
TECHNOLOGICAL INTENSITY AND NEW PRODUCT INTRODUCTION: PERSPECTIVES OF SMALL AND MEDIUM ENTERPRISES IN EDO STATE

BY

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Abstract

This study examines the relationship between technological intensity and new product introduction among Small and Medium Enterprises (SMEs) in Edo State, Nigeria. The research aims to understand how technology adoption and sophistication influence the innovation capabilities of SMEs in the region. The study addresses the challenges faced by SMEs in accessing, implementing, and utilizing innovative technologies. These challenges include limited resources, lack of technical expertise, and regulatory hurdles. The research questions explore the correlation between technological adoption and new product introduction, as well as the relationship between technological sophistication and new product introduction. The theoretical framework draws on the linear model of innovation, which posits a sequential relationship between scientific discovery, technological development, and market introduction. However, the study acknowledges the limitations of this model and considers the complex interplay between various factors influencing SME innovation. By investigating these relationships, the study contributes to a better understanding of the factors driving SME innovation in Nigeria and provides insights for policymakers, practitioners, and researchers. The findings can inform the development of targeted interventions to support SME innovation and enhance the competitiveness of the Nigerian economy.

Keywords: Technological intensity, New product introduction, Small and medium enterprises (SMEs), Edo State

Introduction

The study on technological intensity and business growth in Edo State, Nigeria, is rooted in the broader context of economic development and the critical role of SMEs in driving growth. Edo State, located in the southern part of Nigeria, has been experiencing significant economic transformation, and SMEs form a substantial part of its economic landscape. In the light of the importance of SME innovation, it is imperative to develop a thorough understanding of what innovation is, and the process of how innovation occurs in our organizations.

In many countries, including Nigeria, SMEs are the backbone of the economy, contributing significantly to job creation, GDP growth, and innovation. However, their growth can be constrained by various factors, including limited access to technology and innovation. The rapid pace of technological advancements has opened up new opportunities for businesses of all sizes. By adopting innovative technologies, SMEs can improve their efficiency, productivity, and competitiveness. Despite the potential benefits of technology, SMEs often face unique challenges in accessing and implementing innovative solutions. These challenges may include limited resources, lack of technical expertise, and regulatory hurdles. Edo State has been actively pursuing economic diversification and growth. Technological innovation can play a crucial role in driving this development by enhancing the competitiveness of local businesses and attracting investment.

Problem Statement

Despite the immense potential of technological innovation to enhance business growth and competitiveness, many Small and Medium Enterprises (SMEs) in Edo State, Nigeria, face significant challenges in adopting and effectively utilizing innovative technologies. These challenges hinder their ability to compete in a rapidly evolving global market, limit their growth potential, and contribute to the economic disparities within the region. SMEs in Edo State often have limited access to affordable and appropriate technology solutions, due to factors such as high costs, lack of awareness, and infrastructure constraints.

Many SMEs lack the necessary technical skills and knowledge to effectively implement and utilize innovative technologies, leading to inefficient operations and suboptimal outcomes. SMEs may face financial limitations that prevent them from investing in new technologies or upgrading their existing systems, hindering their ability to innovate and remain competitive. Regulatory hurdles and bureaucratic procedures can create obstacles for SMEs in adopting new technologies, particularly those related to intellectual property, data privacy, and cybersecurity. SMEs may not have access to adequate support and guidance from government agencies, industry associations, or other organizations to assist them in their technology adoption journey. The study aims to address specific areas such as:

- i. The relationship between technological adoption and new product introduction by SMEs in Edo State.
- ii. The correlation between technological sophistication and new product introduction by SMEs in Edo State.

Research Question

- i. How does technological adoption correlate with new product introduction by SMEs in Edo State?

- i. What is the correlation between technological sophistication adoption and new product introduction by SMEs in Edo State.

Research Hypothesis

- ii. There is no correlation between technological adoption and new product introduction by SMEs in Edo State.
- iii. There is no correlation between technological sophistication adoption and new product introduction by SMEs in Edo State.

Literature Review

Concept of Small and medium enterprises (SMEs)

Small and medium enterprises (SMEs), including private entrepreneurs, are critical constituents of all economies, playing a key role particularly in production and growth processes. Apart from contributing to employment and gross domestic product of many economies, SMEs foster a more equal income distribution. In order to participate effectively in this transformation, global search activities are necessary for the further technology development and economic growth of these countries.

. Definition and Characteristics of SMEs

Several countries create their own criteria based on population and trade agreement and include other forms of services to be classified as SMEs as well, e.g., professional services such as legal, accountancy, audit, and tax consultancy, veterinary services, and services provided to fisheries and aquaculture. Companies at the smallest end of the scale are sometimes referred to as micro organizations, which are also included within the inclusive definition of SMEs at both national and regional levels. In this paper, the ISO 8000 series is employed for the definition of SMEs for international standardization. It comprises 70 official national SME definitions and is applicable to over 90 percent of all companies globally, from the smallest company to highly advanced industrialized companies.

