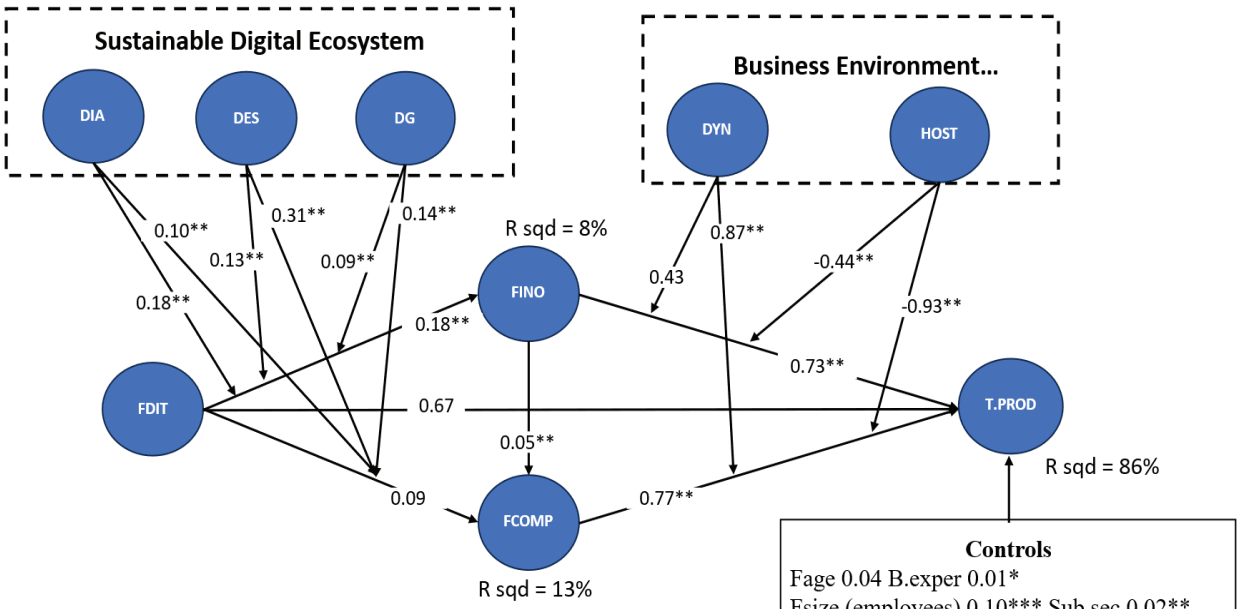
Leveraging the Digital Ecosystem for Improved Competitiveness and Productivity: Evidence from Manufacturing Entreprises in Tanzania

Mutaju I. Marobhe and Jonathan P. Kansheba



Model fit: Chi-square = 1235.016, df = 689, CFI= 0.93, TLI= 0.91, RMSEA=0.042, SRMR=0.066. Observations= 944. *, **, and *** = Statistical Significance at 10%, 5%, and 1% respectively

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ABSTRACT

The study employs the Crepon-Duguet-Mairesse (CDM) (1998) model to investigate the effects of digitalization on productivity, innovation, and competitiveness in manufacturing organisations. Eight regions were conveniently chosen to include Small and Medium Enterprises (SMEs) functioning in the main manufacturing sub-sectors namely: Dar es Salaam, Morogoro, Dodoma, Arusha, Kilimanjaro, Mwanza, Mbeya, and Iringa. To understand digitalization discrepancies caused by diverse digital ecosystem conditions, it was essential to study the phenomena in cities and towns of various sizes with respect to urbanization and population. First, the relationship between digitalization and innovation and competitiveness was assessed. Second, in accordance with CDM model for the innovation component, an analysis of the effects of innovation and competitiveness on productivity was carried out. The study also examined the degree to which the innovation-promoting advantages of digitalization are moderated by the sustainability of the digital ecosystem. In Addition, the moderating effects of the business environment on the relationships between productivity, innovation and competitiveness were evaluated. The use of structural equation modelling (SEM) allowed for a comprehensive analysis of the interactions between the variables. The primary findings indicate that there is no statistically significant relationship between productivity and digitalization. However, the findings suggested that the relationship between productivity and digitalization was mediated by innovation and competitiveness. The results also show that the benefits of digitalization for innovation and competitiveness are amplified by a sustainable digital ecosystem. It was further found that dynamism in the business environment had a favourable impact on productivity, whereas hostility had a negative moderating effect on the linkages between innovation, productivity, and competitiveness. The study has significant theoretical and practical implications for digital service providers, SMEs in the manufacturing sector, and policymakers.

CHAPTER ONE
INTRODUCTION

1.1 Rationale for the Research Project

In an era marked by rapid technological advancements, the transformative impact of digitalization on business operations has become a global phenomenon. This impact is particularly profound in the manufacturing sector, which has historically been a cornerstone of economic growth and innovation. As industries worldwide grapple with the pressures of globalization and increased competition, the adoption of digital technologies offers a strategic advantage by enhancing productivity, competitiveness, and innovation (Gaglio et al., 2022). Digitalization in manufacturing entails integrating digital technologies (e.g., cloud computing, big data analytics, the internet of things, artificial intelligence and machine learning, blockchain, robotics and automation, 3D printing, mobile technologies) into all aspects of business operations and value chain. This integration enables manufacturers to achieve significant efficiencies, improve product quality, and reduce time-to-market, thereby fostering new revenue generation opportunities and enhancing market responsiveness (Björkdahl, 2020). For example, European firms have reported a productivity boost of 3.5% by leveraging digital innovations (Borowiecki et al., 2021).

However, the benefits of digitalization are not uniform across all geographies. In developing countries, particularly in sub-Saharan Africa, the manufacturing sector faces distinct challenges that impact the adoption and outcomes of digital technologies. For instance, with manufacturing sector contributing 8% to its GDP (Tanzania Investment Centre, 2022), Tanzania stands at a pivotal point where digitalization could significantly influence its economic trajectory. Despite this potential, the adoption and impact of digital technologies in Tanzanian manufacturing are still nascent, hindered by factors such as inadequate digital infrastructure and limited technical expertise. Furthermore, uneven Tanzanian digital landscape (discussed in detail in the next chapter), adds up to the complexity of the phenomenon in the country. While there is considerable progress in urban areas, rural areas, which are pivotal to manufacturing sector as raw materials producers are still lagging behind, thereby creating disparities in digital adoption and benefits. Moreover, the focus on large firms in existing research overlooks the role of SMEs, which are the backbone of Tanzania's manufacturing sector. These SMEs face unique challenges, including limited access to advanced digital tools and technologies, which stifles their ability to compete on a larger scale.

This backdrop sets the stage for this study, which seeks to unearth the nuanced impacts of digitalization on productivity of manufacturing SMEs in Tanzania, exploring how digital tools can be leveraged to overcome regional disparities and industry-specific challenges. By focusing on the interconnected roles of digital ecosystems and

business environments, this research aimed to provide a detailed understanding of how digitalization can be a game-changer for the Tanzanian manufacturing sector.

1.2 Problem Statement and Initial Research Questions

While studies have shown digitalization's potential to enhance productivity and competitiveness in developed economies (Borowiecki et al., 2021), less is known about how these dynamics play out in less developed and emerging regions. This knowledge gap is further justified by the lack of comprehensive studies that examine the interaction between digitalization and firm capabilities in environments characterized by economic and infrastructural constraints typical of many Sub-Saharan African countries. Moreover, while existing studies predominantly focus on large companies (Guo et al., 2023), SMEs, which are pivotal to manufacturing in developing economies like Tanzania, remain under-researched. SMEs face unique challenges such as inadequate access to digital technologies, limited infrastructure, and a scarcity of skills necessary to leverage digitalization effectively, directly impacting their innovation and competitiveness in the global market. Thus, this study uses Tanzanian context, a country at the cusp of a digital revolution but facing unique challenges such as limited digital infrastructure and skills (United Nations Conference on Trade and Development, 2021). Moreover, it explores the moderating effects of business environmental factors like dynamism and hostility, which have been noted to influence digital transformation outcomes (Agostini et al., 2020) but are less studied in the Tanzanian context. This study provides tailored insights into how digital ecosystems can bolster manufacturing SMEs' productivity through strategic interventions. These interventions are essential for harnessing digital technology's potential to drive sustainable industrial advancement and economic resilience in developing contexts.

1.3 Research Questions

The overall objective of this study was to explore the role of digital ecosystem in fostering manufacturing SMEs' competitiveness and productivity in Tanzania. Moreover, the study aimed at achieving the following specific objectives:

a) To assess the extent to which business digitalization affects firms' innovation, competitiveness, and productivity.
b) To examine the role of sustainable digital ecosystem on the nexus between firms' digitalization, innovation, and competitiveness.
c) To examine the role of business environmental dynamism and hostility on the nexus between firms' innovation, competitiveness, and productivity.

In achieving the above objectives (goals), this study responded to the following research questions:

a) How does business digitalization influence firms' innovation, competitiveness, and productivity?
b) How does a sustainable digital ecosystem influence the role of business digitalization in firms` innovation and competitiveness?
c) How do business environmental dynamism and hostility influence the role of firms` innovation and competitiveness in firms` productivity?

1.4 Expected Contributions to Knowledge and Policy

Despite the novelty of "digitalization-innovation-competitiveness-productivity" nexus to the economic theory and research, the topic has for long received scant scholarly attention particularly in the developing world. As of late, there has been a keen interest among researchers to study the subject. Much of these studies, however, have presented evidence to show how digitalization affects manufacturing firms' performance through improved innovation in the developed contexts e.g. Sweden, China, Spain and Netherlands (Zhai et al., 2022; Martín-Peña et al., 2020; Jardak and Ben Hamad, 2022; Borowiecki et al., 2021). The phenomenon has seldom been studied in the developing countries such as Tanzania. Few recent studies (e.g., Gaglio et al., 2022) shed scholarly light on the topic in South Africa (upper middle-income country). While all the studies stress the innovation aspect and its influence on firms' performance, it is novel to explore its nexus with other phenomena such as firms` competitiveness and productivity.

Moreover, the project took a holistic approach by examining the moderating effects of digital ecosystems and business environment on the linkages between digitalization, innovation, competitiveness, and firms' productivity. Digital ecosystem refers to a network of informal and formal technology actors e.g. customers, suppliers and data service providers that interact digitally to mutually create value. Evidence shows that places with sustainable digital ecosystem attract talents, encourage creativity, and disruptive thinking (Deloitte, 2022). On the other hand, the nature of business environment in terms of its dynamism, heterogeneity, and hostility has potential effects on firms` innovation and competitiveness (Grama-Vigouroux et al., 2022). The findings of this project offer vital insights to policymakers and practitioners in building and capitalizing on a sustainable digital ecosystem for improved productivity in a context of changing business environments.

CHAPTER TWO
LITERATURE REVIEW

2.1 The Overview of Tanzania's Manufacturing Sector Landscape

Since gaining independence in 1961, Tanzania's industrial sector has progressed through several phases: from its early stages of development and lack of diversification to state-led import substitution industrialization and finally to de-industrialization that followed structural adjustment programmes and policy reforms (Wangwe et al., 2014). The Sustainable Industrial Development Policy (SIDP) 1996 - 2020 outlined the government's intention to gradually withdraw the public sector from productive endeavours, thereby enabling the private sector to assume the primary role in driving economic expansion (Ministry of Industry & Trade, 2011). Despite the successful transition from the public to the private sector facilitated by SIDP, the manufacturing sector in Tanzania is still in its nascent phase and has not yet emerged as a pivotal driver of self-sustaining economic growth.

