of the environmental and economic imprints. World Environment, 8(2), 47-62.

[48] Paul, R. (Ed.). (2019). High performance technical textiles. John Wiley and Sons.

[49] Peiris, P. A. N., Hui, F. K. P., Ngo, T., Duffield, C., and Garcia, M. G. (2022). Challenges in transport logistics for modular construction: A case study. In 12th International Conference on Structural Engineering and Construction Management: Proceedings of the ICSECM 2021 (pp. 501-510). Singapore: Springer Nature Singapore.

[50] Pless, S., Podder, A., Kaufman, Z., Klammer, N., Dennehy, C., Muthumanickam, N. K., ... and Blazek, C. (2022). The energy in modular (EMOD) buildings method: A guide to energy-efficient design for industrialized construction of modular buildings (No. NREL/TP-5500-82447). National Renewable Energy Lab. (NREL), Golden, CO (United States).

[51] Renne, E. P. (2018). The Politics of Adire Production and Use in West Africa. In Textiles and Politics in West Africa (pp. 15-30).

[52] Rodrigues, A. M., Formiga, K. T. M., and Milograna, J. (2023). Integrated systems for rainwater harvesting and greywater reuse: a systematic review of urban water management strategies. Water Supply, 23(10), 4112-4125.

[53] Saliu, L. O., Monko, R., Zulu, S., and Maro, G. (2024). Barriers to the integration of Building Information Modeling (BIM) in modular construction in sub Saharan Africa. Buildings, 14(8), 2448. https://doi.org/10.3390/buildings14082448

[54] Samson, D., and Gloet, M. (2018). Integrating performance and risk aspects of supply chain design processes. Production Planning and Control, 29(15), 1238-1257.

[55] Shin, J., Moon, S., Cho, B. H., Hwang, S., and Choi, B. (2022). Extended technology acceptance model to explain the mechanism of modular construction adoption. Journal of Cleaner Production, 342, 130963.

[56] Sikander, A. (2024). Artificial Intelligence and the Circular Economy: How AI Advances Waste Reduction. Green Environmental Technology, 1(2), 23-34.

[57] Smith, R. E. (2010). Prefab Architecture: A guide to modular design and construction. John Wiley and Sons.

[58] Sun, X., Zhang, Y., Xie, K., and Medina, M. A. (2022). A parametric study on the thermal response of a building wall with a phase change material (PCM) layer for passive space cooling. Journal of Energy Storage, 47, 103548.

[59] Sverdlik, A. (2011). Ill-health and poverty: a literature review on health in informal settlements. Environment and urbanization, 23(1), 123-155.

[60] Thurairajah, N., Rathnasinghe, A., Ali, M., and Shashwat, S. (2023). Unexpected challenges in the modular construction implementation: are UK contractors ready? Sustainability, 15(10), 8105.

[61] Venigalla, S. G., Nabilah, A. B., Mohd Nasir, N. A., Safiee, N. A., and Abd Aziz, F. N. A. (2022). Textile-Reinforced Concrete as a Structural Member: A Review. Buildings, 12(4), 474.

[62] Windapo, A. O., and Cattell, K. S. (2013). Sustainability of the construction industry in South Africa. Journal of Construction, 6(1), 1–10.

[63] Wu, C., Pan, Y., and Yan, L. (2023). Mechanical Properties and Durability of Textile Reinforced Concrete (TRC)—A Review. Polymers, 15(18), 3826.

[64] Wuni, I. Y., and Shen, G. Q. (2020). Barriers to the adoption of modular integrated construction: Systematic review and meta-analysis, integrated conceptual framework, and strategies. Journal of Cleaner Production, 249, 119347.

[65] Yeung, H. T., Choi, T. M., and Chiu, C. H. (2010). Innovative mass customization in the fashion industry. Innovative quick response programs in logistics and supply chain management, 423-454.

[66] Ziataki, E. (2023). Navigating change: lessons learned from implementing a change management plan to improve team performance.