



Technology and Product Innovation in Manufacturing Companies in Nigeria

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Abstract

The study examined the impact of technology and product innovation in manufacturing companies in Nigeria. The objective of the study is to ascertain the impact of technology on product innovation and customer satisfaction, and the impact of product innovation on competitive advantage and profitability. The study adopted the survey type of research design, where questionnaires are administered to respondents. The population of the study comprised of twenty-three (23) manufacturing companies that are into consumer goods listed on the Nigeria Stock Exchange, each company was used as a unit of analysis. Purposive sampling was used to select eighteen (18) manufacturing companies which were used as the sample size. In each company, questionnaires were administered to the managers and production managers to get their view on the subject matter, making it thirty-six (36) copies of questionnaires administered and thirty-one (31) were retrieved and used for analysis. Simple regression was used to test the formulated hypotheses in line with the objectives of the study and the result revealed that technology impacted positively on product innovation and customer satisfaction, while product innovation impacted positively on competitive advantage and profitability in manufacturing companies in Nigeria. The study concluded that technology and product innovation had positively impacted manufacturing companies in Nigeria. This connotes that sustainable product innovation and development cannot be attainable without the driving forces of technology. The face of production and operational processes have changed over time in manufacturing companies due to the effect of dramatic changes in technology. The study recommended that manufacturing companies should set up Competitive Intelligence (CI) and Strategic Intelligence (SI) to attract every new technology invention in their product innovation from the competitive market environment to attain sustainable business performance.

Keywords: Competitive Advantage, Customer Satisfaction, Product Innovation, Profitability and Technology

Introduction

In today's business environmental context, technology is an outstanding and dramatic variable that changes periodically and affects the interest in solving the problem of humanity. The incremental value of technology cannot be overemphasized in our society now and in the future. The current trend of technology has added value to new and existing product development, the core value of products and services in terms of the qualities, users and usage. In the current turbulent markets, the



firms that are successful and sustainable are those that adopt modern technology in driving product and services design innovation (Coccia, 2017; Aibar-Guzman, Garc ía-Sanchezb, Aibar-Guzman & Hussain, 2022; Kaplinsky & Kraemer-Mbula, 2022; Afrifa, Amankwah-Amoah, Yamoah et al. 2022; Agarwal, & Gaule, 2021). Afrifa, et al. (2022) and Agarwal & Gaule, (2021) opined that technology and technologies are the strengths that have helped to drive innovation and improvement in research and development during the Covid-19 pandemic. Most manufacturing companies that are into processing and production were sustainable and profitable in their operation and are at competitive war due to their continuous alignment with new technology and help to attain a competitive edge as a result of their alignment with the dramatic change in technology and its complexity.

Technology and product innovation are vital in the modern digital business environment for manufacturing companies in Nigeria to attain sustainable strategic marketing management and competitive advantages. Many manufacturing companies in Nigeria are structuring their production plans in alignment with the modern technology to meet up with the current marketing and competitive environment and they are counting on sustainability and profitability in their operation while many other manufacturing companies have failed due to failure in the application of technology driving forces with their strategic marketing management Kouhizadeh, Saberi, and Sarkis, (2020) assert that innovativeness can be driving sustainable and profitable with the strategic strengths of manufacturing companies to adopt new digital technologies. Therefore, this study intends to address the relevant issue of the impact of technological forces on product innovation in selected manufacturing companies in the production of consumer goods in Nigeria.

The continuous dramatic change and complexity of technology forces in the business setting both nationally and globally have created turbulent competitive global markets. Today manufacturing companies are pushing and searching harder to get dynamic sustainable technologies for their product innovation processes at a low and affordable cost for their target markets and end users in Nigeria to have long term sustainability in competitive markets. The bane of most business leaders/strategic thinkers in the rapidly changing technological deployment in manufacturing companies' products and the swiftness to adopt these changes have coursed a drop in some companies' market share and sales volume, which may edge out some companies in the modern market environment. In mobile phone companies, the average users focus and buy those mobile phones that have a sustainable battery life span and upgradeable android that can sustain fast browsing in Nigeria. Technology and product innovation favour the firms which act fast to changes to gain acceptability and positioning in the competitive target market. Another major challenge faced by most manufacturing companies is staying too long on a particular deployed technology on a product and services, and failure to attend to other factors that affect innovation processes. Many manufacturing companies in different industries have attained drastic changes in their business and corporate performances at sustainability and profitability in mixed of dramatic changes in technological forces and their swift adoption of their product innovation in recent years in Nigeria.

In recent years Nigeria's business settings, a high number of manufacturing firms do not actually budget and invest funds enormously to adopt and deploy modern and new technology either as a result of lack of finance or improper management structure and culture that may be rigid. This has led to long stay and low attraction to product innovation in many manufacturing companies in Nigeria and led the slow pace of new product development. In the nutshell, a long stay in business without product modification and modernization in the current harsh competitive markets can lead



a company to a decline stage of its business life cycle. Recent Global Innovation Index (GII) 2021 ranked Nigeria 118th when compared to 2020 which shows that Africa's biggest economy (Nigeria) was ranked 117th whereas others African states such as; South Africa (60), Kenya (86) and Mauritius (52) were above Nigeria ranking. GII report shows that South Africa, Kenya and Mauritius are brave three economies in terms of technology deployment and product innovativeness in Africa higher than Nigeria. Even measuring the level of product innovation deployment and development among the low-middle-income nations globally still shows that Nigeria is ranking 15nd globally which is just higher than Bangladesh, Nicaragua, and Zambia of the total 26 countries measured globally (GII, 2020). It is on this premise that this study, therefore, intends to examine the causal relationship and the contributing impact between technological growth and product innovation in manufacturing companies in Nigeria.