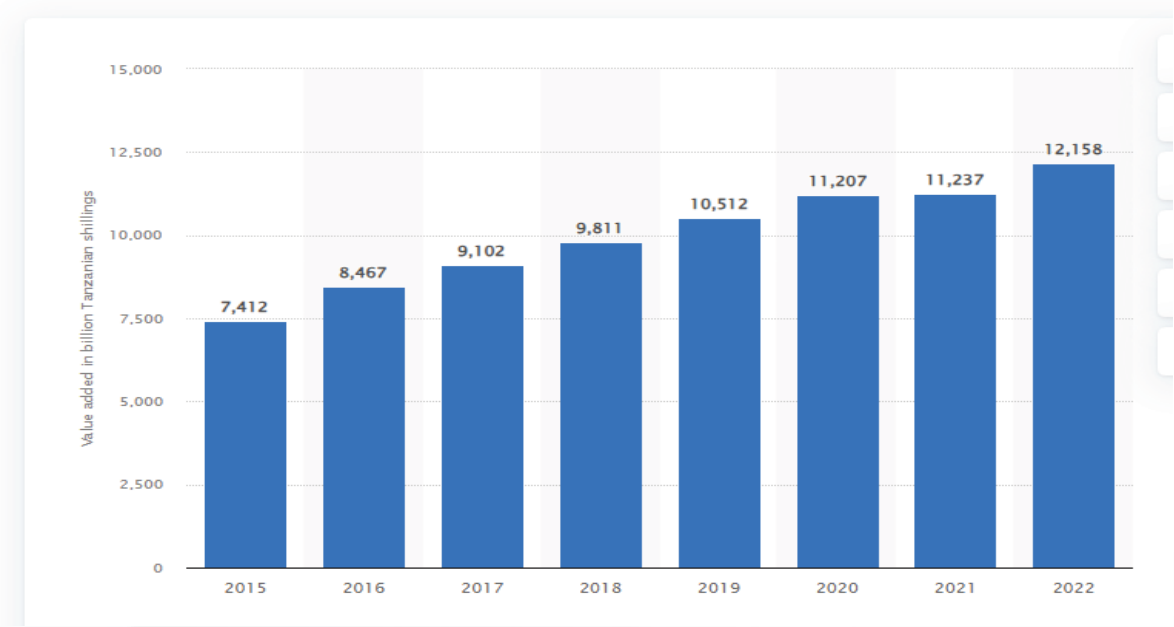
The Tanzania National Development Vision 2025 (TDV 2025) acknowledges the manufacturing sector's pivotal position in the country's economic transition from an agrarian-based economy reliant on weather and market conditions to a self-sufficient semi-industrial economy. Accordingly, by the year 2025, the government aims at creating a strong, diversified, resilient and competitive economy, which can effectively cope with the challenges of development, and which can also easily and confidently adapt to the changing market and technological conditions in the regional and global economy. In line with these objectives, the Tanzania Long Term Perspective Plan 2011/2012-2025/2026, which serves as the foundational blueprint, underlines industrialization as a primary policy objective. This strategic emphasis is designed to elevate Tanzania to middle-income status by enhancing its industrial capabilities and infrastructure.

The plan not only aims to augment the manufacturing sector's capacity but also focuses on value addition in both traditional and non-traditional industries. Moreover, it advocates for strengthening linkages between agricultural production and industrial processes to ensure steady supply of raw materials and promoting sustainable practices. Moreover, this guiding tool to TDV 2025 stress on the need for the development of human capital through education and vocational training, tailored to meet the demands of a burgeoning industrial economy. In addition, the plan highlights the importance of fostering a conducive business environment that attracts domestic and foreign investments, essential for the technological upgrades and capital infusion necessary for industrial advancement. Literature that places industrialization at the core of economic transformation, employment, and development (Martorano et al., 2017), is consistent with this national industrialization initiative. Although Tanzania's manufacturing sector remains relatively modest in scale, it contributes significantly to

the country's gross domestic product (GDP). The sector has contributed an average of eight percent to GDP and expanded at an annual rate of four percent over the past ten years (Figure 1). (International Trade Administration, 2021). The manufacturing sector of Tanzania generated USD 4.1 billion (eight percent of GDP) in 2018, a 39% increase from USD 3 billion in 2014 (eight percent of GDP). As agriculture serves as the fundamental pillar of the Tanzanian economy, the refining of domestic agricultural products dominates the manufacturing sector (Tanzania Invest, 2018).

The sector generates a small number of low-value basic commodities with minimum processing of agricultural or resource raw materials, making up the majority of its narrow product range (The African Development Bank Group, 2014). It is comprised primarily of the following: food processing (24%), textiles and apparel (10%), chemicals (8.5%), beverages, leather and leather products, paper and paper products, publishing and printing, and plastics, among others. With fewer than ten workers per firm, microenterprises make up 97% of manufacturing firms; the majority of these are unofficial businesses. Geographically, approximately 50% of manufacturing is cantered in Dar es Salaam, along with other major cities like Arusha and Mwanza while the remaining proportion is distributed in the other regions

Figure 1 *Contribution of manufacturing sector to Tanzanian GDP*



Source: Statista (2024)

Primary commodities account for most Tanzania's exports, which increased significantly between 2000 and 2010 at a rate of roughly 31% annually owing to the super-commodity cycle that ran from 2000 to 2014. Tanzania's primary exports consist of agricultural commodities, the most significant of which are tobacco, coffee, cotton, cashew nuts, tea, and cloves. Among the additional exports are manufactured products and gold. Germany, India, Japan, China, the United Arab Emirates, and the Netherlands

are Tanzania's principal export partners. Despite this expansion, rigorous standards prevent much penetration into export markets in North America and Europe (ADBG, 2014).

Over the years, the Government of Tanzania have taken steps to boost investment and productivity in the manufacturing sector to strengthen the industry. These strategies include the creation of Export Processing Zones (EPZ) and Special Economic Zones (SEZ), infrastructure and service development, attracting foreign direct investment (FDI), and improving business conditions and promoting macroeconomic stability (Ismail & Lwesya, 2021). Notwithstanding these efforts, challenges persist that impede the nation's capacity to grow a manufacturing sector that is competitive. For thirty years, the manufacturing sector's GDP share has remained around 10%, a significant variance from Tanzania's Industrial Development Strategy of 2011's that aims of 23% by 2025. Furthermore, a small number of capital-intensive firms generate much of the manufacturing value added, while informal manufacturing has expanded employment without appreciably raising wages or productivity (Diao et al., 2021). Above all, the Government of Tanzania's manufacturing policy implementation capacity is hampered by an unfavourable regulatory environment, insufficient financial resources, and ineffective coordination among ministries, departments, and agencies (Kweka, 2018). The competitiveness of firms is primarily impacted by external factors, including exorbitant expenses, insufficient accessibility of intermediate inputs and quality raw materials, qualified labour, and affordable financing.

2.2 The Digitalization Landscape in Tanzania

Tanzania is currently experiencing a digital revolution, characterized by a growing internet user base, improved accessibility to critical services, and increased productivity in diverse industries. Mobile technology is a major driver of Tanzania's digital transformation with a total of 57.42 million cellular mobile connections being active in early 2023, with this figure equivalent to 86.4 percent of the total population (GMSA, 2023). To accelerate progress toward attaining the Tanzania Development Vision 2025, which seeks to transform the country from a low-productivity agricultural economy to a knowledge-based, semi-industrialized middle-income economy, Tanzania initiated the Second Five-Year Development Plan (FYDP II) in 2016. FYDP II prioritizes the role of digital technologies in advancing development objectives, in accordance with the National ICT Policy 2023. This policy establishes a structure for the expansion of the ICT sector and encourages socioeconomic progress within the nation.

An examination of Tanzania's digitalization efforts can be conducted by utilizing the framework of the Digital Tanzania Project (DTP), which is administered by the Ministry of Communication and Information Technology (MCIT) (MCIT, 2021). By enhancing the government's capability to provide digital public services, the DTP aims to expand access to high-quality internet services for citizens and the government in specific regions. Components of the proposed programme include the following:

a) Digital Ecosystem

I. *Digital Enabling Environment (Refurbishment of ICT Equipment, Establishment of the National ICT Professional and Innovation Centre, and Scanning of the ICT Regulatory Environment);*

II. *Establishment of an Infrastructure to Facilitate E-Commerce and National Development (Promotion of the National Statistical Information Management System, Improvement of the National Addressing and Postcode System, and National E-Commerce Initiatives).*

b) Digital Connectivity

i. *Connected Government—By expanding the Government Communication Network and augmenting the capacity of the Government Bandwidth, this initiative aims to link all unserved MDAs and LGAs to high-speed broadband.*

ii. *Rural Broadband for Development entails the augmentation of mobile coverage in rural areas, the migration from 2G to broadband to facilitate connectivity, and the utilization of spectrum vacant space.*

c) Digital Platforms and Services

I. *Productivity Platforms and Digital Services (Huduma Pamoja Centres, One-Stop Service Centres) across all regions (facilitating in-person transactions and providing access to public online services; promoting the transition from a traditional to a digital economy).*

II. *Improvement of Data Centre Infrastructure to Support the Data Centre (iii) Digital Literacy and Capacity Building (Citizen Digital Literacy and Awareness Program and Government ICT Cadre Training Programme).*

Tanzania is in a good position to join the global digital economy because of its expanding economy, strategic location, and quickly evolving innovation ecosystem. Large-scale public investment initiatives, ongoing FDI, and rising public awareness of emerging technologies like mobile money are all anticipated. The government has put in place e-government services, such as the government electronic payment gateway (GePG), which enables all government agencies to use a single payment platform, and a government site for public services. In addition, Zanzibar has adopted e-government services, such as the Zanzibar Business and Property Registration Agency's Online Business Registration System (BPRA). By liberalizing the telecoms industry, Tanzania has advanced its mobile broadband coverage, and the National ICT Broadband Backbone links metropolitan areas and regional offices. As a result, there is now more coverage for mobile broadband, more e-government applications, and better service delivery in areas like birth and death registration, power, and water (GMSA, 2023). Urban mobile users can access 4G services, but rural communities, primarily rural ones, have limited 3G coverage.

Furthermore, Tanzania's stride towards industrialization, as envisioned in the TDV 2025, can harness significant synergies from its expanding digital capabilities. The pervasive influence of mobile technology and internet penetration sets a foundation for digital tools that catalyse industrial efficiency and innovation. National initiatives

such as development of ICT Professional and Innovation Centre foster an environment ripe for technological advancements and industrial growth. These digital initiatives have the potential to accelerate industrial activities by providing industries with tools for efficiency and innovation, like internet of things (IoT), artificial intelligence (AI) applications that optimize manufacturing processes and big data analytics that enhance decision-making. In addition, the integration of digital services across regions fosters a more inclusive economic environment, enabling rural industries to compete on a national and global scale. By harnessing its digital potential, Tanzania not only meets its industrialization targets more effectively but also ensures a sustainable transition into a competitive player in the global digital economy. This synergy between digital capabilities and industrial ambitions is pivotal for Tanzania to achieve its vision by 2025.

Despite these progresses, the Tanzania's digitalization efforts are hampered by a number of setbacks. The underfunding of backbone network infrastructure is one of them. With a goal of expanding to 15,000 km by 2025, the National ICT Broadband Backbone (NICTBB) has already installed 7,910 km of fibre. The network, particularly for cross-border communications, lacks enough loops to provide enough redundancy to withstand cuts. High rights-of-way costs further discourage investment (The World Bank, 2021a). In addition, the domestic market is small and income and digital literacy levels are minimal. Tanzanian consumers of ICT services are exceedingly price sensitive due to the country's low average income. This, coupled with intense competition in the mobile retail sector, has resulted in service providers earning low marginal revenues. Consequently, investments in infrastructure and services in rural regions, where the consumer base is insufficient to offset the low margins, are discouraged.

2.3 Firm's Digitalization and Productivity

The process of digitalization is having a profound impact on individuals' worldviews and is also forcing businesses to re-evaluate their approaches to product development and marketing (Schubert et al., 2023). In addition, it changes the approaches that businesses employ to generate, acquire, and distribute value, consequently causing a revolution in worldwide economies. It has been demonstrated that digital technologies like big data, cloud computing, and enhanced front-office operations that lower the expenses of communicating with suppliers and consumers boost productivity. According to recent data from the OECD, for example, a ten-percentage point rise in the sector-wide adoption rate of cloud computing is linked, after five years, to a 3.5 percent gain in productivity for average European firms (Gal et al., 2019).

By reorienting business strategy towards a customer-oriented perspective, digitalization can increase efficiency. This may increase product options and drive-up prices for better or more inventive items. To support new innovations, businesses must enhance their technical and market context-specific competencies in order to effectively absorb new digital business resources (Wang, 2021). Through the digitalization of the economic environment in which the company operates, new

markets are created in addition to enabling the creation of new goods for already-existing ones.

