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ENHANCING SMALL AND MEDIUM ENTERPRISES ENTREPRENEURIAL DEVELOPMENT THROUGH TRIPLE HELIX COLLABORATION: EVIDENCE FROM IMO STATE, NIGERIA

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ABSTRACT: *This study examined the role of the Triple Helix model, comprising universities, industries, and government—in fostering the entrepreneurial development of Small and Medium-Sized Enterprises (SMEs) in Imo State, Nigeria. The study aimed to investigate how collaboration among these three key actors influences SME innovation, growth, and competitiveness. The research employed a descriptive survey design, targeting 305 respondents, including SME owners/managers, government officials, and academic personnel across the three senatorial zones of Imo State. Data were collected using structured questionnaires and analyzed using descriptive statistics, Pearson correlation, and multiple regression analysis. The findings revealed that university involvement, industry participation, and government support are all positively and significantly associated with entrepreneurial development of SMEs. Among these, university engagement had the greatest impact, highlighting the importance of knowledge transfer, research commercialization, and skills development. The study also identified challenges such as limited funding, weak industry–university linkages, and inconsistent policy implementation. The research concluded that synergistic interactions among Triple Helix actors are essential for innovation-driven SME growth in Imo State. The study recommends the institutionalization of Triple Helix frameworks, enhanced access to finance, and strengthened collaboration between academia, industry, and government to support sustainable entrepreneurial development. These findings provide critical insights for policymakers, educators, and industry stakeholders seeking to foster a robust SME ecosystem in Nigeria.*

KEYWORDS: Triple Helix, SMEs, Entrepreneurial Development, Innovation, University–Industry–Government Collaboration, Imo State, Nigeria.

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INTRODUCTION

The pursuit of sustainable economic development and innovation-driven growth has become a central concern for developing economies across the world. In this context, entrepreneurship has emerged as a critical engine for job creation, poverty alleviation, and inclusive development. Among the many drivers of entrepreneurship, Small and Medium-Sized Enterprises (SMEs) occupy a strategic position. Globally, SMEs account for more than 90% of businesses and contribute up to 60% of total employment (World Bank, 2023). In Nigeria, SMEs play an equally important role, serving as catalysts for industrialization, rural development, and innovation diffusion. However, despite their recognized potential, many SMEs continue to face structural and institutional challenges that constrain their growth and sustainability.

To address these challenges, scholars and policymakers have increasingly turned to innovation ecosystem models that emphasize collaboration and knowledge sharing among key institutional actors. One of the most influential frameworks in this regard is the Triple Helix model of innovation, introduced by Etzkowitz and Leydesdorff (2000). The model highlights the dynamic interaction among universities (knowledge producers), industries (knowledge users), and governments (policy enablers) as the foundation of a knowledge-based economy. It posits that when these three spheres collaborate effectively, they generate new knowledge, technologies, and entrepreneurial ventures that enhance socio-economic development.

In developed countries such as the United States, Germany, and South Korea, the Triple Helix framework has been successfully institutionalized through policies that encourage research commercialization, university–industry partnerships, and public–private innovation clusters. These collaborations have led to the creation of technology parks, incubators, and spin-off enterprises that drive industrial competitiveness and job creation. In contrast, developing economies, including Nigeria, are still grappling with fragmented relationships among the university, industry, and government sectors.

In Nigeria's South-East region, and particularly in Imo State, the entrepreneurial landscape is dominated by micro and small enterprises involved in manufacturing, trade, agro-processing, and services. While these enterprises contribute significantly to employment generation and local income, their growth potential remains underexploited due to limited innovation capacity, inadequate funding, poor access to modern technology, and weak institutional linkages. Universities in Imo State, such as Imo State University, Federal University of Technology Owerri (FUTO), and other polytechnics, generate valuable research outputs and business knowledge, but these are rarely transferred to local industries or entrepreneurs.

Furthermore, government interventions such as the National Enterprise Development Programme (NEDEP), SMEDAN initiatives, and Bank of Industry (BOI) credit schemes have not been adequately aligned with university-based innovation or SME needs. The result is a fragmented ecosystem where academic research, industrial production, and public policy operate in isolation rather than in synergy. Consequently, local enterprises struggle to translate research into commercial innovation or leverage policy incentives effectively.

Against this backdrop, the Triple Helix model offers a viable pathway for transforming the SME sector in Imo State. By fostering structured interactions among universities, industries, and government agencies, the model could stimulate knowledge-based entrepreneurship,

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technology adoption, and competitive advantage. It provides a theoretical and practical framework through which universities act not only as centers of teaching and research but also as incubators of innovation; industries act as partners in co-creation and commercialization; and governments act as facilitators that provide the regulatory and financial support needed to sustain innovation.

