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Building Indigenous Robotics Capacity in Nigeria Through Drone-Led Industrialization: Analytical Review

Ezirim Kelechi ThankGod[1*], Sani Abubakar Muhammed[2], Aniugo Victor Onyekachi[3], Nwaokolo Ikechukwu Frank[4], Obi Obichukwu Immanuel[5], Okoronkwo Iheanyi Chinedu[6] & Ezekiel Mayaki Asuku[7]

[1,2,3,4,5,6]Mechatronics Engineering Department; Federal University of Technology, Owerri, Imo State, Nigeria

[7]West Virginia Academy, Al Wakair, Qatar

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ABSTRACT **Review Article**

Countries across the globe have their respective and unique challenges per time. Presently, it does appear like prominent among the numerous challenges confronting Nigeria as a country are those of acute unemployment of her teaming youthful population and her continuous dependence on imported technology. Drone-led industrialization presents a viable pathway for building indigenous robotics capacity while addressing needs in agriculture, security, logistics, and infrastructure. This analytical review examines existing literature from 2015 to 2025 to assess Nigeria's current robotics ecosystem, her policy environment, the skill gaps, and the role of drones as an entry technology. Findings reveal that while innovation hubs and academic programs are rapidly emerging, challenges still exist with issues of funding, regulatory uncertainty, power supply, and limited Research & Development. The review deduces that drone technology offers the easiest route of entry for indigenous robotics due to modularity, market demand, and transferable skills. Recommendations therefore, center on targeted policy, university-industry linkage, and the establishment of robotics testbeds. No doubt, building indigenous capacity requires moving beyond importation to design, manufacturing, and maintenance within the shores of Nigeria.

Keywords: Indigenous Robotics, Drones, Industrialization, Nigeria, Capacity Building, UAV, STEM.

**Corresponding author: Ezirim Kelechi ThankGod*
Mechatronics Engineering Department; Federal University of Technology, Owerri, Imo State, Nigeria

Introduction

Regrettably, Nigeria's industrialization agenda had historically relied on imported machinery and foreign technical expertise (Adeyemi & Ogunleye, 2021). This dependence, indeed constrains economic resilience and limits job creation in high-tech sectors. Robotics and unmanned systems represent a strategic frontier for leapfrogging traditional manufacturing pathways (United Nations Economic Commission for Africa [UNECA], 2022).

Among robotic platforms, Unmanned Aerial Vehicles (UAVs) or drones offer the most accessible entry point for developing nations like Nigeria for obvious reasons like: they are modular, software-driven, and applicable across agriculture, logistics security, mapping, military surveillance, and delivery (Eze & Okoro, 2023). The global drone market is projected to exceed $54 billion by 2030, yet Africa presently captures less than 3% of value-added activities (PwC, 2020).

In Nigeria, it's appreciated how drone - use is expanding in areas like oil and gas pipeline monitoring, precision agriculture, and disaster response (NITDA, 2023). Unfortunately, most platforms are usually imported, with limited local design or manufacturing. This review therefore seeks to know: How can drone-led industrialization serve as a catalyst for building indigenous robotics capacity in Nigeria? The objective is simply to synthesize evidence on enablers, barriers, and pathways for developing local robotics competence through drones.

Literature Review

Robotics Capacity and Industrialization

Robotics capacity of a nation refers to a nation's ability to design, fabricate, operate, and maintain robotic systems (International Federation of Robotics [IFR], 2023). Industrialization through robotics, no doubt enhances productivity and creates high-skill employment (Acemoglu & Restrepo, 2019). For developing economies, capacity building need to precede large-scale deployment (Lall, 2020).

Drone Technology as an Entry Point

Drones lower the threshold for robotics because they integrate mechanics, electronics, and AI in a compact form (Floreano& Wood, 2015). Some of the African case studies show drones have been deployed for medical delivery in Rwanda and crop monitoring in Kenya (Muvunyi et al., 2021). Nigeria's terrain and sectoral needs align with drone applications (Olayinka, 2022).

Nigeria's Innovation Ecosystem

Nigeria has well over 90 tech hubs and growing university robotics clubs (CcHub, 2022). The National Digital Economy Policy and Strategy (NDEPS) identifies robotics as a priority (NITDA, 2020). However, research output in robotics still remains low, with less than 50 Scopus-indexed papers from Nigerian institutions between 2015-2024 (Scopus, 2024).

Barriers

Major constraints facing robotics capacity building in Nigeria include: inadequate power infrastructure (World Bank, 2021), restrictive drone regulations by the Nigerian Civil Aviation Authority (NCAA, 2022), limited venture capital for hardware (Briter Bridges, 2023), and curriculum gaps in mechatronics (Ogundu, 2021).