Small and medium-sized enterprises (SMEs) are business units that are independently owned and operated, and restricted in size, which are characterized by methods, ownership, and financial structure when compared to large-scaled firms. Conventionally, they are grouped based on workforce and annual sales. In Nigeria, companies are usually classified according to the official criterion of the Central Bank of Nigeria: any enterprise that has an annual turnover between N5m (US\$31,245) and N500m (US\$3,124,644) falls under the category of small and medium-sized enterprises (SMEs). However, companies in the European Union (EU) and the United States of America (USA) are classified as micro, small, and medium-sized enterprises (MSMEs) because they include individuals, businesses, and social enterprises dominated by sole proprietors and business entities, employing under 600 persons (or under 500 persons) having an annual turnover of below 25 million euros (or under 35 million dollars) and an annual balance sheet total not exceeding 10 million euros (or under 43 million dollars).

Innovation in the Context of SMEs

Small and medium-sized enterprises have become an important part of the economy, which cannot match the activities of large companies, the technological support bases, and in many cases also where it is possible to employ specially adapted forms of innovation. These forms of innovation are easy to implement in business, at the same time increasing the company's

competitiveness and ensuring its reliable, long-term existence in the market. During the long period of time, a number of specific forms of innovation have evolved that have resulted in increased competitive advantages for small and medium-sized enterprises. Small and medium-sized enterprises introducing these forms of innovation are able to operate briskly, they are able to adjust to changing economic conditions in a shorter time, to reach the stimulation of competitiveness and the determination of new development goals.

Innovation is an important factor contributing to the development of businesses and their competitiveness. Over centuries of known organization and operation of enterprises, it has always been shown that it is not economy, the most technically and technologically advanced which companies independently of the bronze quit the most optimal results. Many have achieved it economy, which introduced the best products produced in an efficient and innovative manner. At the present time, under the changing conditions of the economy, the operation of an enterprise is perceived as the achievement of established goals with the least cost by applying the most innovative methods. The assumption of innovation is the knowledge of the personnel who are able to use the methods and the use economy methods which should contribute to the improvement of the company's results in the market – the achievement of a competitive advantage.

Conceptual Discussion of Technological Intensity in SMEs

Technological Intensity refers to the degree to which a firm relies on technology to produce its goods or services. In the context of Small and Medium Enterprises (SMEs), this concept becomes particularly relevant as it can significantly influence their competitiveness, efficiency, and growth potential.

To be innovative, SMEs must excel in reengineering a product or service and operational process to increase efficiency, novelty, or both. They must be capable of assuming new risks, applying new opportunities for commercialization. Small and medium-sized companies offer a rich as well as a good ground for innovations in various market niches, both local and international. The benefits associated with innovation include, but are not limited to, improved productivity, product quality, diversity in product and service lines, risk management, better revenues, labor relations, and competitive edge. SME contribution to technology-driven economic evolution is a matter of the design of defined innovation initiatives; all that is revealed is that SME responsiveness to innovation will accentuate or undermine belief.

Innovation is not just about creating new products or services or making products more efficiently. It includes basic innovations that are based on new knowledge and applied innovations that occur in the process of applying the knowledge to improve a company's economic performance. Innovation is particularly important for the SME sector, as it has been regarded as a vehicle to improve economic performance, including job creation and economic growth. In the ambit of the discourse, SMEs can focus on different types of innovation which can lead to competitiveness. The different types are broadly classified into the following: product innovations, when products are improved or new ones developed, and process innovations, where production, distribution methods, delivery channels, or supply chain configurations become more efficient.

Key Dimensions of Technological Intensity in SMEs

Technology Adoption: The extent to which an SME has adopted and integrated advanced technologies into its operations. This can include areas such as production processes, customer relationship management, supply chain management, and marketing.

Technology Sophistication: The complexity and level of advancement of the technologies used by an SME. This can range from basic computer systems to sophisticated automation and artificial intelligence tools.

Technology Investment: The amount of resources an SME allocates to technology acquisition, development, and maintenance. This includes both capital expenditures and operational costs.

Technology Integration: The degree to which an SME has successfully integrated technology into its overall business strategy and operations. This involves aligning technology with business goals, ensuring compatibility with existing systems, and effectively utilizing technological capabilities.

Factors Influencing Technological Intensity in SMEs

Industry Characteristics: The specific industry in which an SME operates can significantly influence its technological intensity. Industries characterized by rapid technological change, high levels of competition, or complex production processes often require higher levels of technological sophistication.

Business Strategy: An SME's business strategy can also impact its technological intensity. Firms that focus on innovation, differentiation, or cost leadership may be more likely to invest in advanced technologies.

Resource Availability: The availability of financial resources, human capital, and technological infrastructure can constrain or enable an SME's ability to adopt and utilize advanced technologies.

Government Policies: Government policies, such as tax incentives, research and development funding, and regulatory frameworks, can play a crucial role in shaping the technological intensity of SMEs.

