OPPORTUNITIES OF DIGITAL TRANSFORMATION IN INTERNATIONAL TRADE: A STUDY OF IMPORT AND EXPORT ACTIVITIES AT DAR ES SALAAM PORT IN TANZANIA

Dissertation Manuscript

Submitted to Unicaf University in Zambia
in partial fulfillment of the requirements
for the degree of

Doctorate of Business Administration (DBA)

By Bosco Joseph Haule

December, 2025

Approval of the Thesis

OPPORTUNITIES OF DIGITAL TRANSFORMATION IN INTERNATIONAL TRADE: A STUDY OF IMPORT AND EXPORT ACTIVITIES AT DAR ES SALAAM PORT IN TANZANIA

This Thesis by Bosco Joseph Haule has been approved by the committee members below, who recommend it be accepted by the faculty of Unicaf University in Zambia in partial fulfillment of requirements for the degree of

Doctorate of Business Administration (DBA)

Thesis Committee:

Dr Pantea Foroudi, supervisor

Dr Olga Novokhatskaya, chair

Dr Omari Khalifa Mbura, external examiner

Dr Elenica Pjero, internal examiner

Abstract

OPPORTUNITIES OF DIGITAL TRANSFORMATION IN INTERNATIONAL TRADE: A STUDY OF IMPORT AND EXPORT ACTIVITIES AT DAR ES SALAAM PORT IN TANZANIA

Bosco Joseph Haule

Unicaf University in Zambia

The digital economy is reshaping global trade, positioning digital transformation (DT) as a strategic driver of international trade opportunities (ITO), global competitiveness (GLC), and efficiency in import/export activities (EIM). However, a persistent digital divide continues to limit the full participation of developing and least-developed countries in digitally enabled trade. In Tanzania, shortcomings in digital infrastructure, regulatory support, digital knowledge and skills, readiness, leadership, innovation, and institutional capacity constrain the effective diffusion of DT within international trade systems.

This study examines the influence of DT, shaped by digital infrastructure (DI) and regulatory frameworks (RF), on ITO, GLC, and EIM, while assessing the moderating roles of competition and efficiency. A mixed-methods approach was employed, integrating quantitative data from a cross-sectional survey of 409 international trade stakeholders at the DSM Port with qualitative insights from 11 key informant interviews. SEM using SPSS AMOS tested the hypothesized relationships, and NVivo-supported thematic analysis provided contextual depth.

The findings reveal that DT significantly enhances ITO ($\beta = 1.296$, $p < 0.001$). Digital infrastructure plays a significant enabling role in supporting DT-driven trade opportunities ($\beta =$

0.452, $p < 0.05$), whereas RF does not demonstrate a statistically significant effect. Efficiency positively moderates the DT–ITO relationship, while competition does not significantly influence this link. Moreover, DT and ITO jointly and significantly improve GLC ($\beta = 0.851$, $p < 0.001$) and EIM ($\beta = 0.354$, $p < 0.001$). Competition, however, strengthens the relationship between ITO and EIM ($\beta = 0.075$, $p < 0.001$). Qualitative evidence supports these results, with 82% of respondents emphasizing the importance of DT despite infrastructure and regulatory setbacks.

The study concludes that DT is a strategic enabler of trade expansion, global competitiveness, and efficiency in developing economies. It highlights the pivotal role of robust DI and strengthened RF in converting digital initiatives into measurable trade outcomes. The study recommends targeted investment in DI, regulatory reform, to foster inclusive and effective DT while addressing demographic disparities in international trade. The findings provide important theoretical and policy contributions by emphasizing the need to bridge the digital divide and advance an inclusive, digitally enabled trade ecosystem.

Declaration

I declare that this thesis has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where stated otherwise by reference or acknowledgment, the work presented is entirely my own.

AI Acknowledgment

Use of AI:

I acknowledge my use of Chat GBT (https://chatgpt.com/) to proofread chapter 2 and chapter 3 of my thesis. This action was completed in 08.04.2025.

The prompts used included: Proofread and correct grammar for the text below.

Copyright Page

Dedication

With deepest humility and gratitude, I dedicate this thesis first and foremost to Almighty God. His unfailing guidance, boundless strength, and daily provision have illuminated my path and sustained me through every step of this journey.

This doctoral thesis is respectfully dedicated to my parents and family, whose unwavering support, sacrifices, and values have been fundamental to the completion of this work. I dedicate this work to the cherished memory of my late parents, Joseph Nyampangula and Emilia Akilindogo, whose enduring love, guidance, and commitment to integrity and perseverance laid the foundation for my academic and personal development. Their legacy continues to inspire my pursuits and achievements.

I further dedicate this thesis to my family, beginning with my beloved wife, Elma, whose steadfast support, patience, and encouragement have been indispensable throughout this demanding journey. I also dedicate this work to my children Benedicto, Elisha, and Benjamin whose love, resilience, and inspiration give purpose to my efforts. May this achievement stand as a testament to perseverance, lifelong learning, and the enduring influence of family.

Acknowledgments

My doctoral journey has been an incredible enriching experience, which was made possible by the scholarship I received from Unicaf University. Without this scholarship, my journey would not have even begun. I am thankfully for the generous support provided.

I would like to express my deep appreciation for the unwavering guidance of my supervisor, Dr. Pantea Foroudi. Her encouragement during challenging times, along with her constant availability and insightful coaching, has been crucial in helping me complete my research. Dr. Foroudi's belief in my potential, encapsulated in her empowering words, "You can" has inspired me throughout this dissertation process. For the rest of my life, I promise to continue to remember her as she remains to be part of this success story.

I also extend my heartfelt thanks to Dr. Eleni K. Komodronou, Dr. Isaak Papadopoulos, Dr. Evangelos Tsoukatos, Dr. Christodoulos Kakouris, Dr. Fanos Tekelas, and the entire UNICAF team, whose support has been instrumental in making this journey successful.

Lastly, I acknowledge my fellow students, who embarked on this journey alongside with me. Their contributions during group discussions reshaped my thinking and provided invaluable momentum and encouragement. Thank you all for being an integral part of this experience.

Table of Contents

List of Abbreviations

ACMS	Automated Customs Management Systems
AfCFTA	African Continental Free Trade Area
AGFI	Adjusted Goodness of Fit Index
AI	Artificial Intelligence
Amos	Analysis of Moment Structures (software used in SPSS)
ANOVA	Analysis of Variance
ASV	Average Shared Variance
AU	African Union
AVE	Average Variance Extracted
C. R	Critical Ratio
CAMIN	Chi-Square
CARE	Claims, Affronts, Response, Equilibrium
CE	Customer Experience
CFA	Confirmatory Analysis
CFAs	Clearing and Forwarding Agents
CFI	Comparative Fit Index
CO	Communication
COM	Competition
COSTECH	Commission for Science and Technology
CFVs	Confrontation Variables

CVs	Control Variables
COVID	Coronavirus Disease
CR	Composite Reliability
DF	Degree of Freedom
DI	Digital Infrastructure
DIY	Do It Yourself
DRC	Democratic Republic of Congo
DSM	Dar es Salaam
DT	Digital Transformation
e.g.	exempli gratia (for example)
EAC	East Africa Community
e-commerce	Electronic Commerce
e-customs	Electronic Customs
EFA	Exploratory Factor Analysis
EFF	Efficiency
EIM	Efficiency in Import/Export Activities
EMA	European Medicines Agency
EU	European Union
FMIN	Function Minimum Fit Function
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
GFI	Goodness of Fit Index
GLC	Global Competitiveness

GPDR	General Data Protection Regulation
H_0	Null Hypothesis
H_a	Alternative Hypothesis
ICT	Information and Communication Technology
IFI	Incremental Fit Index
IoT	Internet of Things
IRB	Institutional Review Board
ISPs	Internet Service Providers
ITO	International Trade Opportunities
LCDs	Least-Developed Countries
ML	Machine Learning
M-Pesa	Mobile Payment System
MSV	Maximum Shared Variance
NACOSTI	National Council for Science and Technology
NCIP	Northern Corridor Integration Projects
NVivo	Non numerical Unstructured Data Indexing Searching and Theorizing software
PE	Trade Performance
PLS-SEM	Partial Least Square Structured Equation Modelling
PPPs	Public - Private Partnerships
PRIDA	Policy and Regulatory Initiative for Digital Africa
R&D	Research and Development
RF	Regulatory Frameworks

RFI	Relative Fit Index
RMR	Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
ROI	Return On Investment
S. E	Standard Error
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SEM	Structural Equation Modelling
SMEs	Small and Medium Enterprises
SPSS	Statistical Package for Social Sciences
SQ	Service Quality
SWS	Single Window Systems
TAEC	Tanzania Atomic Energy Commission
TESS	Tanzania Electronic Window System
TLI	Tucker-Lewis Index
TRA	Tanzania Revenue Authority
UNCTAD	United Nations Conference on Trade and Development
UREC	University Research Ethical Committee
WTO	World Trade Organization

List of Tables

List of Figures

CHAPTER 1: INTRODUCTION

Digital technologies are increasingly integrated into every facet of business and commerce, playing a transformative role on how goods and services are bought and sold globally. Digital transformation (DT) has evolved through several key phases: the pre-internet era (characterized by manual processes and early innovations), the post-internet era (marked by mass connectivity and digital integration), the mobile era (which accelerated access and coined the term 'digital transformation'), and the post-COVID-19 era, which significantly hastened digital adoption (He & Harris, 2020; Fready, Vel & Nyadzayo, 2022).

DT is a complex and strategic undertaking that entails the intentional use of digital technologies to innovate and optimize business processes, systems, and models. Its primary goals include improving organizational performance, agility, and customer experience (Verina & Titko, 2019). DT extends beyond merely adopting new technologies as it embodies a continuous, iterative process grounded in a clear organizational vision, effective leadership, and a culture that encourages innovation and adaptability (Mihardjo & Rukmana, 2018). As a catalyst for disruptive change, DT significantly accelerates transformations across industries, reshaping markets and societal structures by redefining how value is generated and sustained in the digital era (Hai, Van & Thi Tuyet, 2021). In this regard, DT acts as the foundation of today's interconnected business environments, enabling seamless integration among people, platforms, and data across global supply chains (Behdani et al., 2020).

From a broader development perspective, the African Union identifies DT as a strategic enabler of innovation, regional integration, digital equity, job creation, service improvement, and sustainable economic growth (Union, 2020). Moreover, DT is redefining global trade dynamics by transitioning from a producer-centric model to one increasingly influenced by consumer preferences. This shift means that consumer expectations now drive supply chain strategies, production methods, and market responses (Zaki, 2019; Guerrero, Letrouit & Pais-Montes, 2022). As consumers gain greater access to information, personalized services, and faster delivery options, businesses are compelled to become more agile, transparent, and customer centric. This has fundamentally reoriented global value chains, moving away from traditional trade practices.

The aftermath of the COVID-19 pandemic has rapidly accelerated digital innovation, transforming the way people work, learn, shop, and conduct business (Fready, Vel & Nyadzayo, 2022). E-commerce has experienced rapid growth, particularly in developed economies, where market penetration was projected to reach 25% by 2026 (Escursell, Llorach-Massana & Roncero, 2021). This shift is fueled by evolving consumer behavior, technological advancements, and the necessity for businesses to adapt to digital platforms to remain viable. Consequently, DT, which involves incorporation of digital technologies into business operations and strategies, has become essential for developing innovative models, enhancing efficiency, and achieving competitive advantage (Vaska et al., 2021; Song et al., 2022).

In developing countries, the evolving digital environment presents both prospects and hurdles. To remain globally competitive, these nations must move beyond merely adopting new technologies by investing in digital infrastructure, strengthening institutional and human capacities, and establishing supportive policy frameworks (Raisanen & Tuovinen, 2020). Seaports, as key nodes in global logistics, must likewise transition from traditional operations to smart ports to enhance efficiency and competitiveness (Tiwasing, 2021).

Despite these trends, many ports in the Global South, including DSM Port, face difficulties to fully embrace DT. Common obstacles include poor digital infrastructure, low digital literacy, and resistance driven by concerns over traceability and taxation (Ismagilova et al., 2022; Escursell et al., 2021). The DSM Port, which manages about 90% of Tanzania's import and export traffic, still relies on manual procedures such as physical verifications and 100% container scanning. These outdated processes lead to cargo clearance delays, higher operational costs, and reduced competitiveness both regionally and globally (Mwantimwa, 2019; Ye & Ramadhani, 2020).

Although the global shift toward digital seaports is inevitable, Tanzania's transition has been slow, hindered by limited awareness among business operators, concerns over tax exposure, and a lack of technical capacity to manage digital systems effectively (Tiwasing, 2021). The country also faces a significant urban–rural digital divide, where high internet costs and inadequate infrastructure in remote areas limit equitable access to digital services, thus constraining the scalability of digital trade (Nguyen, Hargittai & Marler, 2021). Nguyen et al., (2021) emphasize that despite the global acceleration of digital adoption during the COVID-19 pandemic, socioeconomic inequalities continue to restrict digital access, skills, and meaningful participation, especially for marginalized groups. Their findings highlight that DT cannot be inclusive or effective without addressing these systemic disparities through investments in infrastructure, digital literacy, and equitable policy frameworks. At the operational level, Ye and Ramadhani (2020) identify persistent inefficiencies at Tanzania's DSM Port, including reliance on manual processes and outdated systems, which contribute to delays and reduced trade competitiveness. Their study reinforces the urgency of port digitalization and strategic investment in modern technologies to improve efficiency, transparency, and integration into global trade networks.