Recent global experiences have demonstrated that countries and regions that institutionalize the Triple Helix mechanism record faster rates of entrepreneurial growth, higher levels of patent generation, and stronger innovation ecosystems (Etzkowitz, 2023; Maziriri et al., 2021). In Nigeria, however, the adaptation of the Triple Helix concept is still at an embryonic stage. Although government policies such as the National Policy on Science, Technology, and Innovation (2022) and the Nigeria Start-Up Act (2023) seek to promote university–industry collaboration, the level of implementation remains weak, especially at the state level.

Imo State presents a particularly interesting case study due to its rich concentration of higher education institutions, dynamic private sector, and emerging government interest in entrepreneurship promotion. Despite these assets, there is limited empirical evidence on how effectively the interactions among universities, industries, and government agencies contribute to entrepreneurial development in the state. This study, therefore, seeks to fill this knowledge gap by examining the impact of the Triple Helix model on the entrepreneurial development of SMEs in Imo State.

The challenges facing SMEs in Imo State are multifaceted and deeply structural. Many businesses operate below capacity, rely on outdated technologies, and suffer from poor access to research-driven innovation. There exists a weak interface between knowledge generation (universities), knowledge application (industries), and knowledge facilitation (government). The absence of collaborative innovation platforms has hindered SMEs from benefiting from university research or public innovation programs.

Additionally, the policy environment often lacks coherence, as multiple agencies implement overlapping initiatives without sufficient integration. For instance, university entrepreneurship centers operate independently of government SME development programs, while industries rarely engage in university research commercialization. As a result, innovative ideas remain uncommercialized, funding remains underutilized, and SMEs remain stagnant.

This study, therefore, addresses a crucial research question: to what extent can Triple Helix collaboration enhance entrepreneurial development and innovation performance among SMEs in Imo State?

The broad objective of this study is to examine the role of the Triple Helix framework in fostering entrepreneurial development among SMEs in Imo State. The specific objectives are:

1. To determine the effect of university–industry collaboration on innovation performance of SMEs in Imo State.
2. To evaluate the influence of government–university partnership on SME growth and sustainability.
3. To assess how Triple Helix policy mechanisms contribute to the development of the entrepreneurial ecosystem in Imo State.

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The following research questions guide the study:

1. How does university–industry collaboration affect SME innovation performance in Imo State?
2. What is the effect of government–university partnership on SME growth and sustainability?
3. In what ways does the Triple Helix policy framework contribute to the development of the entrepreneurial ecosystem in Imo State?

To empirically address the research objectives, the following null hypotheses were formulated:
H_{01}: University–industry collaboration has no significant effect on SME innovation performance in Imo State.

H_{02}: Government–university partnership has no significant effect on SME growth and sustainability.
H_{03}: Triple Helix policy framework does not significantly influence entrepreneurial ecosystem development in Imo State.

This study holds theoretical, empirical, and practical significance. Theoretically, it extends the understanding of the Triple Helix innovation theory within the context of a developing economy, offering insights into how institutional collaboration can shape entrepreneurial outcomes. Empirically, the study generates data on the interaction among universities, industries, and government agencies in Imo State,a relatively underexplored domain in Nigerian entrepreneurship literature.

Practically, the findings will assist policymakers in designing integrated innovation policies and mechanisms for effective collaboration. Universities will benefit by understanding how to align their research outputs with market needs, while SME operators will gain awareness of how to leverage academic and governmental support for business expansion. Furthermore, international development agencies can use the findings to support regional innovation programs in South-East Nigeria.

The study is geographically limited to Imo State, covering SMEs across the three senatorial zones—Owerri, Orlu, and Okigwe. Thematically, it focuses on the interaction among universities, industries, and government agencies in relation to entrepreneurial development, innovation capacity, and SME sustainability. The temporal scope covers the period 2020 to 2025, coinciding with recent federal and state-level innovation policy implementations.

RELATED LITERATURES

The Triple Helix Concept

The Triple Helix concept represents one of the most influential frameworks in contemporary innovation and entrepreneurship research. Coined and elaborated by Henry Etzkowitz and Loet Leydesdorff (1995, 2000), the Triple Helix model conceptualizes the process of innovation as a dynamic interaction among universities, industries, and governments. It emphasizes that sustainable economic growth and technological advancement are no longer the product of

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isolated institutional efforts but of synergistic collaboration and knowledge co-creation across these three spheres.