Implications of Technological Intensity for SMEs

Competitive Advantage: SMEs with higher levels of technological intensity can gain a competitive advantage by improving their efficiency, productivity, and product quality.

Market Access: Advanced technologies can enable SMEs to enter new markets, reach a wider customer base, and enhance their export potential.

Risk Management: Technology can help SMEs to mitigate risks, improve decision-making, and enhance their resilience to market fluctuations.

Innovation: A higher level of technological intensity can foster innovation and creativity within an SME, leading to the development of new products, services, or business models.

Nigeria's SME Landscape

SMEs have become a potential lever of development in many countries. To date, the debate on the role of SMEs has been involved in their role in national economies in either developed countries such as the USA and the United Kingdom; on the other hand, they are seen as micro-enterprises which may be registered or unregistered engaged with self-employed activity. Their activities in both the formal and informal sectors are varied. SMEs refer to those legal entities (i.e. sole proprietorship, partnerships, companies, or associations) that meet the following criteria: have owners, either managers or other officers, with a principal within the country in which the entity is recorded, providing they did not have a permanent address in another country, and did not engage in an activity, nor maintain any facilities in another country nor engage in any transaction in the other country, outside of those required to operate the entity.

The features and demography of Nigeria's SME landscape have been empirically tracked from numerous studies. The importance of SMEs as a pillar in the development of the Nigerian economy, if any, is difficult to overemphasize. Small and medium-scale enterprises are mainly micro, small, and medium enterprises (MSMEs), though the term SMEs as used in Nigeria encompasses companies in the manufacturing, trade, and service sectors which employ not more than two hundred (200) people and have an annual turnover of not more than two million naira (2,000,000) in the case of retailing, in the case of a trading business, and not more than ten million naira (10,000,000) in the case of mechanical trading.

Overview of SMEs in Nigeria

Small and medium-scaled hot, moderate hot, medium-hot, medium-hot, et al. All experts and business development are of the opinion that they have significant importance in economic growth and development processes. SMEs undertake a variety of enterprises, such as thrift contribution, flexible technologies, skills acquisition, employment generation, and introduction of indigenous entrepreneurial cultures and traditions, transforming the operation of difficult employment, modernize and institutionalize the informal sector by giving birth and diversification through the generation of new business enterprises.

Small and medium-sized enterprises (SMEs) are referred to as the lifeblood of industrial economies. They are the spur and boost for sustainable development in any country. Therefore, the role of small and medium-scale enterprises (SMEs) in the development of the Nigerian economy cannot be undermined. The contribution of SMEs in expanding the productive base and uplifting the economy cannot be neglected. SMEs are often seen as the agents of economic development and they generate employment, engage in value addition, and generate other economic and social activities to uplift the economy. As such, this paper investigates the concept of SMEs, the overview of small and medium-scale enterprises in Nigeria, the challenges facing SMEs in Nigeria, and the prospects of SMEs in the Nigerian economy.

Challenges Faced by Nigerian SMEs

It is generally believed that SMEs, if developed, will drive economic development through industrialization and value-adding processes. They help in the development of local technology or know-how in Nigeria and promote entrepreneurship. They can do this by not being just at the bottom of the value chain in areas like education, agriculture, and manufacturing, but can take their place in value addition in the manufacturing, telecommunications, and oil and gas sectors. It is believed that SMEs can add more value and more jobs can open up. This would create sustainable value for the economy. They also provide a solution to employment deficits. For instance, if a value-adding packaging industry

is set up, this can be linked to the food and beverage industry, which buys its raw material primarily from the agriculture sector. It provides a link for aggregation and increases value that is distributed among the various players. Small and growing businesses also provide investment opportunities for the populace. Small businesses generally multiply job opportunities and increase self-employment. This provides support for the sustainability of any investment.

In Nigeria, about 95 percent of registered businesses are classified as small businesses, employing about 72 percent of Nigeria's workforce, which consists of its adult population, and contribute about 40 percent to the country's Gross Domestic Product (GDP).

Small and medium-sized enterprises in Nigeria are faced with a myriad of challenges. Whereas the benefits of small business are clearly stated by the government, SMEs find it difficult to operate in the environment introduced by their policies. The cost of doing business in Nigeria is high and inherently favors multinational corporations, making market entry even more challenging. Some of these challenges include lack of funds, infrastructural deficiencies, lack of skilled workers, complex business registration processes, lack of business management skills, poor business and road infrastructure, difficulties in selling products abroad, access to markets, and lack of technology.

Access to Finance

The interest rates should be at a level that would enable both the small and medium enterprises to get access to funds and still make reasonable profit on commencement. This would enable them to pay back the loan without much stress and it would also make for more productive use of the loan. The rate of interest on the facility will depend on various factors, which include the level of risk involved in the type of activity; the term and the special nature of the national economic and social development objectives such as employment creation and increase in export capacity. Such loan could be used to buy factory machinery, equipment, vehicles and lease owner-occupied real estate. It could also be used as "did-wait-pay-interval and the take-or-pay principles" and the financing of material suppliers to the SMEs after receipt of performance bond. There are also opportunities for the financial institutions in loan-making to SMEs. These include: shortening the processing period of micro-loans to OUVK companies each costing 100,000 naira with 30 days with reduced interest rate and the proper organization of loan products marketing to the quality small-sized companies.