The following research questions guide the study: In what ways do technological changes enhance product innovation in manufacturing companies in Nigeria? What is the effect of product innovation on the competitive advantage of manufacturing companies in Nigeria? To what extent has product innovation contributed to the profitability of manufacturing companies in Nigeria? And how does technology impact customer satisfaction in manufacturing companies of Nigeria? Based on the objectives of the study and the research questions of this study, the following null hypotheses were formulated as follows:

H01: Technological changes do not have a significant impact on product innovation in manufacturing companies in Nigeria.

H02: Product innovation does not have a significant impact on the competitive advantage of manufacturing companies in Nigeria

H03: Product innovation does not contribute significantly to the profitability of manufacturing companies in Nigeria.

H04: Technology does not have a significant impact on customer satisfaction in manufacturing companies in Nigeria.

Literature Review

Market segmentation, target market and product positioning of products and services for the target customers were effective and sustainable for strategic marketing thinkers of various manufacturing companies due to the alignment of technology in those organizations. Vaccaro, Jansen, Bosch, and Volberda (2012), were of the assertion that competition has pushed manufacturing companies toward technological changes and firms need to renew their internal structures. However, the corporate images of manufacturing companies can be sustainable from the continuous marriage of the organizations with technological driving forces, because it is the driving and dramatic force that changes the shape of every business model in modern business settings to attain long term sustainable business growth and performance. Technology advancement is very vital in new product development stages and product innovation because it helps organizations' products and services to be successful in the full commercialization stage and also facilitates a new product model. In the modern business model and intelligence, technology has become a variable tool for various levels of management to adopt and apply in their strategic formulation to the implementation stage in terms of product design and redesign to suit the interest of the target market segment and the end users.



Technology adaptation in the modern business model will pave way for companies' sustainability and profitability in the operations. From the above discussions, technology can be viewed as the radical and dramatic business operational enhancer to sustainability and profitability in every dynamic and competitive business context. It is the root of sustainable change in the organization and management of business settings. Technology also is the bedrock for business organizations' survival in the modern digital business environment.

Product innovation in manufacturing companies can survive and is attainable from the roots of the technological driving force in modern business settings. Product innovation is vital for the survival of firms in the modern digital business world, because, product positioning and market acceptance can be viewed by consumers from the perspective of those companies whose products are technological perceptible in the competitive marketing environment. In the nutshell, innovation is a brand that creates a lasting brand, because modifying a product through technological means brings out a new brand that has an effect to change behaviours' of the consumers. In the case of mobile phone manufacturing companies in Nigeria, the various users are attracted to purchase those mobile phones that have a long life battery life span, fast browsing, quality pictures, and other viable features on them which are driven from the impact of technological forces. The firms' products need periodic innovation to gain continuous acceptance in the modern digital business setting and the key instrument for its innovation in technology. Innovation is the process of adding more value to existing products in terms of quality and usage value. In the area of product innovation, technology forces are useful in the modification and differentiation of the core value of the product to enhance the users and usage rate, the branding, the packaging and the labelling. Product innovation can be described as the modification, differentiation and redesigning of an existing company's product in terms of its features and attributes to meet the changing needs of the target markets through technological means. Duygu, Wever and Brezet (2020) opined that product innovation strategic adaption and implementation in modern marketing and manufacturing companies bring creative changes in operational performance and market sustainability.

Concept of Technology in Business Environment

Modern technological growth attracts demand from the global market environment in the modern digital business setting and in every organization. No productive sectors or industries in the world today can survive and sustain the global changing market demand without the deployment of technology. Technology is the pillar that holds the growth of many industries in Nigeria and another part of the world. Modern technological growth is an essential part of any business or manufacturing organization that they need to align with their corporate and strategic plans. The theme (that technology is the best option for environmental performance and sustainability) is favoured by many recent studies (Dana, Salamzadeh, Mortazavi & Hadizadeh, 2022; Tsao, Mukherjee, and Ray, 2022; Fadda, Sanna, Sakar, et al. 2022; Hervas-Oliver, et al., 2018). Technological growth has an impact, on technical growth, production growth, administrative growth, creative and radical growth and sales growth in the organizations. In the nutshell, technological growth runs the entire organizational activities because it has pave the ways for creativity and innovation in organizations and is a sustainable source of competitive advantage. Modern technology is a very vital tool in product development processes as an indicator of the impact of IT on product development performance (Nambisan, 2013). Tsao, et al. (2022) opined that technology leaders and followers are driving innovative investment in modern manufacturing companies. Tsao, et al. (2022) concluded that



modern business leaders and innovators are changing faces of competitiveness and service to humanity with the advancement in technology. Kaplinsky and Kraemer-Mbula (2022) assert that the advancement in innovation and improvement in organizational productivity and performance is a result of advancement in technology. That is, from their perspectives, technology drive growth, diversification and expansion of innovation and productivity in modern organizations.