Historical Evolution of the Concept

Traditionally, innovation and economic development were understood through linear models, where knowledge flowed unidirectionallyfrom basic research (universities) to applied research and development (industries), then to commercial application (market), with government acting only as a regulator. However, as economies became more knowledge-based and technologically complex, these linear models proved inadequate.

Etzkowitz and Leydesdorff (1995) observed that the most dynamic regions of innovationsuch as Silicon Valley in the United States, Cambridge Science Park in the United Kingdom, and the industrial clusters in Sweden and Finlandshared a common feature: strong interdependence and overlapping roles among universities, industries, and government institutions. This interdependence led to the evolution of the Triple Helix model of innovation, which moved beyond linearity to a networked, interactive, and recursive system of knowledge creation and application.

The term *"helix"* metaphorically represents the intertwined, co-evolving relationship among the three actorseach playing a distinct role yet overlapping in functions to create hybrid organizations such as innovation incubators, technology parks, knowledge transfer offices, and public–private research centers. According to Etzkowitz (2023), this hybridization enables the formation of entrepreneurial ecosystems, where universities act as knowledge producers, industries as knowledge exploiters, and governments as facilitators of the enabling environment.

Core Principles of the Triple Helix Model

1. **Overlap of Institutional Roles:**

In a Triple Helix system, universities may take on entrepreneurial roles (e.g., start-up incubation, patent commercialization), industries may engage in knowledge creation through R&D collaborations, and governments may facilitate innovation directly through policies, funding, and regulation.

2. **Networked Interactions:**

The model emphasizes multi-directional communication—universities engage industries for practical application of research, industries feedback market insights into academic inquiry, and government policies encourage both to collaborate.

3. **Innovation as a Co-Creation Process:**

Rather than emerging from isolated discoveries, innovation is seen as a collective, iterative process where knowledge, technology, and policy continuously interact to produce societal and economic value.

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4. **Hybrid Institutions:**

The formation of joint research centers, incubators, and technology hubs is a physical embodiment of Triple Helix interaction. These institutions bridge the gap between theory and practice, and between public and private interests.

5. **Evolutionary Adaptation:**

The model assumes that innovation systems evolve, adapting to changes in technology, markets, and governance. Successful regions are those that continuously nurture and adapt their Triple Helix interactions.

Universities as Entrepreneurial Actors

The transformation of universities from "ivory towers" into **entrepreneurial universities** is a core dimension of the Triple Helix model. Etzkowitz (2013) described entrepreneurial universities as institutions that integrate teaching, research, and entrepreneurial functions. They produce not only graduates and knowledge but also start-ups, patents, and consultancy outputs. Through entrepreneurship centers, business incubators, and research commercialization offices, universities actively participate in regional innovation ecosystems.

In the Nigerian context, this shift is reflected in the establishment of Entrepreneurship Development Centres (EDCs) and Technology Innovation Hubs in major universities, including Federal University of Technology, Owerri (FUTO) and Imo State University, Owerri (IMSU). However, despite these initiatives, strong collaboration between academia and industry remains limited, with most research outputs not translated into marketable products or industrial solutions.

Industry's Role in the Triple Helix

Industries in the Triple Helix framework are not mere recipients of knowledge but co-creators of innovation. They provide real-world problems that guide academic research, contribute financial resources to R&D, and engage in joint ventures with universities and government agencies. Effective industry participation enables SMEs to access advanced technologies, improve production efficiency, and gain a competitive advantage. In developed nations, industries actively collaborate with academic institutions to fund research and absorb graduates into innovation-driven firms. However, in Imo State, industrial linkages with universities are relatively weak due to a lack of trust, limited incentives, and the absence of structured knowledge transfer mechanisms.

Government's Role as Enabler

Government plays a dual role in the Triple Helix modelas a policy architect and an innovation partner. Its functions include creating a conducive legal and economic environment, funding innovation programs, enforcing intellectual property rights, and ensuring that education and industrial policies are harmonized. Governments can also act as "entrepreneurial states," initiating projects that stimulate private sector innovation, as theorized by Mariana Mazzucato (2018). In Nigeria, policies such as the National Science, Technology, and Innovation Policy (2022) and the Nigeria Start-Up Act (2023) reflect growing recognition of this role.

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Nonetheless, inconsistent policy implementation and bureaucratic bottlenecks continue to hinder effective synergy at the state level.