Financial institutions like banks, etc., in addition to designing specific financial instruments, should increase their patronage to small and medium enterprises in the zone. Although some government financial institutions and the World Bank support some SMEs in Nigeria, much more would be gained through scaling up the efforts of the institutions on credit and specifically tailored down investments to individual needs. Incessant demand for good governance and stability of the financial institutions were usually emphasized during the consultations conducted. This is to ensure that the small and medium enterprises do not suffer adverse consequences of sudden collapse of the banks and other financial institutions. The availability of credit from financial institutions enables growth, development, and viability of the small and medium enterprises. The clause of speed in which the proposal and application to be processed and approved must be highlighted.

Role of Government in Promoting SME Innovation

It is a well-established fact that for SMEs to be innovative and saturate the implicit and explicit benefits, government intervention is imperative. In response, government and public sector agencies often develop an extensive range of policies, initiatives, and programs to

encourage SMEs to access and utilize innovation opportunities. It is in contrast to the argument that SMEs often experience a diverse range of difficulties and obstacles in their efforts to innovate and that these problems may either be fundamentally different from those facing larger firms. They may also be far more acute for SMEs. The obstacles and difficulties that SMEs encounter often have their origins in their size and the specific structural characteristics that this gives rise to, such as a more limited resource base, greater risk sensitivity, and higher costs of external finance, as well as general risk aversion. Consequently, SMEs rarely generate enough finance from internal resources to fund high-risk innovative projects, and this may restrict their capacity and ability to exploit innovation opportunities to the full.

For SMEs to be innovative, provide adequate finance, thrive, and contribute effectively to national economic development, policies are needed in place to address the specific needs and problems of such sectors. National governments can apply different approaches to support SME innovation processes. Small firms are important and foster economic growth and design SME policies to support their innovation processes. Although small firms account for a relatively small share of employment, they contribute disproportionately to economic and particularly to private sector employment growth. SMEs are innovative in projects that increase public sector productivity, reduce costs, and create a competitive advantage.

Global Best Practices in SME Innovation

Over the years, the promotion of small and medium-sized enterprises (SMEs) has been at the heart of industrial strategies in developing countries such as Australia, Denmark, Malaysia, Japan, Italy, Ireland, New Zealand, Canada, Republic of South Korea, People's Republic of China, United States, and Singapore. These countries are also some of the most successful countries not only in the growth of their internal economies but in the innovations and technology that have made them prominent economic players in the global world. Tradition and theory suggest that fostering and expanding the role and scale of SMEs contribute, directly and indirectly, to economic growth, industrial development, and perhaps even social equity. The positive contributions of SMEs are manifested in creating significant employment opportunities, encouraging technological innovation, massive distribution of income, revival of standardized products manufacturing, labor-intensive operations, territorial wealth, and diversified risks in economic downturns.

In delivering sustainable and robust economic growth, it is necessary to promote and foster small and medium-sized businesses. To do this, SME innovation is critical in driving economic recovery and sustainable long-term growth, since innovation is a process that creates an increase in the output of goods and services. For developing economies like Nigeria, it may be necessary for the country to look to experience other countries that have successfully sustained their economic development to date. A major policy instrument used to stimulate industrial innovation in developing economies for the above objective is the promotion of small and medium enterprises (SMEs). Learning from them may provide a credible valuable lesson for both developed and developing countries. The objective of this paper is to discuss how SME innovativeness has been encouraged and supported in selected countries, recognizing that the success factors could be influenced substantially by the innovation environment in such countries.

Technological Advancements and SMEs

The paper explores issues of the internationalization of Nigerian SMEs in the last two decades and its relative simplicity compared to adopting technological advancements. Since the turn of this century, businesses have witnessed crucial transformations, whose common

denominator is the rapid pace of technological innovation. The world of 2025 and beyond will undoubtedly bring in a multitude of so far unseen, unheard revolutions in disease management, political systems, energy supplies, food security, and environmental services. This means that the world needs to prepare for the impacts of a myriad of brand new technologies, many of which will change the world as we know it. Examples include advanced biotechnologies, advanced materials, advanced manufacturing, artificial intelligence, machine learning, big data analytics, blockchain, cryptocurrencies, data analytics, drones, e-commerce, fintech, geothermal, horizontal and directional drilling technology, internet of things, nanotechnology, next-generation methane-powered vehicles, next-generation sequencing, robotics, and solar power among others. The applications of these technologies are extensive and cover many areas, including emerging methods of software testing and assurance, data-driven healthcare projects, expressions of the Internet of Things (IoT) phenomenon, blockchain payment systems and related services, drones, and robotic technologies, digital agriculture, data analytics with machine learning capabilities and cloud computing as well as Artificial Intelligence technologies.