The scholarly literature has extensively examined the links between digitalization and firm productivity throughout the years. Productivity in this case, measures the efficiency of using resources to produce a specific outcome, while inputs, such as raw materials, equipment, and labour, are used in the production process, and the outputs and the results obtained are the outcomes of the production process (Dresch et al., 2018). Empirical evidence indicates that digital transformation significantly impacts the overall productivity of firms. This was demonstrated, for instance, in a study by Guo et al. (2023), which demonstrated how the productivity of Chinese companies increased when those companies invested in digitalization processes.

The survey of Dutch firms yielded comparable findings, indicating that the level of digital skill intensity positively and significantly affects the development of productivity at the firm level, particularly in the service sector and among younger firms (Borowiecki et al., 2021). According to Anderton et al. (2023), although digitalization increases productivity, not all firms experience productivity gains. The effect of digital investment is sector-specific and contingent on the firm's comparative productivity with rivals. Firms that are already more productive gain the most from digitalization, whereas those that are less productive have difficulty capitalizing on the prospective productivity gains.

Drawing from the Economic Development in Africa Report 2021 by United Nations Conference on Trade and Development, it is evident that digital technologies are key enablers of productivity and economic growth in developing countries, including Tanzania. The report emphasizes that digitalization in African industries, particularly in manufacturing, has facilitated significant improvements in productivity through enhanced supply chain management and streamlined production processes. The report also highlights challenges such as inadequate digital infrastructure and skills, which are pertinent to the Tanzanian context. This study aimed to explore these dynamics further by assessing how digitalization influences productivity in Tanzania's manufacturing sector. It is therefore hypothesized that:

***H1**: Firm's digitalization positively influences its firm's productivity.*

2.3.1 Firm's innovation as a bridge between digitalization and productivity

Firm's digitalization and innovation

The study postulated that the effects of digitalization on productivity are indirect. The innovation channel mediates the effects. Innovation can take the shape of ideas, strategies, and practices used by firms to create goods and services for the market ahead of their rivals (Rogers, 2003). The innovation process takes two forms, namely, product innovation and process innovation. Product innovation includes the introduction of new products and services, small adjustments to technical requirements, and substantial advancements in hardware, software, and materials.

Process innovation is the implementation of novel or much enhanced production techniques, including automation, to lower unit costs or raise quality (Jitsutthiphakorn., 2021). The process of digitalization facilitates the acquisition of new skills, abilities, and knowledge, hence fostering the emergence of innovative products and processes (Agostini et al., 2020). The importance of firms' absorptive capacity in facilitating innovation cannot be overstated. Digitalization, particularly through the utilization of big data analytics, has the potential to significantly augment firms' access to existing information or even generate new knowledge. This expansion of absorptive capacity can greatly boost firms' ability to develop novel products and processes. Radicic and Petković (2023) present empirical findings that demonstrate significant impacts of digitalization on both product and process innovations within the context of SMEs in Germany.

Digital transformation initiatives in developing countries have shown potential to drive innovation within SMEs, crucial for competitive differentiation and growth. For instance, Vial (2019) document how digital transformation in South African firms led to significant shifts in innovation strategies, particularly focusing on process improvements that enhance quality and reduce costs. Similarly, Bongomin et al. (2020) explore how mobile money services have not only improved financial inclusion but also spurred innovation in SMEs across Sub-Saharan Africa by facilitating new types of business engagements and expanding market reach. These studies underscore the potential for similar impacts in Tanzania, where increasing digital uptake among firms could catalyse substantial innovation, particularly in the manufacturing and service sectors. Thus, the ability of Tanzanian (small and medium) firms to leverage digital tools could be a crucial determinant of their innovation outputs, aligning with observations in comparable economies. It is therefore hypothesized that:

H2a: *Firm's digitalization positively influences firm's innovation.*

Firm's innovation and productivity

The model proposed by Crepon, Duguet, and Mairesse (1998), commonly referred to as the CDM model, offers insights into the relationship between innovation and productivity. In their study, Crépon et al. (1998) develop a comprehensive structural model that encompasses three distinct stages. First, the authors examine the decision-making process inside a firm regarding the allocation of resources towards innovation input. Second, they investigate the effect of innovation input on the resulting innovation output. Third, the researchers explore the relationship between innovation output and firm productivity. According to Reichstein and Salter (2006), process innovation—which they describe as the introduction of new equipment, task specifications, and input materials into production or service operations—increased the productivity of the firm. Jitsutthiphakorn (2021) provided empirical findings that demonstrate a positive linkage between process innovation and firm productivity in six developing countries within the Association of Southeast Asian Nations (ASEAN). Hu et al. (2020) conducted a study that showed that the use of innovative strategies in

both products and processes can significantly enhance the growth and profitability of the hotel industry in Ghana, surpassing the performance of non-innovative establishments. Xu et al. (2021) reported comparable findings in a comprehensive study conducted on firms across 32 African economies. It is therefore hypothesized that:

***H2b**: Innovation positively influences firm's productivity*

2.3.2 Firm's competitiveness as a bridge between digitalization, innovation and productivity

Firm's digitalization and competitiveness

As elaborated in the previous subsections, a relationship between digitalization and organisational productivity has been established. An additional pathway by which this relationship transpires is via competitiveness. D'Cruz & Rugman (1992) defines firm-level competitiveness as the capacity of an organisation to develop, manufacture, or promote products that are of higher quality than those offered by competitors, considering both price and non-price attributes. The impact of digitalization on competitiveness can be explicated at its core through the lens of the Dynamic Capability Theory (DCT). The DCT places a strong emphasis on how crucial it is for businesses to adapt to changing environmental challenges as well as changing market and business dynamics (Liu et al., 2023). It implies that implementing digital technology can improve a company's competitiveness and sustainability by assisting it in recognizing, grasping, and capitalizing on possibilities.

The process of digital transformation is facilitating small firms to reduce expenses and altering business models, production, and distribution. Small businesses can scale production, sell online, and compete with the aid of platforms (Organisation for Economic Cooperation and Development, 2018). Digitalization increases the competitiveness of businesses through the facilitation of improved visualization, the reduction of errors and waste, and the enhancement of process efficiencies. In addition, it facilitates the integration of departments, establishes connections between organisations and external constituents, and supplies the organisation with valuable data (Kaushik & Rahman, 2015). In addition to promoting efficient information exchange and timely stakeholder communication, digitalization facilitates an overall improvement in operational effectiveness. It is therefore hypothesized that:

***H3a**: Firm's digitalization positively influences firm's competitiveness*

Firm's competitiveness and productivity

The perspective known as the "Darwinian view" asserts that firm competitiveness has a positive impact on productivity development through innovation, hence promoting the survival of firms (Porter, 1990). The competitiveness of firms is closely linked to their dynamism, which serves as a driving force for innovation and encourages the entry and growth of more efficient firms, while also easing the exit of less efficient ones (The World Bank, 2021b). Firm competitiveness can lead to higher productivity through

three main mechanisms. First, competitiveness acts as a disciplining device within firms, putting pressure on managers to become more efficient. This decreases 'x-inefficiency', the difference between a firm's most efficient behaviour and its observed behaviour (Baldwin & Gu, 2006). Second, it ensures that firms with higher productivity increase their market share at the expense of less productive firms. As a result, firms with higher productivity enter the market to take their place. Last, competitiveness drives firms to innovate, increasing dynamic efficiency through technological improvements or new products and services. Golban (2016) provides empirical evidence on the effects of competition on productivity, demonstrating how raising firm competitiveness raises total factor productivity in Moldova's horticultural industry. The findings align with the research conducted by Carvalho (2017), which demonstrated a significant association between competitiveness and both total factor productivity and labour productivity in Portuguese enterprises. It is therefore hypothesized that:

***H3b**: Firm's competitiveness positively influences firm's productivity*

Firm's innovation and competitiveness

According to Schumpeter's theory, innovation is a more effective way to gain market power than competitive price. Technological innovation often leads to temporary monopolies that produce anomalous profits, which are subsequently challenged by competitors and imitators, encouraging companies to develop new products and processes (Ciocanel & Pavelescu, 2015). Innovation is vital for a firm's competitive edge, since it leads to the launch of new products, improvements in process models, market openings, the application of new marketing tools, and the development of new industries (Rambe & Khaola, 2021). Technology transfer and innovation are intimately intertwined, with Kooli-Chaabane et al. (2014) stating that a process of technology transfer is a process of innovation.

The competitiveness-innovation nexus can be explained by the Diamond Model for competitiveness (DMC) (Porter, 1990). According to the DMC, firms require infrastructure, capital resources, human resources, physical resources, and knowledge resources. Thus, for businesses to pursue innovation and competitiveness, they need to transmit and acquire ideas, best practices, skills, technical knowledge, intellectual property, and creativity. They also need to compete with one another and with demanding domestic customers. A competitive advantage is the result of innovation, which is described as a process that enables businesses to produce more with the same number of resources or as much with less resources. As a result, the business establishes itself as a market leader with the ability to provide superior value by utilizing the outcomes of organisational and marketing innovation as well as product/process innovation. It is therefore hypothesized that:

***H4**: Firm's innovation positively affects firm's competitiveness.*

2.4 The Moderation Role of Sustainable Digital Ecosystem

A digital ecosystem (DE) is a sustainable, self-organising system comprised of digital platforms that provide a unified information environment for government, business, and society (Barykin *et al.,* 2020). Contemporary digital technologies are pivotal in the formation of this ecosystem, which transcends business environments supporting Business-to-Business (B2B) and Business-to-Consumer (B2C) transactions. By facilitating the exchange of information and resources, the coordination of objectives, and the organisation of processes, the digital environment connects members and enables seamless collaboration and interaction. Three elements constitute a sustainable digital ecosystem (SDE): digital infrastructure, digital governance, and the digital economy. High connectivity is required for digital infrastructure in terms of both financial investment in fibreoptic cables and microwave towers, antennae and the maintenance of a robust telecommunications market. Moreover, digital services must be affordable, consumers must have digital literacy, and access and utilization disparities based on factors such as gender, location, etc. should be minimized. The second component is digital governance, which entails addressing online digital repression and establishing adequate digital rights protection for users (Wareham et al., 2014). The digital economy, encompassing digital financial services such as mobile money and e-commerce, constitutes the third element.

Digital ecosystems are valuable to businesses because they provide a collaborative environment for ideation and contribution to digital solutions (Felicetti *et al.,* 2023). Within a digital ecosystem, digital technology can stand in for operational and venture formation procedures. In the first example, the ecosystem uses knowledge of entrepreneurship to create and offer novel products. In the second instance, it brings together a variety of stakeholders to provide cutting-edge goods and services. Accordingly, the quality of the sustainable digital ecosystem and how businesses interact with such ecosystems have a significant impact on how innovatively a business operates (Hsieh & Wu, 2019). Therefore, the study's postulation is that the sustainability of the underlying local DE affects the relationship between digitalization and innovation. Digitalization may have more profound effects on firm innovation in the presence of conducive digital ecosystem.

In a digital ecosystem, data and connection are critical for enabling both production and consumption. Product-generated data is exchanged and used both inside and outside the value chain, resulting in chances to change a company's customer interactions and giving it a competitive advantage (Subramaniam, 2020). Utilizing the potential of data and digital ecosystems, firms can restructure their business models to develop a novel competitive strategy. Firms can transform their value chains into production ecosystems through the utilization of interactive data. These ecosystems

leverage pre-existing value chain infrastructures to generate data that either enhances operational processes or inspires the creation of novel services (Subramaniam, 2022). Alternatively, they may establish entirely new consumption ecosystems that link product consumers with third-party organisations that provide supplementary services. Therefore, the study postulates that through the digitalization process, firms can leverage a digital ecosystem in order to improve innovation and competitiveness of its goods and services. It is therefore hypothesized that:

***H5**: Digital economy stability (**5a**), Digital infrastructure adequacy (**5b**), and Digital governance (**5c**) positively moderate the effects of firm digitalization and innovation.*

***H6**: Digital economy stability (**6a**), Digital infrastructure adequacy (**6b**), and Digital governance (**6c**) positively moderate the relationship between firm digitalization and its competitiveness.*

2.5 The Moderation Role of Business Environment Dynamism and Hostility

In the preceding sub-sections, it was demonstrated how innovation and competitiveness can boost firms' productivity. However, this relationship is not clear cut since it depends much on differences in the business environments that firms operate in. This can be explained from the lenses of contingency theory (Koberg et al., 1996), which posits that the environments in which a firm competes are important factors for the firm's growth and development. The study identifies two main features of the business environment in strategic management among those proposed by Lumpkin and Dess (2001): dynamism and hostility. Dynamism refers to the continuous nature of modifications in the business environment of an organisation, which are induced by factors such as technological progress, competitive rivalry, regulatory changes, and analogous influences (Chung et al., 2021). To navigate the complexities of a dynamic business environment, organisations are compelled to allocate resources towards fostering innovation as a means of mitigating uncertainties and attaining a competitive edge (Boutillier & Uzunidis 2014). Innovation serves to mitigate environmental risks by affording enterprises with temporary market power, enabling them to enhance their performance.