In contrast, developed nations are increasingly adopting cutting-edge technologies like blockchain, AI, big data, and the Internet of Things (IoT) to enhance their trade systems. These tools are often integrated into national e-government platforms and have proven effective in reducing paperwork, expediting processes, enhancing transparency, and increasing the reliability and security of international trade operations (Buttolo, 2021; Indira & Kusumasari, 2020; Morris et al., 2022). However, even in these advanced contexts, issues such as cybersecurity risks, policy inconsistencies, and internal digital divides remain (Ismagilova et al., 2022). When deployed effectively, smart port technologies offer considerable advantages, including improved operational safety, real-time data access, and increased profitability (Caceres et al., 2022; Schipper, 2019).

Digital exclusion remains a pressing concern. Despite the promise of inclusive digital trade, many individuals in developing regions are left out due to limited connectivity, infrastructure shortfalls, and skill deficiencies (Peprah, Atarah & Kumodzie-Dussey, 2024; Du, Deng & Wood, 2021). Africa continues to lag in internet penetration and mobile usage compared to other regions (Adeola & Evans, 2020). Nonetheless, regional initiatives such as the African Continental Free Trade Area (AfCFTA) and the East African Community's (EAC) harmonization efforts aim to enhance cross-border trade by promoting integration through unified digital platforms. Successful examples like Kenya's M-Pesa demonstrate the transformative impact of digital tools in promoting financial inclusion and supporting SMEs (Akbari & Hopkins, 2022; Lisinge, 2020).

This study explores the role of DT in creating international trade opportunities for enhancing efficiency and competitiveness in import/export activities at the DSM port. As global trade increasingly adopts digital technologies, tools such as AI, blockchain, and cloud computing are revolutionizing logistics by enabling real-time tracking, reducing fraud, improving transparency, and accelerating customs processes (Hidalgo et al., 2020; Mwenda & Kimutai, 2022). Global platforms like Amazon, Alibaba, and eBay show how SMEs can access international markets directly (Furr, Ozcan & Eisenhardt, 2022). In Africa, digital logistics solutions are becoming essential for improving trade performance and simplifying documentation (Maury et al., 2020; Union, 2020). This research aims to evaluate how DT can elevate Tanzania's participation in international trade and support broader regional economic integration.

The United Nations Conference on Trade and Development (UNCTAD) predicts that by 2030, digital trade will constitute a significant share of global commerce, reshaping how goods, services, and data are exchanged (ESCAP et al., 2023). Countries that fail to keep pace with this digital evolution risk marginalization from global value chains and diminished access to international markets (Herve, Schmitt & Baldegger, 2021). In response, Tanzania has launched reforms to digitalize DSM Port operations, recognizing its central role in national trade (Lwesya, 2021). However, persistent issues such as outdated systems, limited funding, bureaucratic delays, and underdeveloped infrastructure continue to hamper progress (Mwantimwa, 2019; Ye & Ramadhani, 2020). Additionally, there is a lack of empirical research assessing Tanzanian firms' readiness for DT. This study seeks to fill that gap by analyzing how DT can enhance trade efficiency, competitiveness, and integration into the global digital economy.

This research is underpinned by multiple theoretical perspectives integrated to provide a comprehensive view of DT in trade. It begins with CARE theory, aligned with UREC requirements, which offers ethical guidance by emphasizing integrity, accountability, and respect for participants' dignity throughout data collection and engagement, thereby ensuring responsible and transparent research practices (Leidner & Tona, 2021). In contrast, Dynamic Capabilities Theory (Conboy et al., 2020) explains how organizations sense opportunities, adapt to change, innovate, and reconfigure resources to remain competitive in rapidly evolving environments. Finally, Network Theory (Moro Visconti, 2019) frames international trade as an interconnected system, underscoring the importance of collaboration and information sharing for successfully implementing DT within trade ecosystems.

Statement of the Problem

As digital technologies reshape the landscape of global trade, logistics, and supply chain systems, seaports around the world are evolving into smart, technology-driven hubs. These smart ports integrate digital tools to streamline operations, lower transaction costs, boost transparency, and enable real-time communication among multiple stakeholders. While developed countries are experiencing rapid digital harmonization and technological transformation, developing nations continue to lag due to the persistent digital divide and digital inequality (Pollitzer, 2018). This divide is particularly evident in disparities in internet access, technological infrastructure, digital literacy, and policy maturity (Vassilakopoulou & Hustad, 2023).

Globally, DT has proven to be a key driver of trade competitiveness and economic efficiency. As of recent estimates, 86.7% of the population in developed countries has internet access, compared to just 44.4% in developing nations (Nguyen, Hargittai & Marler, 2021), and in Tanzania, only around 50% of the population uses the internet (Semlambo, Lubua & Mkude, 2022). This unequal access significantly limits the ability of developing economies to fully engage in e-commerce. For instance, global e-commerce sales grew from $2.3 trillion in 2017 (Verhoef et al., 2021), expanded to $5.8 trillion by 2023, and are projected to reach $7.9 trillion by 2027 (Cui et al., 2025). Despite this rapid growth, many developing economies continue to struggle to capitalize on these opportunities due to persistent setbacks posed by the digital divide.

Moreover, the contribution of e-commerce to economic growth remains uneven: while developed countries have seen a 3.4% GDP boost from DT, this figure drops below 1.9% in developing economies (Banga & te Velde, 2018). In Tanzania, the contribution of information and communication technologies to GDP stood at just 1.51% in 2018 (Kahyarara, 2022), reflecting the country’s limited capacity to leverage digital tools for economic expansion. Despite DT's potential to eliminate traditional trade barriers by bridging geographic, informational, and time gaps (Butollo, 2021), the diffusion of e-commerce and digital practices from developed economies to developing economies like Tanzania remains slow (Peprah, Atarah & Kumodzie-Dussey, 2024).

Grounded in CARE Theory (Leidner & Tona, 2021), the Theory of Dynamic Capabilities (Conboy et al., 2020) and Network Theory (Moro Visconti, 2019), the frameworks help to explore how organizational readiness, adaptive capacity, and stakeholder networks influence DT outcomes. Despite some progress, especially in critical trade infrastructure such as the DSM Port, the country continues to lag behind in the digital age, constrained by fragile technological infrastructure, limited digital literacy, underdeveloped policy frameworks, and nascent digital ecosystems (Furr, Ozcan & Eisenhardt, 2022). This highlights the urgent need to assess the opportunities of DT within Tanzania's trade ecosystem, particularly in enhancing competitiveness and efficiency through digital integration at major trade nodes like DSM Port.

Over 80% of the world's cargo is transported by sea, underscoring the vital role maritime trade plays in the global economy (Yau et al., 2020). In Tanzania, the DSM Port is particularly significant, handling over 90% of the country's import and export cargo (Mlepo & Zheng, 2023). Recognizing this importance alongside the global shift toward digitalization, the Government of Tanzania has committed to a comprehensive DT agenda through the Digital Economy Strategic Framework 2024–2034 (URT, 2024). This framework aims to integrate digital technologies across all sectors of the economy to promote innovation and sustainable growth. Within this context, modernizing DSM Port is a key priority. As the country's main maritime gateway, the port's DT is critical to improving trade efficiency, expanding access to international markets, and strengthening Tanzania's competitive position in global trade.

Despite its strategic importance, DSM port continues to face major operational inefficiencies that limit its ability to function as a modern, smart port. Existing studies consistently report impediments such as excessive delays in cargo clearance, long queues, high transaction costs, bureaucratic red tape, excessive paperwork, and a heavy reliance on manual handling of goods (Mlimbila & Mbamba, 2018; Mwantimwa, 2019; Ye & Ramadhani, 2020). These inefficiencies not only hinder operational performance at ports but also reduce trade competitiveness and discourage investment in the broader logistics sector. These inefficiencies not only reduce the port's overall productivity but also negatively affect Tanzania's standing as a competitive trading nation. A significant factor contributing to these problems is the digital divide or inequalities in access and/or use of digital technologies (Mlepo & Zheng, 2023).

The digital divide at the port activities remains a critical obstacle to achieving effective DT in international trade. Defined as the gap between those with and without access to digital technologies (Pollitzer, 2018), this divide deepens existing inequalities in developing countries, where infrastructure and digital literacy are limited (Durand et al., 2022). At DSM Port, the divide is reflected in outdated digital infrastructure, poor systems integration, minimal automation, and limited access to real-time data platforms (OECD, 2021). These shortcomings prevent traders, freight forwarders, and other port users from fully leveraging digital tools to streamline operations. Additionally, many port personnel and stakeholders lack the digital skills necessary to support or adopt these systems effectively (Nguyen, Hargittai & Marler, 2021; Tiwasing, 2021). As a result, delays, inefficiencies, and high operational costs persist, undermining competitiveness and inclusive trade participation. Bridging this divide is essential for Tanzania to modernize its port operations, foster innovation, and align with broader digital economic goals (Union, 2020).

More broadly, Tanzania's digital divide extends beyond the port environment. The country faces holdups in digital infrastructure development, internet accessibility, and policy coherence. For example, Tanzania had one of the lowest internet penetration rates in East Africa, with only 65% of the population connected in 2021, compared to 72% in Kenya and 82% in Rwanda (Morris, J., Morris, W. & Bowen, 2022). This reflects broader infrastructural and affordability obstacles, which continue to constrain the country's DT strategic initiatives and its ability to fully participate in the digital economy. Digital literacy also remains low among SMEs, particularly those involved in trade, limiting their ability to adopt e-commerce and digital trade practices. Furthermore, regulatory issues such as gaps in data protection laws, cybercrime and trade standards contribute to an uncertain environment that deters investment (Magesa & Jonathan, 2021).

While existing literature widely acknowledges the potential benefits of digital DT in developing economies such as enhancing operational efficiency, promoting transparency, and fostering economic inclusion (Tiwasing, 2021; Choudrie, Zamani & Obuekwe, 2022), there remains a noticeable gap in context-specific research related to Tanzania. In particular, very few studies have focused on the DSM Port, despite its strategic importance as the country's main trade gateway, handling most imports/exports operations. Although digital interventions have been discussed at a general level, limited empirical evidence exists on how such interventions could be effectively applied to modernize port operations, reduce inefficiencies, and support Tanzania's broader digital economy ambitions. Most existing studies overlook the unique opportunities that characterize Tanzania's trade logistics environment. Addressing this knowledge gap is critical to support the transition from traditional port practices to a smart, agile, and globally competitive logistics hub. This study contributes by offering evidence-based insights to guide policy, investment, and implementation efforts toward DT in import/export activities.

Purpose of the Study, Research Aims, and Objectives

The primary purpose of this study is to critically examine the role of DT in enhancing international trade performance within the context of developing economies, with particular emphasis on Tanzania's import/export activities at the Port of DSM. As global trade systems become increasingly digitized, developing countries are presented with significant opportunities for integration into global value chains, while simultaneously confronting persistent structural constraints that may hinder their competitiveness. Situated within the broader global development agenda, this study aligns with the objectives of Agenda 2030 by contributing to the advancement of an inclusive, competitive, and sustainable digital economy (Walsh, Murphy & Horan, 2020).

Building on this foundation, the overarching aim of the study is to investigate how DT can enhance competitiveness and operational efficiency within the international trade ecosystem. To achieve this aim, the research examines digital transformation, digital infrastructure, and regulatory frameworks as key explanatory variables influencing international trade opportunities at the DSM port. Competition and operational efficiency are conceptualized as moderating factors that shape the strength and direction of these relationships. The study is guided by the digital transformation framework proposed by Hanelt et al., (2021), which conceptualizes DT as the integration of enhanced customer experience, advanced digital technologies, and improved operational processes. Drawing on this framework, the research evaluates how these interrelated dimensions enable organizations to adapt to dynamic environments, improve service delivery, strengthen coordination, enhance efficiency and sustain competitive advantage. In doing so, the study contributes to a deeper understanding of how DT supports performance improvement (Tiwasing, 2021), service quality enhancement (Djafarova & Foots, 2022), effective communication and coordination (Song et al., 2022), and enriched customer experience (Van Veldhoven & Vanthienen, 2022).

To operationalize this aim, the study advances a coherent set of research objectives designed to address both theoretical and practical gaps in the literature. First, it investigates the influence of DT on the creation of international trade opportunities at the DSM port (Halpern et al., 2021; Choudrie, Zamani & Obuekwe, 2022). Second, it examines the moderating roles of competition and efficiency in shaping the relationship between DT and international trade opportunities, with a view to strengthening global competitiveness and efficiency in import/export activities (Pazi & Chatwin, 2019; Union, 2021; Hanelt et al., 2021). Third, the study evaluates the contribution of digital infrastructure to facilitating international trade opportunities (Hausberg et al., 2019; Union, 2020; Tiwasing, 2021). Fourth, it assesses the extent to which regulatory frameworks enable or constrain the realization of digital trade opportunities within the port ecosystem (Brunetti et al., 2020; Djafarova & Foots, 2022). Fifth, the research analyzes how digitally enabled port operations contribute to enhanced global competitiveness (Van Veldhoven & Vanthienen, 2022; Song et al., 2022). Finally, it investigates the impact of DT on improving operational efficiency in import/export processes (Hanelt et al., 2021; Pazi & Chatwin, 2019).

Responding to calls for more sector-specific analyses of DT in international trade (Rossini et al., 2021; Zhang, Xu & Ma, 2022) and to the growing scholarly emphasis on capabilities as key mechanisms for addressing inequalities associated with the digital divide (Choudrie, Zamani & Obuekwe, 2022), this research aims to make a timely and substantive contribution to the business community, academia, and policymakers. Specifically, it advances existing knowledge by situating DT within the operational realities, thereby bridging the gap between conceptual frameworks and practical implementation.