The world has been transformed significantly by technological innovations, but despite several benefits accruable from the breakthrough, small and medium-sized firms tend to have a matter of concern when it comes to adopting these technologies. The silent cries of the SMEs about these technologies revolve around its cost, and as such, they almost never adopt them until their existence is threatened. Paradoxically, despite the overwhelming innovations leading to reduced computer and portable device prices, SMEs in Nigeria and many places, especially the first-time adopters still find adopting the technologies a quadruple helix viz: unaffordable, complex, incompetent, and assessing vendor problems. Delays in adopting these technologies lead to a higher cost burden for the first-time adopters than for subsequent users. The further accumulation of these problems compound that of internationalization resulting in a low ratio of Nigerian SME participation.

Collaborations and Partnerships for SME Innovation

Therefore, to understand how small and medium-sized enterprises cope with managing their innovation, the paper draws its attention to two dimensions of coping with innovation: the mode of capital involvement in innovation (especially how SMEs internalize their innovativeness) and the requirement of fickleness attached to managing knowledge-based and/or learning-based business. SMEs internalize their innovativeness either through collaborative networking or through staying within their protected indigenous boundaries of previously learned knowledge or know-how. The lack of involvement and requirement of fickleness render the creation of knowledge-based and learning-based business a daunting and uneconomical business task. Nevertheless, both modes of capital involvement as well as managing the need of fickleness have their place in the modern innovative business, which needs flexible, efficient, and quick responses to innovation change.

Important to the collaboration and partnership approach to innovation, we highlight the concepts of managing partnerships for effective innovation: the five key activities of maintaining, aligning, controlling, information sharing, and contract drafting. These seem to encompass the performance of innovation partnership of any level of formality and innovation of any scope. The depth, speed, and direction of linkages in an integrated approach is no other than the necessary rethinking, redesigning, and reshaping of relations that constitute different partnership forms, levels, and innovation strategies. Such an understanding can be translated into the choice of planned and deliberate innovation actions that signal the move from nice-sounding rhetoric about global, networked, or entrepreneurial

SMEs to the harsh reality of SME with real sustainable opportunities in today's and tomorrow's markets.

. Digital Transformation in Nigerian SMEs

The application of digital technologies is the catalyst of innovation as it enhances capacities for new multi-technological innovations, products, and services. Digital transformation can also be developmental, value-producing, and generative. Economies are now concentrating more on innovative aspects based on knowledge resources and intellectual property, and knowledge is decentralized and multi-spatial. It is a consequence of transformation, as all economic and societal mechanisms undergo digital processes. Such processes result in the formation of multi-spatial innovative or cognitive territories and more so in the development of small and medium-sized enterprises (SMEs).

The general concept of digital transformation (DT) is concerned with the reshaping and redesigning of corporate structures and systems using digital technologies. The spread, diffusion, and rapid development of digital technology have made the topic of DT one of the most discussed and researched topics in the world. The innovative explosion of digital transformation is bringing radical changes to every aspect of our working life as well as private lives. This is expected to drastically change the manufacturing sector, which is now experiencing an intensive flow of high-tech generated data. However, practices in developing countries like Nigeria are rather limited due to the relative immature institutional environment and shortage of information.

Theoretical Framework

Linear Model of Innovation

The Linear Model of Innovation was an early model designed to understand the relationship of science and technology that begins with basic research that flows into applied research, development and diffusion (Godin 2006). It posits scientific research as the basis of innovation which eventually leads to economic growth.(Rogers 2003). The model has been criticized by many scholars over decades of years. The majority of the criticisms pointed out its crudeness and limitations in capturing the sources, process, and effects of innovation (Rogers, 2003). However, it has also been argued that the linear model was simply a creation by academics, debated heavily in academia, but was never believed in practice (Rogers, 2003). The model is more fittingly used as a basis to understand more nuanced alternative models. Two versions of the linear model of innovation are often presented:

"technology push" model (Rogers, 2003).

"market pull" model (Rogers, 2003).

From the 1950s to the Mid-1960s, the industrial innovation process was generally perceived as a linear progression from scientific discovery, through technological development in firms, to the marketplace (Rogers, 2003). The stages of the "Technology Push" model are:

→Design and engineering→Manufacturing→Marketing→Sales

From the Mid 1960s to the Early 1970s, emerges the second-generation Innovation model, referred to as the "market pull" model of innovation. .(Rogers 2003). According to this simple sequential model, the market was the source of new ideas for directing R&D, which had a reactive role in the process. The stages of the "market pull" model are:

Market need—Development—Manufacturing—Sales

The linear models of innovation supported numerous criticisms concerning the linearity of the models. These models ignore the many feedbacks and loops that occur between the different "stages" of the process. Shortcomings and failures that occur at various stages may lead to a reconsideration of earlier steps and this may result in an innovation. A history of the linear model of innovation may be found in Benoît Godin's *The Linear Model of Innovation: The Historical Construction of an Analytical Framework*. (Godin 2006). A critical look at the origin of the terminology and how it may have a dubious history can be found in David Edgerton's 'The linear model' did not exist: Reflections on the history and historiography of science and research in industry in the twentieth century. (Rogers 2003).