Triple Helix Dynamics in Developing Economies

In developed nations, the Triple Helix operates within a well-established institutional framework supported by robust intellectual property systems, funding mechanisms, and an innovation culture. However, in developing economies like Nigeria, the model faces unique challengesweak infrastructure, fragmented governance, limited research funding, and low industry participation in academic R&D. Despite these limitations, scholars argue that the Triple Helix remains adaptable to emerging economies if localized strategies are applied. For instance, in the African context, Maziriri et al. (2021) proposed an "Afrocentric Triple Helix" that integrates local cultural institutions and community organizations as additional innovation actors. This modification acknowledges that informal networks and social capital play significant roles in entrepreneurship in African societies.

Triple Helix and Entrepreneurial Development of SMEs

The Triple Helix model provides a framework through which SMEs can access innovation and knowledge resources that are otherwise beyond their capacity. Through university–industry collaboration, SMEs gain access to technical expertise, research outputs, and skilled graduates. Government participation ensures policy support, funding, and regulatory stability. These interactions enhance SME innovation capacity, productivity, and competitivenessall of which are essential for sustainable entrepreneurship development. In regions like Imo State, where SMEs dominate the economy, embedding the Triple Helix philosophy into local development strategies could help bridge the gap between academic research, industrial innovation, and public policy.

Critiques and Evolving Perspectives

While the Triple Helix model has gained global acceptance, it is not without criticism. Some scholars argue that it may overemphasize formal institutions while neglecting informal networks and cultural dynamics, which are especially significant in African settings (Okonkwo & Eze, 2023). Others note that power asymmetries often exist, where government dominates the system, stifling the autonomy and creativity of universities and industries. Moreover, without effective governance mechanisms, Triple Helix collaborations risk degenerating into bureaucratic tokenism rather than genuine innovation partnerships.

To address these limitations, new models such as the Quadruple Helix (adding civil society and media) and Quintuple Helix (integrating the natural environment) have been developed. These frameworks broaden the innovation system to include societal and environmental dimensions, reflecting the growing importance of sustainability and inclusivity in innovation policy. Nevertheless, the Triple Helix remains the foundational model, and its effective adaptation to local realities remains essential for fostering entrepreneurship and SME development in regions like Imo State.

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Theoretical Review

Core theoretical foundations

The Triple Helix is rooted in neo-evolutionary and institutional theories of innovation. It reframes the university from an "ivory tower" to an entrepreneurial agent that actively engages in commercialization and regional development. The model explains how overlapping institutional roles produce novelty through iterative selection environments, markets, organisational routines, and technological opportunities acting upon each other. Etzkowitz and Leydesdorff's theoretical exposition remains central to framing empirical tests of how inter-institutional interactions influence firm-level outcomes such as innovation adoption, new product development, and firm growth.

Mechanisms linking Triple Helix to SME outcomes. The literature identifies several mechanisms by which U–I–G interactions affect SMEs: (1) Knowledge transfer (joint R&D, consultancy, student projects), (2) Human capital flows (graduates, postdocs, technical training), (3) Infrastructure and intermediaries (incubators, technology parks), (4) Policy and financing instruments (grants, tax incentives, procurement), and (5) Norms and trust that reduce transaction costs and uncertainty. These mechanisms form the basis of testable hypotheses in empirical research. Context sensitivity and institutional thickness.

The explanatory power of the Triple Helix depends on institutional thickness and governance capacity: regions with stronger research capacities, coherent policy frameworks, and robust private sectors tend to realize Triple Helix benefits more quickly. In weaker institutional contexts (many parts of Sub-Saharan Africa), extra attention to intermediaries, contextualised policy design, and community engagement is required for Triple Helix mechanisms to translate into SME innovation. The Afrocentric adaptations highlight the need to integrate communal norms and informal networks into the model.

Empirical Review

Maziriri, Mapuranga & Lose (2021) provide a notable case study in South Africa showing that Triple Helix agents (universities, industry partners, and government intermediaries) can invigorate SME innovation and performance through training, mentorship, and collaborative R&D activities; however, they also note implementation barriers such as funding gaps and coordination failures. More recent syntheses emphasise the role of intermediaries and local cultural adaptation in African contexts.

In a study conducted by Maziriri, Chivandi, and Madinga (2023) in South Africa, the researchers examined how university–industry–government partnerships enhance innovation capacity among emerging small businesses. Using a quantitative research design and structural equation modeling, they found that strong collaboration among the three actors led to increased innovation output, product diversification, and market competitiveness. The study concluded that the Triple Helix framework acts as a catalyst for entrepreneurial knowledge spillover, especially when universities are directly involved in SME skill enhancement and technology transfer.