Consumers' behaviour towards a company's product or services in a target market can be monitored and evaluated with the effect of the technological deployment of the organization and its product and similarly, the application of modern technological growth is vital in new product development and in turn can enhance product development performance and sustainability. Technology is very important in the new product development stage especially at the prototype design stage, to have a successful commercialization stage and a sustainable product life cycle phases. Yoo, Henfridsson, and Lyytinen, (2010) suggest the consideration of a layered modular architecture for digital innovations and the technical and strategic dimensions that would likely shape a firm's decisions on such architectures. Yoo et al, (2010) believed that new technology is an instrument for a sustainable firm's decision-making process for digital innovation.

Modern technological growth has become vital tool to analyze and evaluate the vision and mission statement of organizations in modern business settings. The long term sustainability and performance of organizations can be viewed by the public from the perspective of technological growth. Abbas (2017) confirmed that technology increases the development of teaching methods and learners' knowledge. Studies from Murrey et al. (2020); Vita et al., (2020) and Liu et al., (2020) expressed that newer technological improvements in the business context tends to shape and reshape human learning skills and sustainable operational performance in manufacturing and other global business operational dealings. The above idealist believed that technological deployment in an organization enhances growth in knowledge and skills for sustainable creativity and innovation. Pourhosein and Lai-Mei (2012) asserted that modern technological growth has posited new strategies in the teaching and learning of language skills. Technologies are increasingly widespread, impacting many aspects of our social and work lives, and many of our leisure activities. Osterwalder and Pigneur, (2010) suggest that new technology is an important equipment to be incorporated into a company's product offering in order to attain superior effect in the competitive market. They viewed technology as an instrument that exposes value in a variety of product offers. Modern technological growth in totality with value chain in all facets of our human existence and the life span of business organizations and modern technology has an impact on their survival and sustainability. In Barley's (2015) view, cited by Wayne et al., (2016) it was suggested that digital technology is rapidly becoming as infrastructural as electricity, there is surprisingly little research on how it is altering work systems or the work that people do. From the above reviews, technology is a perceived intelligence system that modern manufacturing settings and business organizations need to adopt and adapt consistently to shape and reshape the operational behaviour in the interest of the current market behaviour to attain sustainability and profitability.

Concept of Product Innovation

Strategic growth of any modern manufacturing setting can be attainable and sustainable in its operational performance when operating on policies and strategies that back consistence product innovation and innovativeness. Dess et al., (2014) describe innovation as applying and adopting modern knowledge and skill to attain positive change in the structure of the product and service of



the manufacturing enterprise processes that involve the use of modern technology. The sustainability of business organizations relies on how frequently they vary with the changes that occur in the business environment. As the technology driving forces changes, it is very vital for strategic thinking organizations should modify the entire elements in the organization to make a sustainable ending. One key element in the organization is its products that need to change with the dramatic change in technology. Because strategic modification and modernization of continuous companies products will lead to sustainable profitability of the organization as the consumers' need also varies with modern technological changes. Torben (2021) viewed product innovation as an instrument to ensure equity share value in employment patterns and ways of improving strategic capabilities in manufacturing companies' operational dealings. Product innovation in organizations occurs as a result of frequent modernization in technology that corporate organizations need to tap into to attain and sustain long term growth.

To the views of Dougherty and Dunne, (2012); Fara et al., (2011), technological forces are the technical tool for organization innovativeness in terms of product and process. Product innovation involves the modification and modernization of existing products in a company to add more value to the quality, the brand, the package, the users and the usage. In totality, product innovation brings more value and quality to existing products to increase the customers' satisfaction and lead to an increase in the customers' base. Dess et al., (2014) assert that product innovation is the application of organizational competencies to create new products via modern technology for the teaming potential and existing customers and do occur at the introductory stage of the industrial life cycle. Muhammad et al., (2021) assert that product innovation from newer technological variables is a strategic tool to ensure sustainable operational management and boost the speedy market and competitive performance in modern competitive markets. Aibar-Guzm, et al. (2022) described that attaining sustainable product innovation required effective and well-structured financial back-up to acquire the needed technological infrastructures.

The company's product is the most important element that has the direct link and alignment with the customers' intentional needs and to ensure consistency product acceptance and positioning in the target market segment, the strategic managers of the organization need to look for ways of adding more values to the product through persistent innovation. Robert and Scott, (2010) assert that companies with effective product innovation programs rely on several tools to implement them, including strategic buckets for resource allocation and strategic product roadmaps. From the opinion of Robert and Scott, companies with sustainable human and financial resources are more prompt to be successful in a product innovation programs. To them, sufficient resources in organizations to deploy new technology and attract strategic managers will enhance sustainable product innovation programs. Strategic product innovation requires the strategic development of frameworks, setting up goals that will be supported by specific sales and profit objectives for product innovation (Robert and Scott, 2010). Cherroun (2014), viewed a product innovation program as a source of competitive advantage for a firm in an industry.

In the nutshell, product innovation helps to expose the corporate image of organizations and helps to attain long term growth as well as help to attain differential strategy of the firm. Product innovation can take a different shapes and do take place in the firm as a result of the occurrence. Radical and incremental innovations do occur in new product innovativeness in a competitive industry. The radical product innovations emanating from the dramatic changes that occur from

technological forces which attracted a change in product restructure and development by the firms and the incremental product innovations occur when firms change part of their existing and new products by modification and modernization to sustain among competitors. Siti and Haryanto (2022) concluded in their study that strategic improvement in product innovation as a result of adoption and implementation in technological infrastructures can enhance sustainable competitive advantage and sustainable market and business performance respectively.