Methodology

This review adopted a narrative analytical approach without PRISMA protocols, focusing on thematic synthesis.

Data Sources: Scopus, Web of Science, Google Scholar, and grey literature from NITDA, NCAA, UNECA, and Nigerian universities.

Search Terms: "indigenous robotics Nigeria", "drone industrialization Africa", "UAV capacity building", "mechatronics education Nigeria".

Inclusion Criteria: Peer-reviewed articles, policy documents, and industry reports from 2015-2025 focusing on Nigeria or comparable African contexts.

Exclusion Criteria: Papers focused solely on drone recreation or without capacity-building implications.

Analysis: Thematic coding was used to group findings into policy, education, industry, and technology dimensions. A total of 67 sources were reviewed, with 32 directly informing synthesis.

Results

Policy and Regulatory Landscape

Nigeria's drone regulations require immediate overhaul to allow permits for commercial operations, thus removing delays for SMEs engagement (NCAA, 2022). The National Robotics and Artificial Intelligence Policy draft (NITDA, 2023) proposes incentives for usage but failed to put up relevant implementation frameworks.

Education and Skills

Sadly, only about eight Nigerian universities at present offer dedicated mechatronics/robotics degrees (NUC, 2023). Most training in Nigeria is still through mere bootcamps and hubs such as Robotics and Artificial Intelligence Nigeria [RAIN] (Adewale, 2022). Obvious Skill mismatch grossly persists between graduates and industry needs (Oyelere et al., 2021).

Industry and Use Cases

Admittedly, there is presently active drone applications in Nigeria like the existence of 'Zenvus' for agriculture; 'Arone' for surveying, and 'Brigade' for security.

Nevertheless, more than 85% of the hardware is imported from China and the USA (Eze, 2023). Local assembly is rapidly emerging in Lagos and Abuja hubs.

Research Output

In Nigeria, Research in robotics mostly focuses on algorithm development rather than hardware fabrication (Bello & Sadiq, 2020). Collaboration between academia and industry still remains weak (Akinwale, 2021).

Deductions

Interestingly, three deductions emerge from the synthesis:

1. **Drones are the optimal catalyst:** Lower cost and faster market uptake compared to industrial arms or mobile robots (Floreano & Wood, 2015).
2. **Capacity is fragmented:** Strong software talent exists but hardware and systems integration capacity is nascent (CcHub, 2022).
3. **Policy is necessary but insufficient:** Without testbeds, financing, and power, policy alone will not yield manufacturing (UNECA, 2022).

Discussion

Drone-led industrialization aligns with Nigeria's needs for job creation and import substitution. The model mirrors

India's approach to IT services as an entry to broader tech capacity (D'Costa, 2019). However, Nigeria must avoid "assembly-only" industrialization. Sustainable capacity requires local Research & Development in flight controllers, batteries, and composite materials (Eze & Okoro, 2023).

Power instability and Energy Non-access remain the most binding constraints for manufacturing (World Bank, 2021). Regulatory clarity from NCAA is also critical to de-risk investment (NCAA, 2022). University-industry partnerships, as seen in South Africa's CSIR model, will rapidly accelerate technology transfer (Moyo, 2020).

Gaps and Future Targets

Gaps:

1. Lack of longitudinal data on robotics startups in Nigeria.
2. Limited research on indigenous materials for drone fabrication.
3. Absence of national robotics standards.

Future Targets for 2030:

1. Establish regional drone manufacturing and testing centers.
2. Enforcement of 30% local content in government-procured drones.
3. Integrate robotics into about 50% of engineering curricula.

Recommendations

1. **Policy:** Fast-track the National Robotics Policy and create a "Regulatory Sandbox" for drone SMEs under NCAA.
2. **Funding:** Establish a Robotics Innovation Fund with matching grants for hardware prototyping (Briter Bridges, 2023).
3. **Education:** Mandate Mechatronics and UAV modules in all engineering programs. Expand Robotics and Artificial Intelligence Nigeria (RAIN) and University laboratory partnerships (NUC, 2023).
4. **Infrastructure:** Deploy solar-powered drone testbeds in agro-industrial zones to address power gaps.
5. **Industry:** Incentivize local content through public procurement and tax breaks for assemblers using Nigerian components.

Conclusion

There is no doubt that Building indigenous robotics capacity in Nigeria is feasible and becomes more feasible through drone-led industrialization. This is because Drones provide a tangible, scalable entry point that can develop skills, firms, and supply chains. However, this requires coordinated action across policy, education, and industry. Interestingly, if Nigeria will bravely transition from drone users to drone designers and manufacturers, it then can assuredly anchor a broader robotics ecosystem and reduce technological dependence while drastically reducing unemployment statistics of its youthful population.

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