Hostile environments are characterized by an oppressive business climate, intense competition, and limited opportunities; they are precarious industry conditions. These environments frequently exhibit limited opportunities and resources, frequently due to labour shortages, regulatory constraints, and contracting markets (Dele-Ijagbulu et al., 2020). This scarcity of resources may result in increased competition, decreased demand for products or services, and unwelcome change, all of which are detrimental to the objectives and mission of an organisation. Consequently, these environments impede the development and sustained stability of an organisation (Rosenbusch et al., 2013). The successful creation of innovative goods necessitates the allocation of significant resources and investment, hence exposing firms to substantial risks, while

operating in hostile environments. Consequently, organisations operating in hostile environments may adopt a strategic approach focused on financial preservation through the implementation of cost-cutting measures and a reluctance to invest in promoting innovations, which may affect their competitiveness (Latham & Braun, 2009). It is therefore hypothesized that:

***H7**: Business environment dynamism positively moderates the influence of firm's innovation (**7a**) and competitiveness (**7b**) on productivity.*

***H8**: Business environment hostility negatively moderates the influence of firm's innovation (**8a**) and competitiveness (**8b**) on productivity.*

2.6 Gaps in Knowledge

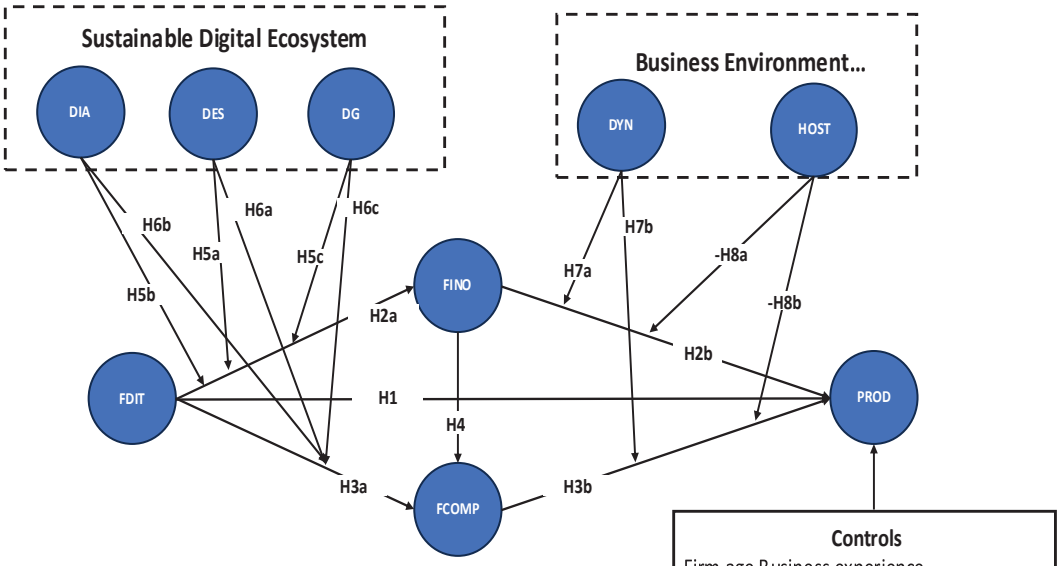
The study offers several contributions to the existing body of knowledge on digitalization and productivity among manufacturing SMEs in developing counties. First, theoretical perspectives on the paradox between digitalization and productivity are contradictory (Guo et al., 2023; Gebauer et al., 2020; Brynjolfsson et al., 2017). Diverse researchers have reached dissimilar conclusions by employing distinct methodologies and samples. The current study contributes to the body of knowledge by hypothesizing that digitalization has indirect effects on productivity. The relationship is established primarily through the channels of innovation and competitiveness. Although it is widely believed that digitalization can improve the productivity and efficiency of organisations, there is still a lack of comprehensive understanding and study on its potential impact on innovation performance (Sarbu, 2021). There exists a limited body of research examining the relationship between digitalization and innovation success in (manufacturing) small and medium-sized enterprises (SMEs) (Radicic & Petković, 2023).

The research evaluated in developing economies demonstrates that innovation and productivity are closely related. Nevertheless, the analysis fails to account for the extent to which firms utilize e-commerce and the intensity of internet bandwidth. This information is vital for comprehending the ramifications of digital transformation in developing regions such as Africa, where broadband internet access has increased at an unprecedented rate (Gaglio et al., 2022). Moreover, the current state of scientific research on the influence of digitalization on the competitiveness of firms is nascent, as there is a dearth of prior scholarly literature that specifically addresses this topic (Leão & Mira da Silva, 2021). Several studies express scepticism over the influence of digitalization on competitiveness, contending that the expenses associated with implementation may substantially augment business costs, hence potentially jeopardizing a firm's competitive position (Liu et al., 2023). This observation gives rise to the premise that the process of digitalization has the potential to substantially augment the expenses associated with conducting commercial operations.

2.7 Research Model

To provide an exhaustive synopsis of the interrelationships among the variables under investigation, the research model was constructed (refer to Figure 2). Initial assertions of the model posit a direct relationship between digitalization and the productivity of firms. In addition, indirect relationships between the two variables are illustrated, with competitiveness and innovation serving as examples. In addition, it has been demonstrated that innovation and competitiveness are intrinsically linked. Furthermore, moderating variables in the relationships are illustrated in the model. Sustainable digital ecosystem, which moderates the relationships between digitalization and both innovation and competitiveness, is the initial moderating variable. The business environment, which moderates the relationship between innovation and productivity as well as competitiveness and productivity, is the second moderating variable.

Figure 2: *illustrates the postulated relationships that holistically bring about improved firms' productivity*



Note: **DIA**=Digital infrastructure adequacy, **DES**= Digital economy stability, **DG**= Digital economy governance, **FDIT**= Firm digitalization, **FINO**= Firm innovation, **FCOMP**= Firm competitiveness, **DYN**= Dynamism, **HOST**= Hostility, **PROD**=Firm (labor, capital, total factor) productivity

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Research Approach

The research utilized a quantitative approach to assess the statistical significance of hypothesized relationships. The utilization of a quantitative method is justified by the existence of a pre-existing theory, specifically the Crepon-Duguet-Mairesse (1998) framework, which offers a theoretical foundation for understanding the connections between digitalization and productivity. The researchers collected quantitative data from informants employed in manufacturing enterprises and subsequently conducted an analysis. This analysis allowed for the extrapolation of findings to other developing nations, thereby enabling the generalization of conclusions. (Nørreklit et al., 2016).

3.2 Research Context

Tanzania, an East African country with a lower-middle income status, was a focus of the research. The country offers an ideal environment for researching the digitalization phenomenon and the productivity of manufacturing enterprises in developing countries. First, with an annual GDP growth rate of roughly 6.4 percent during the last 10 years, the nation has seen tremendous economic growth (Kansheba et al., 2022). Second, Tanzania's industrial sector contributes significantly to the GDP of the nation, despite being relatively small. The industry has averaged 8 percent of GDP and 4 percent annual growth over the last ten years (ITA, 2021). Tanzania offers a rich backdrop for researching the subject because of the manufacturing sector's potential to drive the nation's industrialization goals.

3.3 Study Population and Sampling Procedures

The study's population comprise SMEs in the manufacturing sector in Tanzania. This consideration was driven by the pivotal role that SMEs play in the manufacturing industry of many developing countries such as Tanzania. These enterprises are often at the forefront of adopting innovative manufacturing practices due to their size and agility, thus being crucial for understanding the impact of digitalization on manufacturing innovation. Furthermore, SMEs contribute significantly to employment and GDP in Tanzania, yet face unique challenges that differ from larger entities, such as limited access to technology and capital. By examining SMEs, this study aims to capture a nuanced view of the manufacturing phenomena—how small-scale operations adapt to and evolve with digital technologies, and how these adaptations influence their productivity and innovation capabilities. Moreover, the chosen population was selected to help in addressing gaps in the literature largely dominated by large firms as focal study focus, while SMEs are less understood, despite their substantial contribution to the economy.

Accordingly, the project concentrated on firms from the primary manufacturing subsectors, which include steel-related items, foods, drinks, tobacco, textiles, chemicals, plastic, and wood (ITA, 2021). Random sampling was impractical as large number of businesses in Tanzania operate in the informal sector. As a result, the study employed a convenient sampling technique. Eight regions were selected to provide samples of manufacturing firms namely: Dar-Es-Salaam, Mwanza, Mbeya, Dodoma, Morogoro, Iringa, Kilimanjaro, and Arusha. A total of 1,200 questionnaires—150 in each town—were distributed. 987 of these were obtained from respondents, indicating an approximate 82 percent response rate. Following the sorting and cleaning of the data, 43 questionnaires were deemed incomplete (i.e., either partially or not at all filled out) and had a straight-lining issue, meaning that respondents answered the same question to ten or more consecutive items, including items from multiple-item constructs that were not related to each other (Shneor & Munim 2019). As a result, only 944 questionnaires (representing 78.7% of the total) were kept for further data analysis.

3.4 Constructs' Operationalisation

The study developed and measured the latent constructs using various measurement items from previous studies covering the digitalization and productivity topics by conceptually adjusting them to fit Tanzania's context. Various five-point Likert scale measurements were used to rate different items that represent constructs.

a) *Firm's digitalization:* The construct was developed using prior postulations from literature, such as (Schubert et al., 2023; Gal et al., 2019; Wang, 2021). This was measured using a total of five items, for instance, the extent to which the firm uses social media, e.g., Facebook and Instagram, for its business and uses internet surfing in its business operations. A five-point Likert scale was used (1=To a very small extent to 5=To a very large extent).
b) *Firm's Innovation:* The construct was developed from prior postulations by Rogers (2003), Jitsutthiphakorn (2021), and Agostini et al. (2020). It was measured using a total of six items, for instance, the extent to which the firm invests in research and development (R&D) and the extent to which the firm's new products capture new markets or increase market share. A five-point Likert scale was used (1=To a very small extent to 5=To a very large extent).
c) *Firm's competitiveness:* The construct was developed using prior postulations (Kaushik & Rahman, 2015; Ciocanel & Pavelescu, 2015; Rambe & Khaola, 2021). It was measured using nine items, for instance, the extent to which the firm seeks opportunities for growth and expansion, attracts, and retains top talents in the industry. A five-point Likert scale was used (1=To a very small extent to 5=To a very large extent).
d) *Business Environment Dynamism:* The construct was formulated using prior postulations (Lumpkin and Dess, 2001; Chung et al., 2021; Boutillier & Uzunidis, 2014). It was measured by nine items: for instance, our competitors change their

sales strategies often, and customers` product preferences change often. A five-point Likert scale was used (1=Strongly disagree to 5=Strongly agree).

e) *Business Environment Hostility:* The construct was developed using prior postulations (Chung et al., 2021; Boutillier & Uzunidis, 2014; Dele-Ijagbulu et al., 2020). A total of six items were used to measure the construct, e.g., the extent of threats from new entrants, disruptive technologies, or other external factors, and the level of aggressiveness exhibited by the competitors in the market. (1=Strongly disagree to 5=Strongly agree).

f) *Digital Infrastructure Adequacy:* The construct was developed using prior postulations (Barykin et al., 2020; Wareham et al., 2014; Felicetti et al., 2023). A total of four items were used to measure the construct, for instance, the inclusivity of digital services regardless of gender, age, economic status, the presence of digital services, e.g., the internet, and payment systems. A five-point Likert scale was used (1=Strongly disagree to 5=Strongly agree).

g) *Digital Economy Stability:* The construct was formulated using prior postulations by Wareham et al. (2014), Felicetti et al. (2023), and Hsieh & Wu (2019). A total of four items were used to measure the construct, for instance, the use and affordability of digital financial services, e.g., mobile phone transactions, e-banking, the speed of tech startup formation, e.g., technology and innovation-driven new businesses. A five-point Likert scale was used (1=Strongly disagree to 5=Strongly agree).

h) *Digital Governance:* The construct was developed using prior postulations (Hsieh & Wu, 2019; Subramaniam, 2020; Barykin et al., 2020). A total of five items were used to measure the construct: for instance, the government actively promotes the digital economy agenda by including it in national and sector framework documents; the presence of active laws and regulations supporting the digital economy, e.g., data privacy, cyber security, and payment regulations. A five-point Likert scale was used (1=Strongly disagree to 5=Strongly agree).

i) *Firm's Productivity:* The construct was divided into three main parts, namely firm, capital, and total factor productivity (Dresch et al., 2018; Guo et al., 2023; Borowiecki et al., 2021). Firm labour productivity = the ratio of net sales to the number of employees; firm capital productivity = the ratio of net sales to fixed assets; firm total factor productivity = the ratio of net sales to weighted average inputs (as number of employees and fixed assets).

