



Promoting Research Commercialisation in Nigerian Polytechnics: Challenges, Strategies, and Opportunities

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Abstract: Research commercialisation plays a crucial role in transforming academic knowledge into tangible economic value - particularly within developing nations such as Nigeria. In Nigerian polytechnics - where technical education intersects directly with industrial manpower needs - commercialisation serves as a strategic mechanism for driving innovation and national development. This study evaluates the institutional, structural, technological, and strategic parameters governing research commercialisation in Nigerian polytechnics. Findings reveal that while polytechnics possess significant strategic potential due to their applied mandate, commercialisation output remains severely constrained by systemic infrastructure deficits, chronic funding shortfalls, digital skill gaps, underdeveloped Technology Transfer Offices, and weak polytechnic-industry linkages. To overcome these bottlenecks, institutions must transition from isolated academic research toward market-driven innovation ecosystems. This study proposes a phased implementation pathway: short-term actions focus on establishing functional Technology Transfer Offices and embedding experiential entrepreneurship into curricula; medium-term strategies emphasize revolving innovation funds, digital infrastructure upgrades, and phased industry collaboration; and long-term goals center on deploying the Entrepreneurial Polytechnic Model alongside institutionalised Triple Helix governance. Ultimately, aligning intellectual property management, digital transformation, and multi-stakeholder partnerships enables Nigerian polytechnics to convert research outputs into viable market solutions - driving job creation, industrialization, and sustainable economic growth.

Keywords: Commercialisation; Entrepreneurship; Innovation; Promoting; Research

1.0 Introduction

Research commercialisation plays a pivotal role in converting academic knowledge into tangible economic and societal value - particularly within developing economies such as Nigeria. In the context of Nigerian polytechnics - where technical education directly intersects with industrial manpower needs - commercialisation of research outputs is increasingly recognised as a strategic mechanism for fostering innovation, enhancing institutional relevance, and contributing to national development. Empirical evidence suggests that key institutional variables - including awareness of emerging Fourth Industrial Revolution (4IR) technologies, availability of functional laboratory facilities, and the strength of institutional support systems - significantly influence entrepreneurship and commercialisation outcomes, accounting for a substantial proportion of observed variation in institutional performance indicators (Abdelwahed et al., 2026).

Despite these potentials, Nigeria's investment in research and technological development remains critically low. The country allocates less than 1% of its Gross National Product to technology development - far below globally recommended benchmarks - thereby intensifying the imperative for higher education institutions to adopt commercialisation-oriented approaches as alternative pathways for resource mobilisation and sustainable growth (Asaju & Ashepo, 2025; Uchechukwu et al., 2016).

Nigerian polytechnics occupy a strategically important position within the tertiary education landscape due to their applied, skill-based training orientation - which aligns closely with local industrial and market needs. However, existing literature indicates persistent structural and capacity-related constraints. For instance, research competence among academic staff in polytechnics has been reported to be in decline - necessitating stronger mentoring systems and continuous professional development frameworks (Ibeme, 2020). Furthermore, although some institutions have

established intellectual property and technology transfer offices, their effectiveness is often limited by inadequate funding, weak industry engagement, inconsistent policy implementation, and the absence of sustainable financing mechanisms - such as revolving innovation funds (Bolo, 2025; Pandey et al., 2025). Collectively, these challenges continue to restrict the effective commercialisation of research outputs in Nigerian polytechnics.

2.0 Institutional and Structural Challenges of Commercialisation in Nigerian Polytechnics

Nigerian polytechnics face profound infrastructural limitations that severely constrain research commercialisation efforts. Technical staff constraints - combined with inadequate laboratory facilities and poor equipment maintenance - significantly reduce operational efficiency and practical learning outcomes across digital and engineering laboratories in Nigerian higher education institutions (Ayoko et al., 2023). Severe infrastructural weaknesses - alongside limited technical capabilities, data privacy concerns, and weak regulatory frameworks - remain persistent barriers to technological adoption in higher education settings (Ayomide, 2025). The digital infrastructure gap is particularly acute across polytechnic campuses. Despite the wide availability of digital tools, institutions maintain a high reliance on paper-based administrative and academic workflows - with unreliable internet access, high hardware device costs, and unstable power supply presenting major obstacles to digital transformation (Roleola & Jolaoso, 2025). Unstable power grids and inadequate access to digital software resources continue to impede virtual research and advanced technical teaching among academic personnel (Daudu et al., 2026).

