ISA Journal of Business, Economics and Management (ISAJBEM)

Homepage: https://isapublisher.com/isajbem/
Email: office.isapublisher@gmail.com

Volume 2, Issue 6, Nov-Dec, 2025 ISSN: 3049-1835

The Impact of Emerging Computing Technologies on the Growth of Technology Entrepreneurship

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Received: 05.11.2025 | **Accepted:** 23.11.2025 | **Published:** 15.12.2025

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DOI: *10.5281/zenodo.17942428*

Abstract **Original Research Articles**

The fast pace of creation of new computing technologies has transformed the world entrepreneurship though the direct effect of the technology on the advancement of technology entrepreneurship particularly in developing areas has not been properly researched. The study aims at addressing the problem of the conceptual void in the position of technologies (e.g., artificial intelligence, cloud computing, big data, the internet of things, and digital platforms) in entrepreneurial innovation, scale, and sustainability. It is proposed to speak about the role of these technologies, investigate the factors which should be considered to be important to define the use of technology, and interpret the association between this technology and sustainable growth of this business in global, African, West African and Nigerian businesses. Under the supportive research questions, which are coherent with these objectives, the research takes the conceptual approach of research using a secondary data presented in scholarly articles, books, conference papers, policy papers, and reliable online databases. The analysis has shown that emerging technologies are significantly contributing to increased innovation capability, efficiency of operations and expansion of the market whilst software engineering presence and usage of technology are causing the sustainability of the ventures. Other issues such as infrastructural breakage, shortage of skills, and adoption issue remain a reality in emerging economies. The paper finishes by giving recommendations to ensure digital preparedness, making innovations-driven development, to the actors in the ecosystems and policies as an entrepreneur.

Keywords: Emerging Technologies, Technology Entrepreneurship, Technology Adoption, Business Sustainability, Digital Innovation.

1.0 Introduction to the Study

1.1 Background of the Study

The world of entrepreneurship is being shaken by new computing technologies that are widely prevalent in the world. The innovations such as artificial intelligence (AI), cloud computing, Internet of Things (IoT), blockchain and advanced data analytics have generated new opportunities in the markets to entrepreneurs, enhanced operational efficiency and scale innovation in new business models (Kenney and Zysman, 2016; Kishor, 2023). Digital technologies like Amazon, Google and Uber have the capability to demonstrate to the world that much entrepreneurship and innovation are possible powered by ecosystems with digital technology which has redefined business creation and value capture globally (Chesbrough, 2003; Kenney and Zysman, 2016). It has been found that the nations capable of adopting and implementing new technologies are more likely to have a higher entrepreneurial growth and economic dynamism (Ács, Szerb, and Autio, 2017; Fitzgerald, Kruschwitz, Bonnet, and Welch, 2014). Co-morbidly, in the African continent, the emergent computing technology, increasingly is becoming familiar with their significance in propelling start-up and digital entrepreneurship. Digital adoption is gradually changing the landscape of the entrepreneurial ecosystem in the continent and offering the opportunities to innovate during infrastructural and policy challenges (Shahadat, Nekmahmud, Ebrahimi, and Fekete-Farkas, 2023). Research has indicated the inter-dependence of technology uptake in the context of African SMEs, where the supportive role of the top management, costs of adoption, the willingness to innovate, and government support are reported to contribute and stress the interplay of technological as well as organizational variables (Shahadat et al., 2023).

In West Africa, the adoption of new computing technologies is spotty but rapidly increasing in locations such as Ghana, Senegal and Nigeria, with entrepreneurial activities increasingly making use of cloud-based services and artificial intelligence, drawing on and using such new technologies to support competitiveness and scalability (Aliyu Mohammed, 2024; Wadhwa, Saxenian, Rissing, & Gereffi, 2007). These technologies can give entrepreneurs access to global markets, break down operation barriers, and facilitate data-driven decision-making, which is the key to the growth of technology-based ventures (Powell & Dent-Micallef, 1997; Kishor, 2023). Specifically in Nigeria, the benefits of technology entrepreneurship are coming into full swing, as startups and spin-offs in the fintech sector, e-commerce and software development are leading the charge. However, there are still challenges regarding the adoption of technologies, digital literacy, and lack of infrastructure (Aliyu Mohammed, 2024; Shahadat et al., 2023). Nigerian entrepreneurs are gradually turning to the new computing technologies in order to innovate and compete; the effectiveness of these technologies in serving the innovation and growth of sustainable development is dependent on the extent to which this technology is integrated into the business operation process, supported by the appropriate policies, and complemented by the appropriate human and organizational resources (Mohammed & Sundararajan, 2023; Compeau, Higgins, & Huff, 1999).

1.2 Problem Statement

Despite the proliferation of emerging computing technologies across the world, there exists a huge gap in the literature on the effect of emerging computing technologies on growth and sustainability of technology entrepreneur particularly in the developing regions such as Africa and Nigeria. Globally, innovations in cloud computing, AI and platform-based ecosystems have uncovered potential for building scale and high-impact entrepreneurial ventures (Kenney & Zysman, 2016; Chesbrough, 2003). However, to what extent these technologies convert into concrete business growth and competitive advantage depends upon contextual factors such as technological readiness, organizational capacity and entrepreneurial skills (Ács, Szerb, & Autio, 2017; Fitzgerald et al., 2014). In Africa, despite the opportunities that new innovations bring and the new markets they open up, numerous challenges face many technology-based businesses, such as poor digital infrastructure, poor access to financing, insufficient policy support, and low technology adoption levels (Shahadat et al., 2023; Aliyu Mohammed, 2024). These challenges limit the capacity of entrepreneurs to use computing technologies to the fullest extent possible in sustainable business growth.

In the region of West Africa, and Nigeria in particular, there have been upswings of technology entrepreneurship, but empirical evidence has suggested startups are grappling with challenges such as skill gap, technology anxiety, incorporating the advanced computing systems in the business processes, etc. (Meuter, Ostrom, Bitner, & Roundtree, 2003; Mohammed & Sundararajan, 2023). In addition, the relationship between emerging computing technology and strategies applied by small businesses, organization and resource endowment in the developing economies is weakly researched (Mohammed, 2023; Powell and Dent-Micalles 1997). Such lack of evidence at the local area creates doubt in policy makers, owners and investors on the right steps that can be taken to serve their interests to enhance technology entrepreneurship. Thus, there is a necessity to conduct appropriate research, read how the emerging computing technologies can be implemented strategically to generate sustainable growth, enhance the level of innovation as well as competitive positioning of technology entrepreneurs in Nigeria and similar to it.