3.5 Data Analytical Techniques

Due to the complexity of the relationships between various variables as depicted in Figure 2, structural equation modeling (SEM) was employed to affirm the postulated relationships. SEM provides more holistic and simultaneous path analyses of the relationships between different variables (Kansheba et al., 2022). Due to the multitude of relationships observed in the research model (Figure 2), SEM was an appropriate tool to effectively capture these relationships in a single model.

3.6 Ethical Considerations

This project was carried out by adhering to research ethical practices since it involved human subjects whose rights must be protected (Parekh et al., 2021). The respondents were first informed about the aim of the study and continued to seek their voluntary consent for their participation, with an emphasis on maintaining their anonymity.

CHAPTER FOUR
DATA ANALYSIS AND FINDINGS

4.1. Data Validity and Reliability

A pilot survey of 30 questionnaires was first administered to a small sample of respondents (pre-tested) to improve the quality of the instrument. The responses from the pilot survey were used to improve the final questionnaire. Using the indices from exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) (Griffith, 2014), different tests of data validity and reliability were done. Data validity examines the magnitude at which an instrument measures what it is really supposed to measure. We checked for convergent validity (the extent to which two or more items that are supposed to be related to each other are, in fact, related) by looking at the factor loadings and the average variance extracted (AVE) for each factor (Table 1). All the retained items had a significantly and sufficiently factor loading (or closely to) 0.7 and above. The AVE scores for each factor were well above the threshold of 0.5, thus providing evidence of the convergent validity of the factors (Kansheba et al., 2022). Composite reliability (CR) was used to measure the data reliability (Table 1). The results showed that all the constructs had CR scores exceeding the 0.7 cut-off point, which signifies consistency between the adopted methodology and the research questions (Haradhan, 2017).

Table 1: *Constructs operationalizations*

Latent Constructs and their operationalizations	Loadings	Sources
Firm digitalization CR= 0.88 AVE= 0.61		
The extent that the firm…		
Uses social media e.g., Facebook, Instagram for the business	0.716***	Schubert et al. (2023) Gal et al. (2019)
Uses internet surfing in its business operations	0.816***	Wang (2021)
Uses mobile phones and/or computers to interact with customers	0.708***	Dresch et al. (2018) Guo et al. (2023
Uses e-commerce or online sales	0.883***	
Uses mobile money to make/receive payments	0.759***	
Firm Innovation CR= 0.90 AVE= 0.60		
The extent the firm invests in research and development (R&D)	0.814***	
The frequency that the firm introduces new product offerings	0.795***	Rogers (2003) Jitsutthiphakorn (2021) Agostini et al. (2020) Radicic and Petković (2023)
The extent the firm's new products capture new markets or increase market share	0.830***	
The extent the firm improves its production processes/methods	0.726***	

Latent Constructs and their operationalizations	Loadings	Sources
The firm's speed of new technology or methods adoption	0.696***	Crépon et al. (1998)
The extent firm's processes enhance cost savings, lead times, quality	0.783***	
Firm competitiveness CR= 0.94 AVE= 0.62		
The extent to which the firm …		
Seeks opportunities for growth and expansion	0.823***	
Constantly outperform competitors in terms of market share	0.854***	
Invest in R&D to stay ahead of innovation	0.861***	
Efficiently and effectively manage costs and operations	0.811***	D'Cruz & Rugman (1992)
Has a strong and well-established brand in the market	0.682***	Liu et al. (2023)
Attracts and retains top talents in the industry	0.829***	Kaushik & Rahman (2015)
Quickly adapt to business environment changes	0.770***	Ciocanel & Pavelescu (2015)
Forge a strong network with key suppliers and partners	0.835***	Rambe & Khaola (2023)
Has strong and well-established customer loyalty	0.755***	
Evaluates and improves products/services based on customers' preferences and feedback	0.639***	
Bus. Environment Dynamism CR= 0.93 AVE= 0.60		
Our products and brands change often.	0.857***	
Our sales strategies change often.	0.804***	Koberg et al. (1996)
Our sales advertisements change often.	0.766***	Lumpkin and Dess (2001)
Our competitors change their products and brands often	0.831***	Chung et al. (2021)
Our competitors change their sales strategies often	0.774***	Boutillier & Uzunidis 2014
Our competitors change their sales advertisements often	0.742***	Dele-Ijagbulu et al. (2020)
Customers` product preferences change often.	0.722***	Rosenbusch et al. (2013)
Customers` brand preferences change often.	0.715***	
Customers` price preferences change often	0.726***	
Bus. Environment Hostility CR= 0.89 AVE= 0.61		
The extent of threats from new entrants, disruptive technologies, or other external factors	0.655***	
Confidence that the firm can survive and thrive in a competitive environment over the long term	0.793***	Koberg et al. (1996)
The level of aggressiveness exhibited by the competitors in the market.	0.878***	Chung et al. (2021)
Prevalence of unfair business practices in the market	0.805***	Boutillier & Uzunidis (2014)
Occurrence of tied selling and deceptive pricing tactics	0.762***	Dele-Ijagbulu et al. (2020)
Extent of false advertisements and customers misleading	0.831***	Rosenbusch et al. (2013)
Digital Infrastructure Adequacy CR= 0.90 AVE= 0.6		

Latent Constructs and their operationalizations	Loadings	Sources
Broadband connectivity e.g., cell towers, fibre-optic cables	0.781***	Barykin et al. (2020)
Ownership of mobile devices	0.892***	Wareham et al. (2014)
presence of digital services e.g., the internet, payment systems	0.758***	Felicetti et al. (2023) Hsieh & Wu (2019)
Inclusivity of digital services regardless of gender, age, economic status	0.866***	Subramaniam (2020) Subramaniam (2022)
Digital Economy Stability CR= 0.80 AVE= 0.51		
The use and affordability of digital financial services e.g., mobile phone transactions, e-banking	0.639***	Wareham et al. (2014)
Digital trade e.g., delivery of products and services over the internet	0.824***	Felicetti et al. (2023) Hsieh & Wu (2019)
The speed of Tech Startup formation e.g., technology and innovation-driven new businesses	0.718***	Subramaniam (2020) Subramaniam (2022)
Availability of talent pool trained for a future-oriented digital economy	0.655***	
Digital Governance CR= 0.86 AVE= 0.62		
The government actively promotes the digital economy agenda by including it in national and sector framework documents	0.688***	
There are active laws and regulations supporting the digital economy e.g., data privacy, cyber security, payment regulations	0.725***	Hsieh & Wu (2019) Subramaniam (2020) Subramaniam (2022)
There are policies that actively promote inclusive digital infrastructures	0.836***	Barykin et al. (2020) Wareham et al. (2014)
The government policies and regulations actively promote innovation and competition in the digital economy	0.873***	
The government promotes digital education and awareness	0.792***	
Firm labour productivity: The ratio of net sales to number of employees		
Firm capital productivity: The ratio of net sales to fixed asset		Dresch et al. (2018) Guo et al. (2023) Borowiecki et al. (2021)
Firm total factor productivity: The ratio of net sales to weighted average inputs (as number of employees and fixed assets)		

Source: own compilation (2023)

The study also tested for discriminant validity (the extent to which two or more items that are not supposed to be related are, in fact, unrelated) by comparing the AVE of each factor with its square-rooted inter-construct correlations (Gaglio et al., 2022). The AVE value of all factors was greater than the squared rooted inter-correlations for each

factor, which shows evidence of discriminant validity (Gonzalez & Griffin, 2001), see Table 2.

Table 2: *Discriminant validity and model fit*

Construct	1	2	3	4	5	6	7	8	Model fit Indices
Inno (1)	1.00								
Comp (2)	0.12	1.00							
Firm. Dig (3)	0.07	0.20	1.00						Chi-sqr/df =
BE. Dynam (4)	0.06	0.67	0.17	1.00					1.987
BE. Host (5)	0.09	0.44	0.19	0.43	1.00				CFI= 0.907
DE. Infrast (6)	0.04	0.07	0.08	0.20	0.09	1.00			TLI= 0.911
DE. Econ (7)	0.02	0.34	0.01	0.36	0.15	0.16	1.00		RMSEA= 0.044
DE. Gov (8)	0.14	0.04	0.07	0.06	0.08	0.23	0.09	1.00	SRMR= 0.051
CR	0.90	0.94	0.88	0.93	0.89	0.90	0.80	0.86	N = 944
AVE	0.60	0.62	0.61	0.60	0.61	0.60	0.51	0.62	

Source: own compilation (2023)

4.2. Non-Response and Common Method Bias Diagnostics

Non-response is a common issue in survey research; wave analysis was utilized to assess the severity of this issue (Kansheba et al., 2022). To conduct this analysis, the sample of 944 responses was divided into two equal subsamples of 472 responses each. Insignificant mean differences among respondents in selected demographic variables indicate the absence of non-response bias in the studied sample (refer to Table 3).

Table 3: *Non-response Bias Test: Mean Comparison between Two (First 94 Responses and Last 94 Responses) sub-samples*

Variable	Test value	df	p-value
Age	F=0.7431	1	0.3451
Gender	F=0.0472	1	0.4265
Education level	F=0.5621	1	0.4153
Experience	F=0.5204	1	0.3451

Source: Own compilation (2023)

Conversely, surveys are prone to common method bias (CMB) when information is gathered via a single instrument, namely a questionnaire. This phenomenon distorts the true strength of relationships, thereby compromising the study's credibility and validity (Liang et al., 2007). CMB was examined through Herman's single factor and the common latent factor analyses (Podsakoff et al., 2003). The created single factor

explained about 14% of the variations. Furthermore, common latent factor results show that the common latent factor is uncorrelated with other latent factors and fixed equal factor loading of all measurement items of the common factor. The equal factor loading value was observed to be 0.004 suggesting that the common factor accounts for only 0.0016% of the variance. Both values from Herman's single factor and common latent factor analyses are below the recommended threshold of 50%, thus indicating the lack of the common method bias issue (Garger et al., 2019).

4.3. Descriptive Statistics

Table 4 provides for the descriptive results of employed dataset. Each variable utilized in the research is characterized according to its properties to offer a comprehensive overview of the data's pattern. Regarding the overall composition of the respondents, namely business owners/managers, 62% identified as male and the remaining individuals identified as female. The mean age of the participants was 34 years; a significant proportion of them possessed an advanced degree or college diploma. A total of 62 percent of the participants identified as business proprietors, while 38 percent identified as managers or non-owners. The respondents' mean business experience was approximately eight years, which is considered adequate to offer comprehensive and precise insights into the phenomena under consideration. The mean age of the firms surveyed was approximately eight years, and their mean workforce consisted of five individuals. With respect to assets, the mean value of the firms was USD 7,919 (equivalent to 19,955,880 Tanzanian shillings). Approximately 73% of businesses were duly registered, with the remainder being unregistered.