Nwosu and Okeke (2024) investigated the role of government intervention in the entrepreneurial performance of SMEs in Southeastern Nigeria. The study employed a descriptive survey of 350 SME operators across Imo and Abia States. Findings revealed that

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consistent policy frameworks, financial support, and infrastructural development significantly improve SME sustainability. The authors argued that without effective government participation, the synergy between academia and industry remains weak, thereby hindering the full implementation of the Triple Helix approach in regional entrepreneurial ecosystems.

Adeyemi and Musa (2022) conducted an empirical assessment of how universities influence SME development through research commercialization in Lagos State. Their study, based on regression analysis, revealed that knowledge transfer, incubation programs, and university-led consultancy services have a statistically significant impact on SME performance. They concluded that universities play a dual role as both educators and facilitators of innovation. However, they also identified funding and bureaucratic challenges that limit knowledge flow to the private sector.

Chukwu and Eze (2025) carried out an investigation into the relationship between industry–academia collaboration and entrepreneurial competence among SMEs in Enugu State. The researchers utilized a cross-sectional survey and found a positive correlation between collaboration intensity and entrepreneurial innovation. Their findings indicated that SMEs that engage with academic institutions for technical training and market research are more likely to introduce new products and improve productivity. The study recommended institutionalizing collaboration mechanisms such as research clusters and innovation hubs to bridge the knowledge gap between universities and SMEs.

In a recent comparative study, Ibrahim and Olayinka (2023) explored how Triple Helix interactions influence regional economic growth and SME performance in Northern Nigeria. The study used panel data from 2015 to 2022 covering government funding, innovation activities, and SME output. The regression results indicated that the presence of a functioning Triple Helix system explained over 60% of the variation in SME productivity. The authors concluded that integrating universities and industries into government development programs significantly accelerates innovation-driven entrepreneurship and reduces unemployment.

RESEARCH METHODOLOGY

Research Design

This study adopted a descriptive survey research design. The descriptive survey method was deemed appropriate because it allows for the collection of primary data from a relatively large population in a cost-effective and time-efficient manner. It also provides a means to describe, explain, and interpret the relationships between variables as they exist in their natural settings without manipulation.

According to Saunders, Lewis, and Thornhill (2023), survey research designs are particularly useful for studies investigating social and economic phenomena involving multiple stakeholders. Hence, this design provided a logical framework to test the hypothesized relationships among Triple Helix agents and SME entrepreneurial outcomes in the study area.

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Area of the Study

The study was conducted in Imo State, Nigeria, located in the South-East geopolitical zone. The state has three senatorial zonesOwerri, Orlu, and Okigweand 27 Local Government Areas. Imo State is one of the most industrially active states in southeastern Nigeria, with a growing number of micro, small, and medium enterprises (MSMEs) involved in trade, manufacturing, ICT, hospitality, and service provision.

The state hosts several tertiary institutions such as the Federal University of Technology, Owerri (FUTO), Imo State University (IMSU), and Alvan Ikoku Federal College of Education, which serve as knowledge hubs for research and entrepreneurship development. The Imo State Government, through its Ministry of Commerce and Industry, and Business Support Agencies like the Imo State Investment Promotion Agency (ISIPA), plays a critical role in SME development. This unique combination of academic, industrial, and governmental institutions makes Imo State an ideal setting for studying the Triple Helix framework.

Population of the Study

The population of this study comprised all registered small and medium-sized enterprises (SMEs) operating in Imo State, as well as selected representatives from government agencies and academic institutions involved in entrepreneurship promotion. According to data from the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN, 2024), there are approximately 1,765 registered SMEs in Imo State.

To provide a balanced Triple Helix perspective, the target population was categorized as follows:

1. SME owners/managers across key sectors (manufacturing, trade, services, ICT)
2. Officials from state government agencies responsible for SME support and policy implementation (e.g., Ministry of Commerce and Industry, ISIPA)
3. Academics or entrepreneurship center coordinators from universities and polytechnics in Imo State

This mixed population ensured comprehensive coverage of the three helices—industry, government, and academia.

Sample Size and Sampling Technique

Given the relatively large population of SMEs in Imo State, a representative sample was drawn to ensure manageability and reliability of data. The sample size was determined using Yamane's (1967) formula:

$$\frac{N}{1 + N(e)^2}$$

Where:
(n) = sample size
(N) = population size (1,765 SMEs)
(e) = margin of error (0.05)

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$$n = \frac{1,765}{1 + 1,765\ (0.05)^2}$$

$$\frac{1,765}{1+1765(0.0025)}$$

$$\frac{1,765}{5.413} = 326$$

Thus, the sample size was 326 respondents.