1.3 Significance of the Study

It is a significant work towards identifying the critical connection between emerging computing technologies and the continuously growing technology entrepreneurship and provides the knowledge that will be accommodated at the global, regional and local level. The advent of digital platforms, cloud computing, AI and big data has transformed how entrepreneurs do value creation, how companies are built and scaled, and competitive markets are complicated globally (Kenney and Zysman, 2016; Chesbrough, 2003). These technologies offer business opportunities that can be used strategically to direct entrepreneurs in distressing competitive advantage and building a sustainable business (Fitzgerald, Kruschwitz, Bonnet, and Welch, 2014; Weill and Broadbent, 1998). The study is interesting in the realms of African and West Africa since it provides workable information about how technology entrepreneurship may be enhanced amidst infrastructural and institutional issues. The role of new technology in contributing to sustainable growth, finding job, and economic development fueled by innovations is solidified in the research by knowing what factors determine the adoption of technology, which are digital skills and the paired organization practice (Shahadat, Nekmahmud, Ebrahimi, and Fekete-Farkas, 2023; Mohammed and Sundararajan, 2023).

In the case of Nigeria, the study contributes to the growing body of knowledge of technology-driven entrepreneurship, as well as it presents some empirical data and suggestions that can be used by the policymakers, business leaders and investors. The findings are expected to help in making effective intervention in areas such as development of digital infrastructure, reskilling and upskilling of people and intervention in support of technology start ups to help where a entrepreneurial ecosystem in the country is improved (Aliyu Mohammed, 2024; Mohammed, 2023). Academically the research complements existing literature with a combination of theoretical perspectives, namely Technology Acceptance Model (TAM) and Resource based views (RBV) to examine the dynamic interplay between emerging computing technologies and entrepreneurship growth. It also reveals the gaps in research related to developing economies, which provides a conceptual and empirical basis for future research studies in the area of technology entrepreneurship, innovation management, and sustainable business practices (Davenport, 1993; Powell & Dent-Micallef, 1997).

1.4 Research Objectives

The main objective of the proposed research is exploring how the computing technologies that are emerging affect the development of technology entrepreneurship along with the attainment of the following goal which is to comprehend the significance of software engineering practices and technology acceptance to business sustainability. The specific objectives are:

1. To investigate how the new computing technologies including cloud computing, artificial intelligence, big data and digital platforms can support the development of technology entrepreneurship in the world, region (Africa and West Africa) and Nigeria, in particular.

2. To assess the extent to which software engineering and agile practices, DevOps, secure coding, and software lifecycle management are beneficial to entrepreneurial innovation and sustainable growth of business.

3. To assess the determinants of technology adoption in technology-driven entrepreneurial ventures, considering factors such as organizational readiness, managerial support, and perceived relative advantage.

4. To examine the correlation between technology adoption and business sustainability, in both economic, social and environmental perspectives.

5. In order to determine the challenges and opportunities of technology entrepreneurship in

Nigeria and West Africa, and to provide recommendations that will encourage innovation and sustainable development to the entrepreneurs, politicians, and stakeholders.

1.5 Research Questions

The research questions aimed at the study are the following:

1. To what extent will new computing technologies impact the development of technology entrepreneurship in the world, Africa, and Nigeria at large?
2. How can software engineering practices help improve entrepreneurial performance and sustainability in technology intensive ventures?
3. What commonalities are identified to mean the adoption of emerging computing technology in the business of starting an enterprise, especially in third world countries?
4. What is the effect of technology adoption on business sustainability in the economic, social, and environmental aspects?
5. What challenges and opportunities exist for technology entrepreneurship in Nigeria and West Africa, and how can they be addressed to promote sustainable growth?

2.0 Literature Review

2.1 Conceptual Review

2.1.1 Emerging Computing Technologies (IV1)

Definition and Evolution of Computing Technologies

Emerging computing technologies can be referred to as advanced digital tools, platforms, and systems that can help organizations to innovate, optimize operations, and construct new value propositions (Kenney & Zysman, 2016). These technologies have evolved from simple information systems in the 1980s, to enterprise software and digital platforms in the 2000s, to the use of AI, cloud computing technologies, and IoT-enabled (the hardware and software essential for Internet of Things) environments in the current era (Kishor, 2023; Holtgrewe, 2014). The evolution is a transformation from isolated IT systems to integrated, adaptive, and scaling ecosystems of computing that help entrepreneurship and economic development on various levels.

Artificial Intelligence and Machine Learning

AI and machine learning are a means of providing entrepreneurship ventures with enhanced computational abilities for predictive analysis, automation and decision-making. These technologies allow startups and SME's to process massive data, optimize their business processes, and gain competitive advantage (Chalmers, MacKenzie, & Carter, 2021). The possibilities and opportunities, innovation ideation, and market expansion are also identified with AI-driven tools, which is important in maintaining an entrepreneurial process in technologies development in developed and developing economies (Mohammed, 2023; Fitzgerald, Kruschwitz, Bonnet, and Welch, 2014).

Cloud and Edge Computing in Venture Scalability

Cloud computing has transformed scalability of businesses as it will enable an opportunity to access computing resources on-demand, implement costs are low, as well as deploying technology-oriented solutions within a specific short time (Kishor, 2023). Digital ecosystems powered by platforms such as Amazon Web Services, Google Cloud and Microsoft Azure are facilitating the creation of new entrepreneurial activities and the growth of the global market (Kenney and Zysman, 2016). Edge computing micro-contributes to it by acting with significantly more data nearer to its source, as it enables more process efficiency and responsiveness (in real-time applications, in particular), which is especially important to startups and technologically-oriented SMEs in Africa and Nigeria (Mohammed, 2023).