Table 4: *Descriptive statistics*

Variables	Observations	Mean	Std.	Min	Max
Females	367				
Males	577				
Age	944	34.767	10.576	21	75
Basic Education	443				
College Education	271				
Higher Education	231				
Business Owners	585				
Business Managers	359				
Business Experience (years)	944	8.79	8.372	1	52
Firm's age (years)	944	8.375	7.945	1	23
Firm's size (number of employees)	944	5.233	2.194	4	22
Firm's size (fixed assets in USD)	944	7916	142226	510	160000
Non-registered firms	257				

Variables	Observations	Mean	Std.	Min	Max
Registered firms	687				
Manufacturing subsectors					
Food, beverages, and soft drinks	233				
Textiles and fabrics	166				
Paper, rubber, furniture, woods	271				
Chemicals	35				
Iron and metals	239				
Firm net sales in USD	944	7694	16169	268	260000
Firm labour productivity	944	1419	2739	54	43333
Firm capital productivity	944	1.379	1.538	0.1	19.118
Firm total factor productivity	944	0.541	0.583	0.015	4.835
The firm's investment in ICT in USD	944	889	1774	20	16000
Firm digitalization	944	3.716	0.911	2	5
Bus. Environment dynamism	944	3.774	0.757	1.3	5
Bus. Environment hostility	944	2.695	0.885	1	5
Digital infrastructures adequacy	944	3.938	0.672	2	5
Digital economy stability	944	4.005	0.605	1.7	5
Digital economy governance	944	3.729	0.702	1	5
Firm innovation	944	3.503	1.016	2	5
Firm competitiveness	944	3.525	0.709	1	5
Regions					
Dar-Es-Salaam	132				
Mwanza	121				
Mbeya	116				
Dodoma	109				
Morogoro	132				
Iringa	103				
Kilimanjaro	112				
Arusha	119				

Source: own compilation (2023)

When examining the manufacturing sectors, a significant percentage of the firms surveyed were engaged in the following sub-sectors: paper, rubber, furniture, and timber; food, beverages, and soft drinks; iron and metals. The average investment in ICT equipment was USD 889, or 2,240,280 Tanzanian shillings, whereas the average net sales of firms were USD 7,694, or 19,338,880 Tanzanian shillings. Tanzanian manufacturing SMEs exhibited above-average levels of digitalization, innovation, and competitiveness (on a scale of 1 to 5). This indicates that these three variables were of greater magnitudes. The fact that the scores for all three digital ecosystem indicators were above average indicates that the nation's digital landscape has been increasingly developed over time.

4.4 ANOVA and POST-Hoc ANOVA Results

The ANOVA results for the comparison of differences among the eight regions present some interesting facts that are instrumental in explaining the main results (Table 5).

Table 5: *Disparities in digitalization, innovation, competitiveness, productivity, digital ecosystem and business environment among regions*

Groups	Prod	Inno	Comp	F. Dig	BE Dyn	BE Host	DE Infr	DE Econ	DE Gov
Dsm Vs Mby	3.08	2.02**	1.09	1.39**	2.89	1.34**	2.40	1.48	-0.29
Dsm Vs Dom	2.13**	2.40**	2.40**	0.74	1.70	0.30	1.06	1.20	-2.24
Dsm Vs Mwz	0.15	1.40	3.27	-0.42	1.29	0.67	-0.36	0.29	0.13
Dsm Vs Arsh	0.29**	1.76	2.39**	0.49	1.16**	1.03**	-0.03	1.16	-1.03
Dsm Vs Iringa	2.24	0.99*	0.81**	1.13**	0.41***	0.35**	-1.40	0.41*	-0.35
Dsm Vs Klm	2.39	0.67	0.06	-0.26	0.55**	0.70**	-1.08	-0.55	-0.70
Dsm Vs Moro	0.94**	1.36**	2.40*	0.69	0.74	0.08*	0.27	2.61	-0.89
Mby Vs Dom	0.98	0.56	-1.64**	-0.72	1.30	1.92	-1.48	0.16	0.05
Mby Vs Mwz	-3.78*	-0.67**	-2.69*	-2.13	-1.83	-2.38	-3.24	1.62	2.87
Mby Vs Arsh	-3.99	-0.26	-1.61	-1.06	2.01*	-2.83	-2.87	1.96	2.80
Mby Vs Iringa	2.68*	-1.19	0.97**	-1.35	0.49	0.41*	-1.67	2.70	3.22
Mby Vs Klm	-2.86	-0.80	0.07	-0.31	0.66*	-0.83	-1.29	-0.10	0.33
Mby Vs Moro	0.17**	0.41	1.06	1.06	-0.17	-0.43	0.39	0.41	0.05
Dom Vs Mwz	5.50	-0.16**	0.05	0.38	3.13	-0.87**	2.70	0.22	1.14
Dom Vs Arsh	-0.99**	1.43	2.54	0.73	0.78**	-0.90	-0.09	0.07	-1.51
Dom Vs Iringa	1.91*	1.73	2.47**	2.10	5.96**	0.98**	0.36	1.13	0.62
Dom Vs Klm	-0.77	2.38	2.85	-0.75	4.43	0.19*	1.01	2.14	-1.15
Dom Vs Moro	-0.90	0.09*	0.29	-0.72	4.77	0.07	-1.51	2.53	-2.53
Mwz Vs Arsh	0.98*	0.36	0.04	1.43	2.29	1.13	0.62	1.48	-3.45
Mwz Vs Iringa	0.16*	0.86*	0.33***	1.26**	0.59**	0.88**	-1.54	1.59	-2.16
Mwz Vs Klm	0.06	-1.29	-1.89**	-1.24	0.87	0.10	-2.10	-0.90	-0.74
Mwz Vs Moro	0.97	0.53**	0.29*	-2.39	1.34***	0.26*	1.59	-0.60	0.05
Arsh Vs Iringa	0.88	1.54**	-1.85	2.38**	1.08**	2.03	-0.90	1.23	2.17
Arsh Vs Klm	0.10*	-2.10	-2.16	0.03	0.26	0.12	0.04	0.42	-1.24
Arsh Vs Moro	-0.26	1.59	-2.16	0.44	1.05	-0.93	-0.03	-0.51	-2.03
Iringa Vs Klm	-1.83	-0.81**	-0.66	-0.92	0.33**	0.28	-1.14	-0.18	-1.10
Iringa Vs Moro	-3.68	-1.03	0.09	-0.41**	0.85	-1.07*	-1.67	-1.53	-1.25
Klm Vs Moro	2.09*	0.21	0.06	0.50	4.03	1.37	-2.59	-1.03	0.09

Note: *, **, and *** = Statistical Significance at 10%, 5%, and 1% respectively.

Tanzania's largest metropolis, Dar es Salaam, exhibits the highest level of productivity among manufacturing firms in the region, followed by Mbeya and Mwanza. Manufacturing firms in Dar es Salaam and Mwanza exhibited superior performance in terms of innovation, owing to significant disparities that were identified between these cities and other specific regions. Conversely, the efficacy of those businesses located in Dar es Salaam, Mwanza, and Dodoma was superior to that of other regions. A limited number of discrepancies were identified among municipalities regarding the level of firm digitalization, except for Dar es Salaam, which surpassed Mbeya and Iringa. When considering the dynamism of the business environment, Dar es Salaam exhibited the

greatest degree of this characteristic relative to other regions, with Dodoma and Mwanza following suit. Once more, Dar es Salaam was identified as the region with the most hostile business environment, in contrast to the vast majority of regions where differences are negligible. The lack of substantial differences between regions in all three aspects of the digital ecosystem may be attributed to the greater rates of urbanization in those areas.

4.5 Model Goodness-of-Fit Check

SEM was utilized in the investigation to ascertain the significance of hypothesized relationships among numerous constructs that delineate the research issue. In total, three modelling iterations were conducted for each of the three dependent variable measures of firm productivity. Labour productivity was utilized in the first model, capital productivity in the second, and total factor productivity in the third. Prior to presenting the outcomes derived from these models, the study initially presents various goodness-of-fit results for the models.

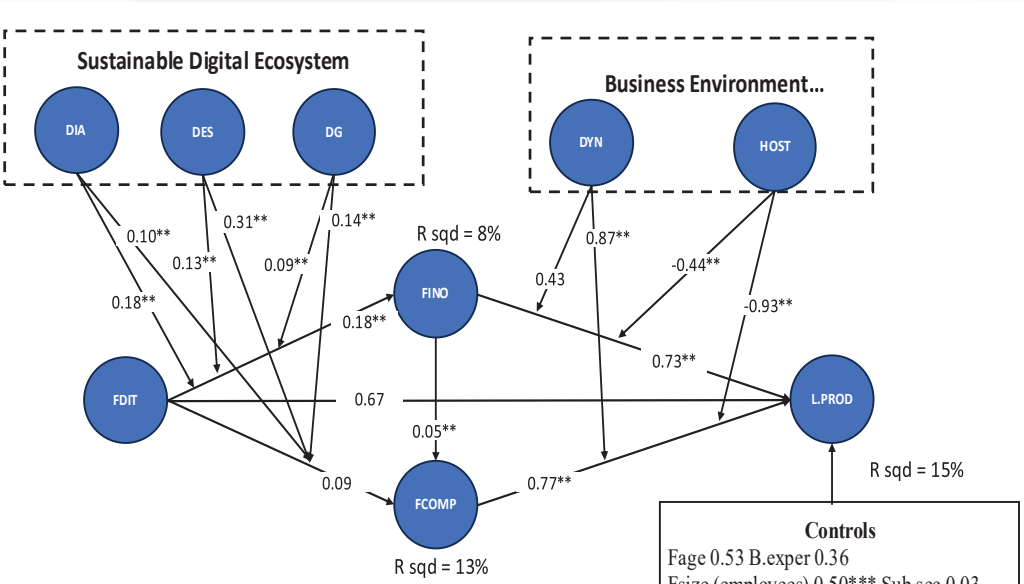
The ratio of chi-square (1199.894) to degree of freedom (601) for the first model is 1.99, which is lower than the suggested threshold of 3. Furthermore, the remaining model goodness-of-fit indices satisfied the suggested thresholds. Both the Tucker-Lewis Index (TLI) and the Comparative Fit Index (CFI), both with values of 0.912 and 0.914, are in close proximity to the critical value of 1.0 (Hair et al., 2010). Both the Standardized Root Mean Square Residual Index (SRMR) of 0.061 and the Root Mean Square Error of Approximation Index (RMSEA) of 0.053 fall below the critical value of 0.08 (Shneor & Munim, 2019).

The second model exhibits a chi-square ratio of 1.136.894 to a degree of freedom of 572 (1.98), which falls short of the suggested threshold of 3. Furthermore, the remaining model goodness-of-fit indices satisfied the suggested thresholds. The TLI and CFI, both with values of 0.907 and 0.911, are in close proximity to the critical value of 1.0. Both the Standardized SRMR of 0.051 and the RMSEA of 0.044 fall below the critical value of 0.08. In conclusion, the chi-square ratio of 1235.016 to the degree of freedom of 689 for the third model is 1.79, which is lower than the suggested threshold of 3. Furthermore, the remaining model goodness-of-fit indices satisfied the suggested thresholds. The TLI and CFI, both with values of 0.93 and 0.91 respectively, are both in proximity to the critical value of 1.0. Both the SRMR of 0.066 and the RMSEA of 0.042 fall below the critical value of 0.08.

4.6 Structural Equation Modelling estimation results

The SEM outcomes for the three models mentioned earlier are presented in the study. The primary relationship under evaluation is that between firm digitalization and productivity. For each of the three models (Figures 3, 4, and 5), estimations are performed.

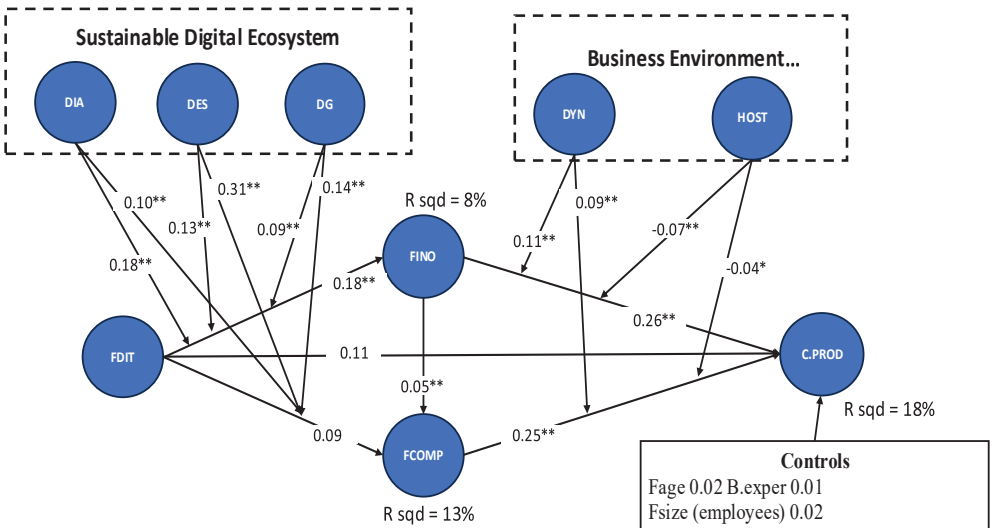
Figure 3: *SEM estimation results for Model 1 (Labour productivity)*



Model fit: Chi-square = 1199.894, df = 601, CFI= 0.912, TLI= 0.914, RMSEA= 0.053, SRMR= 0.061. Observations= 944. *, **, and *** = StatisticalSignificanceat 10%, 5%, and 1% respectively.