The findings of this study generate actionable insights for key stakeholders, including business organizations, policymakers, and regulatory authorities. For firms engaged in international trade, the research offers strategic guidance on leveraging digital technologies, organizational readiness, and process innovation to improve efficiency and competitiveness. For policymakers and regulators, it provides evidence-based recommendations to support the development of effective regulatory frameworks, digital governance structures, and institutional reforms, while informing strategic investments in digital infrastructure and capacity building (Tiwasing, 2021). The study shows that DT improves trade performance and resilience by replacing paper based systems with integrated, technology driven processes that support inclusive participation in the digital economy. These contributions are achieved through the systematic pursuit of the following research objectives:

1) To investigate the influence of digital transformation on creating international trade opportunities at DSM port in Tanzania
2) To establish the moderation role of competition and efficiency in creating international trade opportunities, improving global competitiveness and efficiency in import/export activities at DSM port
3) To examine the transformative influence of digital infrastructure on international trade opportunities at DSM port
4) To determine the transformative influence of regulatory frameworks on international trade opportunities at DSM port
5) To assess the influence of digitally enabled DSM port activities on global competitiveness
6) To investigate the influence of digitalization of DSM port operations on efficiency in import/export activities

Nature and Significance of the Study

This thesis examines the digital divide in developing countries, which restricts access to digital technologies and was exacerbated by the COVID-19 pandemic (Union, 2020; Bonina et al., 2021; Mwantimwa, 2019; Barnes, 2020). Adopting digital technologies has the potential to reduce exclusion and socio-economic marginalization (Bonina et al., 2021). To investigate this, the study employs an abduction approach, combining deduction and induction to allow data collection and analysis within a single study, generating both explanatory and exploratory insights (Weyant, 2022). This is complemented by a mixed-methods, cross-sectional, and descriptive design, integrating quantitative and qualitative analyses to examine the current state of the digital divide and DT in international trade (Jarvenpaa et al., 2019). Quantitative data are analyzed using SEM to explore relationships among DT, digital infrastructure, regulatory frameworks, efficiency, and competition, while qualitative interviews are thematically analyzed to contextualize and validate the statistical findings. This approach ensures a comprehensive understanding of how DT influences trade efficiency and competitiveness within digitally constrained environments.

The study's significance is multifaceted, encompassing empirical, sectoral, methodological, theoretical, practical, and policy dimensions. Empirically, it addresses the persistent and widening digital divide that continues to disadvantage developing and least-developed countries (LDCs) in accessing and adopting digital technologies (Union, 2020; Bonina et al., 2021; Mwantimwa, 2019). These inequalities were intensified by the COVID-19 pandemic, which accelerated global digitalization while exposing structural weaknesses such as inadequate digital infrastructure, limited digital skills, and other institutional constraints in low-income economies (Barnes, 2020). By examining DT within international trade operations at the DSM Port, the study provides context-specific evidence on how digital infrastructure, regulatory frameworks, efficiency, and competition interact to shape trade opportunities, operational performance, and competitiveness in a digitally constrained environment.

Contextually and sectorial, the study focuses on port-based international trade systems, which remain central to Tanzania's economy but are characterized by slow, costly, and inefficient manual processes (Zaki, 2019; Hohlov & Ershova, 2018). Prior research in Tanzania and Sub-Saharan Africa has largely emphasized broadband connectivity, ICT usage, and general digital readiness (Haji, Silla & Musuguri, 2017; Pazi & Chatwin, 2019; Mwantimwa, 2019), yet few studies examine how DT directly transforms import/export systems and connects local firms to global markets. Responding to calls for context-driven, sector-specific DT research (Banalieva & Dhanaraj, 2019; Zhang, Xu & Ma, 2022), this study investigates how smart port technologies that can reduce delays, lower transaction costs, and enhance trade competitiveness, addressing inefficiencies caused by the digital inequalities, misalignment of digital systems and/or the use of outdated manual procedures (Hohlov & Ershova, 2018).

Methodologically, the research integrates quantitative and qualitative approaches within a cross-sectional design to provide a robust and comprehensive understanding of DT in international trade. Quantitative data analyzed via SEM examines the complex interrelationships among DT variables, while thematic analysis of qualitative interviews validates and contextualizes the findings (Hair et al., 2021; Benitez et al., 2022). This triangulated approach enhances robustness, validity, and explanatory depth, offering a replicable framework for examining DT in other LDC trade ecosystems (Weyant, 2022; Appio et al., 2021).

Theoretically, the study combines Dynamic Capabilities Theory, CARE Theory, and Network Theory to conceptualize DT as both a technological and strategic organizational capability (Leidner & Tona, 2021; Conboy et al., 2020; Moro Visconti, 2019). Dynamic

Capabilities Theory explains how trade actors sense opportunities, seize them through innovation and investment, and reconfigure resources to remain competitive (North, Aramburu & Lorenzo, 2020). CARE Theory emphasizes ethical, human-centered practices, including data governance and balancing performance with responsibility, while Network Theory highlights the role of digital networks in facilitating coordination, information flow, and collaboration among trade stakeholders, reinforcing efficiency and value creation. Together, these theories provide a comprehensive framework for understanding how organizations can adapt to digital change, integrate emerging technologies, and leverage networked interactions to enhance trade performance and competitiveness.

Practically, the study provides actionable insights for policymakers, port authorities, and trade stakeholders seeking to enhance efficiency and global competitiveness. It demonstrates how digital tools such as e-commerce platforms, payment systems, e-customs, automated logistics, and smart port solutions can streamline trade processes, reduce transaction costs, improve transparency, and expand market access (Nguyen, Hargittai & Marler, 2021; Zaki, 2019). By identifying strategic enablers and constraints of DT, the study informs decisions on digital investment, business innovation, and capacity building within Tanzania's international trade.

From a policy perspective, this research highlights the critical need for coherent and comprehensive digital trade policies, supportive regulatory frameworks, and institutional reforms to facilitate technology adoption, optimize import/export activities, and bridge the digital divide. Its findings provide evidence-based guidance for policymakers, directing infrastructure investment, digital skills development, and the establishment of effective governance mechanisms that foster trust, encourage innovation, and promote sustainable digital trade growth. These contributions directly support Tanzania's National Development Vision and align with the United

Nations’ Agenda 2030, particularly Sustainable Development Goals related to decent work and economic growth (SDG 8), innovation and infrastructure (SDG 9), reduced inequalities (SDG 10), and global partnerships (SDG 17). By strengthening digital infrastructure, governance, and skills development, the study further promotes sustainable industrialization, inclusive economic participation, and long-term competitiveness in the global digital economy.

The study further underscores the critical importance of addressing gaps in existing regulatory frameworks governing e-commerce, data protection, cybersecurity, and digital platforms, which currently create uncertainty, increase operational risks, and constrain the growth of digital trade in Tanzania (Verhoef et al., 2021; Bonina et al., 2021). By providing actionable insights for regulatory reform, infrastructure development, and capacity building, the research equips policymakers with the tools to create an enabling environment that attracts strategic investment, fosters innovation, strengthens institutional readiness for DT, and ensures that trade systems are secure, reliable, and efficient.

Ultimately, the study demonstrates how targeted DT can shift traditional, paper-based trade systems toward integrated, agile, transparent, and technology-driven processes. This transformation not only enhances international trade performance but also strengthens economic resilience, reduces inefficiencies, and promotes inclusive participation in the global digital economy. By bridging the digital divide and fostering equitable access to digital trade infrastructure, the research provides both theoretical and practical insights that are relevant to Tanzania and other developing countries facing similar structural and technological encounters. In doing so, it supports inclusive economic growth, sustainable development, and long-term competitiveness in international trade while highlighting the strategic value of DT as a driver of both national and regional economic integration.

Research Questions and Research Hypotheses

Dunwoodie, Macaulay and Newman (2023) identify several effective strategies for developing strong research questions. One approach involves drawing from the researcher's own experience or engaging in discussions with field experts to uncover relevant issues worth exploring (Pandey & Pandey, 2021). Another method focuses on identifying gaps in the existing literature which present opportunities for deeper inquiry (Thekdi & Aven, 2024). A more critical approach, known as problematization, encourages researchers to question established assumptions, expose contradictions, and highlight unresolved tensions in theory or practice (Rabetino, Kohtamäki & Federico, 2021). This process not only enhances the researcher's understanding of the issue but also helps shape more focused, relevant, and impactful research questions (Giermindl et al., 2022).

In addition, Dunwoodie et al., (2023) emphasize the importance of choosing a research approach, whether inductive or deductive, before formulating questions, as this decision defines the study's trajectory. Complementing this, Zoppelletto et al., (2023) suggests that coding open-ended questions can uncover deeper competencies and provide richer insights. In this study, research questions were guided by the problem statement and gaps identified in the literature, forming the backbone of a qualitative inquiry into how DT influences international trade. The study also considered the moderating roles of competition and efficiency. These questions shaped the research design, from hypothesis development to data collection and interpretation. The central qualitative question asked: "*How is the DSM Port progressing in the transition from traditional trade systems toward DT, and in what ways do regulatory frameworks and digital infrastructure influence the port's efficiency and competitiveness in import/export activities?*" Based on this, supplementary questions and corresponding hypotheses were later developed to guide the quantitative phase of the study:

Research Questions

RQ1: To what extent does digital transformation (DT) generate international trade opportunities (ITO) at DSM port in Tanzania?

This research question explores and discusses the attributes of digital readiness, innovation, leadership, knowledge and skills, to find out how they create ITO (Machado et al., 2021; Kokolek, Jakovic & Curlin, 2019). Before embarking on the journey of DT, understanding these attributes is crucial, as they directly impact the failure or success of the change initiatives. In addition, this question explores the digital future which depends on differences in social-political-economic systems where essential conditions are frequently missing in developing economies (Pollitzer, 2018). Furthermore, although the investments required for digital technology is huge, developed countries are coping with the pace of change while developing countries are struggling (Reardon et al., 2021). Despite the struggle which developing countries are going through, digitalization is continuing to reshape the way businesses are conducted (Verhoef et al., 2021). Because of the inconsistent digital technology utilization, developed countries are enjoying digital harmony while developing countries are suffering from digital divide (Pollitzer, 2018). Furthermore, many African countries exhibit slow adoption and limited innovation in digital technologies that could be leveraged within the digital economy (Union, 2020). Specifically, Tanzania continues to experience ongoing operational setbacks at the DSM port, as documented in previous studies, including excessive delays, bureaucratic hurdles, long queues, high costs, cumbersome paperwork, and reliance on manual processes (Mlimbila & Mbamba, 2018; Mwantimwa, 2019; Ye & Ramadhani, 2020). In alignment with the research conceptual framework, DT is identified as the predictor variable, influencing the outcome variable, international trade opportunities (ITO), during both the data collection and analysis stages.

RQ2: To what extent does the moderation role of competition (COM) and efficiency (EFF) in digital transformation (DT) create international trade opportunities (ITO) to facilitate global competitiveness (GLC) and efficiency in the import/export activities (EIM)?

This research explores the roles of efficiency (EFF) and competition (COM) as moderators within the context of DT, investigating their influence on international trade opportunities (ITO), global competitiveness (GLC), and import/export efficiency activities (EIM). Di et al., (2022) emphasize that competition is a key factor in shaping the digital trade business environment by improving market access and fostering conditions for the growth of the digital economy. Similarly, Mlepo and Zheng (2023) highlight how efficiency in port operations can reduce costs and attract hinterland countries. This research examines the moderating roles of COM and EFF in two key dimensions, as detailed below.

The first dimension of this research question examines how competition (COM) moderates the relationship between DT and the formation of ITO. It investigates how COM moderate DT the relationship between ITO, GLC, and EIM. Specifically, the study explores the interaction between DT and COM (DT_COM) and its potential impact on the digital trade environment. Additionally, it assesses how COM affects GLC and EIM through the interaction term ITO_COM. Drawing from the work of Peng and Tao (2022), the study examines whether DT drives GLC through innovation, automation, and resource sharing. Furthermore, the research investigates how competition impacts EIM, as discussed by Du, Deng and Wood (2021), with the goal of understanding whether competition positively or negatively influences ITO, GLC, and EIM.

The second dimension of this research question delves into the moderation of efficiency (EFF) in the association between DT and international trade opportunities (ITO). This dimension investigates how EFF impacts the creation of ITO. This dimension also examines the moderating effect of EFF on GLC and EIM through the interaction term ITO_EFF. Building on the work of Li and Fei (2023), this dimension evaluates how efficiency moderates the interplay between DT, ITO, GLC, and EIM. The study examines how DT fosters GLC through innovation and automation, drawing from Peng and Tao (2022). Moreover, it focuses on how EFF influences EIM, with particular attention to Tanzania's Port of DSM. Drawing from previous studies, like Rossini et al., (2021), Rotblat (2018), and Tabrizi et al., (2019), this dimension assesses how digital technologies can improve international trade efficiency by reducing costs, enhancing automation, and facilitating resource sharing. Additionally, the research explores whether the ITO_EFF interaction accelerates GLC and EIM activities beyond their individual effects.

RQ3: To what extent does the transformative influence of digital infrastructure (DI) have on creating international trade opportunities (ITO) at DSM port?

The third research question investigates the influence of digital infrastructure (DI) on DT, specifically how DI facilitates the creation of international trade opportunities (ITO). The central aim is to assess how the availability, quality, and development of DI play a crucial role in enabling DT and subsequently fostering ITO.