Inadequate funding represents perhaps the most persistent barrier to research commercialisation in Nigerian polytechnics. Severe financial constraints - impacting tuition structures and institutional operational funds - limit distance learning, open research opportunities, and institutional expansion (Kamalu, 2025). Governmental support through special research grants, internet-enabled laboratory facilities, and access to electronic databases remains insufficient across public polytechnics (Abazie & Guo, 2025). Furthermore, administrative structural inefficiencies - driven by rigid hierarchical decision-making and poor technological integration - exacerbate existing financial pressures (Sule, 2024). A persistent communication gap between academic departments and central administrative units - coupled with financial shortages that prevent capital investments in technology - creates a cycle that directly stifles research productivity and commercialisation capacity (Sule, 2024).

The shortage of skilled researchers and specialized commercialisation experts represents another critical bottleneck. Mentoring relationships and structured lifelong learning strategies - which strongly drive research competence among teaching staff - remain underdeveloped across polytechnic institutions (Ibironke et al., 2025). Additionally, staff absenteeism - driven by socio-economic pressures and institutional instability - acts as a hidden driver of research productivity loss (Kis, 2025). A pronounced digital literacy gap further slows technical advancement. While over 98% of higher education personnel express willingness to adopt advanced Artificial Intelligence (AI) tools if provided adequate training, actual utilization remains low - standing at 51.9% for teaching and 41.6% for academic research (Ebiringa et al., 2025). High implementation costs - coupled with insufficient professional training frameworks - hinder the effective integration of emerging technologies into research workflows (Sambo-Magaji et al., 2025).

3.0 Technology Transfer, Intellectual Property Management and Commercialisation Strategies

Successful research commercialisation requires structured polytechnic-industry collaboration mechanisms. Sustainable institutional partnerships must move beyond informal arrangements - towards formal governance mechanisms, digital implementation channels, and long-term sustainability frameworks (Bolo, 2025). AI-driven technology transfer frameworks - featuring automated research matchmaking, centralized digital IP portals, and targeted tax incentives - offer viable strategies for bridging academia and industry (Osayande et al., 2025). By focusing on community empowerment, regional skill development, and market-driven solutions, polytechnics can catalyze regional competitiveness through their applied educational mission (Natário & Oliveira, 2025). Active governmental policy support - combined with functional knowledge transfer networks - directly determines the success and commercial impact of polytechnic-industry partnerships (Muhammad et al., 2026).

Establishing dedicated Technology Transfer Offices (TTOs) signals institutional readiness - yet operational success depends on policy coherence, sustainable funding, active industry engagement, and an internal culture that values innovation (Montañez & Mateo, 2025). Although awareness of technology transfer concepts is high among academic

staff, actual commercialisation through formal channels - such as contract research (32.4%), technology licensing (22.5%), and joint ventures (10.8%) - remains severely restricted (Mafu, 2023). Developing economies must establish tailored TTO typologies - aligning institutional mission statements, governance structures, and staff expertise - to effectively transition polytechnic prototypes into commercial products (Fai et al., 2018).

The Triple Helix Model explains innovation as an interactive ecosystem among universities/polytechnics, industry, and government - fostering entrepreneurial institutions that embed knowledge, technical innovation, and enterprise into broader society (Etzkowitz & Zhou, 2017). Continuous knowledge exchange - supported by government incentives and industry pull - strengthens internal innovation capabilities and nurtures a commercialisation-oriented academic culture (Hailu, 2024). Academic entrepreneurship is further enhanced when institutions incorporate proof-of-concept funding, business incubators, and flexible IP policies (Gaspar Pacheco et al., 2024). Extending this framework - as seen in the Entrepreneurial University Wheel - incorporates student start-ups and local community entrepreneurs into the core innovation ecosystem (Benabdellah & Diani, 2025).