Product Innovation Stages

From the opinion of the researchers, the innovation of a product starts from the product development stage. Critically, to the researcher's view, innovation emphasizes a change of existing phenomenon to a current or modern look. Product innovation in a nutshell emphasizes the reproduction or makes changes to an existing product in an organization to boost the interest of the target market in a particular industry. The following are the stages of product innovations in the organization as suggested by this study:

- i. Product development/Invention stage
- ii. Product innovation stage: modification/modernization stage, product differentiation stage and diversification/positioning stage.

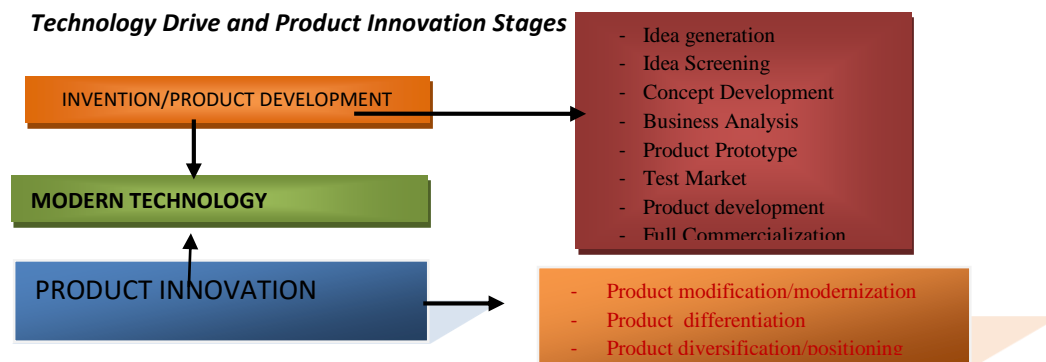


Fig. 1: Diagram Representing Modern Technology Alignment with Product Innovation Stages in Manufacturing Company, (Ovivi, Fasasi & Okolo, 2022)

- ❖ **Product Development Stage:** Product development is an invention that is carved out from the development of a new product after a deliberated prototype of the product was screened and agreed upon by the idea generators of the company and production took place as a result of a new innovative technological push. The company product is then pushed out into full commercialization in target markets for their notice and awareness of a new product into existence. The actions and reactions in terms of the perception of the customers towards the product in the target markets will trigger the product to move fast into the innovation phase. And also the complications the product itself perceived in the product life cycle stages will determine the quick call for product innovation programs of companies at the introductory stage.



- ❖ **Product Innovation Stage:** At this stage, the product is considered passing innovation processes which involve improvement in the product qualities, quantity, the core product, and changes in brand and package structure to suit the interest and perception of the target markets and customers to maintain a competitive edge and catch up with the competitive advantage. Innovation of products by marketing organizations will reduce the cost and effort of a promotional programs, because a well strategic innovated product will sell itself without excess hunting for customers. Organizations need to improve their product quality more than to have a product and keep hunting for customers. Well innovated products need less marketing effort to succeed in the target market. The product innovation stage involves several phases to maintain the long term profitability of corporate organizations and attain the level of a market leader. The following are:
- 1. Modification /Modernization Phase:** The product modification phase of product innovation will be successful from the emanation of modern technology after the reactions of the consumers from the product development stage. The strategic aspect of the modification phase involves changing the product into modern usage for the end users. This involves modernizing the product qualities with the current technological environment trends and the current digital market structure to help the organization attain sustainable growth and maintain long term competitive advantages.
 - 2. Differentiation Phase:** At this product innovation stage, the company now targets its product innovation strategy and programs on differential innovation in the competitive marketing environment. This can be strategically carried out by targeting product innovation that maintains unique branding and packaging. The strategic managers' role of companies at this stage of product innovation is to access and deploy modern technology to work on sustainable innovative branding and packaging of a product that has sharp differentiation mirage in the operational markets.
 - 3. Diversification Phase:** product diversification phase of product innovation focuses on attaining long term market coverage and retentive positioning by deploying current technology to attain varieties of innovated products with different brand names for different customers group. The strategic thinking of this phase is to conduct masses innovation process on a group of products to attract more markets and more customers coverage and retention. This phase of product innovation helps to maintain the long term sustainability and profitability of the corporate organizations. The phase of product innovation has helped companies like Coca-cola, Toyota, Samsung, Apple and other manufacturing companies to sustain the long term maturity stage in the product life cycle, because they provide the operational markets and customers with product choices. Coca-cola display a variety of product offering in the operations like; Coke, Fanta, Sprite and others. In the same way, Toyota offers its operational market with Camry, Corolla, Hilux, Matrix and many other brand names and they keep improving on their qualities. Kotler and Keller, (2012, 2009) assert that P&G is an active product innovator, devoting \$2 billion annually to research and development, an impressively high amount for a packaged goods company. And they keep modifying their products with the current changing technology to maintain and sustain the changing needs of the target operational markets and customers and this is the market leader's strategy that made the above-mentioned companies market leaders in their various industries in the current global market trends.

Benefits of Product Innovation to Manufacturing Companies

The long term growth and the general attainment of the company's vision and mission can be attracted to their consciousness and rate of innovativeness of the entire organization especially the

innovation of the company's products that have a direct link with the customers. The following are the benefits of product innovation to manufacturing companies:

- i. An organization with product innovative strategies and programs are prone to have a sustainable corporate image.
- ii. Product innovativeness of manufacturing companies creates the chances of attaining and sustaining successful strategic marketing management programs.
- iii. Innovativeness of an organization on product can increase its employee's competence and organization capability as well as enhance positive changes in the organization.
- iv. Innovativeness of a company's products mostly is a source of creating a competitive edge and advantage in target operational markets.
- v. The market share and sales volume of a marketing company can increase as a result of its product innovation.
- vi. Well innovated products will reduce the marketing effort and cost of manufacturing companies.