Theories of technological change and innovation attempt to explain the factors that shape technological innovation as well as the impact of technology on society and culture. Some of the most contemporary theories of technological change reject two of the previous views: the linear model of technological innovation and other, the technological determinism. To challenge the linear model, some of today's theories of technological change and innovation point to the history of technology, where they find evidence that technological innovation often gives rise to new scientific fields, and emphasizes the important role that social networks and cultural values play in creating and shaping technological artifacts. To challenge the so-called "technological determinism", today's theories of technological change emphasize the scope of the need of technical choice, which they find to be greater than most laypeople can realize; as scientists in philosophy of science, and further science and technology often like to say about this "It could have been different." For this reason, theorists who take these positions often argue that a greater public involvement in technological decision-making is desired.

Empirical Review

In many developed and developing countries, the SMEs account for between 60-70% of the workforce, and in some economies, they contribute over 90% to workplace employment. Much of this development is made possible by the proactive roles that SMEs have played in relation to innovation capability. Consequently, innovation and the capacity to become innovation-driven is now viewed as critical for the survival and growth of businesses.

Carvalho & De Siqueira, (2005) stated that SMEs are not just a key driver of economic growth, but they also play a key role in meeting current challenges, such as climate change, resource scarcity, and worldwide poverty. Thus, although innovation has become more widely recognized, the challenges inherent in expanding and sustaining innovation activities within the SMEs in developing and developing economies have received less attention. The current business setting characterized by environmental changes, new requirements, technological development, and new opportunities pushes SMEs to rethink their traditional production methods and introduce new technologies to remain competitive over time (Paoloni et al. 2022; Priyono et al. 2020). However, introducing a new technology is challenging for SMEs with limited access to external knowledge, unclear innovation strategies (Müller et al. 2021), and scarce time and resources for innovation (Bouwman et al. 2019). Indeed, studies have shown that SMEs struggle to exploit and benefit from new technologies (O'Toole 2003; Nguyen et al. 2015).

Studies such as (Baird et al. 2017) & (Alojaiiri et al. 2019) highlights the need for technology assimilation for SMEs to benefit from new technology. They concluded that technology assimilation is needed for efficient technology use.

Similarly, Baird et al. 2017 opined that much is required to exploit the opportunities offered by the technology.

Alojaiiri et al. 2019 stated that as technology per se is not enough to provide value for companies. In fact, technology assimilation I are not independent of each other, but they interact when introducing new technology, and their interconnectedness is crucial for performance.

Smajlović et al. 2019, However, stated that although the complementarity between technology assimilation and advancement for exploiting new technology is acknowledged by previous studies (Chesbrough 2007; Baden-Fuller and Haefliger, 2013), little attention has been devoted to connecting these two concepts (Smajlović et al., 2019), especially in the context of introducing technology (Sabatini et al., 2022). To conceptually express the organization's transformation due to the introduction of technology (including technology assimilation and BMI), we denominate it as technological transformation.

Technological transformation as a research field is fragmented and lacks explicit academic attention, especially in the SMEs' context: existing literature reviews focus on the separate streams of technology assimilation (e.g. Ahmad and Siraj, 2018) and (Hidayat et al. 2020). Moreover, studies within this context focus on aspects of technology assimilation, such as factors or business model configurations (Groot et al. 2019); or case studies on specific technologies (Priyono et al. 2020), which limits the generalizability of their results. Even the individual streams of (Pucihar et al. 2019; Gatautis et al. 2019) and technology assimilation (Ahmad and Siraj, 2018) are not well explored in the SMEs' context.

The role of small and medium-sized enterprises (SMEs) in innovation and economic development is seen in the promotion of competition and entrepreneurship, and they are key for job creation and poverty alleviation. They have been the engine of growth of every economy, generating sustainable development in many countries. The globalized world has brought economies that have seen the resurgence of the SMEs sector. It is often argued that in this new world of globalization, the SMEs face enormous challenges, especially in their ability to innovate and take advantage of the unparalleled opportunities thrown up by globalization. The purpose of this study is to explore the propensity of the SMEs in Nigeria to engage in innovation and address the deficiency in innovation literature on this important growth sector.

Methodology

SMEDAN and NBS are contributing to policy explanations by classifying and characterizing active staff throughout Nigeria. It was calculated firm Character Olympic medal counts and it was charted "Firm characteristics that appear to significantly elevate the probability of converting constructs to the innovation category. In addition, "SME-rhythm" path was charted and "Hobbyist" path was ciphered. Lastly, the Incubator's "Million-Dollar Homepage" was depicted and associate immigrants were bar-charted. Data on SMEs operative service less acquired from SMEDAN with a grim calendar was then sectioned. Consequently, NBS evaluations of the proportions of banking SMEs were obtained and formulated and the norms of productivity were sketched.