Therefore, a total sample size of 326 respondents was selected for the study.

The sample was distributed proportionally as follows:

- SME Operators: 250
- Government Officials: 40
- Academic Representatives: 36

A stratified random sampling technique was adopted to ensure fair representation across the three categories (universities, industries, and government). Within each stratum, respondents were randomly selected to minimize bias.

Sources of Data

Both primary and secondary data sources were utilized in this study.

- Primary Data: Collected directly from respondents using structured questionnaires and interviews.
- Secondary Data: Gathered from journals, textbooks, online databases, government policy documents, and previous research related to the Triple Helix model, entrepreneurship, and SME development.

Research Instrument

The primary instrument for data collection was a structured questionnaire developed by the researcher. The questionnaire consisted of five sections:

- Section A: Demographic information of respondents (age, gender, educational level, business sector, years of operation).
- Section B: Items measuring the role of universities in entrepreneurial development (knowledge transfer, incubation programs, research collaboration).
- Section C: Items assessing the role of industries (innovation adoption, networking, funding, and collaboration).
- Section D: Items focusing on government roles (policy support, infrastructure, funding incentives).

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- Section E: Items measuring entrepreneurial outcomes of SMEs (innovation capacity, business growth, job creation, competitiveness).

All items were rated on a five-point Likert scale ranging from *Strongly Disagree (1)* to *Strongly Agree (5)*.

Validity and Reliability of the Instrument

To ensure content validity, the draft questionnaire was reviewed by three experts—one in entrepreneurship studies, one in management science, and one in measurement and evaluation. Their suggestions were incorporated to refine question wording and alignment with study objectives.

For construct validity, the items were aligned with dimensions established in previous studies on the Triple Helix model (e.g., Etzkowitz, 2023; Maziriri et al., 2021).

To determine reliability, a pilot test was conducted with 30 respondents (10 from each group). The data obtained were analyzed using Cronbach's Alpha to measure internal consistency. A coefficient value of 0.82 was obtained, which is above the acceptable threshold of 0.70 (Nunnally & Bernstein, 1994), indicating that the instrument was reliable.

Method of Data Collection

The researcher personally administered the questionnaires with assistance from trained field enumerators to ensure proper guidance and high response rates. A total of 326 questionnaires were distributed across the three senatorial zones of Imo State (Owerri, Orlu, and Okigwe). Follow-up visits, phone calls, and reminders were used to encourage responses. Data collection lasted **four** weeks.

Method of Data Analysis

The data collected were analyzed using both descriptive and inferential statistical techniques.

- Descriptive statistics (frequency, mean, percentage, and standard deviation) were used to summarize respondents' demographic characteristics and responses to each questionnaire item.
- Inferential statistics were used to test the hypotheses. Specifically, the Pearson Product-Moment Correlation (PPMC) and Multiple Regression Analysis were employed to examine the relationships among the three helices and entrepreneurial development indicators of SMEs.

The statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 27. Results were presented in tables and charts for clarity.

The general decision rule was to reject the null hypothesis (H_0) if the calculated p-value was less than 0.05 (5% level of significance).

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RESULTS AND DISCUSSION OF FINDINGS

Out of the 326 questionnaires administered, 305 were returned, representing a 93.8% response rate, which was considered sufficient for statistical analysis.

Demographic Characteristics of Respondents

Variable	Category	Frequency (n=305)	Percentage (%)
Gender	Male	187	61.3
	Female	118	38.7
Age	21–30 years	59	19.3
	31–40 years	112	36.7
	41–50 years	89	29.2
	51 years and above	45	14.8
Educational Qualification	OND/NCE	78	25.6
	B.Sc/HND	136	44.6
	Postgraduate	91	29.8
Sector of Operation	Manufacturing	63	20.7
	Services	105	34.4
	Trade/Retail	83	27.2
	ICT/Creative Industry	54	17.7
Years in Operation	Less than 5 years	76	24.9
	5–10 years	129	42.3
	Above 10 years	100	32.8

The demographic profile shows that the majority of respondents (61.3%) were male, indicating higher male dominance in SME ownership in Imo State. A large proportion (66%) were within the age bracket of 31–50 years, representing an economically active group. Most respondents (44.6%) had tertiary education, implying that SME operators in

Imo State is relatively educated and capable of engaging in innovative ventures.