DI encompasses both the physical and technological components that form the foundation for DT across various sectors. It includes essential elements such as internet connectivity, data storage systems, cloud computing, and advanced hardware, all of which enable businesses to adopt and integrate digital technologies effectively. A strong DI allows businesses to take advantage of cutting-edge technologies like cloud computing, AI, blockchain, and the IoT to engage in more efficient and competitive international trade activities. Constantinides, Henfridsson and Parker (2018) argue that DI is fundamental in driving DT, as it provides the essential tools and capabilities for businesses to adapt to digital processes and expand their reach in the global market.

Union (2020) emphasizes that digital infrastructure (DI) is a foundational pillar driving digitalization across economies. In international trade, DI and DT work together to identify and create global market opportunities. Robust DI enables seamless communication, data exchange, and transaction processing, helping businesses operate more efficiently, lower costs, and better engage with international markets. This supports the creation of inclusive trade opportunities (ITO), especially benefiting SMEs that often face barriers to global participation. The expansion of DI fosters digital platforms that streamline trade processes such as e-business and tech-enabled systems, simplifying customs, regulations, and logistics. These platforms enhance import/export activities by overcoming geographical, financial, and regulatory limitations, enabling businesses to access new markets and improve trade efficiency.

In regions such as East Africa, where DI is still in the process of development, the improvement has the potential to transform international trade. For example, in countries like Tanzania, DI, including mobile payment systems like M-Pesa, has created new opportunities for SMEs to engage in cross-border trade, particularly in financial services (Lisinge, 2020). Similarly, efforts to modernize ports and harmonize trade regulations through digital platforms are expected to increase efficiency and enhance international trade opportunities (Union, 2021).

However, the influence of DI on DT and ITO is not uniform across regions. In developing countries, where DI shortcomings remain, the full potential of DT to create ITO may not be realized unless there is significant investment in both physical and DI (Mwantimwa, 2019; Lwesya, 2021). As noted by various scholars, including Magesa and Jonathan (2021), the slow adoption of digital technologies in Tanzanian import/export activities can be attributed to barriers such as limited internet access, insufficient broadband coverage, and inadequate investment in technology infrastructure. Confronting these obstacles is important for unlocking DT's full potential, ensuring that businesses can effectively use it to access global markets and generate new ITO.

RQ4: To what extent does transformative influence of regulatory frameworks (RF) have on creating international trade opportunities (ITO) at DSM port?

The fourth research question examines how regulatory frameworks (RF) influence digital transformation (DT) and its potential to create opportunities in international trade (Azmeh, Foster & Echavarri, 2020; Ismagilova et al., 2022). Robust RFs are essential for shaping effective DT strategies, emphasizing transparency, stakeholder engagement, clear rationale, and strong commitments to targeted goals (Meltzer, 2020). In Africa, key frameworks like PRIDA and the African Continental Free Trade Area (AfCFTA), alongside other regional agreements, aim to enhance regulatory outcomes by promoting welfare, lowering costs, and ensuring that digital trade regulations are non-restrictive and trade-friendly (Union, 2020; AUC, 2021). As highlighted by Trischler and Li-Ying (2023) and Grewal et al., (2020), effective regulatory oversight and collaboration between governments and businesses can drive transformative changes across sectors including education, manufacturing, and trade. Well-structured RFs not only spur economic and social development but also protect public welfare (Union, 2020). This research explores how regulatory frameworks impact DT in unlocking international trade opportunities by facilitating smoother, more efficient cross-border transactions (Buttolo, 2021; Rachinger & Muller, 2024; Akbari & Hopkins, 2022; Verhoef et al., 2021; Zaki, 2019).

RQ5: To what extent do digitally enabled port activities (DT/ITO) influence global competitiveness (GLC) at DSM port?

This research investigates the impact of DT on international trade opportunities (ITO), with a focus on how DT enhances global competitiveness (GLC). Increasingly, competitive advantages in ports are linked to the strategic integration and siting of digital technologies to optimize port ecosystems and supply chains (Ye & Ramadhani, 2020; Mlepo & Zheng, 2023). The study aims to evaluate how advancements in automation, digital platforms, and data-driven decision-making can streamline trade processes, boost efficiency, and unlock access to new markets (Tolstoy, Nordman, & Vu, 2022). These technological improvements are anticipated to elevate the global positioning of ports such as the DSM port within the international logistics landscape (Ghosh et al., 2022). By exploring the interrelations between DT, ITO, and GLC, the research seeks to reveal how digitalization shapes competitive advantage and how strategic digital adoption can promote sustained trade growth and economic development.

RQ6: To what extent does digitalization (DT/ITO) of DSM port operations influence efficiency in import/export activities (EIM) at DSM port?

This research investigates the impact of DT on international trade opportunities (ITO), with a particular emphasis on improving operational efficiency in import/export activities (EIM). The study seeks to understand how DT enables more seamless and cost-effective trade processes by automating routine tasks, minimizing paperwork, and enhancing data flow and transparency among key stakeholders in the trade ecosystem (Karas, 2020). By leveraging advanced digital technologies such as electronic documentation systems, real-time tracking, and integrated digital platforms, DT is expected to reduce operational costs (Benitez et al., 2022), increase the speed and accuracy of transactions (Rai et al., 2022), and optimize supply chain coordination. Ultimately, the research aims to assess how these digital advancements can significantly enhance the efficiency and competitiveness of import/export activities (Ghosh et al., 2022).

Hypotheses

Aligned with the research objectives and questions, the researcher formulated a hypothesis for each of the research questions 1, 3, 4, 5, and 6 to predict the causal relationships between the variables. Since multiple tests were needed for the second research question, an additional six hypotheses were developed to assess the moderate effects of competition and efficiency.

1) $H1_0$. Adoption of DT does not unfold international trade opportunities (ITO) at DSM port in Tanzania.
2) $H2A_0$.Competition (COM) does not moderate DT and international trade opportunities (ITO) at DSM port in Tanzania
3) $H2C_0$.Competition (COM) does not moderate ITO and global competitiveness (GLC) at DSM port in Tanzania
4) $H2E_0$.Competition (COM) does not moderate ITO and efficiency in import/export (EIM) at DSM port in Tanzania
5) $H2B_0$.Efficiency (EFF) does not moderate DT and international trade opportunities (ITO) at DSM port in Tanzania
6) $H2D_0$.Efficiency (EFF) does not moderate ITO and global competitiveness (GLC) at DSM port in Tanzania
7) $H2F_0$.Efficiency (EFF) does not moderate ITO and efficiency in import/export (EIM) at DSM port in Tanzania
8) $H3_0$. Robust digital infrastructure (DI) does not influence DT in creating ITO at DSM port in Tanzania
9) $H4_0$. Supportive regulatory frameworks do not influence DT in creating ITO at DSM port in Tanzania

10) $H5_0$. DT and ITO have no influence on global competitiveness (GLC) at DSM port in Tanzania

11) $H6_0$. DT and ITO have no influence on efficiency in import/export activities (EIM) at DSM port in Tanzania

In this study, the null hypotheses (H_0) are represented by $H1_0$, $H2_0$, $H2B_0$, $H2C_0$, $H2D_0$, $H2E_0$, $H2F_0$, $H3_0$, $H4_0$, $H5_0$, and $H6_0$, corresponding to the respective research questions (RQ1 to RQ6). These null hypotheses posit that there is no significant relationship between the variables. The alternative hypotheses (H_a) represented by $H1_a$, $H2A_a$, $H2B_a$, $H2C_a$, $H2D_a$, $H2E_a$, $H2F_a$, $H3_a$, $H4_a$, $H5_a$, and $H6_a$, were not listed above.

To evaluate the validity of the hypotheses, the study employed statistical testing using the p-value criterion. A p-value less than 0.05 led to the rejection of the null hypothesis (H_o), offering adequate evidence to endorse the alternative hypothesis (H_a). Conversely, p-values greater than 0.05 resulted in retaining the null hypothesis, suggesting no statistically significant effect. This approach follows established statistical conventions, as described by Hair et al., (2021), where the null hypothesis represents no effect or relationship, and the alternative hypothesis suggests the presence of one. During the study the variables under investigation were tested to either reject H_0 or accept the H_0 hypotheses depending on specified criteria and when significant effect (which is below 0.05) is not achieved (Hair et al., 2021). When H_0 is rejected then H_a is accepted and the vice versa is true.

CHAPTER 2: LITERATURE REVIEW

Introduction

Digital transformation (DT) is increasingly reshaping international trade by changing how import/export activities are organized and managed. This study investigates the role of DT in international trade, focusing on import/export activities at the DSM port. Despite the widespread adoption of digital technologies, significant inequalities persist in access to digital resources, their effective use, and the benefits generated, contributing to the broader socioeconomic digital divide (Picatoste, Mesquita, & González-Laxe, 2023). DT strategies are widely viewed as tools for leveraging innovation and digital technologies to transform economies, promote regional integration, foster inclusive growth, and reduce poverty (Union, 2020). However, the digital divide remains multidimensional, encompassing disparities in infrastructure, connectivity, skills, and the capacity to use digital tools, which continue to shape economic and social outcomes (Choudrie, Zamani, & Obuekwe, 2022). Addressing these limitations requires coordinated investments in digital infrastructure and supportive regulatory frameworks to enhance efficiency and competitiveness (Klein & Todesco, 2021).

International trade has expanded markedly in scale and complexity, with global value chain transactions reaching approximately USD 25 trillion by 2021 (Gupta, Ghosh, & Sridhar, 2022). Within this increasingly digitalized trade environment, addressing the digital divide requires strategic investments in digital infrastructure alongside coherent regulatory frameworks (Klein & Todesco, 2021). Policy evidence from Tunisia’s 2019 trade reforms illustrates how competition assessment tools can effectively reduce trade barriers (AUC, 2021). Additionally, both digital infrastructure (Tiwasing, 2021) and regulatory frameworks (Ismagilova et al., 2022) play crucial roles in transforming the international trade landscape.

Description of Key Concepts

In this study, "*digital*" refers to value creation, process optimization, and strengthening organizational capabilities (Kokolek, Jakovic, & Curlin, 2019). Building on this, unlike temporary technological trends, DT represents a fundamental and long-term structural shift that is becoming progressively embedded in everyday life, organizational routines, and business operations (Trischler & Li-Ying, 2023). Within this context, digital adoption "*is the strategic implementation and assimilation of digital infrastructures and technologies into a firm's operations, serving as the foundation for digital transformation*" (Wang & Zhang, 2025 p.3).

To develop a thorough knowledge of DT, the literature distinguishes three related concepts. The first is "*digitization*" which refers to converting analog information into digital formats (Saarikko, Westergren, & Blomquist, 2020, p. 828). The second is "*digitalizatio*n", which involves the application of digital information (Ritter & Pedersen, 2020, p. 766). Finally, "*digital transformation*" goes beyond technological boundaries to influence every facet of human life, transforming society and the economy alike (Brunetti et al., 2020, pp. 698–702). Trischler and Li-Ying (2023), support Hai, Van, and Thi Tuyet (2021), arguing that DT affects all organizations by reshaping economic structures, leadership styles, processes, and communication practices.

This study reviewed scholarly contributions on DT opportunities in international trade using databases such as Google Scholar, UNICAF's Virtual Learning Resources Centre, ResearchGate, and BASE. Search terms included *"Digital," "Digitalization," "Information age," "Digital era," "Industry 4.0," "Digital readiness," "Digital innovation," "Digital infrastructure", "Digital literacy", "Digital leadership," "International trade," "Digital divide," "Smart port" and "DT Opportunities"***.** The chapter presents an introduction, the conceptual framework, a description of the industry, thematic subsections, and concludes with a synthesis of the literature.

Conceptual Framework

In today's business environment, globalization (Bougie & Sekaran, 2019) and digitalization (Ritter & Pedersen, 2020) are often conflated, yet they represent distinct aspects of modern business dynamics. Globalization refers to the expansion of economic, political, and cultural interactions across borders, shaping how organizations operate in global markets (Fairbairn, Kish & Guthman, 2022). It also serves as a key driver of ICT development (Verhoef et al., 2021; Rai et al., 2022). Meanwhile, digitalization enables organizations to improve operational efficiency (Trenerry et al., 2021) and gain competitive advantage (Furr, Ozcan & Eisenhardt, 2022), creating opportunities to transform the international trade landscape.

The primary drivers of globalization include production, trade, foreign investment, and capital flows (Akbari & Hopkins, 2022). Volberda et al., (2021) further argue that globalization not only enables the flow of goods and services in import/export activities but also encourage the sharing of ideas and technologies. As developing countries often lag in digital innovation, these technologies tend to diffuse from digitally advanced nations (Reardon et al., 2021). Consequently, importers/exporters engaged in global trade are compelled to innovate and refine their processes, making digitalization an integral part of their strategic planning (Humphreys et al., 2019). Understanding the interplay between globalization and digitalization is therefore critical for analyzing import/export dynamics (Moretto & Macchion, 2022).

According to Volberda et al., (2021), DT manifests across three dimensions: organizational (cognitive models), technological (digital routines), and social (application of innovations). The organizational dimension focuses on enhancing business processes to improve efficiency and responsiveness to market demands. The technological dimension emphasizes deploying digital tools to streamline workflows, elevate quality, and drive revenue. The social dimension highlights the need to create new consumer experiences and mindsets, as modern customers expect personalized, interactive, and meaningful engagement.