Technology Contribution to Product Innovation to Manufacturing Companies



Fig. 2: Diagram Showing Link of Effects of Technology on Product Innovation (Ovivi, et al. 2021)

From the diagram above show how product innovation strategy and competency can be attained effectively and efficiently with contribution and role technology of various kinds. Technology influence new product development or product innovation the specification and expectations of new product or change in product and technology have an influence on product structure and design because technology helps to attain suitable branding and packaging of product to meet the end users' need and satisfaction during innovation processes. Product innovation cannot carry out in manufacturing companies without the deployment of technological forces as a competitive advantage. Modern technology has tremendous contributions to the growth of innovativeness of the entire company and its product in terms of their sustainability and profitability in the harsh business environment. Studies have shown that no society operating modern manufacturing companies that want to be stringent in product innovation and holistic innovativeness without the adoption and adaption of newer and current technological variables in their operational dealings (Dmitry et al., 2021; Murmura et al. 2021; and Khanfar. Et al. 2021). The other contributions are:

- i. Influence on product modification and modernization of companies' products



- ii. Influence on product differentiation and diversification of companies' products
- iii. Stabilizing product positioning and brand acceptance of companies' products
- iv. Building corporate image of business organizations
- v. Ensuring long term profitability of organizations
- vi. Sustain other uncontrollable variables in the target operational markets
- vii. Rise and retention of customers and markets coverage.

Theoretical Framework

Creative Destruction Theory

Creative destruction theory foresees the future impact of technologies and technical know-how on innovation for rapid industrial growth (Schumpeter, 1940). The theory expresses the need for continuous new innovation in an organization that will back out the old shape of the entire elements in organizations through the growth and adoption of modern technology. The theory proposes that adopting modern technology in product innovation of manufacturing companies will enhance the sustainability and profitability of the firms. The theory also asserts that replacing new product offerings with the old ones for the target customers will foster the firms to attain a competitive edge and competitive advantages as the target market demands change with the changes in modern technology. Schumpeter's view has distinct alignment with the current study as it exposes the contributions of modern technology to product innovation in the manufacturing industries. Innovativeness cannot be attained without destroying the old ones and creating new ones in the organizations. The modern digital world has influenced in the taste and fashion of the target customers in terms of their perception of product offerings that also have changed the perception of manufacturing companies to continuously ensure the best product offering are attained through modern technology and innovation strategy for the target markets, which have been asserted by Schumpeter theory of creative destruction.

Intelligence Volatility Assessment Theory (IVA Theory)

Intelligence Volatility Assessment Theory (IVA Theory) was built to improve on the Technology, Organization and Environment framework (TOE model) by Torbatzky and Fleisher (1990). The TOE model focused on three crucial elements accessibility, analysis and evaluation to enhance sustainability in organizations but IVA theory sees the need to create attention to the newer consistent change in environmental behaviours that effect change in intelligence gathering that lead to change in operational performance in modern business settings.

IVA theory centred and was built around the simultaneous complexity and dynamism in business situations and radical changes in the variation of data and information in the modern business world. The theory believed in fortuitous business herculean misshapes in intelligence gathering, assessment and analysis alignment with the survival of business operations. IVA theory is a modern theory propounded by Ovivi (2020). The theory posits that fortuitous changes in behaviour of business contexts leads to change in behaviour of intelligence systems which variably changes the behaviour in operational performances. It stated that continuous variation in business contexts and intelligence analyses are the roots of the flow of business sustainability. The theory predicts that SMARTER intelligence is a huge resource for SMARTER sustainability in operational performance. IVA theory



believed that simultaneous variations in business contexts and intelligence trends are pillars that matter to business future. From the perspective of this theory, change behaviour in environmental issues creates and invents opportunity and core values to the existing business through intelligence gathering. Many global businesses trends to profitability and sustainability during the COVID-19 Pandemic despite the harsh and changed business situations and many engaged in different diversification operations positively. The Assumptions of IVA theory are that:

- i. Environmental issues are fortuitous consistency, dynamic and complex
- ii. Intelligence is not constant but dynamic and complex
- iii. SMARTER Intelligence management predicts future business strength
- iv. Business expectations and opportunities rely on Intelligence
- v. Intelligence is an immune booster of SMARTER business sustainability

IVA Model

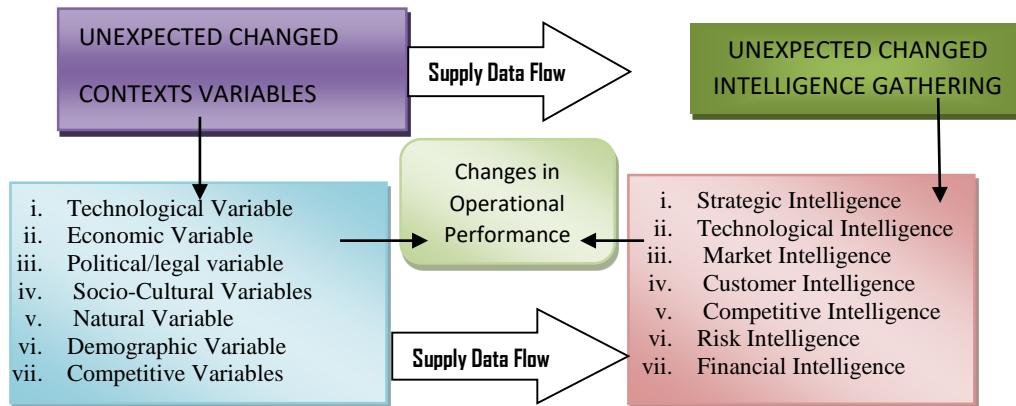
IVA model gives more details on how the variations in business contexts give more strengths to intelligence gathering and enhance business operational performance in modern business settings