Internet of Things (IoT) in Business Model Innovation

IoT technologies have made it possible to interconnect devices, sensors, and systems, creating real-time data that can be utilized by entrepreneurs to create innovative business models. IoT adoption helps enable smart operations, predictive maintenance, and personalised customer experiences that enable technology-powered ventures to be more sustainable and grow (Kishor, 2023; Petti, 2012). By combining IoT with cloud and AI technologies, start-ups can be innovative in an ever-changing and responding dynamically to market demands which is essential in emerging economies where resource optimisation serves as the key to entrepreneurial survival and growth. (Mohammed, 2023; Shanmugam Sundararajan et al., 2024)

Blockchain Technology for Trust and Transaction Efficiency

Blockchain technology offers decentralized and tamper-proof ledgers that help in making financial and business transactions more trustworthy, transparent, and efficient. For technology entrepreneurs, according to Chesbrough (2003), problem areas include transactional frictions, supporting secure self-managing (peerto-peer) interactions, supporting innovative business models (e.g., decentralized marketplaces and token-based ecosystems) (Kenney & Zysman, 2016). In Nigeria and other West African economies, the interest in blockchain is on the rise for purposes such as fintech startups, supply chain management and cross-border, trade facilitation and providing a platform for scaling entrepreneurial ventures in secure and transparent ways (Mohammed & Sundararajan, 2023).

Human–Computer Interaction and User-Centric Technology Design

The practice of Human-Computer Interaction (HCI) and user-centered design is ensuring the intuitiveness of technology solutions, their availability and alignment with what should be done. Effective design leads to an increase in the rate of adoption and customer satisfaction which is paramount to sustainability of technology based enterprises (Meuter, Ostrom, Bitner, and Roundtree, 2003; Compeau, Higgins, and Huff, 1999). With the inclusion of feedback mechanisms and usability tests and interfaces to adapt into their interface and products, entrepreneurs can design products and services that will resonate throughout their local and worldwide markets (Isaeva et al., 2025; Mohammed, 2023).

Cybersecurity and Secure System Architecture

As it is becoming increasingly reliant on digital infrastructures, startups and SMEs alike must have robust and secure cybersecurity measures as well as secure system architectures in order to protect sensitive business and customer data. Cybersecurity strengthens an organization's capacity for resiliency, secures compute trust while safeguarding operational risks through broad entrepreneurship for sustainable advancement of technology (Moor, 2005; Kishor, 2023). Nigerian tech companies in particular must ensure that they focus on secure coding methods, threat detection mechanisms, and adherence to the global security standards to retain their competitive edge and investor confidence (Holtgrewe, 2014).

Role of Data Analytics in Entrepreneurial Value Creation

Data analytics helps entrepreneurs to derive their business-specific actionable insights from large amounts of structured and unstructured data. This capability makes certain things like informed decision-making, market trend prediction, customer behavior analysis, and optimization of operation's processes possible (Fitzgerald, Kruschwitz, Bonnet, & Welch, 2014; Chalmers, MacKenzie, & Carter, 2021). In Africa, and Nigeria in particular, the use of data-driven approaches helps empower start-ups to find niches, allocate resources, and boost business model innovation which are directly relating to the increasing growth and sustainability of technology entrepreneurship (Mohammed, 2023; Shahadat, Nekmahmud, Ebrahimi, & Fekete-Farkas, 2023).

2.1.2 Technology Adoption (IV2)

Concept of Technology Adoption in Entrepreneurship

Technology adoption is the process of integrating new technologies into the business operations of entrepreneurs and startups to create value, improve efficiency, and gain competitive advantage. In relation to entrepreneurship in technology, adoption is not only a process of acquiring tools and equipment, but also about aligning them to organizational goals, culture and needs within the marketplace (Davis, Bagozzi, & Warshaw, 1989; Powell & Dent-Micallef, 1997). For entrepreneurs in Nigeria and West Africa, using and adopting technology is an essential aspect to scale businesses, promote innovations to engage the global digital economy (Mohammed, 2023; Shahadat, Nekmahmud, Ebrahimi, & Fekete-Farkas, 2023).

Digital Transformation in Startups and Innovation Ecosystems

Digital transformation includes wholesome integration of digital technologies to drastically change the business processes, engagement with the customer and the value creating mechanisms. Startups use other digital tools such as cloud services, e-commerce platforms, and data analytics to innovate quickly and react to the changing needs of the market (Chesbrough, 2003; Kenney & Zysman, 2016). Globally, digital transformation has facilitated the growth of entrepreneurial ecosystems by facilitating linkages of resources, knowledge and networks across borders and in Africa, digital transformation assists in boosting the rise of scalable, technology-driven businesses within resource-deprived environments (Aliyu, 2024; Mohammed, 2023).

Determinants of Technology Adoption (TAM, UTAUT)

Multiple factors influence the adoption of technology with the primary factors being perceived usefulness, perceived ease of use, social influence, and facilitating conditions. The Technology Acceptance Model (TAM) highlights the user perceptions as pivotal factors of adoption whereas the Unified Theory of Acceptance and Use of Technology (UTAUT) incorporates the social and the organizational determinants in the model (Davis, 1989; Compeau, Higgins, & Huff, 1999). In practice, the degree of technology performed by Nigerian entrepreneurs is influenced by top management support, infrastructure readiness, cost issues, and cultural factors which determine the success of technology adoption in entrepreneurial practices in Nigeria (Shahadat et al., 2023; Mohammed & Sundararajan, 2023).

Adoption of Cloud Computing and AI Tools in Startups

Cloud computing and AI tools enable startups to have available scalable infrastructure, powerful AI analytics and automation capabilities without investing heavily in the initial phases. These technologies are helping entrepreneurs optimize operations and decision-making, and to quickly develop innovative products and services (Kishor, 2023; Chalmers, MacKenzie, & Carter, 2021). With emerging economies, cloud-based platforms and AI adoption lead to rapid startup growth along with global market entry and resiliency for the reversal of resources, this makes cloud computing and AI extremely valuable parts of the modern entrepreneurial tool package (Mohammed, 2023; Shahadat et al., 2023).

Automation, Data-Driven Strategies, and Lean Startup Methods

Entrepreneurs are making more and more use of automation and data oriented approaches to optimize the functioning, costs and reactivity to market demands. Lean startups methodologies with the focus on iterative product development, rapid prototyping, and validated learning have frequently been facilitated by new computing technologies (Chesbrough, 2003; Mohammed, 2023). Data analytics and AI can enable startups to make more informed strategic decisions, optimize resource allocation and spot opportunities in the market more quickly, thereby increasing the chances of sustainable growth (Kishor, 2023; Chalmers, MacKenzie, & Carter, 2021).