Krco et al., (2019) further argue that digitalization is client-driven, characterized by programmability, infrastructure, and intangibility. Programmability enables firms to separate functional logic from physical implementation, meeting diverse customer needs (Karabulut, 2020). Infrastructure underscores the importance of robust technological foundations (Tiwasing, 2021), while intangibility captures the non-physical nature of data and software, enabling solution delivery to international trade stakeholders (Joukhadar et al., 2023, p. 249). Recent studies such as those carried out by Brunetti et al., (2020) on "*understanding the DT"*; Engesmo and Panteli (2021) "*digital leaders and the transformation of the IT function"*, Burri (2021) "*towards a new treaty on digital trade*", and Di et al., (2022) "*digitally deliverable services*" indicate how DT is reshaping the international trade landscape and accelerating global competitiveness and efficiency.

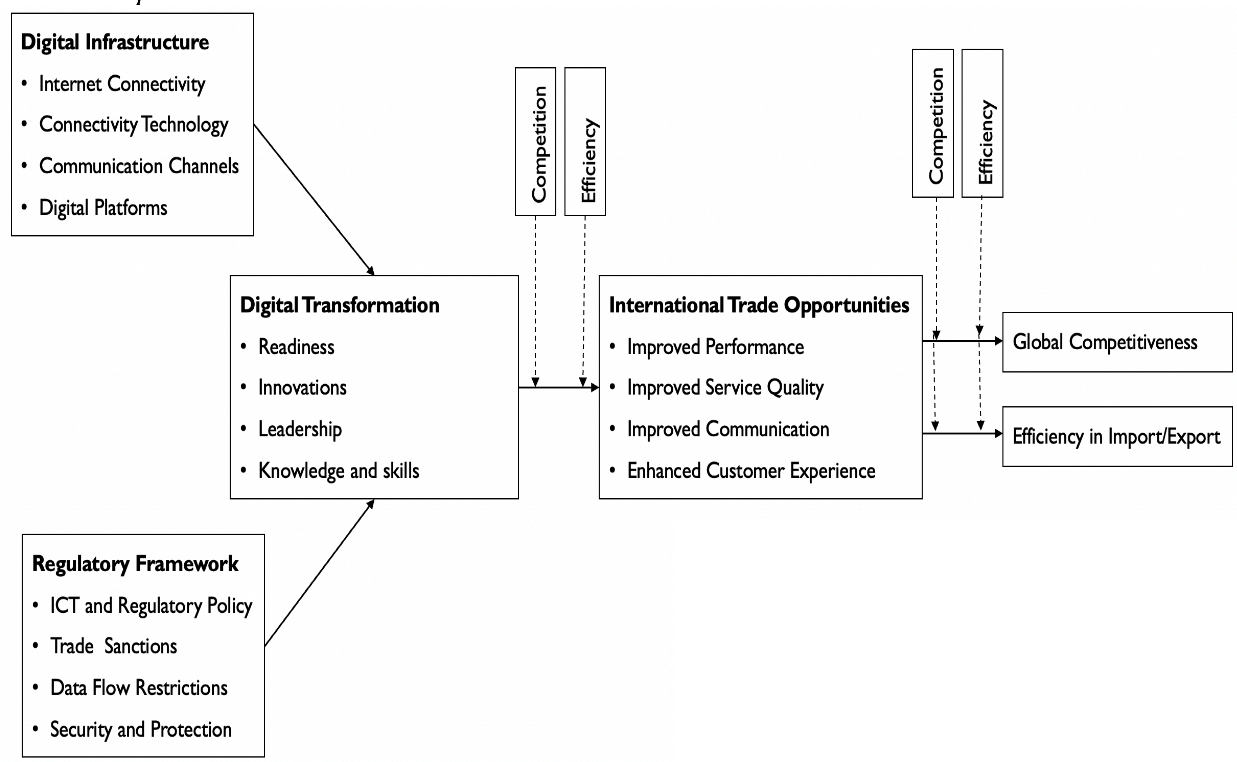
Scholars such as Nayernia, Bahemia and Papagiannidis (2022) note that international trade firms are undergoing substantial transformations driven by digital technologies central to the Fourth Industrial Revolution. Automation, AI, robotics, and the Internet of Things (IoT) serve as key drivers of these digital advancements, creating new avenues for efficiency, innovation, and global competitiveness (Lobschat et al., 2021). Consequently, stakeholders in international trade should recognize DT as essential for enhancing customer experience, engagement, and strategic competitiveness in an increasingly digital global market (Furr, Ozcan & Eisenhardt, 2022).

Building on these insights, the conceptual framework of this study positions DT as a critical driver of international trade opportunities. It emphasizes that the integration of digital infrastructure and compliance with regulatory frameworks directly influence trade outcomes, while competition and efficiency serve as moderating variables that amplify the benefits of DT.

The framework further identifies key enabling dimensions, including organizational readiness, innovation, leadership, and digital literacy (knowledge and skills), through which DT creates value for importers, exporters, and other trade stakeholders, ultimately fostering global competitiveness and operational efficiency in international trade. Figure 1 visually synthesizes these relationships while illustrating the proposed conceptual framework of the study.

Figure 1

The Conceptual Framework



Note: Developed from the Literature

This study develops a conceptual model that positions DT as a central driver of international trade opportunities (ITO). Building on prior research, DT is understood as a multidimensional process that enhances organizational readiness, innovation, leadership, and workforce skills, thereby enabling firms to adapt to competitive pressures and global market dynamics. The model integrates insights from Verina and Titko (2019), who emphasized DT's role in creating sustainable growth and competitive advantage, and Zhao et al., (2021), who highlighted both the opportunities and risks associated with digital disruptions in trade contexts.

At the foundation of the model lies digital infrastructure (DI), which provides the essential conditions for DT to influence trade outcomes. Reliable internet connectivity, advanced connectivity technologies such as 5G and fiber optics, diverse communication channels, and robust digital platforms collectively enable seamless global interactions. These elements facilitate real-time coordination, transparency in trade processes, and efficiency in import/export activities. By strengthening organizational capacity and innovation potential, digital infrastructure amplifies the transformative impact of DT on international trade.

Complementing infrastructure are regulatory frameworks (RF), which define the boundaries within which DT operates. ICT and regulatory policies shape the adoption and interoperability of digital systems, while trade sanctions and data flow restrictions impose constraints on market access and cross-border communication. Security and protection regulations safeguard digital trade operations but also introduce compliance requirements that firms should navigate. These frameworks act as both enablers and inhibitors, influencing the extent to which DT can generate sustainable international trade opportunities.

Through the interaction of digital infrastructure and regulatory frameworks, digital DT generates significant international trade opportunities, which in turn enhance efficiency in import/export activities (EIM) and global competitiveness (GLC). The model further identifies competition and efficiency as moderating variables that strengthen the relationships. Collectively, these dynamics ensure that organizations not only adopt digital technologies but also leverage them strategically to achieve trade success, supporting Dash and Paul's (2021) assertion that digital harmony in international trade enhances both competitiveness and operational efficiency.

Theoretical Foundations

Although Markus and Rowe (2021) argue that DT lacks a strong theoretical foundation, this study engages multiple theoretical perspectives to interrogate this complex phenomenon. Gentle-Genitty et al., (2018) define theory as an integrated system of interrelated hypotheses, concepts, and constructs grounded in empirical evidence, whereas Markus and Rowe (2021) contend that theories explain and interpret relationships among recurring phenomena. Within this study, the theoretical framework synthesizes existing knowledge to support interpretation of findings, while the conceptual framework structures the research design, providing a coherent foundation for systematic analysis and organization (Rojon, Okupe, and McDowall, 2021).

Building on prior scholarship (Verina & Titko, 2019; Zhao et al., 2021; Machado et al., 2021; Halpern et al., 2021; Schrage, Muttreja & Kwan, 2022), this research addresses both empirical and theoretical gaps by examining the applicability of CARE Theory, Dynamic Capabilities Theory, and Network Theory to import/export activities, and by analyzing how digital infrastructure and regulatory frameworks shape the relationship between DT and international trade opportunities (ITO). Existing studies demonstrate that DT enhances operational efficiency (Rotblat, 2018), improves service quality through innovative digital models (Lee & Lee, 2020; Di et al., 2022), strengthens communication and information exchange (Oduro, 2020; Butollo, 2021), and enhancing customer experience which is among the essential determinant of global competitiveness (Vadana et al., 2020; Nadkarni & Prugl, 2021).

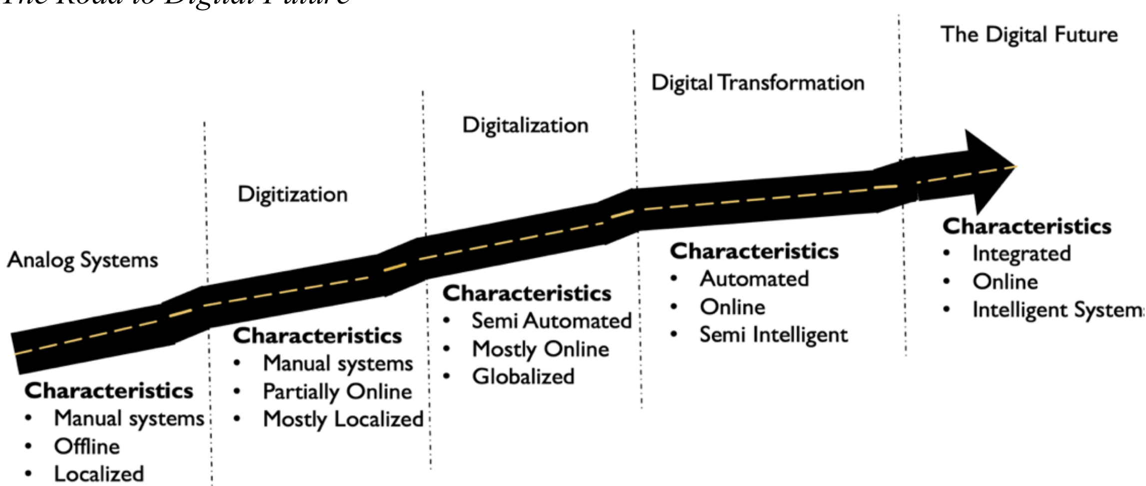
Responding to assertions of theoretical fragmentation in DT research (Markus and Rowe, 2021), this study advances an integrated framework combining CARE Theory, Dynamic Capabilities Theory, and Network Theory to examine DT within complex international trade systems. Together, these perspectives elucidate how organizations such as DSM Port operate in dynamic, interdependent environments by aligning ethical data governance, adaptive capabilities, and network relationships to address persistent DT constraints, including limited digital infrastructure, low digital literacy, and resistance linked to traceability and taxation concerns. CARE Theory foregrounds the ethical imperatives of DT, emphasizing the reconciliation of efficiency with human dignity (Leidner & Tona, 2021). Dynamic Capabilities Theory explains how infrastructural deficiencies and skills gaps restrict an organization’s ability to sense opportunities, seize digital innovations, and reconfigure resources to sustain competitiveness in smart port development (Conboy et al., 2020). Network Theory extends this analysis by conceptualizing international trade actors as interconnected nodes embedded within regulatory and technological structures that condition information flows, collaboration, and trust (North, Aramburu & Lorenzo, 2020). Weak infrastructure and fragmented regulation intensify the digital divide and resistance, whereas strong digital connectivity and regulatory alignment reinforce network effects and enhance DT outcomes (Amalesh et al., 2019; Moro Visconti, 2019; Ekman et al., 2020; Martin & Balestra, 2019).

Accordingly, this integrated theoretical lens captures ethical considerations, organizational adaptability, and inter-organizational connectivity, while clarifying how digital infrastructure and regulatory regimes mediate the relationship between DT and international trade opportunities. By situating DT within broader institutional and technological contexts, it explains how structural enablers and constraints shape trade outcomes. Collectively, these complementary theories provide a rigorous and coherent foundation for interpreting DT outcomes and understanding the persistent barriers, including but not limited to limited digital literacy, infrastructural inadequacies, leadership deficiencies, weak change readiness, bureaucratic rigidity, and resistance associated with traceability and taxation requirements within complex trade ecosystems.

Description of Digital Transformation

DT has become a defining phenomenon across industries, fundamentally reshaping how organizations create value, compete, and interact with customers. At its core, DT refers to the strategic integration of digital technologies to redesign organizational processes, business models, and stakeholder relationships, enabling firms to enhance efficiency, agility, and customer value (Hallencreutz & Parmler, 2021). As technologies continue to evolve rapidly, organizations face increasing pressure to align leadership, strategy, and capabilities with digital imperatives to remain competitive in dynamic environments (Verhoef et al., 2021). Prior research emphasizes that successful DT initiatives are underpinned by strong leadership and a clear strategic vision that promotes enterprise-wide integration of technologies rather than isolated technological adoption (North, Aramburu, & Lorenzo, 2020). Figure 2 illustrates the key dimensions and strategic components underpinning DT as discussed in the literature.

Figure 2
The Road to Digital Future



Note: Researcher's Own Conceptualization

A rigorous understanding of DT requires a clear conceptual distinction between digitization, digitalization, and digital transformation, terms that are frequently used interchangeably in both academic and practitioner discourse despite their theoretical and practical differences. Rather than constituting mutually exclusive processes, these concepts represent progressive and cumulative stages along an organization's trajectory toward a digital future, with analog systems continuing to coexist alongside digital innovations (Verina & Titko, 2019). As illustrated in Figure 2, organizations typically advance incrementally from basic digital conversion toward increasingly complex and transformative outcomes. Throughout this progression, ethical considerations related to data use, stakeholder responsibility, and societal impact become increasingly salient and must be systematically addressed. In this context, the CARE framework provides a normative and analytical lens through which ethical responsibility, transparency, and accountability can be embedded across all stages of the digital transformation journey.