The findings indicate a positive but insignificant relationship between productivity and firm digitalization for the first model. H1 is rejected as models 2 and 3 exhibit similar results. Conversely, it seemed that firm digitalization had a significant positive effect on innovation across all three models, providing support for H2a ($p < 0.05$). Regarding the association between innovation and productivity, the findings indicate a statistically significant positive relationship across all three models. This supports hypothesis H2b at $p < 0.05$.

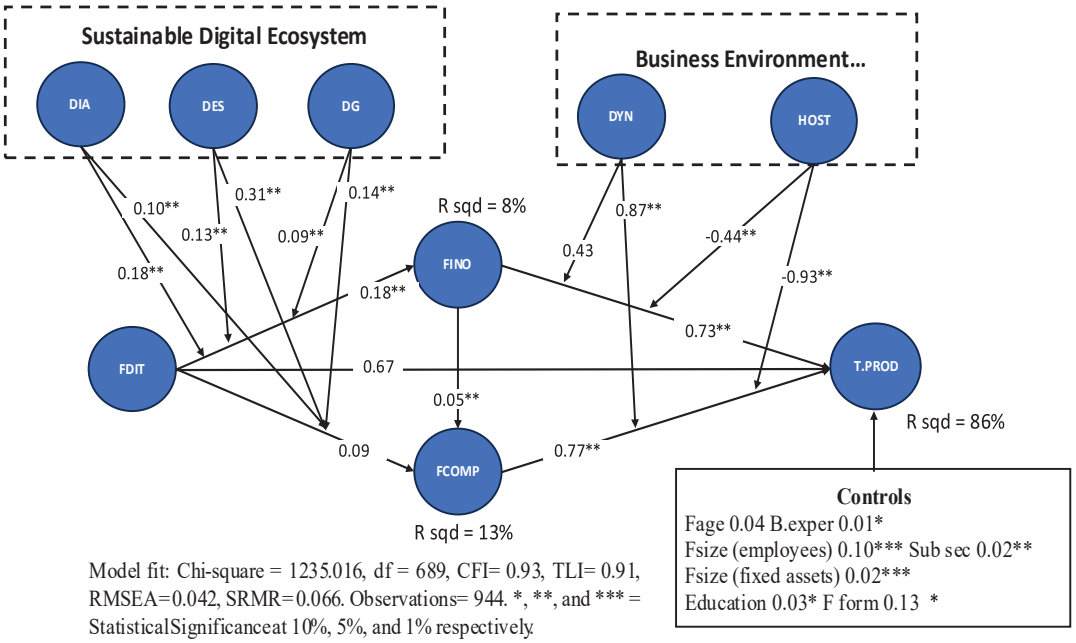
Figure 4: *SEM estimation results for Model 2 (Capital productivity)*



Model fit: Chi-square = 1136.894, df = 572, CFI= 0.907, TLI= 0.911, RMSEA= 0.044, SRMR= 0.051. Observations= 944. *, **, and *** = StatisticalSignificanceat 10%, 5%, and 1% respectively.

The study also investigated the effects of firm digitalization on competitiveness and observed non-significant positive effects for all three models, leading to the rejection of H3a. However, competitiveness is seen to have significant positive effects on productivity for all three models, which supports H3b ($p < 0.05$). For all three models, innovation was observed to have significant positive effects on competitiveness, thus H4 was accepted at $p < 0.05$. The moderation effects of sustainable digital ecosystems were evaluated based on the relationships between firm digitalization and each of the two constructs, namely, innovation and competitiveness. The findings derived from all three models indicate that digital economy governance, digital infrastructure adequacy, and digital economy stability have significant positive moderating effects on the relationships between firm digitalization and innovation ($p < 0.05$). Consequently, it was not possible to reject hypotheses H5a, H5b, and H5c.

Figure 5: *SEM estimation results for Model 2 (Total Factor Productivity)*



On the other hand, it was found that the three components of the sustainable digital ecosystem had significant positive moderation effects on the relationship between a firm's digitalization and its competitiveness ($p < 0.05$). Hypotheses H6a, H6b, and H6c were consequently accepted. Finally, the research assessed the moderating effect of business environment hostility and dynamism on the relationship between innovation and productivity, as well as competitiveness and productivity. The findings revealed that the moderating effects of business environment dynamism on the relationship between innovation and productivity were not significant. Thus, H7a was rejected for all three models. On the other hand, H7b, which postulated negative moderation effects of business environment hostility on the relationship between innovation and

productivity, was accepted at $p < 0.05$. Moreover, the results indicate significant positive moderation effects of competitiveness on productivity ($p < 0.05$), thus H8a could not be rejected. H8b, which postulates negative moderation effects of business environment hostility on the relationship between competitiveness and productivity, was confirmed at $p < 0.05$.

CHAPTER 5
DISCUSSION AND CONCLUSION

5.1 Discussion

Over time, the manufacturing sector in Tanzania has witnessed a progressive expansion, resulting in a greater contribution to the nation's GDP. Digitalization has garnered acclaim as a mechanism that can empower a firm to enhance productivity in the contemporary digital age. Therefore, the present study aimed to investigate the interconnected functions of competitiveness, innovation, and digitalization in enhancing the productivity of Tanzanian manufacturing SMEs across eight regions: Dodoma, Dar es Salaam, Morogoro, Mwanza, Mbeya, Kilimanjaro, and Arusha. Furthermore, this study investigated the potential moderating influence of a sustainable digital ecosystem on the relationship between digitalization and both innovation and competitiveness. In the end, an examination was conducted into the moderating effect of business environment hostility and dynamism on the relationships between innovation, competitiveness, and productivity.

Though the manufacturing sector in Tanzania includes both SMEs and large (established) companies, they experience the impact of digitalization differently. SMEs, characterized by their limited resources and agile decision-making processes, often adopt digital technologies to overcome operational constraints and access new markets, which can lead to rapid gains in productivity and competitiveness. In contrast, established companies leverage digitalization primarily to optimize existing processes and enhance supply chain efficiencies. The expected influence of digitalization thus varies. While for SMEs, it can be a transformative tool that levels the playing field, for large companies, it serves as an enhancer of scalability and sustainability. Recognizing these nuanced differences is crucial for developing targeted policies that support the unique needs and opportunities of each group within Tanzania's manufacturing sector. These insights into the sector-specific impacts of digitalization can inform tailored recommendations that drive effective integration of digital technology across all scales of manufacturing operations.

The initial results indicate notable discrepancies among cities with regards to innovation, productivity, digitalization, and competitiveness. Prominent metropolitan areas such as Dar es Salaam and Mwanza seem to exhibit superior performance compared to their counterparts. Regarding digitalization, the observed outcomes may be attributed to the location-dependent nature of digitalization initiatives. Greater emphasis is placed by businesses in major metropolitan regions on digitalization, including website operation and online marketing, as a result of the large youth population, high level of education, and dense population, all of which contribute to the extensive utilization of digital services (Thonipara et al., 2023). The increased productivity and competitiveness of businesses in Tanzania's major metropolitan areas can be attributed to a variety of advantages that these areas provide. Major

metropolitan areas offer opportunities to tap into expansive domestic and international markets, and they are replete with public entities and stakeholders that foster innovation, including universities, private "change agents," and economic development organisations (Markatou and Alexandrou, 2015). Furthermore, their elevated levels of human connectivity facilitate the formation of knowledge networks and businesses, thereby enhancing the dissemination of novel concepts and the introduction of products to the market.

In cities including Dar es Salaam, Mwanza, and Dodoma, business environment dynamism and hostility are also found to be more pronounced. The heightened dynamism of the business environment in major cities can be attributed to several factors: frequent technological advancements among firms, greater levels of cultural and consumer preference change, and the unpredictable actions of competitors (Li and Liu, 2014). Conversely, greater environmental hostility observed in major cities can be attributed to the presence of fierce rivalry, an overpowering business environment, and a scarcity of viable opportunities, as the majority of these have already been capitalized on by established firms (Anderson et al., 2015).

Concerning the primary findings, the results indicate that the correlation that exists between firm digitalization and productivity is not statistically significant. These results may be explained by the indirect effects of firm digitalization on productivity via innovation and competitiveness. The supplementary findings suggest that while there is a strong relationship between innovation and firm digitalization, this does not extend to competitiveness. This line of reasoning is corroborated by the findings of Dana et al. (2021), who demonstrated that digital transformation facilitates enhanced resource allocation, value generation, and capital attraction within physical settings, thereby empowering organisations to innovate more effectively. Digitalization facilitates innovation by enabling organisations to modify their business models, production and distribution processes, and competitive strategies, according to the Organisation for Economic Cooperation and Development (2018). In addition, the results demonstrate that innovation is crucial for enhancing the competitiveness of businesses. The results of this research corroborate the assertions made by Lestari et al. (2020), which demonstrated the critical role that production process innovation plays in enhancing a company's competitiveness by facilitating cost reductions and quality enhancements for its offerings and services.

In addition, the results indicate that a sustainable digital ecosystem moderates in a positive way the relationship between digitalization and both innovation and competitiveness. The results of this study provide evidence in favour of the claim that the advantages of digitalization for innovation are not isolated occurrences. Instead, they are experienced within a regional digital ecosystem that operates efficiently and provides support, which propels the digital transformation of society. Organisations that adopt digital technologies have the potential to enhance their innovation and competitiveness through the utilization of digital ecosystem components, such as

connectivity and data, to generate new insights and ideas, as well as to create novel opportunities for transforming customer interactions (Subramaniam, 2020).

Further, the results demonstrate that innovation and competitiveness have substantial impacts on the productivity of businesses. The results are consistent with prior research that provides support for the notion that process, and product innovation increase output (Jitsutthiphakorn, 2021; Mishra et al., 2021; Morris, 2018; Laureti and Viviani, 2010). Firm productivity can be increased through process and product innovation, such as the introduction of new input materials, task specifications, and equipment, as demonstrated by these studies. In conclusion, the research offers empirical support for the notion that business environment dynamism moderates the relationship between productivity and competitiveness in a positive way.

The impact of firm competitiveness on productivity is particularly significant in areas with a highly dynamic business environment, where changes in business conditions are unpredictable. Such an environment compels firms to continuously adapt their business models to maintain competitiveness. Environmental dynamism necessitates that those businesses be highly adaptable and flexible in the face of external changes; this increases the efficiency of their competitiveness efforts (Revilla & Fernández, 2013). However, the study demonstrates that the impact of innovation and competitiveness on productivity is adversely influenced by workplace hostility. This phenomenon can be elucidated by the fact that increased industry competition in antagonistic environments reduces demand for the company's products, thereby threatening the company's survival through declining revenues and productivity (Bratnicka, 2014).

5.2 Conclusion

Notwithstanding the increasing prominence of the manufacturing sector in Tanzania's economy, its modest eight percent contribution to the country's GDP remains insignificant relative to the benefits of manufacturing sector in any economy. Digitalization is one of the factors that has the potential to enhance the manufacturing sector. Digitalization possesses the capacity to enhance the business models of manufacturing companies by facilitating more efficient information exchange and providing affordable and expedited entry to domestic and global markets. The digitalization initiatives in Tanzania that are integrated into the Digital Tanzania Project (DTP) under the administration of the Ministry of Communication and Information Technology (MCIT) have the potential to lead the nation towards the realization of Vision 2025 and subsequent development targets. The present study investigated the impact of digitalization on the productivity of manufacturing companies, utilizing data from eight regions on the mainland. The proposition posits an indirect relationship between the two variables, illustrating the mediating function of competitiveness and innovation. Furthermore, the impact of a sustainable digital ecosystem on the interconnections between digitalization, innovation, and competitiveness is subject to

moderating influences. In essence, the business environment acts as a moderator in the relationship between productivity, competitiveness, and innovation.