Barriers to Technology Adoption in Emerging Markets

In as much as there are the tabled benefits, there are several obstacles of technology adoption in emerging markets. Among the key obstacles present are the absence of digital infrastructure, high costs of implementation, unskilled human capital availability, and change resistance as well as regulatory constraints (Shahadat et al., 2023; Mohammed and Sundararajan, 2023). Such barriers in the instance of West Africa and Nigeria specifically can depress the entrepreneurial expansion and render the startups hard to compete globally. All of these obstacles will need to be addressed with specific policy assistance, education, and investment in digital infrastructure (Aliyu, 2024; Mohammed, 2023).

Technology Adoption as a Source of Entrepreneurial Competitive Advantage

Technological adoption can include a tremendous competitive edge when effectively utilized. It assists new businesses in making their offering distinct, improving the operational performance, and dynamically responding to market demands (Powell and Dent-Micallef, 1997; Mohammed, 2023). Clouds, A.I instruments, and automation have empowered ventures to grow fast and use innovation as an integral part of business strategy. We have observed that in emerging economies, technology, coupled with strategic management (when it is coupled with novel business models, e.g., start-up business models) may enable new actors to be better prepared to compete at the local level as well as at the international level (Shahadat et al., 2023; Mohammed and Sundararajan, 2023).

2.1.3 Growth of Technology Entrepreneurship (DV)

Concept and Dimensions of Technology Entrepreneurship

Technology entrepreneurship is a phenomenon, in which new businesses are created, developed, and managed using a new technology as an implementation tool to provide new forms of products, services, or business models. It encompasses the entrepreneurial mind and the technological challenges that should be in place to exploit the opportunities of dynamic and competitive markets (Chesbrough, 2003; Mohammed, 2023). The important dimensions are the technological innovativeness, recognition of opportunities, risk taking, mobilization of resources and scalability. Technology entrepreneurship is built around the idea to harness the strength of digital tools, computing technologies, and data-informed insights and create value and achieve sustainable growth, unlike traditional entrepreneurship (Kenney and Zysman, 2016; Chalmers, MacKenzie, and Carter, 2021).

Venture Creation, Innovation Capability, and Market Expansion

The rise in technology entrepreneurship is strongly linked to the ability of ventures to keep innovating and to scale effectively. Emerging computing technologies such as AI, cloud computing, IoT, and blockchain enable the creation of ventures through procurement in several ways, including rapid prototyping and automated operations, efficient resource allocation (Kishor, 2023; Mohammed, 2023). Startups targeting these technologies are more prepared to take their technologies into new markets, adapt to changing customer needs, and differentiate their product or service offering. Innovation capability, such as the very level of adaption and creative application of technology is a critical driver of market expansion and long-term survival of a business (Fitzgerald et al., 2014; Shahadat et al., 2023).

Economic Contribution of Tech-Based Startups

Technology based start ups are very important for the economic development as they provide jobs, investments and industrial diversification. In the world context, it is common for firms based on technology-related business models to become major contributors to the GDP and innovation indices (Oliner & Sichel, 2000; Ács, Szerb, & Autio, 2017). In Africa, especially in West Africa and Nigeria, the culture of technology entrepreneurship has become one of the most critical drivers of economic growth through the creation of high-value jobs, improved productivity, and the stimulation of the formalization of digital markets (Aliyu, 2024; Mohammed & Sundararajan, 2023). Other than the economic benefits that may emerge as an outcome of governmental projects, the latter may also strengthen the local market resilience, improve more financial inclusion, and boost their global competitiveness.

Entrepreneurial Ecosystems and Digital Platforms

Entrepreneurial lively ecosystems drive the emergence of tech entrepreneurship and include universities, incubators, people, investor, governmental policies and industry networks. Digital platforms such as Amazon, Google and Uber are examples of how technological infrastructure can be leveraged to scale opportunities to entrepreneurs by making them a scalable marketplace, cloud computing and data analytics (Kenney and Zysman, 2016; Mohammed, 2023). This supply and use of such platforms in emerging economies is allowing startups to break the traditional barriers of entry, allow access to global markets, and create innovative value chains. Moreover, eco systems built on platforms facilitate collaboration, knowledge sharing and co-creation, which are significant in the efforts to keep technological projects sustainably (Chalmers, MacKenzie, and Carter, 2021; Mohammed, 2023).

Sustainability and Scalability of Tech Ventures

Technological entrepreneurship is said to be sustainable when a tech venture can maintain its operational, economic, and social performance over a certain duration and respond to the market changes (Drucker and Maciariello, 2014; Mohammed, 2023). New computing tools like cloud computing, AI, IoT, and data analytics have assisted startups in growing their operations in an efficient way that will save them expenses and serve more people (Kishor, 2023; Shahadat et al., 2023). This is achieved with the help of elastic technology infrastructure, modular product design, and automation; as ventures are able to expand into the new markets or segments without necessarily having to proceed to allocate the necessary resources (Chesbrough, 2003; Fitzgerald et al., 2014). Long-term sustainable and scalable businesses are also both environmentally and socially aware to make sure that they are sustainable in the long term besides making money (Mohammed & Sundararajan, 2023).

Challenges of Tech Entrepreneurship in Developing Economies

Nevertheless, the opportunities have a few challenges in entrepreneurialism in tech start-ups in third world economies. Such factors as a small availability to capital, absence of technological infrastructure, absence of technological literacy and regulatory conditions can collapse venture development (Shahadat et al., 2023; Aliyu, 2024). Other obstacles are the unwillingness to implement technology, the lack of skilled labour and fragmented entrepreneurial ecosystems (Mohammed, 2023; Kenney and Zysman, 2016). These are mainly acute in the West Africa and Nigeria where the emerging startups are forced to contend with international competition and domestic market limitation. Furthermore, cybersecurity threats, privacy concerns surrounding data, and the high cost of implementing advanced technologies are some of the challenges that might restrict the potential of startups to exploit new computing tools to their maximum (Kishor, 2023; Chalmers, MacKenzie, & Carter, 2021).