Digitization constitutes the foundational stage of this progression and refers to the technical process of converting analog data into digital formats suitable for storage, processing, and transmission by computational systems. This process encompasses the encoding of text, images, audio, and video into machine-readable forms (Verina & Titko, 2019). There is broad scholarly consensus on this definition, with digitization commonly described as the conversion of analog information into binary data (North et al., 2020) or standardized digital content formats (Schneider, 2018). Although digitization in itself does not fundamentally alter organizational structures, strategies, or business models, it establishes the essential data infrastructure upon which more advanced digital initiatives depend. From the perspective of dynamic capability theory, digitization primarily supports the sensing function by enabling organizations to systematically capture, codify, and analyze data that reveals emerging trends, risks, and opportunities within international trade environments. Beyond its technical characteristics, digitization carries significant economic and competitive implications. In the context of international trade, Meltzer (2020) identifies digitization as a key driver of productivity gains and competitive advantage, while George and Schillebeeckx (2022) highlight its role in cost reduction and organizational adaptation. By enhancing information flows and coordination across organizational and institutional boundaries, digitization strengthens network linkages among firms, regulators, government and private-sector experts, logistics service providers, and customers, thereby contributing to greater transparency, traceability, and trust within international trade networks.

Building upon digitization, digitalization represents a more advanced and integrative stage in which digitized data and digital technologies are embedded into organizational processes, operational routines, and value creation mechanisms. Peng and Tao (2022) conceptualize digitalization as a transitional phase characterized by the online storage of data, the deployment of digital tools, and the emergence of new operational and market opportunities. Unlike digitization, digitalization entails substantive organizational and process-level change, including the integration of digital systems that reconfigure workflows, enhance productivity, and enable new forms of economic activity (Verina & Titko, 2019; Ritter & Pedersen, 2020). Within the dynamic capability framework, digitalization corresponds to the seizing phase, as organizations actively exploit sensed opportunities by mobilizing digital technologies to reconfigure processes and capture value. In industry contexts, digitalization has been closely associated with the development of digital business models, e-commerce platforms, and digitally enabled modes of international trade. Empirical research demonstrates that digitalization supports innovation, job creation, transparency, and sustainable growth, while reducing dependence on physical presence for transactions and coordination (Meltzer, 2020; Nadkarni & Prügl, 2021). From a network theory perspective, digitalization enhances connectivity among nodes within international trade ecosystems, enabling intensive collaboration among suppliers, customers and institutional stakeholders across national borders. The COVID-19 pandemic further accelerated digitalization, underscoring its capacity to mitigate constraints related to time, distance, and information asymmetries (Pandey & Pal, 2020). Highly digitalized firms, often described as "*born-digital*" or "*born-global*", leverage digital infrastructure to access international markets rapidly, scale operations efficiently, and engage stakeholders directly without extensive physical investments (Vadana et al., 2020; Monaghan, Tippmann, & Coviello, 2020). At the same time, these developments intensify ethical responsibilities related to data privacy, inclusion, and equitable access, reinforcing the importance of ethical data practices throughout digitalization processes.

While digitization and digitalization primarily enable efficiency gains and incremental innovation, DT represents a more profound, systemic, and strategic shift. DT extends beyond the adoption of digital tools to encompass fundamental changes in organizational strategy, culture, leadership, governance, and value creation logic (Rachinger & Müller, 2024). Scholars increasingly conceptualize DT as a continuous and evolutionary process in which digital technologies function as catalysts for structural and disruptive change across organizations, industries, and society at large (Hai, Van, & Thi Tuyet, 2021). DT involves the deliberate and strategic deployment of digital technologies to redesign operations, enhance customer experiences, and innovate business models, thereby strengthening organizational competitiveness and long-term performance (Verina & Titko, 2019; Gong & Ribiere, 2021). From a dynamic capability perspective, DT embodies the reconfiguring phase, during which organizations continuously realign resources, capabilities, and organizational structures to adapt to volatile and complex international environments. From an organizational standpoint, DT is increasingly understood as a socio-technical phenomenon shaped by the interaction of human, technological, and institutional factors. Mihardjo and Rukmana (2018) argue that DT is initiated through leadership vision and strategic intent and evolves through process digitalization toward cultural and business model innovation. Similarly, Mhlungu, Chen and Alkema (2019) identify customer centricity, governance structures, innovation orientation, and resource capabilities as critical success factors in DT initiatives. Technological advances in artificial intelligence, the Internet of Things, blockchain, and machine learning further accelerate DT by enabling real-time monitoring, automation, and personalized service delivery across sectors such as logistics, ports, and international trade (Romero et al., 2020; Seufert, Guggemos, & Sailer, 2021). These technologies simultaneously intensify interdependencies within global trade networks, underscoring the relevance of network theory for understanding digitally mediated value co-creation.

Despite its strategic potential, DT also introduces significant bottlenecks related to data governance, cybersecurity, regulatory compliance, and skills development. Increasingly stringent data protection and cybersecurity regulations shape DT strategies, highlighting the need for robust governance frameworks that balance innovation with risk mitigation (Acquisti, Brandimarte, & Loewenstein, 2020). In this regard, the CARE framework is particularly salient, as it emphasizes ethical data stewardship, accountability, and responsible innovation throughout the transformation process. Effective leadership and continuous organizational learning are therefore essential to foster innovation, enhance digital literacy, and ensure sustainable and ethically grounded transformation outcomes (Engesmo & Panteli, 2021; Voipio et al., 2023).

DT constitutes an industry-wide phenomenon that extends far beyond the mere adoption of digital technologies, driving fundamental and sustained changes in organizational structures, operational processes, leadership practices, and human capabilities. Rather than representing a purely technological shift, DT reflects a multidimensional transformation in which technological, organizational, and human elements are deeply intertwined. Through their strategic integration, DT enables organizations to enhance operational efficiency, improve decision-making, develop innovative business models, and sustain value creation in an increasingly interconnected digital economy. This conceptualization aligns closely with Dynamic Capability Theory, which explains how organizations sense, seize, and reconfigure resources to adapt to rapidly changing environments (Teece, 2007). Within the context of international trade, DT assumes particular significance by reshaping network relationships among firms, institutions, and markets. Digital technologies facilitate faster and transparent information flows, enable real-time coordination, and reduce transaction costs, thereby supporting agile and resilient trade ecosystems.

Although DT outcomes are shaped by diverse organizational, technological, and contextual conditions, the literature identifies several interrelated enablers as decisive. At the organizational level, digital readiness reflects the strategic orientation, technological resources, governance structures, and structural flexibility required to initiate and sustain digital initiatives (Nasution et al., 2018). Digital innovation captures the capacity to develop improved processes, services, and business models, while digital leadership provides strategic direction, ensures governance, and fosters a culture supportive of change (Khin & Ho, 2019). From a Network Theory perspective, digital leadership also enhances collaboration, coordination, and knowledge exchange among interconnected stakeholders (Moro Visconti, 2019). Complementing these factors, digital knowledge and skills enable the effective implementation and institutionalization of DT (Dunwoodie, Macaulay & Newman, 2023). Beyond firm-level determinants, broader structural conditions significantly shape transformation trajectories (Behdani et al., 2020). Evidence from the Tema port demonstrates how automation and systems integration enhance operational efficiency (Mlepo & Zheng, 2023), while scalable infrastructure and advanced technologies transform ports into smart, competitive trade ecosystems (Romero et al., 2020; Voipio et al., 2023).

Digital Readiness

Digital readiness has emerged in the literature as a critical prerequisite for successful DT, particularly in environments characterized by rapid technological change and increasing competitive pressure. According to Nasution et al., (2018), digital readiness involves both the preparedness and the willingness of an organization to implement digital technologies in ways that enhance connectivity among stakeholders and improve operational efficiency. This conception highlights that digital readiness extends beyond technological availability to include organizational intent, openness, and psychological readiness for change. Implementing digital technologies therefore requires a fundamental shift in corporate mindset, skills, systems, and processes, rather than a purely technical upgrade.

Extending this view, Halpern et al., (2021) frame digital readiness as an organization's capacity for change, emphasizing clarity, collaboration, capabilities, and culture in adapting policies and practices to new digital technologies. This perspective underscores the importance of organizational alignment and shared understanding in enabling digital initiatives. Similarly, Pirola, Cimini, and Pinto (2020) conceptualize digital readiness as the ability of individuals and organizations to navigate change by embracing digital technologies and adopting new ways of thinking. These definitions collectively position digital readiness as a multidimensional and process-oriented construct, encompassing cognitive, cultural, and behavioral elements alongside technological factors. Machado et al., (2021) further define digital readiness as the preparedness to adopt and exploit digital technologies across leadership, innovation, learning, and operational activities, a definition adopted by this study due to its integrative scope and strategic orientation.

The literature consistently emphasizes that digital readiness operates across multiple levels whereby at the organizational level, digital readiness encompasses leadership commitment, organizational culture, and technological infrastructure (Wulf, Mettler & Brenner, 2017). At the institutional and national levels, it is shaped by supportive policies, digital literacy, and access to enabling infrastructure such as reliable internet connectivity and digital services (Lobschat et al., 2021). Peng and Tao (2022) argue that for emerging economies, investments in both digital infrastructure and education are essential for fostering inclusive growth and long-term development. In a similar vein, the African Union (2020) highlights the importance of public private partnerships with governments strengthen digital skills and stimulate innovation. These perspectives collectively indicate that digital readiness is not solely an organizational attribute but is embedded within broader socio-economic and institutional contexts.

Empirical evidence also points to variation in digital readiness across demographic and organizational dimensions. Younger generations generally demonstrate a higher readiness index for technology compared to older cohorts (Warf, 2019), suggesting that human capital characteristics influence readiness outcomes. Furthermore, successful DT requires not only technological investments but also financial and organizational readiness (Rossini et al., 2021). Firms that achieve higher levels of digital maturity are consistently found to outperform their less mature counterparts in terms of revenue growth and profitability (Gong & Ribiere, 2021). Despite this, the discourse on DT remains at an early stage, with many countries and organizations lagging in their transition to a digital economy (Maisiri & van Dyk, 2019; Khin & Ho, 2019). In developing contexts such as Tanzania, persistent setbacks including limited capital for SMEs, low levels of technology adoption, inadequate infrastructure, and governance constraints which continue to impede digital economic growth (Maisiri & van Dyk, 2019; Ye & Ramadhani, 2020).

Given its complexity, scholars have proposed various frameworks to operationalize and measure digital readiness. Nasution et al., (2018) identify two key dimensions, action readiness and attitudinal readiness, operationalized through indicators such as personal innovativeness, predisposition, and emotional response to technology. Pirola, Cimini and Pinto (2020) propose the use of the Technological Readiness Index in the ICT sector, although this approach has been criticized for its narrow focus on technological factors at the expense of organizational and strategic dimensions. Maisiri and van Dyk (2019) assess digital preparedness across six areas, including strategic alignment, technological infrastructure, operational processes, data-driven services, and workforce capabilities, while Rachinger and Muller (2024) offer a broader Industry 4.0 readiness framework encompassing strategy, leadership, customer engagement, operations, and technology. As emphasized by Nayernia, Bahemia, and Papagiannidis (2022), these diverse approaches reinforce the view that digital readiness is a multifaceted construct integrating technological capabilities with market dynamics.

This growing body of literature suggests that digital readiness should be understood as an evolving organizational capability rather than a static condition. This conceptualization aligns closely with Dynamic Capability Theory, which explains how organizations sense, seize, and reconfigure resources to adapt to rapidly changing environments (Teece, 2007). From a dynamic capability perspective, digital readiness represents a foundational capability that enables firms to adjust their resources in response to the market dynamics. The emphasis on preparedness, willingness, and mindset shifts in the digital readiness literature directly corresponds to the sensing dimension of dynamic capabilities, whereby organizations identify emerging digital opportunities and threats (Nasution et al., 2018; Halpern et al., 2021; Pirola, Cimini & Pinto, 2020).

Similarly, the literature's focus on leadership, organizational culture, workforce competencies, and technological infrastructure reflects the seizing dimension of Dynamic Capability Theory. Digitally ready firms are better positioned to mobilize resources, invest in digital technologies, and redesign business models to capture value from digital opportunities (Wulf, Mettler & Brenner, 2017; Machado et al., 2021). The ability to continuously reassess and adjust digital readiness in response to technological and market changes corresponds to the reconfiguring dimension of dynamic capabilities, emphasizing organizational renewal through the transformation of processes, competencies, and asset structures (Volberda et al., 2021). In this sense, digital readiness functions as a dynamic capability that supports sustained competitive advantage in turbulent digital environments.

While Dynamic Capability Theory foregrounds internal adaptation, Network Theory provides a complementary lens by emphasizing the role of inter-organizational relationships, connectivity, and knowledge flows in shaping digital readiness. Nasution et al., (2018) highlight that digital readiness enhances connectivity among stakeholders, strengthening collaboration between firms, customers, suppliers, governments, and technology providers. Digital platforms and ecosystems increasingly serve as the primary arenas for innovation, learning, and international trade, in emerging economies (Gupta, Ghosh & Sridhar, 2022). From a network perspective, digital readiness enhances a firm's structural position within digital and innovation networks, facilitating access to external knowledge and shared digital infrastructure.

Integrating Dynamic Capability and Network Theories positions digital readiness as both an internal adaptive capability and a relationally embedded construct. Internally, digital readiness equips organizations with the technological, cultural, and cognitive foundations required to sense, seize, and reconfigure in response to digital change. Externally, it enables firms to leverage networks and digital ecosystems for collaboration, innovation, and resource sharing. This integrated perspective strengthens the theoretical foundation for examining digital readiness as a critical antecedent of DT and sustained performance in the evolving digital economy.