The primary findings showed that the direct relationship between digitalization and productivity is not statistically significant. Nevertheless, the results indicate that innovation and competitiveness acted as mediators in the connection between digitalization and productivity. In addition, the findings demonstrate that a sustainable digital ecosystem enhances the competitiveness and innovation benefits of digitalization. Furthermore, the influence of business environment dynamism on productivity was found to be positive, whereas the relationships between innovation, productivity, and competitiveness were found to be negatively moderated by hostility. The most important conclusion to be drawn from these results is that the ability of manufacturing SMEs in Tanzania to capitalize on opportunities presented by digital technologies is crucial to their success in the current digital era.

5.2.1 Theoretical Implications

The results of this study have significantly advanced the theory in the domains of entrepreneurship and innovation. A ground-breaking model that clarifies the connections between innovation and productivity in businesses is the CDM. The results contribute to a broader understanding of the model by including digitalization, a metaphor that has been more closely associated with enhanced innovation in business. The results demonstrate that innovation is a channel via which digitalization affects business productivity in the contemporary digital era. The significance that sustainability of the digital environment plays in enhancing the advantages of digitalization for innovation is significant. The results suggest that innovation and digitalization need to be fostered by an ecosystem that is supportive and well-functioning and has characteristics like strong digital financial literacy, low data prices, and high connection, among others. Furthermore, the results contribute to the field by illuminating an additional pathway via which innovation influences productivity. They show how innovation is essential to boosting a company's competitiveness, which gives them an advantage in productivity. The results indicate that while theoretical postulations suggest a relationship between productivity and innovation/competitiveness, this relationship depends on how hostile and dynamic the underlying regional business environment is. The results demonstrate how a hostile business climate is detrimental to the occurrence, which advances our understanding of the innovation and competitiveness vs. productivity conundrum. However, it has been demonstrated that a dynamic business environment increases the effects of competition on productivity.

5.2.2 Practical implications

The results of this study have significant implications or lessons for managers in manufacturing firms, digital service providers, and policymakers. First, policy makers should work to strengthen the sustainability of the nation's digital ecosystem. If society

becomes increasingly digitalized, manufacturing companies will be able to take advantage of new prospects in the digital age. The development of digital business opportunities, such as e-commerce, is heavily reliant on access and pricing of data services, and people's digital financial literacy. Second, regulators i.e., the Tanzania Communication Regulatory Authority (TCRA) should take a proactive approach in developing policies targeted at expanding communication coverage, or internet connectivity, as well as making cost of data services relatively low. Manufacturing companies will benefit from this as it will boost their ability to engage with customers and reach new markets more affordably and conveniently.

Incentives should be provided by the government to encourage the nation's use of digital services. The COVID-19 epidemic has demonstrated the importance of digitalization by enabling the conduct of commerce through online business and payment systems without the need for physical contact between a business and its customers. The government should, for example, give lower taxes, or value-added taxes, for all goods purchased and paid for using digital platforms to encourage the usage of digital services. Due to the ease with which electronic transactions can be tracked, businesses and the government will both benefit from this reduction in tax evasion. In addition, as customers would be encouraged to buy goods online, firms will be able to increase their earnings.

Third, SMEs in the manufacturing sector can increase innovation, competitiveness, and productivity by digitalizing their operations using the digital ecosystem. Particularly for young, educated consumers living in the digital era, Tanzania's population is becoming more educated, and the country's mobile phone ownership rate has skyrocketed over time. These businesses should concentrate on targeting young people's platforms on the internet to draw in clients from the previously specified demographic. For example, social media has become an even more significant digital advertising strategy. Given the prevalence of social media use among youth, manufacturing SMEs ought to leverage these channels to engage with their clientele and promote their products. Social media platforms like Facebook and Instagram provide advertising services to companies looking to boost their product visibility. In nations like the USA and France, these have shown to be effective for businesses by increasing revenues from social media contacts with customers in both business-to-business (B2B) and business-to-consumer (B2C) sales (Franck and Damperat, 2023; Rodriguez et al., 2012). In addition, digitalization can boost innovation in SMEs by enabling them to get digital client feedback on the calibre of their products, which can inspire fresh concepts to boost their competitiveness.

Fourth, digital service providers, including internet providers, ought to prioritize enhancing the geographical reach of their services due to the existing inadequacy of network reception in areas adjacent to urban centres. The successful implementation of digitalization is contingent upon the availability of high-speed, dependable, and cost-effective broadband enabled services. Consequently, service providers must prioritize the enhancement of these three fundamental elements to facilitate the

utilization of digital technologies by both enterprises and consumers, thereby enabling them to harness the advantages presented by the digital realm. The advent of global innovators like Starlink, who offer satellite-based internet services that are fast, affordable, and capable of providing coverage in even the most remote regions, has significantly advanced digitalization endeavours.

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APPENDICES

Appendix 1: Correlation matrix

	L.prod	C.prod	gen	age	edu	pos	exper
L.prod	1						
C.prod	0.6534*	1					
gen	0.1032	0.0055	1				
age	0.2082*	0.0221	0.1258	1			
edu	0.0114	0.1087	0.0912	0.126	1		
pos	0.027	0.0861	0.0942	0.3705*	0.1155	1	
exper	0.2223*	0.0237	0.1591	0.2648*	0.1735	0.3603*	1
fage	0.2290*	0.0319	0.1339	0.2037*	0.1752	0.3306*	0.1321*
fsizE	0.0445	0.0432	0.0796	0.2259*	0.0628	0.0246	0.2250*
fsizA	0.3293*	0.1475	0.1325	0.2537*	0.1805	0.0036	0.2497*
form	0.1884	0.0631	0.0607	0.2082*	0.1133	0.0585	0.2295*
sec	0.0962	0.1051	0.1474	0.1435	0.0586	0.0281	0.1824
sales	0.669*	0.6280*	0.1061	0.2196*	0.0303	0.0239	0.2416*
icti	0.2407*	0.0816	0.1217	0.0296	0.2503*	0.0192	0.0093
fdig	0.0394	0.0817	0.0187	0.0288	0.1632	0.0326	0.0736
dyn	0.09	0.0363	0.0017	0.0081	0.0939	0.1427	0.0264
host	0.0188	0.0387	0.0011	0.0033	0.0676	0.0574	0.0019
di	0.0491	0.0265	0.0472	0.0626	0.0205	0.0556	0.1167
de	0.0679	0.0056	0.013	0.0533	0.0445	0.0158	0.0377
dg	0.0063	0.1153	0.018	0.0185	0.0968	0.0555	0.0628
ino2	0.0275	0.007	0.0581	0.0506	0.0594	0.0484	0.007
comp	0.0681	0.0468	0.0614	0.0355	0.2301*	0.1729	0.0297

	fage	fsizE	fsizA	form	sec	sales	icti
fage	1						
fsizE	0.2400*	1					
fsizA	0.2681*	0.5090*	1				
form	0.2758*	0.0913	0.2252*	1			
sec	0.2247*	0.0652	0.1938	0.1839	1		
sales	0.2517*	0.2557*	0.4204*	0.1849	0.1065	1	
icti	0.0122	0.077	0.4000*	0.1829	0.0626	0.2264*	1
fdig	0.0277	0.0204	0.125	0.0752	0.0089	0.0489	0.158
dyn	0.1013	0.0762	0.0339	0.0277	0.0311	0.0975	0.1692
host	0.0519	0.0272	0.1053	0.0456	0.0065	0.0126	0.0125
di	0.0985	0.0423	0.0124	0.019	0.0252	0.0328	0.0507
de	0.0073	0.0851	0.0156	0.0762	0.1051	0.0625	0.1833
dg	0.0859	0.1652	0.1542	0.0269	0.0498	0.0352	0.0238
ino	0.0023	0.0425	0.0126	0.008	0.0069	0.0305	0.0239
comp	0.0467	0.2378*	0.082	0.0599	0.0316	0.1103	0.1787

	fdig	dyn	host	di	de	dg	ino
fdig	1						
dyn	0.179	1					
host	0.1014	0.4278*	1				
di	0.0825	0.1960*	0.0899	1			
de	0.0251	0.3595*	0.1478	0.1596	1		
dg	0.0384	0.0643	0.0847	0.2327*	0.0948	1	
ino	0.073	0.0175	0.0675	0.029	0.0734	0.078	1
comp	0.2457*	0.6713*	0.4374*	0.0666	0.3429*	0.0415	0.0272
	comp						
comp	1						

Appendix 2: Multicollinearity test-Variance inflation factor (VIF) results

Variable	VIF	1/VIF
Business experience	3.7	0.8197
Firm age	2.9	0.7756
Respondent age	4.2	0.239
Firm net sales	3.4	0.2932
Firm capital productivity	2.9	0.3505
Firm size-fixed assets	2.5	0.3934
Firm competitiveness	2.5	0.4027
Business Env. dynamism	2.2	0.4647
Firm size-no. employees	1.6	0.6335
Firm investment in ICT	1.4	0.6983
Business Env. hostility	1.4	0.7345
Digital economy stability	1.3	0.7726
Business position	1.3	0.7787
Education level	1.3	0.792
Firm formalization	1.2	0.8239
Firm digitalization	1.2	0.8406
Manufacturing subsectors	1.2	0.8473
Digital infrastructure adequacy	1.2	0.8562
Digital economy governance	1.2	0.8606
Gender	1.1	0.9041
Firm innovation	1.1	0.9482
Mean VIF	**2.6**	

Appendix 3: The project schedule

	Project Activity	Responsible Personnel	Time/Estimated Completion Date
1.	Study Conceptual framing, literature development and Methodology design for the research project	Principal Investigators	02/01/2023 – 16/01/2023
2.	Consultation with industry experts, Questionnaire development and administration of pilot survey	Principal Investigators	17/01/2023 – 31/01/2023
3.	Survey administration	Research Assistants	01/02/2023 – 28/04/2023
4.	Data organisation and analysis	Principal Investigators and Research Assistants	02/05/2023 – 30/06/2023
5.	Report writing	Principal Investigators	03/07/2023 – 31/07/2023
6.	First draft report submission and feedback	Principal Investigators	01/08/2023 – 31/08/2023
7.	Addressing reviewers' comments and preparation of second draft report	Principal Investigators	01/09/2023 – 29/09/2023
8.	Second draft report submission and feedback	Principal Investigators	02/10/2023 – 31/10/2023
9.	Final report submission and preparation of papers for publication	Principal Investigators	01/11/2023 – 29/12/2023

Appendix 4: Research team and biographies

Principal Investigator 1: Dr. Jonathan Mukiza Peter Kansheba

Dr. Jonathan Mukiza. P. Kansheba is an assistant professor of International Business and Management at the Department of Management, International Business and Supply Chain Management - Thomas College of Business and Economics, University of North Carolina at Pembroke, USA. He earned his PhD in International Business from the School of Business and Law of the University of Agder, Norway. He teaches International Business and International Management classes at the UNCP. His main research interests include Crowdfunding; Entrepreneurship and Entrepreneurial ecosystems; Innovation ecosystems; Venture capital; Knowledge management; and (broadly) International Business/Management. His research appears in the Baltic Journal of Management, Journal of African Business, Journal of Small Business and Enterprise Development, Small Enterprise Research, Journal of Hospitality and Tourism Insights, China Finance Review International, SN Business and Economics etc. He also regularly reviews papers for peer-reviewed academic journals in his field. Dr. Kansheba is a member of the Association of International Business, Research, and Practice (AIBRP) and the Co-editor of the Journal of International Business Research and Practice since 2023.

Principal Investigator 2: Dr. Mutaju Isaack Marobhe

He works as a lecturer at the Finance and Accounting Department at Tanzania Institute of Accountancy. He holds a PhD in Economic Sciences from Swiss School of Management (SSM) in collaboration with the Eastern and Southern African Management Institute (ESAMI). He completed his Master of Business Administration (MBA) at University of Dar es Salaam. He also finished his Bachelor of Business Administration (BBA) at University of Iringa (UoI) formerly Tumaini University-Iringa University College. He is a Certified Public Accountant (CPA-T). He has published research articles in various recognized international journals in the areas of behavioural finance, quantitative analysis, financial econometrics and entrepreneurship development. His research works can be accessed in the following link: https://www.researchgate.net/profile/Mutaju-Marobhe.

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