IVA Model = Change BC + Change IS + Change OP

BC= Business Contexts

IS= Intelligence System

OP= Operational Performance



The IVA model expresses the correlation between versatile business contexts and intelligence versatility and how business operational performance can be attained. This model explains the chain of correlation between business contexts, business intelligence system effectiveness and efficiency to operational performance in modern business settings. The dynamism and the behavioural changes in technology in the last ten (10) years and the intelligence gathered by a business operation have huge ways supported behavioural changes in their operational profitability. In the mobile phone and computer-based industry and many manufacturing industries in the last 10 years; the dynamic changes in technological infrastructures have also affected the changes in intelligence gathering, leading to changes in strategic formulation and implementation, leading to changes in



product innovation and product modification and redesign, leading to increases in market share and generally to changes in operational performances and sustainability.

Theoretical Bases for the Study

For stringent analysis and evaluation of this study on technology and product innovation in manufacturing companies in Nigeria, two critical theories were reviewed; the Theory of Creative Destruction (Schumpeter, 1940), and the IVA theory (Ovivi, 2020). But the study adopted the Theory of Creative Destruction. This theory explained that change is a constant variable that manufacturing firms must adapt and align between technology and product innovation to have long term business growth and survival in the complex business environment.

Empirical Studies

Robert and Scott, (2019) conducted a study on developing a product innovation and technology strategy for your business; a framework for developing a product innovation strategy includes defining innovation goals and objectives, selecting strategic arenas, developing a strategic map, and allocating resources and their findings were that their research offers concrete evidence of the importance of a product innovation strategy and the strong positive impact such a strategy has on performance. The above studies conducted have not actually addressed the current study in manufacturing companies in Nigeria as technology is variable and complex in the business environment, which business organizations need to adapt to its continuous changes. Ladokun (2019) conducted a study on product innovation as the panacea for the sustainability of business performance in Nigeria Breweries Plc., using purposive sampling to attain a sample size of 70 prospective respondents and data was analyzed statistically using the SPSS tool and involved the use of both descriptive and inferential statistics. After critical testing of the stated hypotheses, the study revealed that there is a significant correlation between technology changes and product innovation and consumer satisfaction and the study suggested that concrete sustainable relationships should adequately be maintain with existing and prospective consumers.

Nwosu, Awurum and Okoli (2016) studied the effect of technological innovation on the performance of Nigerian manufacturing firms. The population of the study is 8725 the total staff strength of ten manufacturing firms spread across ten sub-sectors of the manufacturing sector on Nigeria Stock Exchange while the sample size was extracted from the population using the Taro Yameni method. A structured questionnaire was used to generate the primary data. The study used a descriptive type of survey design while t-statistics were adopted for hypotheses testing. The result of the study revealed that Process Innovation, Product Innovation, Organizational structure and employee development have a significant positive effects on the performance of manufacturing firms. Given the above findings, the study concludes that even though most firms in the manufacturing sector are not performing, the result from selected few performing manufacturing firms used in this study attests to the presence of technological innovation which is a critical success factor behind their success. The study, therefore, recommends that Nigerian manufacturing firms should give more serious attention to technological innovation.

Research Gap

A significant amount of research has been carried out both within and outside the country on the topic; of technology and innovation such as (Robert and Scott, 2019; Ladokun, 2019; Nwosu, Awurum and Okoli, 2016; Hojin, Sangyoon and Heejun, 2016; Adeyeye, 2014; Yu-Cheng and



Shun-Hsing, 2011). But none had discussed vividly at the topic from the perspectives of evidence and knowledge gaps even from the points of empirical and theoretical gaps. We looked at technology and product innovation and how it impacted the Nigeria Manufacturing Companies positively which makes this uniquely different from other previous studies.

Research Methodology

The research design adopted for this study is the survey type of research design, where questionnaires are administered to respondents to get information about the subject matter. The population of the study comprised of twenty-three (23) manufacturing companies that are into consumer goods listed on Nigeria Stock Exchange as of 31st December 2019. Each company was used as a unit of analysis. Purposive sampling was used to select eighteen (18) manufacturing companies which were used as the sample size. In each company, questionnaires were administered to the managers and production managers to get their view on the subject matter, making it thirty-six (36) copies of questionnaires that were administered and thirty-one (31) were retrieved and used for analysis. A simple regression technique was applied to analyse the data due to the nature of the studied variable. The study covered a period of five years (2014 to 2019). This period was chosen because is the period that characterized technological and product innovation by manufacturing companies in Nigeria.