Indicators for Measuring Growth of Technology Entrepreneurship

Measuring the growth of technology entrepreneurship is based on the presence of quantitative and qualitative indicators. Key metrics are that of tech-based starts developed, the survival rate of ventures, revenue growth, market share, and investment attracted (Ács, Szerb, & Autio, 2017; Oliner & Sichel, 2000). Other measures are taken to evaluate the innovation's output, such as patents filed, new product launching and technology adoption rates in ventures (Fitzgerald et al., 2014; Mohammed, 2023). Both entrepreneurial ecosystem strength (measured in terms of access to mentors, incubators, funding networks, digital platforms etc.) and shortcuts are also critical in judging the growth potential (Kenney & Zysman, 2016; Mohammed & Sundararajan, 2023). Finally, social and environment impacts such as creation of job opportunities, community building and sustainability serve as additional insight to the broader impact of technology entrepreneurship on the development of the economy and the society (Drucker & Maciariello, 2014; Mohammed, 2023).

2.2 Theoretical Framework

The theoretical foundation of this study is built on three complementary theories; the Technology Acceptance Model (TAM), the Resource Based View (RBV) Theory and the Innovation Diffusion Theory (IDT). These frameworks are important regarding providing a robust lens to comprehend the adoption of new computing technologies and their impact on growth of technology entrepreneurship.

Technology Acceptance Model (TAM): Davis (1989)

TAM provides a framework for understanding how individuals in this case, entrepreneurs and startup teams - perceive, accept and utilize new technologies. The model focuses on two determinants that have an impact on choices for adopting a technology: perceived usefulness and ease of use (Davis, 1989; Compeau, Higgins, & Huff, 1999). In the case of technology entrepreneurship, TAM is useful in understanding the reason behind adopting cutting-edge computing technologies by startups such as AI, IoT, blockchain, and cloud computing and how high its adoption translates to better performance and efficiency in business operation (Mohammed, 2023; Shahadat et al., 2023). TAM also involves giving insight into barriers to adoption such as technology anxiety or lack of digital literacy or the perception of being complex which are especially relevant for entrepreneurs operating in developing economies such as Nigeria and West Africa (Meuter, Ostrom, Bitner, & Roundtree, 2003).

Resource-Based View Theory (RBV): Wernerfelt (1984), Barney (1991)

The RBV theory revolves around how firms can get sustained competitive advantage through unique internal resources and capabilities. In regard to technology entrepreneurship, technological capabilities such as access to computing infrastructure, software development expertise, data analytics capabilities, cybersecurity measures, etc., are some of the crucial resources that stand at the forefront between entrepreneurs in competitive markets, referring to Powell & Dent-Micallef (1997). RBV discusses the effective integration of the novel computing technologies to increase the innovation capacity, market responsiveness and scalability of a venture. Using these technological resources in a strategic alignment can enable startups to not only survive but thrive in highly dynamic global and local environments (Chesbrough, 2003; Mohammed & Sundararajan, 2023).

Innovation Diffusion Theory (IDT): Rogers (2003)

IDT complements TAM and RBV in that it gives a framework for how understanding the spread and adoption of innovations in a population or ecosystem. It gives emphasis to the roles to relative advantage, compatibility, complexity, trialability and observability in technology diffusion (Rogers, 2003; Fitzgerald et al., 2014). In the case of technology entrepreneurship, IDT is particularly useful in comprehending the distribution of the adoption, collaboration, and ecosystem development of new computing technologies, such as artificial intelligence (AI), cloud computing platforms and blockchain technology to the startup, incubator, and regional innovation network (Kenney and Zysman, 2016; Mohammed, 2023). The latter theory is also utilized to put the variations in the rates of adoption of technologies of one market by another (i.e. developed and developing markets) in perspective and indicates the influence the factors like infrastructure, regulatory structures, and social norms have on the diffusion processes.

Rationale for Theory Selection

The selection of TAM, RBV and IDT assure a general approach to the study. TAM directly deals with the behavioral and perceptual elements in accepting technology by the technology entrepreneurs characterized as they are vital in expanding understanding of individual-level technology acceptance of upcoming computing technologies. RBV moves this thinking to the organizational level, where it is shown that technological resources and capabilities inside the company are both sources of competitive advantage as well as sources of sustainable growth. IDT, meanwhile, offers the eco-system-level perspective, or in other words it tells us something about the spread of innovative computing technologies throughout entrepreneurial networks and what impact will that have on market-wide transformations. Collectively, these theories allow for a multi-level consideration of the influencing factors of technology adoption and their subsequent impact on the growth, sustainability, and scale of technology entrepreneurship, especially focusing on Africa and other emerging markets (Mohammed, 2023; Kenney & Zysman, 2016; Ács, Szerb, & Autio, 2017).

2.3 Linkages between Theories, IV, and DV

The conceptual relations between the independent variables, Emerging Computing Technologies (IV1) and Technology Adoption (IV2) and the dependent variable Growth of Technology Entrepreneurship (DV) are based on integrative approach of RBV, TAM and IDT. These connections provide a theoretical rationality of the idea to understand the role that technological innovations have in the development and growth of the ecosystems in entrepreneurship.

Emerging Computing Technologies and Entrepreneurial Competitiveness (RBV)

The Resource-Based View (RBV) also focuses on the idea that sustainable competitive advantage comes from the ownership and strategic use of valuable, rare and inimitable resources (Wernerfelt, 1984; Barney, 1991). Such strategic resources, in the context of implementing technology entrepreneurship, are emerging computing technological resources like artificial intelligence (AI), cloud computing, blockchain, internet of things (IoT), and advanced data analysis. Through them, the startups will be able to enhance their innovation capacity, be more efficient, develop differentiated products and services, and gain a competitive edge in the local and global market (Chesbrough, 2003; Powell and Dent-Micallef, 1997; Kishor, 2023). This connection is done to demonstrate that IV1 contributes directly to amplifying the core capabilities of tech ventures in order to drive growth in size, sustainability, and long-term.