Developing clear Intellectual Property (IP) policies is a prerequisite for effective commercialisation. Key institutional strategies include operationalising transparent IP distribution rules, building innovation hubs, and fostering public-private partnerships (Sikombe et al., 2024). Despite increases in patent applications and copyright filings, actual commercialisation rates remain low due to misalignment between academic research topics and market demands (Rashid et al., 2025). High legal fees and administrative red tape within intermediary institutions further hinder successful technology transfer (Rashid et al., 2025). Strategic patent portfolio management strengthens regional innovation ecosystems and long-term economic growth (Ijirshar et al., 2024). However, global IP enforcement frameworks - under strict international patent agreements - often restrict technology diffusion in developing nations (Eni-Olotu et al., 2025). Furthermore, statutory flexibilities - such as compulsory licensing - remain underutilised across African economies due to weak legal structures and limited institutional capacity (Vawda, 2021).

Technology licensing provides a structured pathway for converting academic research into institutional revenue. Employing Technology Readiness Level (TRL) valuation models allows institutions to de-risk innovations as they progress from basic laboratory prototypes to market-ready technologies (Contreras, 2022). Empirical evidence confirms that structured licensing agreements effectively generate sustained royalty revenue while delivering measurable societal and economic impact (Contreras, 2022).

4.0 Entrepreneurship, Innovation Ecosystems and Strategies for Advancing Commercialisation

Embedding entrepreneurship within technical curricula builds institutional innovation capacity. Effective approaches combine experiential learning modules, interdisciplinary project teams, business incubators, and active industry mentorship (Proença, 2025). Student-led ventures thrive when supported by digital learning tools, cross-sector hackathons, and practical venture-building coursework (Prokopenko et al., 2024). Project-based learning paradigms significantly boost problem-solving skills and entrepreneurial mindsets among technical students (Omelianenko & Artyukhova, 2024). Campus-based business incubators act as vital bridge institutions - connecting student researchers with industry mentors, angel investors, and market networks (Etzkowitz & Zhou, 2017). Nevertheless, student ventures frequently encounter obstacles - including limited seed capital, inadequate legal guidance, and poor networking access (Elzoumor & Strachinis, 2020). Well-structured science parks and institutional incubators accelerate regional industrial growth by embedding commercial testing environments within academic settings (Elzoumor & Strachinis, 2020).

Robust institutional support structures - connecting academia, industry, and funding bodies - grant student innovators access to essential facilities, seed funding, and career guidance (AbebeAssefa, 2016). Capital investments must be paired with policy reforms - including clear governance structures and institutional performance incentives - to fully activate local innovation ecosystems (Galt, 2025). Conducive regulatory environments are primary drivers of successful technology transfer and public-private partnerships (Casady, 2021). Strategic science, technology, and innovation (STI) systems require institutional foresight, capacity building, and policy alignment across governmental ministries (Borrás, 2011). Aligning educational mandates with Industry 4.0 skills policies establishes a foundation for long-term economic transformation (Piazer et al., 2025).

Reliable digital infrastructure - characterized by high-speed broadband, stable power systems, and cloud computing - underpins modern innovation ecosystems (Mahmood & Miah, 2022). Digital transformation enhances operational efficiency and market reach - particularly for small and medium enterprises (SMEs) in emerging markets (Díaz-Arancibia et al., 2024). Adopting Industry 4.0 technologies - such as the Internet of Things (IoT) and machine learning - accelerates industrial productivity when backed by multi-stakeholder support (Rath et al., 2024). Coordinated multi-stakeholder partnerships - involving public agencies, polytechnic institutions, and private corporations - are essential for scaling local R&D capabilities (Meissner, 2019). Relational social capital, tax credits for industrial R&D, and phased project development models lower financial risk while scaling technological solutions.