This research will seek to investigate small and medium-sized enterprises' innovation in Nigeria from 2020 to 2023. The purpose of this study will rely on a mixed-methods framework using the survey design, which is feasible and rational. Researchers who will adopt either a qualitative or a quantitative technique should also choose cross-sectional or longitudinal survey designs that include the repetitive intelligence of several observations made in the present study. Correspondingly, this will provide an examination that gives an impression into how small and medium-sized enterprises (SMEs) expand and boost their distinctive radical innovativeness connected with survival and success in a globalized era.

Data Collection and Analysis Methods

Data analysis: The most crucial part of a research lies in the analysis of the research information. Data were analyzed by identifying and listing out primary themes, as provided by the participants, based on their perceptions and experiences of the innovation phenomenon in different firms.

Questionnaire was developed through an extensive review of extant literature, piloted among the selected employees and managers with emphasis on simplicity of language, coherence of statements, appropriateness of questions, and an understanding of the research objectives. The population of the study was drawn from the 2017 National Survey of MSMEs which covered enterprises in Nigeria employing below 200 persons (i.e. micro, small and medium enterprises - MSMEs), and was conducted in all the 36 States of the Federation and FCT. The total number of MSMEs as at December, 2017 stood at 41,543,028, with components as follows, viz: micro enterprises - MEs: 41, 469,947 (or 99.8 percent), small and medium enterprises - SMEs: 73,081 (or 0.2 percent). A sample size of 384 was determined using the Cochran formula for analysis. In order to reduce any bias that might result from surveying members of the private sector, government sector, or the telecommunication sector, improper weighting was used. Also, proportional allocations were used in selecting a given firm based on the total estimate in a sector in each LGA. The proportion of direct investment found in the different LGAs was used to develop a model for each LGA for each sector of the economy. On average, one randomly selected SME was used to represent the sector of each of the sixteen LGAs in the state.

Model Specification

The model put forward in this study is as follows:

$$y=f(x)$$

$$y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \epsilon$$

Where

y= new product introduction

x= x₁,x₂= technological intensity

x₁= technological adoption (The extent to which an SME has adopted and integrated advanced technologies into its operations)

x₂= technological sophistication (The complexity and level of advancement of the technologies used by an SME).

Research Hypotheses

Hypothesis one

There is no correlation between technological adoption and new product introduction by SMEs in Edo State.

Hypothesis two

There is no correlation between technological sophistication adoption and new product introduction by SMEs in Edo State.

Correlations

		Technological adoption	Technological sophistication	New product introduction
Technological adoption	Pearson Correlation	1	.404**	.474**
	Sig. (2-tailed)		.000	.000
	N	273	273	273
Technological sophistication	Pearson Correlation	.404**	1	.463**
	Sig. (2-tailed)	.000		.000
	N	273	273	273
New product introduction	Pearson Correlation	.474**	.463**	1
	Sig. (2-tailed)	.000	.000	
	N	273	273	273

** . Correlation is significant at the 0.01 level (2-tailed).

The analysis of the hypotheses regarding the correlation between technological adoption, technological sophistication, and new product introduction by SMEs in Edo State reveals significant insights.

Hypothesis one

For the first hypothesis, which posited that there is no correlation between technological adoption and new product introduction, the results demonstrated a Pearson correlation coefficient of 0.474. This indicates a moderate positive correlation between the two variables. Moreover, the significance level was found to be 0.000, which is less than the 0.01 threshold. As a result, the study rejected the null hypothesis, concluding that there is indeed a significant positive correlation between technological adoption and new product introduction among SMEs in Edo State.

This aligns with the literature that emphasizes the crucial role of innovation capability in driving the growth and survival of SMEs. As Carvalho and De Siqueira (2005) noted, SMEs are not only key drivers of economic growth but also vital in addressing contemporary challenges, including resource scarcity and climate change. The capacity to innovate is increasingly recognized as essential for SMEs to thrive in an evolving business landscape.

In the context of the challenges SMEs face in adopting new technologies—such as limited access to external knowledge and unclear innovation strategies (Müller et al., 2021)—the positive correlation found in this study suggests that those SMEs that effectively adopt new technologies are more likely to introduce new products. This finding reflects the necessity for SMEs to rethink traditional production methods and embrace new technologies, as highlighted by Paoloni et al. (2022) and Priyono et al. (2020). The study underscores the importance of facilitating technological adoption, as it can lead to increased innovation and product development, ultimately enhancing competitiveness in the market.

Hypothesis two

Similarly, the second hypothesis, which claimed no correlation between technological sophistication adoption and new product introduction, also yielded compelling findings. The Pearson correlation coefficient for this relationship was 0.463, again suggesting a moderate positive correlation. The significance level was 0.000, further supporting the statistical relevance of the correlation. Therefore, the study rejected the null hypothesis for this hypothesis as well, affirming that there is a significant positive correlation between technological sophistication adoption and new product introduction.