Technology Adoption and Entrepreneurial Growth (TAM)

Technology Acceptance Model (TAM) explains the influence of the perceived usefulness and perceived ease of use of new computing technologies on the decision of whether to accept them or not by an entrepreneur (Davis, 1989; Compeau, Higgins, and Huff, 1999). When startups see the potential benefits of technologies like the cloud-based platform, decision tools powered by artificial intelligence, or blockchain systems, they are more likely to integrate technologies like these into their operations. This adoption results into increased productivity, acceleration of market access, and more innovation output which is at the positive aspect of the growth of technology entrepreneurship (Mohammed, 2023; Shahadat et al., 2023). TAM also aids in comprehending the obstacles in developing regions, including technology anxiety, lack of digital infrastructure or lack of skills that can moderate the effectiveness of IV2 in driving DV (Meuter, Ostrom, Bitner, & Roundtree, 2003).

Innovation Diffusion and Adoption Patterns (IDT)

Innovation Diffusion Theory (IDT) focuses on the spread of new technologies through social and organizational network relationships which will affect technology adoption and group behavior (Rogers, 2003; Fitzgerald et al., 2014). In entrepreneurial ecosystems, the information about new computing technologies is spread through knowledge sharing, collaboration, and demonstration of working use cases. Startups see which practices early adopters are using and adopt technologies in ways that improve their market posturing and growth prospects. IDT thus affords a mechanism to gain an understanding of the influence that IV1 and IV2 have not only on DV at the individual firm level but also at a more macro level in terms of startup communities and innovation clusters (Kenney & Zysman, 2016; Ács, Szerb, & Autio, 2017).

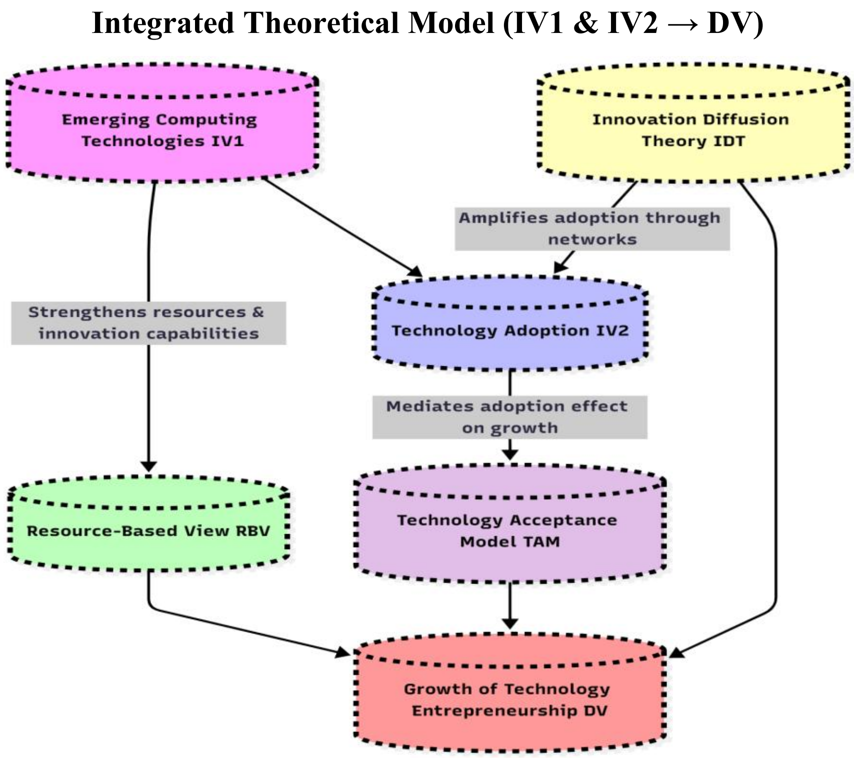

Figure 2.1: Integrated Theoretical Model of Emerging Computing Technologies and Technology Entrepreneurship

Source: Mohammed, A. (2023); Kenney, M., & Zysman, J. (2016); Ács, Z. J., Szerb, L., & Autio, E. (2017); Shahadat, M. H., Nekmahmud, M., Ebrahimi, P., & Fekete-Farkas, M. (2023).

The diagram shows the dynamic interplay between Emerging Technologies of Computing (IV1) and Technology Adoption (IV2) in driving the Growth of Technology Entrepreneurship (DV). IV1 directly builds up the internal resources and innovation competence, which is emphasized in the Resource Based View (RBV), which provides a foundation for sustainable competitive superiority. IV2 mediates the impact of IV1 on entrepreneurial growth via the adoption behaviours guided by Technology Acceptance Model (TAM), which emphasises the concepts of perceived usefulness, ease of use, and also readiness of the organisation as the key factors to be determined. The Innovation Diffusion Theory (IDT) improves on this process by bringing technology adoption through network effects and learning, to achieve the ecosystem-wide scalability and sustainability. Collectively, the model conceptualises a multi-level pathway that blends the combination of technological resources, adoption practices and diffusion patterns of technology to establish and enable successful venture creation, market expansion and resilience of tech startups with relevance for the entrepreneurial context of the world, Africa, West Africa, and Nigeria (Mohammed, 2023; Kenney & Zysman, 2016; Aces, Szerb, & Autio, 2017; Shahadat et al., 2023).

2.4 Empirical Review

Empirical studies have continually pointed out the role of new computing technologies, which are changing entrepreneurial performance. Research shows that technologies like Artificial Intelligence (AI), cloud computing, internet of things (IoT) and blockchain greatly improve the innovation ability, operational efficiency and market responsiveness of firms (Chalmers, MacKenzie, & Carter, 2021; Kishor, 2023; Kenney & Zysman, 2016). For example, the AI Applications in Startups feature has proven to optimise the decision-making process, resources, predictive analytics, and have helped startups to grow and become competitive in the market. Cloud computing and edge technologies, on the other hand, offer the opportunity to access high-performance and scalable infrastructure, giving the startups access to cutting-edge computing resources without requiring significant capital investment, promotes innovation and enables timely implementation of digital products and services. (Mohammed, 2023; Shahadat et al., 2023). Similarly, blockchain technology has been associated with better trust, transparency and efficiency in transactions, which are crucial when it comes to digital marketplaces and fintech ventures (Kennedy & Zysman, 2016). Technology adoption has become an important aspect in deciding the scalability of a startup and entrepreneurial growth. Studies formed by the Technology Acceptance Model (TAM) and Innovation Diffusion Theory (IDT) propose that perceived usefulness, ease of use and social influence play a significant role with startups adopting new computing technologies (Davis, 1989; Rogers, 2003).