Digital Innovation

Digital innovation refers to the application of digital technologies to develop new products, improve operational processes, or redefine business models in response to evolving market demands (Khin & Ho, 2019). This definition underscores that digital innovation is not merely a technological upgrade but a strategic response to changing market conditions, driven by the capacity to reconfigure organizational resources and capabilities. Appio et al., (2021) further describe digital innovation as a nascent yet rapidly expanding phenomenon driven by technological advancements, highlighting its growing centrality in contemporary business environments. Peng and Tao (2022) emphasize the combination of digital technology and managerial expertise as essential for addressing societal demands, arguing that digital innovation extends beyond specific software applications and represents a broader imperative for improving business processes. Karabulut (2020) elaborates this view by defining digital innovation as the use of ICT to improve products, business models, processes, and marketing activities, categorizing digital innovation into product innovation, process innovation, and business model innovation. Despite increasing academic and managerial interest, Khin and Ho (2019) note that the literature remains at an early stage, indicating a need for further empirical research to clarify its conceptual boundaries and outcomes.

DT serves as the primary driver and enabler of digital innovation. It fosters innovation by enabling organizations to integrate digital technologies with business models, thereby improving efficiency and competitiveness (Karabulut, 2020). This integration implies that digital innovation is not an isolated event but part of a broader organizational transformation process. Such innovation requires a digital mindset supported by effective leadership and an adaptive organizational culture (Peng & Tao, 2022). DT also enhances customer experiences through personalized services (Maisiri & van Dyk, 2019) and improves decision-making through advanced technologies such as artificial intelligence and big data analytics (Khin & Ho, 2019). Consequently, successful DT-driven innovation depends on a holistic approach that integrates technology, strategy, and organizational factors (Pirola, Cimini & Pinto, 2020). Nayernia, Bahemia, and Papagiannidis (2022) further emphasize the importance of adopting Industry 4.0 technologies to maintain competitiveness in dynamic markets. In global terms, digital innovation is fundamentally reshaping economies, with countries such as the United States and China generating substantial economic value through extensive digital ecosystems (ESCAP et al., 2023; Furr, Ozcan & Eisenhardt, 2022). In contrast, DT in many developing countries remains at an early stage, underscoring the need for supportive national policies that foster innovation-oriented environments and digital capability development (Pirola, Cimini & Pinto, 2020).

A key challenge in understanding digital innovation is its dual nature as both a process and an outcome. Appio et al., (2021) emphasize this duality, noting that it complicates conceptualization and measurement. They identify individual, organizational, and environmental factors as key determinants of digital innovation, suggesting that innovation emerges from the interaction between human resources, organizational structures, and external conditions. Khin and Ho (2019) propose assessing digital innovation through constructs such as digital orientation, digital capability, and both financial and non-financial performance outcomes. Peng and Tao (2022) extend this view by arguing that digital innovation contributes directly to economic growth and improved living standards. Innovation is therefore fundamental for organizations seeking to survive, grow, sustain competitive advantage, and consistently deliver value.

Verhoef et al., (2021) conceptualize DT as a sustained organizational evolution that enables firms to adapt to technological change. Their framework emphasizes the integration of internal resources and external environmental factors to enhance customer experience and operational effectiveness, underscoring the importance of customer-centric strategies. Burri (2021) supports this view by showing how shifts from traditional to digital business models strengthen customer relationships and stabilize revenue streams. This perspective aligns with Ipsmiller and Dikova (2021) and Pirola, Cimini, and Pinto (2020), who highlight sustained technological innovation as critical for addressing digital disruption and seizing emerging opportunities in the digital economy.

Dynamic Capability Theory explains how organizations sense, seize, and reconfigure resources (Teece, 2007), providing a robust lens for understanding how digital readiness supports digital innovation. From this perspective, DT facilitates the development of dynamic capabilities by integrating digital technologies with organizational resources and strategies (Karabulut, 2020; Pirola, Cimini & Pinto, 2020). This integration enables firms to respond effectively to market changes through product, process, and business model innovation (Karabulut, 2020). The emphasis on leadership and adaptive organizational culture (Peng & Tao, 2022) highlights the role of managerial capabilities in seizing digital opportunities, while the use of advanced technologies such as AI and big data analytics supports the sensing and seizing of opportunities by enabling firms to identify patterns, anticipate customer needs, and develop personalized services (Khin & Ho, 2019; Maisiri & van Dyk, 2019). Continuous digital innovation therefore depends on the firm's ability to reconfigure its resources, including capabilities, processes, and business models, in response to technological disruption (Verhoef et al., 2021; Burri, 2021).

Network Theory complements Dynamic Capability Theory by emphasizing how digital innovation is shaped by inter-organizational relationships, digital ecosystems, and knowledge flows. DT and digital innovation increasingly occur within digital ecosystems that involve firms, customers, technology providers, and regulatory institutions. These ecosystems facilitate collaboration, knowledge sharing, and co-creation, which are essential for innovation (ESCAP et al., 2023; Furr, Ozcan & Eisenhardt, 2022). Network Theory also highlights that digital innovation is influenced by external environmental factors, including industry networks, national policies, and institutional infrastructures. The need for supportive national policies and innovation-oriented environments in developing countries (Pirola, Cimini & Pinto, 2020) reflects the importance of networked institutional support. Firms embedded in strong networks are better able to access complementary resources, knowledge, and technological capabilities, thereby overcoming internal resource constraints and accelerating innovation. This is relevant in contexts where DT remains at an infancy stage, as external networks provide access to skills and technology.

Digital innovation is driven by two interconnected mechanisms, as explained by Dynamic Capability Theory and Network Theory. Internally, DT and innovation require dynamic capabilities for sensing opportunities, seizing them through digital initiatives, and reconfiguring resources and business models (Teece, 2007). Externally, digital innovation is strengthened through engagement in digital ecosystems and institutional networks, which enhance connectivity, collaboration, and access to resources (ESCAP et al., 2023; Furr, Ozcan & Eisenhardt, 2022). Appio et al., (2021) note that digital innovation functions as both a process and an outcome, determined by individual, organizational, and environmental factors. Khin and Ho (2019) propose measuring it through digital orientation, capability, and performance outcomes, while Peng and Tao (2022) argue that digital innovation contributes to economic growth and improved living standards. Verhoef et al., (2021) conceptualize DT as a sustained organizational evolution that integrates internal and external resources to enhance customer experience and operational effectiveness. This view, supported by Burri (2021), underscores the critical role of digital leadership in building a resilient and inclusive digital economy.

Digital Leadership

Digital leadership, also referred to as Leadership 4.0, is characterized by a dynamic, team-centered, and collaborative approach that promotes innovative thinking in digitally turbulent environments (Hai, Van & Thi Tuyet, 2021). This leadership style incorporates a digital mindset and emphasizes methodologies such as design thinking, which are critical for driving organizational change and value creation (Mihardjo & Rukmana, 2018). From a Dynamic Capability Theory perspective, these characteristics enable leaders to support the sensing of digital opportunities, the seizing of those opportunities through strategic initiatives, and the reconfiguration of organizational resources in response to technological change (Teece, 2007). Effective digital leaders therefore combine transformational leadership qualities with technological expertise to enhance organizational capabilities, improve cost efficiency, and stimulate digital innovation.

In the digital era, digital leadership is particularly relevant across the domains of computing, communication, and content (Dunwoodie, Macaulay & Newman, 2023), reflecting the increasing embeddedness of organizations within digitally mediated environments. Klein and Todesco (2021) argue that digital leadership represents a shift away from traditional leadership paradigms toward more adaptive, flexible, and integrative forms of leadership. Rather than relying on hierarchical control, digital leaders foster a culture of digital awareness by guiding employees through continuous training, encouraging experimentation, and supporting innovation (Hai, Van & Thi Tuyet, 2021). Effective DT therefore requires the alignment of technology, processes, and people, with leaders demonstrating vision, innovation, and collaboration. As emphasized by Schrage, Muttreja, and Kwan (2022), it is strategic leadership rather than technology alone that ultimately determines DT outcomes.

Consistent with Dynamic Capability Theory, Hai, Van, and Thi Tuyet (2021) contend that effective digital leadership is essential for organizations seeking to successfully navigate technological change. Such leadership must be dynamic, team-oriented, and collaborative, requiring a clear vision, adaptability, and the capacity to drive change across multiple organizational levels. Mihardjo and Rukmana (2018) similarly stress that proactive leadership is crucial for implementing digital strategies and fostering an innovation-oriented mindset across the organization. Rabetino, Kohtamäki, and Federico (2021) further highlight that overcoming resistance to change and deploying digital technologies effectively require strategic and adaptive leadership, reinforcing the role of leaders in orchestrating organizational transformation. Klein and Todesco (2021) emphasize the importance of a shared digital vision aligned with organizational goals, while Hai, Van, and Thi Tuyet (2021) note that leadership commitment to digital adoption and capability development is critical for sustaining competitive advantage. Vaska et al. (2021) conclude that DT leadership must be collaborative, as empowering teams to take ownership of digital initiatives facilitates organization-wide transformation.

From a Network Theory perspective, digital leadership also plays a central role in shaping how organizations engage with internal and external networks (Moro Visconti, 2019). DT increasingly unfolds within interconnected digital ecosystems that require coordination, collaboration, and knowledge sharing across organizational boundaries (Burri, 2021). By fostering trust, openness, and collaboration, digital leaders strengthen internal social networks while enhancing external linkages with partners, customers, suppliers, and technology providers. This network embeddedness enables organizations to access complementary resources, external expertise, and innovation opportunities, which are essential for successful DT, particularly in complex and uncertain environments.

Moro Visconti (2019) conceptualizes digital leadership as a dual responsibility of achieving performance outcomes while simultaneously nurturing human and relational capital. This balance is particularly salient in digital contexts, where technological change demands not only efficiency and productivity but also employee engagement, learning, and collaboration. Extending this view, Klein and Todesco (2021) identify three interrelated dimensions of digital leadership: digital business capabilities, general mindset attributes, and social attitudes. These dimensions position digital leadership as both a capability-oriented and relational construct, aligning leadership behavior with organizational adaptability and network engagement.

To operationalize digital leadership competencies, Claassen et al., (2021) develop the DigiFuehr score, which assesses leadership across seven domains: personal, relational, strategic, operational, innovative, ethical, and change leadership. This multidimensional framework captures the complexity of leading in digitally intensive environments, where leaders must simultaneously align technological initiatives with organizational change, ethical responsibility, and relational dynamics. By encompassing both task-oriented and people-centered dimensions, the DigiFuehr model reflects the broad scope of competencies required for effective digital leadership. Brunner, Schuster, and Lehmann (2023) further argue that successful digital leadership integrates traditional leadership qualities such as vision, influence, and strategic direction. This integration enhances organizational adaptability by enabling leaders to interpret technological developments and align them with strategic objectives. Similarly, Schrage, Muttreja, and Kwan (2022) emphasize the importance of cultivating a growth-oriented mindset that embraces new technologies while fostering a culture of innovation, continuous improvement, and lifelong learning. These perspectives highlight digital leadership as a multifaceted capability that strengthens organizational resilience and enables to respond effectively to ongoing technological change.

Digital Skills and Knowledge

Digital skills and knowledge are crucial for thriving in a digitally driven economic landscape in both personal and professional contexts (Kokolek, Jakovic & Curlin, 2019). These competencies enable individuals and organizations to capitalize on digital opportunities and are widely recognized as a core determinant of successful DT. Kokolek, Jakovic, and Curlin (2019) identify digital skills as one of six key success factors for DT, alongside strategic vision, agility, continuous learning, leadership, and the ability to adopt emerging technologies. Spante et al., (2018) extend this perspective through the concept of digital proficiency, which encompasses not only technical expertise but also the cognitive, social, and critical capabilities required to manage and sustain DT processes. Consistent with this view, Krco et al. (2019) highlight that DT-driven value creation depends on customer experience, data expertise, and leadership, particularly where individuals possess advanced skills in AI, data analytics, cybersecurity, and cloud computing.

From a Dynamic Capability Theory perspective, digital skills and knowledge strengthen an organization's ability to sense technological opportunities, seize them through informed decision-making, and transform resources and processes in response to rapidly changing environments (Teece, 2018). Investment in workforce capabilities enables firms to continuously reconfigure their operational and strategic assets, thereby supporting innovation and long-term competitiveness (Brunetti et al., 2020). Complementing this internal focus, Network Theory emphasizes that digital skills enhance an organization's capacity to participate effectively in digital ecosystems by enabling collaboration, interoperability, and knowledge exchange across organizational boundaries. Skilled individuals act as connectors within and across networks, facilitating access to complementary resources, technologies, and innovation opportunities.

Digital literacy, defined as the ability to effectively understand and use digital technologies, is therefore essential for active participation in today's economy (Spante et al., 2018). However, in LDCs, the digital divide significantly constrains access to technology and the development of critical digital competencies. Kokolek, Jakovic, and Curlin (2019) emphasize that while digital literacy is vital for innovation and economic growth, its uneven distribution hampers development in low-income regions. Teece (2018) and Brunetti et al., (2020) further argue that shortages of digital skills in LDCs limit both DT adoption and the development of dynamic capabilities. The Union (2020) highlights that limited digital access restricts participation in economic activities, while Bonina et al., (2021) show that inadequate infrastructure and high costs exacerbate these limitations. Scholars advocate targeted digital literacy initiatives (Nguyen, Hargittai & Marler, 2021), supportive public policies, and international collaboration to strengthen network connectivity and narrow these gaps (Zhao et al., 2021). Vassilakopoulou and Hustad (2023) further highlight the acute constraints faced by rural populations, while Durand et al. (2022) conclude that bridging the divide requires sustained investment in both infrastructure and continuous learning.