Estimation of Study Variable

In order to examine the contributing impact of Technology and Product Innovation on Manufacturing Companies in Nigeria, a simple linear model was built.

$$PI = a + b_1TC + e \dots\dots\dots 1$$

$$CA = a + b_2PI + e \dots\dots\dots 2$$

$$P = a + b_3PI + e \dots\dots\dots 3$$

$$CS = a + b_4T + e \dots\dots\dots 4$$

Where,

PI, CS, P and CS are Product Innovation, Customer Satisfaction, Profitability and Customer Satisfaction (Dependent Variable)

a = constant

TC, PI, PI, T are Technological Changes, Product Innovation, Product Innovation and Technology (Independent Variables).

b₁, b₂, b₃ and b₄ are regression coefficients which measure the degree of the responsiveness of the dependent variables to the independent variables

e = residual or stochastic term (which reveals the strength of b₁X₁+ b₂X₂ + b₃X₃+b₄X₄ ; if e is low, this implies that the amount of unexplained factors is low, then the residual R and R₂ will be high and vice versa.



Test of Hypothesis

Table 4.1 Summary of Regression Result

Variables	TC	PI	PI	T
Coefficient	.172	.535	.601	.684
t-value	4.265	7.311	7.835	11.956
P-value	0.00	0.00	0.00	0.00
R ²	0.32	0.59	0.56	0.81
R ² Adj	0.34	0.63	0.52	0.75
F-Stat	31.82	62.20	51.39	110.05
DW	0.19	0.21	0.17	0.32

Source: Computed by the Authors using E-view (Version 23)

Technological Change and Product Innovation

Table 4.1 shows the regression result for hypothesis one indicates that product innovation of the selected manufacturing companies will increase by 17% for every 1% increase in the level of technological change. The coefficient (0.172) of technological change (TC) is positive and significant at 5% with p-value of (0.00) in achieving product innovation in the selected manufacturing companies. This implies that technological change significantly to product innovation in the selected manufacturing companies. Therefore, the null hypothesis is rejected and we accept the alternative hypothesis that there is a significant positive relationship between technological change and product innovation in the selected manufacturing companies.

Product Innovation and Competitive Advantage

Table 4.1 shows the regression result for hypothesis two, indicating that competitive advantage in the selected manufacturing companies will increase by 53% for every 1% increase in product innovation. The coefficient (0.535) of product innovation (PI) is positive and significant at 5% with p-value of (0.00) in achieving competitive advantage in the selected manufacturing companies. This implies that product innovation contributes significantly to competitive advantage in the selected manufacturing companies. Therefore, the null hypothesis is rejected and we accept the alternative hypothesis that there is a significant positive relationship between product innovation and competitive advantage in the selected manufacturing companies.

Product Innovation and Profitability

The regression result in table 4.1 for hypothesis three indicates that the profitability of the selected manufacturing companies will increase by 60% for every 1% increase in product innovation. The coefficient (0.601) of product innovation (PI) is positive and significant at 5% with p-value of (0.00) in achieving profitability of the selected manufacturing companies. This implies that product innovation contributes significantly to the profitability of the selected manufacturing companies. Therefore, the null hypothesis is rejected and we accept the alternative hypothesis that there is a significant positive relationship between product innovation and the profitability of the selected manufacturing companies.

Technology and Customer Satisfaction

Table 4.4 shows the regression result for hypothesis four, indicating that customer satisfaction of the selected manufacturing companies will increase by 68% for every 1% increase in technology.



The coefficient (0.684) of technology (T) is positive and significant at 5% with p-value of (0.00) in achieving the customer satisfaction of the selected manufacturing companies. This implies that technology contributes significantly to the customer satisfaction of the selected manufacturing companies. Therefore, the null hypothesis is rejected and we accept the alternative hypothesis that there is a significant positive relationship between technology and customer satisfaction in the selected manufacturing companies.

Discussion of Results

The analysis in hypothesis 1 revealed that there is a significant correlation between technology and product innovation in manufacturing companies. That is the relationship between technology and product innovation can be described as seamen twins from the study. It was also revealed from the study that technology is the life wire of product innovation in manufacturing companies. This finding was supported by the literature reviewed by Murrey et al. (2020); Vita et al., (2020); Liu et al., (2020) and finding Paunov and Planes (2019) who assert that digital technologies change the face of innovation and reshape creativity in a modern manufacturing setting and that technological growth is a dramatic roadmap that gives direction for sustainable product innovation across all sectors in an economy.

The finding based on the analysis in hypothesis 2 revealed that product innovation has a positive significant relationship with the competitive advantage of Nigerian manufacturing companies. Our position is therefore in line with Cherroun (2014); Siti and Haryanto (2022), who found a positive relationship between product innovation and competitive advantage. The concrete alignment and integration of technology and product innovation have been competitive strengths and drive force for strategic thinkers to restructure and reshape holistic business performance in modern manufacturing companies in the global context.

The analysis in hypothesis 3 revealed that product innovation has a positive relationship with Profitability. The study position is therefore in alignment with the studies and findings of Dmitry et al., (2021), Murmura et al. (2021) and Ladokun (2019), who found a positive relationship between product innovation and Profitability and this buttress the fact that product innovation in manufacturing companies has increased their sales volume and market share over time. The finding from hypothesis 4 shows that technology has significantly increased customer satisfaction of manufacturing companies in Nigeria. In the nutshell, the lifestyle of consumers and end users of products innovated has changed over time positively in the society due to the contributing impact of changing technological forces. Our position is therefore in line with Muhammad and Kalthom (2014), who found a positive relationship between technology and customer satisfaction.

Conclusion

The study examined the effect of technology and product innovation in manufacturing companies in Nigeria. The study revealed that technological changes impact product innovation in manufacturing companies of Nigeria positively; product innovation impacted on the competitive advantage of manufacturing companies in Nigeria positively, product innovation contributed to the



profitability of manufacturing companies in Nigeria and technology influences customer satisfaction in manufacturing companies of Nigeria positively.