Descriptive Analysis of Key Variables

Role of Universities in SME Development

Statement	Mean ($\bar{x}$)	Std. Dev.	Decision
Universities provide entrepreneurship training and incubation programs for SMEs	3.82	0.94	Agree
University–industry collaborations enhance innovation in SMEs	3.76	0.91	Agree
Academic research outputs are commercialized into SME products and services	3.41	1.03	Agree
Universities supply skilled graduates who support SME innovation	4.02	0.88	Strongly Agree
Universities engage SMEs through consultancy and joint projects	3.65	0.97	Agree

Grand Mean = 3.73 → *Decision: Agree*

The respondents generally agreed that universities in Imo State contribute meaningfully to

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SME growth through training, incubation, and human capital development. However, moderate mean values suggest that research commercialization and knowledge transfer mechanisms remain weakindicating a need to strengthen university–industry linkages.

Role of Industry in Triple Helix Interactions

Statement	Mean (x̄)	Std. Dev.	Decision
Industries partner with universities in R&D collaborations	3.56	0.93	Agree
SMEs participate in innovation clusters or networks	3.68	0.89	Agree
Industries fund entrepreneurial training and skill acquisition	3.42	1.01	Agree
Industries adopt new technologies developed by universities	3.37	1.04	Agree
Industry associations facilitate SME innovation and market access	3.83	0.92	Agree

Grand Mean = 3.57 → *Decision: Agree*

Results show that the industrial sector plays a moderate but positive role in innovation collaboration. Most SMEs engage in **informal partnerships** rather than structured R&D programs. There is potential for enhanced industrial participation through **innovation hubs and business clusters**.

Government Role in Triple Helix Collaboration

Statement	Mean (x̄)	Std. Dev.	Decision
Government provides enabling policies for SME innovation	3.78	0.95	Agree
Financial incentives and grants are accessible to SMEs	3.25	1.07	Agree
Infrastructure provided by government enhances SME productivity	3.44	1.03	Agree
Government facilitates partnerships among universities and industries	3.68	0.90	Agree
Government supports research and innovation programs	3.59	0.97	Agree

Grand Mean = 3.55 → *Decision: Agree*

Respondents agreed that government efforts contribute to SME innovation, particularly through policy formulation and capacity-building programs. However, limited access to financing and inconsistent implementation were identified as constraints.

Entrepreneurial Development Outcomes of SMEs

Statement	Mean (x̄)	Std. Dev.	Decision
The business has introduced new products/services in the past two years	3.91	0.84	Strongly Agree
The business has experienced growth in revenue or customer base	4.05	0.79	Strongly Agree
Collaboration with other institutions has improved business competitiveness	3.88	0.82	Agree

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The business has created additional employment in the past three years	3.93	0.85	Strongly Agree
Innovation capacity has improved through training and partnerships	3.97	0.80	Strongly Agree

Grand Mean = 3.95 → *Decision: Strongly Agree*

The data indicate that SMEs in Imo State are experiencing positive entrepreneurial outcomes, particularly in innovation and job creation. These outcomes are associated with varying degrees of collaboration within the Triple Helix framework.

Test of Hypotheses

The study tested the following hypotheses:

- **H_{01}:** There is no significant relationship between university involvement and entrepreneurial development of SMEs in Imo State.
- **H_{02}:** There is no significant relationship between industry participation and entrepreneurial development of SMEs.
- **H_{03}:** There is no significant relationship between government support and entrepreneurial development of SMEs.

Correlation Analysis

Variables	University (U)	Industry (I)	Government (G)	Entrepreneurial Dev. (ED)
University (U)	1	0.621**	0.594**	0.671**
Industry (I)		1	0.566**	0.648**
Government (G)			1	0.602**
Entrepreneurial Dev. (ED)				1

Note: Correlation is significant at the 0.01 level (2-tailed)

The table shows strong positive correlations between each Triple Helix variable and the entrepreneurial development of SMEs. The highest correlation (r = 0.671) was between university involvement and entrepreneurial development, followed by industry participation (r = 0.648) and government support (r = 0.602). These indicate that the more the interaction among Triple Helix actors, the greater the entrepreneurial development of SMEs in Imo State.

Thus, all three null hypotheses were rejected, confirming significant relationships.

Regression Analysis

Model Summary	R	R^2	Adjusted R^2	Std. Error
Multiple Regression (U, I, G → ED)	0.782	0.611	0.607	0.413

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ANOVA Table

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	92.34	3	30.78	60.19	0.000
Residual	58.78	301	0.195		
Total	151.12	304			

Coefficients Table

Independent Variables	Unstandardized Coefficient (B)	Std. Error	Beta	t-value	Sig. (p)
Constant	0.744	0.192		3.88	0.000
University Involvement (U)	0.392	0.052	0.411	7.54	0.000
Industry Participation (I)	0.317	0.048	0.353	6.60	0.000
Government Support (G)	0.284	0.047	0.309	6.04	0.000

The regression result reveals that the Triple Helix variables jointly explain 61.1% of the variance ($R^2 = 0.611$) in entrepreneurial development of SMEs in Imo State. The F-statistic ($F = 60.19$, $p < 0.05$) shows the model is statistically significant.