In developing economies, the rate of adoption is frequently determined by organizational readiness, managerial support and access to digital infrastructure. Based on the evidence from West Africa, Nigeria and other brand new regions in every developing region, it is reported that startups that actually followed and adopted AI, cloud solution and other verging technologies have reported their elevated market penetration, improved operational processes and sure innovation pipeline (Mohammed, 2023; Shahadat et al. 2023). However, there can be challenges in adoption in the form of technology anxiety, high costs of technology implementation, and a shortage of technical expertise that may hinder the adoption process, thus importance of facilitating complementary policies and capacity development initiatives. Several studies on a regional level reinforce the importance of new computing technologies in developing digital entrepreneurship in developing countries. In Africa, it has been found that technology-oriented startups get to benefit from the access to cloud-based platforms and digital ecosystem that allow them to compete against more established firms worldwide (Shahadat et al., 2023). Asian researches indicate that IoT and AI integration has improved the value of products, delivering services, and performing tasks efficiently, leading to entrepreneurial growth (Chalmers et al., 2021). Likewise, data indicate that South America experienced the growth of financial inclusion, trust and transparency, an initiative that can promote the growth of scalable digital ventures by adopting blockchain resources and data analytics (Kenney and Zysman, 2016).

All these empirical findings reveal the place of combination of emerging computing technologies and sound strategies of adoption in a manner that increases sustainability of growth, scalability and competitiveness of technology-related entrepreneurship in the global, regional and local landscape.

2.5 Research Gap

Even though more and more literature is available on technology entrepreneurship, gaps in the direct influence of emerging computing technology on the growth of the entrepreneurship remain enormous. Majority of the studies have been biased in the sense that they have examined individual technologies i.e. AI, cloud computing, or blockchain, alone without developing inclusive models that would connect the technologies to innovation capability, market expansion and scalability of the venture. A lack of unified frameworks that combine numerous aspects of technology use and entrepreneurial performance hinders the idea of how these aspects are combined to achieve a sustainable growth (Mohammed, 2023; Kenney and Zysman, 2016). This gap indicates that research should be conducted through which the avenues through which new technologies are used in adding value to technology based entrepreneurship are conceptualized on a collective basis.

On the aspect of contextual gaps, research is leaning more towards developed economies over comparatively less studies done to developing economies and areas of Africa, Asia and South America. Although it has some evidence in Nigeria and West Africa, it has been so far sporadic and typically concentrated on the empirical researches on the use of the technologies instead of a conceptual investigation of the nature of the connection between computing technologies and the entrepreneurial performance (Shahadat et al., 2023; Mohammed, 2023). This fact of decontextualized research reduces the significance of translated results to the emerging economies where such factors as the insufficiency of the infrastructures, substitution of the existing skilled working-force, and the unfavorable regulatory climate may make a very tangible difference in the rate of technology adoption and businesses development. Understanding these local dynamics is critical in design technologies to foster entrepreneurship via technologies in these regions and build-support mechanisms.

There are also some significant theoretical and methodological gaps. There have been very few studies done which applies a multi-theory approach by integrating Technology Acceptance Model (TAM), Resource Based View (RBV), and Innovation Diffusion Theory (IDT) to explain the adoption and impact on entrepreneurship by emerging technologies. Most previous research is based on monotheory frameworks or case-dependent research which has implications for explanation as it is not very powerful to explore asymmetric interactions between technology, organizational capability and entrepreneurial outcomes (Davis, 1989; Rogers, 2003; Wernerfelt, 1984; Barney, 1991). Additionally, approaches to methodology tend to be dominated by empirical surveys and quantitative studies, with minimal conceptual/theoretical studies that aggregate existing evidence into a holistic model. Addressing these gaps can offer a more subtle picture of the pathways that connect emerging computing technologies, the effects that behaviours of adoption have on entrepreneurial growth, especially in a developing context such as Nigeria, the wider West Africa and other emerging markets.

2.6 Conceptual Framework of the Study

This study suggests a conceptual framework on the basis of which the Emerging Computing Technologies (IV1) and Technology Adoption (IV2) influence the Growth of Technology Entrepreneurship (DV) IV1 involves technologies like AI, IoT, cloud computing and blockchain that improve internal resources, innovation capability and efficiency. IV2 represents the adoption behaviors and processes which mediate the effective use of these technologies that is influenced by factors such as perceived usefulness, ease of use, organizational readiness and network diffusion patterns. The framework emphasizes the importance of success of technological resources and their integration process into adoption and entrepreneurship ecosystems is paramount in achieving success in achieving its global, African, West African, and Nigerian contexts of attainment of growth with scalability, sustainability, its competitive advantage (Mohammed, 2023; Kenney, & Zysman, 2016; Shahadat, et al., 2023; Acs, Szerb, and Autio, 2017).

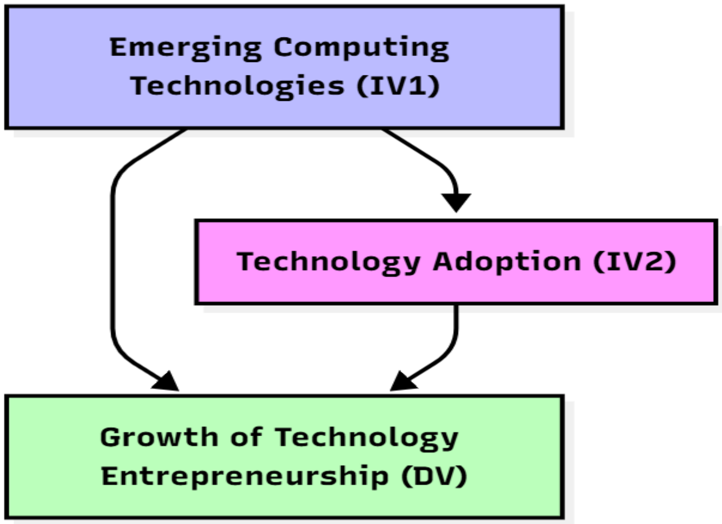

Figure 2.1: Conceptual Framework Linking Emerging Computing Technologies, Technology Adoption, and Entrepreneurial Growth

Source: Aaccording to Mohammed (2023), Kenney and Zysman (2016), Shahadat et al. (2023), Acs, Szerb, and Autio (2017).