Most of the findings of the research are consistent with previous normative and empirical works as it has provided empirical evidence pertaining to the perception of technology and product innovation in manufacturing companies. Therefore, we concluded that technology and product innovation had positively impacted manufacturing companies in Nigeria's operations. This connotes that sustainable product innovation and development cannot be attainable without the driving forces of technology and the face of production and operational processes have changed over time in manufacturing companies due to the effect of dramatic change in technology. Therefore, technology is the life wire and backbone of the product innovation paradigm shift to business sustainability and profitability in modern manufacturing companies.

Recommendations

From the research findings and conclusions drawn from the study, the following recommendations were ascertained:

- i. Manufacturing companies should set up Competitive Intelligence (CI) and Strategic Intelligence (SI) to attract every new technology invention in their product innovation from the competitive market environment in order to attain sustainable business performance.
- ii. Financial budget and resources structure should be set aside to invest in every wanting new technology that will have an impact in developing new products and in modifying the existing products in manufacturing companies and adequate technology infrastructure should be in place to enhance product innovation implementation to enjoy a competitive advantage.
- iii. Knowledge management should be attained as it is a tool to drive organizational capabilities that can enhance the attraction of new technology to manufacturing companies that can be used to drive successful product innovation to enhance profitability.
- iv. Leadership and organisational structure matters to attain successful implementation of attracting new technology to product innovation in manufacturing companies. The leadership style and strategy should be designed in alignment with new thinking towards their companies' products and services and this will drive the strategic leaders to attract new technologies to their product design and modification.
- v. Having structured Business Intelligence (BI) and Artificial Intelligence (AI) in place is another strategic tool to attract effective new technology, robotic operations and machine learning to product innovativeness in manufacturing companies and finally, deployment of resources to the above recommendations will enhance swift changes on product innovation to always meet the target markets and customers' needs in the changing business contexts.

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APPENDIX A

Hypothesis One

Dependent Variable: PI
 Method: Least Squares
 Date: 06/24/2020 Time: 11:50
 Sample (adjusted): 1 18
 Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.592814	0.143171	3.455605	0.0001
TC	0.172605	0.036156	4.265319	0.0000
R-squared	0.323586	Mean dependent var		1.320000
Adjusted R-squared	0.340744	S.D. dependent var		0.471212
S.E. of regression	0.373792	Akaike info criterion		0.908944
Sum squared resid	6.706587	Schwarz criterion		0.985425
Log likelihood	-20.72361	Hannan-Quinn criter.		0.938069
F-statistic	31.86971	Durbin-Watson stat		0.192396
Prob(F-statistic)	0.000002			

Source: Computed by the Author Using E-view Statistical Software (Version 23)
 1% level of significance, 5% level of significance and 10% level of significance

Hypothesis Two

Dependent Variable: CA
 Method: Least Squares
 Date: 06/24/2020 Time: 11:51
 Sample (adjusted): 1 18
 Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.657293	0.186292	8.896203	0.0000
PI	0.531436	0.055223	7.361214	0.0000
R-squared	0.591175	Mean dependent var		3.120000
Adjusted R-squared	0.633700	S.D. dependent var		1.154229
S.E. of regression	0.698571	Akaike info criterion		2.159618
Sum squared resid	23.42407	Schwarz criterion		2.236099
Log likelihood	-51.99046	Hannan-Quinn criter.		2.188743
F-statistic	62.20008	Durbin-Watson stat		0.215073
Prob(F-statistic)	0.000000			

Source: Computed by the Author Using E-view Statistical Software (Version 23)
 1% level of significance, 5% level of significance and 10% level of significance



Hypothesis Three

Dependent Variable: P
 Method: Least Squares
 Date: 06/24/2020 Time: 11:52
 Sample (adjusted): 1 18
 Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.193697	0.229536	0.843863	0.4029
PI	0.601922	0.064057	7.835510	0.0000
R-squared	0.561224	Mean dependent var		1.840000
Adjusted R-squared	0.522083	S.D. dependent var		0.976458
S.E. of regression	0.553510	Akaike info criterion		2.026260
Sum squared resid	20.49962	Schwarz criterion		2.102741
Log likelihood	-48.65650	Hannan-Quinn criter.		2.055385
F-statistic	51.39522	Durbin-Watson stat		0.175501
Prob(F-statistic)	0.000000			

Source: Computed by the Author Using E-view Statistical Software (Version 23)
 1% level of significance, 5% level of significance and 10% level of significance

Hypothesis Four

Method: Least Squares
 Date: 06/24/2020 Time: 11:53
 Sample (adjusted): 1 18
 Included observations: 50 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.066175	0.189278	-0.349618	0.7282
T	0.684716	0.053365	11.95685	0.0000
R-squared	0.814375	Mean dependent var		1.840000
Adjusted R-squared	0.758425	S.D. dependent var		0.976458
S.E. of regression	0.527265	Akaike info criterion		1.596951
Sum squared resid	13.34440	Schwarz criterion		1.673432
Log likelihood	-37.92377	Hannan-Quinn criter.		1.626075
F-statistic	110.0526	Durbin-Watson stat		0.327296
Prob(F-statistic)	0.000000			

Source: Computed by the Author Using E-view Statistical Software (Version 23)
 1% level of significance, 5% level of significance and 10% level of significance