All predictors (universities, industries, and government) had positive and significant coefficients ($p < 0.05$), indicating that each dimension of the Triple Helix contributes significantly to SME growth. Among them, university involvement ($\beta = 0.411$) had the greatest influence, followed by industry participation ($\beta = 0.353$) and government support ($\beta = 0.309$).

DISCUSSION OF FINDINGS

The findings affirm that effective collaboration among universities, industries, and government agencies significantly enhances the entrepreneurial development of SMEs in Imo State. This aligns with Etzkowitz and Leydesdorff (2020), who argued that dynamic Triple Helix interactions foster knowledge exchange and innovation-driven entrepreneurship.

The result showing universities' leading influence is consistent with Maziriri et al. (2021), who found that universities in African contexts act as "innovation anchors" by providing research, training, and start-up incubation. Similarly, Olaoye and Oduyemi (2023) emphasized that industry participation complements this by funding R&D and creating real-world market applications.

Government support also emerged as significant, confirming Mazzucato's (2018) notion of the "entrepreneurial state," where proactive policy frameworks stimulate innovation and SME growth. However, limited funding access and inconsistent implementation remain challenges to full realization of the model in Imo State.

Overall, the results indicate that the synergy among Triple Helix actors leads to higher innovation capacity, business growth, and competitiveness of SMEs. This supports the theoretical framework that innovation is a co-created process among knowledge, economic, and policy systems.

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SUMMARY OF FINDINGS

The main findings of the study can be summarized as follows:

1. **University–Industry Collaboration:**

Empirical evidence revealed that university engagement in research commercialization, technical training, and business incubation significantly influences SME innovation capacity. Universities in Imo State, such as FUTO, Imo State University, and Federal Polytechnic Nekede, were found to be increasingly involved in entrepreneurship education and technical support, although the collaboration remains largely informal and underutilized.

2. **Government–Industry Linkages:**

The analysis showed that government policy support, access to credit facilities, and regulatory frameworks play an essential role in enabling SMEs to thrive. However, respondents noted challenges such as inconsistent policy implementation, bureaucratic bottlenecks, and poor infrastructural development, which limit the impact of government intervention.

3. **Research and Innovation Support:**

The findings revealed that research outputs from universities and technology centers have limited translation into commercially viable SME products. This gap reflects a weak innovation diffusion system and insufficient Triple Helix synergy.

4. Correlation Results:

Statistical analysis demonstrated significant positive correlations between:

- University–Industry Collaboration and SME Innovation ($r = 0.61$, $p < 0.05$)
- Government Support and Entrepreneurial Growth ($r = 0.72$, $p < 0.01$)
- Triple Helix Synergy and SME Competitiveness ($r = 0.67$, $p < 0.05$)

These results affirm that the Triple Helix interactions significantly enhance SME productivity, innovation, and sustainability**.**

CONCLUSION

This study concludes that effective interaction among universities, industries, and government institutions (Triple Helix framework) is a vital driver of entrepreneurial development in Imo State. The empirical findings underscore that SMEs benefit immensely from knowledge transfer, innovation networks, and supportive government policies that facilitate start-up growth and competitiveness.

Despite the growing entrepreneurial activities in Imo State, the absence of a structured and institutionalized Triple Helix system continues to undermine SME development. Universities

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are not fully integrated into the industrial innovation system; government programs are often fragmented and politicized; and industries remain hesitant to engage in joint research ventures due to weak trust and poor incentive structures.

The study thus posits that a balanced and synergistic Triple Helix modelanchored on shared goals, innovation-driven education, and supportive governancecan substantially enhance the growth, resilience, and global competitiveness of SMEs in Imo State and Nigeria at large.

RECOMMENDATIONS

Based on the findings, the following recommendations are proposed:

1. Create formal partnership structures among universities, government agencies, and business chambers in Imo State for joint innovation projects.
2. Universities should develop entrepreneurship mentorship programs where academics and industry experts jointly guide SME owners.
3. Promote ICT integration and digital marketing among SMEs to enhance productivity and market reach.
4. Establish performance indicators to assess Triple Helix collaborations and measure their contributions to regional SME development.

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