Emerging technological fields - including renewable energy, digital fabrication, and sustainable bio-materials-present substantial commercial opportunity within the Nigerian context. Institutional awareness of 4IR capabilities - supported by modern prototyping laboratories - strengthens technical entrepreneurship among engineering students (Font-Cot et al., 2025). Decentralized renewable energy systems offer lucrative commercialisation pathways - provided supportive regulatory frameworks and investment mechanisms are established (Zaman, 2025). Cross-border research partnerships - including South-South collaborations - enable reverse technology transfer and broaden technological access for developing countries (Chen, 2025). Participation in international academic networks facilitates institutional capacity building and joint grant acquisition (Eni-Olotu et al., 2025). Student innovation hubs - established across tertiary institutions - enhance research engagement, hands-on learning, and technical problem-solving (Akeredolu et al., 2025).

Incorporating Indigenous Knowledge Systems (IKS) into technical curricula enhances educational relevance, preserves cultural heritage, and yields context-specific innovations (Ayandibu, 2025). Culturally grounded entrepreneurship models enable polytechnics to solve localized community challenges - converting traditional manufacturing, construction, and agricultural practices into commercial enterprises (Gashi, 2024). Comparative international experiences offer valuable benchmarks: adopting entrepreneurial ecosystem models in South Africa restructured academic R&D to reduce graduate unemployment (Ncanywa & Dyantyi, 2022), while Uganda's Millennium Science Initiative demonstrated how targeted state funding drives health-based research commercialisation (Kamunyor et al., 2010). Similarly, evaluations of Philippine state universities highlight that institutional readiness requires clear IP policy frameworks (Abdulmalik, 2020), and Pakistan's Offices of Research, Innovation, and Commercialisation (ORICs) offer a proven structural model for bridging academic output with industrial needs (Zahra, 2024).

Based on the empirical evidence and systemic gaps synthesized in this study, actionable recommendations for Nigerian polytechnics, regulatory agencies (such as NBTE), and industrial partners include:

- **Short-Term Actions (1–2 Years):** Formally establish or re-engineer dedicated Technology Transfer Offices (TTOs) equipped with legal expertise to operationalise institutional IP policies and patent filing support (Okoroma & Obiajunwa, 2026). Conduct mandatory capacity-building workshops on IP disclosure, technology readiness assessment, and commercial pitch preparation for academic staff, alongside embedding project-based experiential learning into technical curricula (Proença, 2025).
- **Medium-Term Strategies (3–5 Years):** Establish institutional revolving innovation seed funds through public-private partnerships to finance early-stage prototypes (Mafu, 2023; Nsanzumuhire et al., 2023). Adopt phased industry collaboration models - starting with low-risk contract research and consultancy before advancing to complex licensing and joint ventures (Rossoni et al., 2024). Simultaneously upgrade shared digital fabrication facilities, broadband connectivity, and solar energy infrastructure (Daudu et al., 2026; Roleola & Jolaoso, 2025).
- **Long-Term Institutional Development (5+ Years):** Transition fully to the Entrepreneurial Polytechnic Model by deploying the Entrepreneurial University Wheel - integrating student innovators, industrial clusters, and community artisans into a unified innovation ecosystem (Louwrens, 2025). Institutionalise formal Triple Helix governance frameworks uniting polytechnic leaders, industrial executives, and government STI policy makers to drive national industrial priorities (Purnomo & Purwandari, 2025).

5.0 Conclusion

This study evaluated the institutional, structural, technological, and strategic parameters governing research commercialisation in Nigerian polytechnics. The synthesis reveals that while Nigerian polytechnics possess significant

strategic potential due to their applied, skill-based mandate, their commercialisation capacity remains severely hampered by systemic infrastructure deficits, chronic funding shortfalls, digital skill gaps, weak TTO operations, and limited industry engagement.

The findings of this study demonstrate that overcoming these commercialisation barriers requires a deliberate shift from traditional academic research toward market-oriented, ecosystem-driven innovation. Institutional readiness can be unlocked when polytechnics pair clear IP protection frameworks and experiential entrepreneurship education with robust digital infrastructure and active industry-government collaboration. By adopting the phased short-, medium-, and long-term recommendations outlined in this study, Nigerian polytechnics can successfully convert academic research into viable market solutions - driving employment generation, industrial growth, and sustainable economic development.

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