The result supports the notion that simply having access to technology is not sufficient for creating value; rather, the assimilation of technology is crucial. Alojairi et al. (2019) emphasized that technology per se does not provide value without effective assimilation strategies, and Baird et al. (2017) reiterated the need for SMEs to exploit technological opportunities fully.

In summary, both hypotheses were rejected, indicating that technological adoption and sophistication are crucial factors that significantly influence the capacity of SMEs in Edo State to introduce new products. These findings underscore the importance of promoting technology adoption and sophistication within the SME sector, as they can enhance innovation and facilitate product development.

Conclusion

The findings of this study carry significant practical and theoretical implications for Small and Medium Enterprises (SMEs) and the broader field of innovation research. Practically, the substantial positive correlation between technological adoption and new product introduction underscores the necessity for SMEs to enhance their technological capabilities. This involves investing in training programs that equip employees with the skills needed to leverage new technologies for innovation. Supportive policies from policymakers, such as financial assistance, grants, or tax incentives aimed at fostering technology adoption and research and development, are crucial for lowering barriers and empowering SMEs to engage in innovative activities that contribute to economic growth.

Moreover, fostering partnerships and networks between SMEs, research institutions, and larger enterprises is essential for facilitating knowledge transfer and resource sharing. Developing comprehensive technology assimilation strategies that encompass both the acquisition of advanced technologies and the necessary training for effective utilization will better position SMEs for new product introduction. Awareness and education campaigns can also demystify technological processes and encourage SMEs to embrace innovation in addressing challenges like climate change and resource scarcity.

Theoretically, the study contributes to the discourse on innovation models by challenging the limitations of the linear model of innovation. It highlights the critical roles of technological adoption and sophistication in new product introduction, suggesting a more dynamic understanding of the innovation process that emphasizes feedback loops and iterative development. This research aligns with contemporary theories of technological change, which stress the social and cultural contexts of innovation and encourage exploration of how organizational dynamics and external environments shape technological advancements.

Furthermore, this study enriches the literature on SMEs by providing empirical evidence linking technological adoption and sophistication with new product introduction, reinforcing the argument for investing in SMEs as vital catalysts for economic development. By emphasizing the need for effective assimilation strategies alongside technological adoption, the findings challenge the notion of technological determinism, illustrating that organizational choices in adopting and assimilating technology significantly influence innovative outcomes.

The analysis confirms the importance of both technological adoption and sophistication in facilitating new product introduction within SMEs in Edo State, aligning with the broader literature on the role of innovation in SME growth. Fostering an environment conducive to technological transformation is vital for SMEs to remain competitive and innovative amid evolving market demands. Stakeholders should prioritize strategies that enhance both technological adoption and sophistication to drive innovation and growth within the SME sector. Given the interconnectedness of technology assimilation and sophistication, these factors are essential for enhancing performance, particularly for SMEs in Edo State, where limited resources and unclear innovation strategies can hinder effective technology implementation. The findings suggest that SMEs successfully adopting and assimilating sophisticated technologies are better positioned to introduce new products, echoing the views of Smajlović et al. (2019) on the importance of addressing technology assimilation and advancement cohesively.

Recommendations

To enhance technological adoption and sophistication within SMEs in Edo State, several recommendations can be made. First, there should be initiatives to improve access to advanced technologies, including subsidies and partnerships with technology providers. Additionally, training and capacity-building programs focused on innovation management would equip SME owners and employees with essential skills. Government support is crucial, advocating for policies that encourage technology integration, such as tax incentives for adopting new technologies. Fostering collaboration among SMEs, research institutions, and technology providers can facilitate knowledge sharing and best practices. Lastly, encouraging SMEs to develop clear innovation strategies that align with market demands will ensure effective technology adoption.

This study contributes to the literature by providing empirical evidence of the significance of technological adoption and sophistication in enhancing product introduction within SMEs in Edo State, thereby adding depth to the existing understanding of innovation in emerging markets. It proposes a framework linking technology assimilation and sophistication, underscoring their importance in improving SME performance. However, the study does have limitations, including its geographic focus on Edo State, which may restrict the generalizability of the findings to other regions. The limited sample size and reliance on self-reported data may introduce bias, affecting the robustness of the conclusions. Additionally,

the temporal context of the study could influence the relevance of the findings as technology and market conditions evolve.

Future research should aim for a broader geographic scope by conducting similar studies in other regions or countries to compare findings and assess the impact of different contexts on technological adoption. Longitudinal studies could provide insights into changes in technology adoption and innovation performance over time. Qualitative research methods might yield deeper insights into the experiences of SME owners regarding technology adoption. Additionally, exploring the impact of specific technologies on SME performance would help identify targeted strategies for integration. Finally, investigating the perspectives of various stakeholders, including government agencies and technology providers, can lead to comprehensive strategies for supporting technological advancement within SMEs.

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