Conceptual framework offers a two-fold channel of influence of the new computing technologies on the development of technology entrepreneurship. IV1 (Emerging Computing Technologies) has a direct impact on the entrepreneurial performance based on the enhanced innovation, efficient operation, and competitiveness. IV2 (Technology Adoption) is a facilitator towards the potential of technologies transforming into the quantifiable growth outcomes through cross work which guarantees effective implementation and use of technologies. The framework further emphasizes that the adoption is determined by individual and organizational factors and network diffusion, which is consistent with TAM and IDT principles. By merging these pathways, the model brings to light sustainable entrepreneurial development in developing areas not only relies on access to cutting-edge technology, but also on strategic way of adopting and ecosystem incorporating, allowing entrepreneurs to scale, innovate and compete effectively in both local and global markets.

3.0 Research Methodology

This research has adopted a conceptual research approach and focuses on the process of synthesizing existing knowledge, theories, and empirical findings in order to create a coherent framework about the relation between emerging computing technologies, technology adoption, and the growth of the technology entrepreneurship. As a conceptual paper, it does not entail primary accountability gathering, however in any other way, but emphasizes on a real-time detailed examination of existing literature to make theoretical associations between and to identify through patterns, gap, and practical implications entailing the multiple technology-abled entrepreneurial ecosystems across the globe, however with a more prominent attention to Africa, West Africa, and Nigeria (Mohammed, 2023; Kenney & Zysman, 2016). The literature selection strategy used was a systematic review of peer-reviewed publications from journals, conference papers and authoritative reports from international, regional and national sources. Databases such as Scopus, Web of Science, Google Scholar and specialized databases on business and technology databases were used. Keywords were "emerging computing technologies", "technology adoption", "digital entrepreneurship", "startup growth", "Africa", "Nigeria", "entrepreneurial ecosystem".

Inclusion criteria included studies that were relevant to the interest in technology entrepreneurship, digital innovation, and emerging technologies, while exclusion criteria excluded publications that were unrelated to the technological and entrepreneurial context of interest (Shahadat et al., 2023; Ács, Szerb, & Autio, 2017). A conceptual and thematic analysis approach was applied in order to come up with a synthesis of the selected literature. Themes were identified around new technologies in computing, technology adoption processes and indicators of entrepreneurial growth. The analysis combines information from several theoretical perspectives such as the Technology Acceptance Model (TAM), Resource Based View (RBV) and Innovation Diffusion Theory (IDT) to build a consistent conceptual framework. This methodology enables flexible understanding of the weightiness of technological resources, adoption behaviors, and network diffusion from the sustainable and scalable growth in technology entrepreneurship especially developing economies where empirical studies are still limited (Mohammed, 2023; Kenney and Zysman, 2016; Shahadat et al., 2023).

4.0 Findings of the Study

1. Emerging computing technologies play an important role in increasing the growth of technology entrepreneurship as a result of improvement in innovation capacity, efficiency in operations, and increased access to global digital markets. Technologies such as Artificial Intelligence (AI), cloud technology, big data analytics, and digital platforms are advancing the development of products and products that can scale business models and enhance competitive positioning in the global, African, West African and Nigerian entrepreneurial ecosystems.
2. Software engineering best practices are an important factor in the continuing growth of entrepreneurs as agile techniques, DevOps, secure coding, and a good software lifecycle can improve the quality of the products, reliability of the systems, and customer satisfaction. These procedures are favourable to the assurance of swift innovation, to diminish operational risks, as well as to improve long term viability of technology based undertakings.
3. There are a number of determinants of technology use in entrepreneurial businesses, viz. organizational preparedness, managerial capability, apparent utility, ease of use and facilitating digital contexts. The better performance outcomes of emerging technologies and good performance are likely to be achieved by the startup that manages to incorporate the adoption enablers effectively.
4. Adoption of technology is positively relevant towards sustainability of businesses with some businesses becoming more economic, environmental mindful of their digital business and socially inclusive business models. Since the start-ups adopt advanced technologies, they expand the markets coverage, but reduce wastage in operations and improve engagement with the stakeholders, which has contributed in establishing sustainable business on all viewpoints.
5. The Nigerian and West African technology entrepreneurship is characterized with both threats and opportunities that include infrastructural challenges, the absence of adequate funding, cyber threats, and skill set deficiency. Yet, there are good prospects of sustainable technology-driven entrepreneurship development in the region in the light of increased investment in digital infrastructure, increased involvement of the youth in ICT, and increasing number of innovation hubs.

5.0 Recommendations of the Study

1. It is against this that tech startups ought to assume a prudent measure in the direction of the new world of computing technologies, which, to a substantial degree, involves the use of cloud applications, artificial intelligence devices, and the application of safe software engineering standards, to contribute to novelty, scalability of products, and enhanced operation. The entrepreneurial activities need to include capacity building programs on agile development, DevOps and cyber security.

2. Institutionalization of such processes as continuous integration, automated testing, secure coding and sound practices of documenting processes should be introduced by the entrepreneurs in order to enhance software engineering processes. These projects will result into an improved confidence of products and establish ventures with long term viability.
3. Startups will have to make organizations more organizationally prepared to embrace technology by investing in digital strengths, managerial education and facilitating cultures of leadership where experimentation, innovation and evidence-based decision-making is promoted. Enhancement of internal capacity will result in an increase in the adoption and business performance.
4. The policy makers ought to assist in making business sustainable using technology by: enhancing availability of technologies of broadband, subsidization of digital tools, grant of innovations as well as environmental and social sustainability initiatives. The regulatory environments would be required to facilitate safe online transactions and to spur AI implementation and technology transfer throughout the industries.

The stakeholders in West Africa and Nigeria should aim at making the contextual challenges practical through battling digital literacy initiatives, incubators and accelerators, cyber infrastructures and enhancing cooperation between academia, industry and government. Such moves will be providing avenues to sustainable and competitive technology entrepreneurship opportunities in the region.

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