Education and skills development are therefore central to DT. Hai, Van, and Thi Tuyet (2021) advocate educational reform to equip younger generations with innovation-oriented digital skills, while Azevedo and Almeida (2021) stress the need for new communication capabilities aligned with evolving digital customer behaviors. Teece's (2018) sensing, seizing, and transforming framework reinforces the importance of investing in human capital to exploit emerging technologies effectively. Brunetti et al., (2020) similarly emphasize that organizational investment in personnel capabilities is critical for translating opportunities into tangible value.

Sectoral evidence further illustrates these dynamics. Chang, Iakovou, and Shi (2020), in their study of smart ports in Africa, identify persistent bottlenecks related to skills, interoperability, trust, and regulatory coordination, despite technological progress. These findings underscore the need for focused strategies to enhance digital literacy and promote innovation in sectors where DT can significantly improve competitiveness. Voipio et al. (2023) identify technical expertise, communication, teamwork, analytical reasoning, innovation, and problem-solving as essential digital skills, advocating the PRISMA framework as a structured approach to assessing and developing these competencies (Paul & Barari, 2022). The PRISMA domains—Professionalism, Relevance, Innovation, Skills, Motivation, and Adaptability—highlight the alignment between dynamic capabilities and network engagement in supporting DT (Grassini & Laumann, 2020; Alexopoulou, 2024).

Appio et al. (2021) further demonstrate that DT adoption is driven by the interaction of leadership, organizational culture, digital skills, and technology infrastructure. Successful transformation requires environments that promote innovation, adaptability, and continuous learning, as well as alignment between digital strategies and business objectives. In logistics and trade, Behdani et al. (2020) show that digital integration across ports and hinterland networks enhances efficiency and trade flows, while Verhoef et al. (2021) and Alexopoulou (2024) emphasize how automation and smart technologies improve competitiveness.

At a macro level, DT has contributed to widening disparities between developed and developing economies (Banga & te Velde, 2018), reinforcing the importance of skills and network integration. Across sectors, DT reshapes business models, trade systems, and service delivery (Verhoef et al., 2021; Gurcan et al., 2023). Collectively, these studies highlight that digital skills and knowledge are not standalone assets but dynamic and networked capabilities that enable organizations and economies to translate digital technologies into sustainable value and growth.

The Digital Divide

The digital divide, or digital inequality, is a persistent global challenge. Zhao et al., (2021) define it as the gap between those with access to technological tools supporting communication, information sharing, and knowledge exchange and those without such access or skills. This divide manifests not only between developed and underdeveloped countries but also within nations, influenced by economic disparities, education, geography, culture, and disability. Hoekman and Wolfe (2021) identify underprivileged groups, including low-income individuals, the unemployed, adults with low literacy, remote residents, and women constrained by cultural barriers, as most affected by digital exclusion. They argue that the digital divide intensifies social inequality through a '*Matthew effect*,' whereby those already equipped with digital access accrue greater benefits while marginalized populations fall further behind.

Morris, Morris, and Bowen (2022) extend this discourse by identifying additional forms of digital divide, including digital exclusion (Bonina et al., 2021), digital delay (Nguyen, Hargittai & Marler, 2021), the participatory divide (Vassilakopoulou & Hustad, 2023), and internet overuse (Escursell, Llorach-Massana & Roncero, 2021). They further highlight emerging dimensions such as access, socio-demographic, and motivational divides. The access divide originally referred to inequality in accessing personal computers, while the '*net generation*' gap emerged from economic, demographic, and geographic factors. This fragmentation is compounded by uneven national development: LDCs continue to struggle with infrastructure deficits, whereas developed nations face divides rooted in socio-economic status, education, age, ethnicity, and gender. According to Morris, Morris, and Bowen (2022), socio-demographic disparities are primarily driven by social injustice, creating gaps across educational attainment, gender, and age groups.

Pollitzer (2018) conceptualizes the digital divide as the gap between those with and without access to digital technologies. Schelenz and Schopp (2018) extend this perspective by emphasizing intra-national disparities, showing that digital inequality persists even within relatively developed regions, determined by income, geography, and education. Durand et al., (2022) argue that the digital divide deepens existing inequalities in developing countries, where infrastructure and digital literacy remain limited. They emphasize that targeted investments in technology infrastructure, education, and equitable access initiatives are necessary to prevent further marginalization. Grishchenko (2020) also notes that the divide extends beyond device access, emphasizing the importance of digital competencies and literacy programs to reduce inequalities.

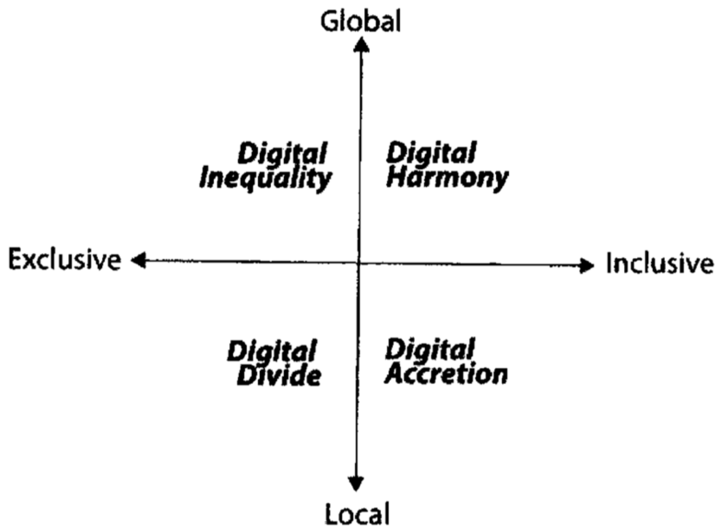
From a Dynamic Capability Theory perspective, the digital divide undermines the ability of individuals and organizations to sense, seize, and reconfigure resources in response to technological change (Teece, 2007). In the absence of digital access and skills, firms and communities cannot effectively scan the environment for digital opportunities or transform their resource base to capture value, limiting innovation and competitive advantage. This deficiency weakens dynamic capabilities and thus hinders long-term resilience and growth. From a Network Theory perspective, digital inequality also disrupts connectivity and knowledge flows across networks. Digital ecosystems rely on inter-organizational linkages, collaborative platforms, and knowledge-sharing networks to create value. The digital divide restricts network participation among marginalized groups, limiting access to information, collaboration opportunities, and digital markets. Thus, the divide is not merely technological but also relational, excluding vulnerable populations from the networks that generate economic growth and innovation.

Van Dijk (2020) advances a holistic framework for analyzing the digital divide, identifying four interdependent dimensions: physical access, digital skills, usage, and the outcomes of digital engagement. He contends that narrowing the divide requires coordinated interventions across all dimensions rather than isolated improvements. Physical access concerns the availability and affordability of reliable digital infrastructure; digital skills refer to the competencies necessary for effective technology use; usage captures the extent and quality of engagement with digital tools; and outcomes denote the broader economic, educational, and social benefits derived from digital participation. Addressing these elements collectively is essential for building an inclusive and equitable digital ecosystem. Complementing this perspective, Verhoef et al., (2021) demonstrate that inadequate infrastructure and limited digital capabilities significantly restrict SMEs from fully participating in digital advancement. They further highlight the adverse implications for economic development and education, particularly in remote learning contexts, and advocate strategies that simultaneously expand access and strengthen digital capacity.

Pollitzer (2018), Durand et al., (2022), Grishchenko (2020), Van Dijk (2020), and Verhoef et al. (2021) collectively argue that the digital divide is a multifaceted challenge requiring coordinated investment in infrastructure, skills training, and policy frameworks. In "*Creating a Better Future: Four Scenarios for How Digital Technologies Could Change the World*," Pollitzer (2018) outlines four future trajectories. The techno-optimism *[Digital Harmony]* scenario suggests that digital technologies can bridge gaps by enabling equitable access to education and economic opportunities. The techno-pessimism *[Digital Inequality]* scenario predicts widening gaps as technological advancements disproportionately benefit affluent nations. The techno-collapse *[Digital Divide]* scenario warns that rapid change may outpace societal adaptation, causing job displacement and instability. Finally, the techno-adaptation *[Digital Accretion]* scenario emphasizes proactive strategies, including targeted investments and policies to mitigate inequality. Pollitzer (2018) concludes that the future of digital society depends on choices made by individuals, organizations, and governments, highlighting the need for inclusive and ethical policy frameworks to ensure that DT benefits all. Figure 3 summarizes these four scenarios and illustrates their implications for digital inequality and inclusion.

Figure 3

Four Scenarios for the Digital Future



Note: Adopted from Pollitzer (2018 p. 85).

Warf (2019) notes that even developed nations experience digital inequality, marked by disparities in access and usage across socio-economic groups and regions. Beaunoyer, Dupere, and Guitton (2020) argue that underserved groups; including low-income households, the elderly, and rural communities; remain disadvantaged despite strong infrastructure. Van Dijk (2020) adds that lower socio-economic groups often lack digital competencies, creating a "*second digital divide*." The COVID-19 pandemic exposed and exacerbated these disparities, as remote work and education became essential (Klein & Todesco, 2021; Beaunoyer et al., 2020). Students from low-income families particularly struggled with online learning, leading to adverse educational outcomes. Zhao et al., (2021) conceptualize digital inequality in three levels: (1) digital access divide, (2) digital capability divide, and (3) digital outcome divide, calling for research and interventions that address these dimensions comprehensively.

Schelenz and Schopp (2018) emphasize that a significant gap persists between the Global North and South, with internet penetration ranging from 90% in Western Europe to as low as 12% in Central Africa and 51% in Southern Africa. These disparities stem from infrastructure deficits, high connectivity costs, and limited digital literacy (AUC, 2021). Consequently, unprivileged remain excluded from essential digital services (Haji, Silla & Musugur, 2017). The International Telecommunication Union (ITU, 2019) reports that approximately 2.9 billion people remain offline, limiting economic development, education, and social inclusion (Verhoef et al., 2021). Durand et al. (2022) and Nguyen, Hargittai, and Marler (2021) report that internet access in developed regions is 86.7% compared to 44.4% in LDCs, reflecting persistent inequalities.

In Tanzania, the digital divide is driven by disparities in ICT infrastructure, socioeconomic inequalities, and geographic constraints (AUC, 2021). Although mobile phone usage is widespread, reliable internet access remains uneven, particularly in rural areas where weak infrastructure and low incomes limit connectivity (Union, 2020; ITU, 2019). Urban areas report higher penetration rates; however, persistent income and educational inequalities continue to shape patterns of digital engagement (Vimalkumar, Singh & Sharma, 2021). Gender disparities further restrict access, constraining women's participation in online education, entrepreneurship, and financial empowerment (Nguyen et al., 2021). Rural enterprises also face difficulties adopting digital solutions due to poor connectivity and high infrastructure costs (Haji, Silla & Musuguri, 2017). Moreover, the high cost of mobile data limits low-income households' ability to benefit fully from digital services (Union, 2021). As digital connectivity becomes central to trade, inequalities risk deepening social exclusion and limiting participation in the digital economy.

Digital Infrastructure

According to Tiwasing (2021) and Saarikko, Westergren, and Blomquist (2020), digital infrastructure is a foundational pillar of contemporary society, supporting economic growth, social inclusion, and technological innovation. It encompasses a broad range of digital technologies, including internet connectivity, communication networks, and digital platforms, which collectively form the backbone of modern communication, business operations, and governance systems (Koutsikouri et al., 2018). Digital infrastructure is often defined as an integrated structure of shared components that operate together to support various business processes and services (Constantinides, Henfridsson & Parker, 2018). Behdani et al., (2020) support this view, arguing that DT is fundamental to connected business, enabling success and linking people globally. Consequently, access to and effective use of digital infrastructure is essential for driving innovation, improving performance, and promoting social well-being (Hanelt et al., 2021).

From a Dynamic Capability Theory perspective, digital infrastructure forms a key part of an organization's resource base, enabling the sensing of opportunities, seizing, and reconfiguring organizational processes (Teece, 2007). Thus, digital infrastructure is not merely a technical asset but a strategic capability that supports ongoing adaptation and transformation. At the same time, Network Theory highlights how digital infrastructure enables interconnections among stakeholders, linking individuals, organizations, and ecosystems through shared platforms, data, and communication channels (Moro Visconti, 2019). This interconnectedness is crucial for knowledge exchange, collaboration, and resource sharing across networks.

Behdani et al., (2020) further describe digital infrastructure as a shared architecture that includes platforms, telecommunications, networks, data, and core applications designed to support organizational processes. Ndubuisi, Otioma, and Tetteh (2021) identify six key indicators for assessing a country's digital infrastructure: accessibility, network access, infrastructure investment, human capital, usage, and capacity, and call for further research to expand these metrics. Benitez et al., (2022) propose that developing nations could adopt a digital infrastructure sharing model to reduce capital expenditures, lower operational costs, and promote sustainability while stimulating growth in the digital economy. Anwar and Graham (2022) observe that among African countries, only South Africa has well-developed infrastructure supporting information technology, a view consistent with Zhang, Xu, and Ma (2022), who argue that the digital economy depends on intelligence, platforms, infrastructure, and technological innovation. Koutsikouri et al., (2018) further contend that infrastructure must evolve through innovation and technological change, describing "*adaptive infrastructure*" as having the capacity to expand and accommodate future developments through new services, processes, identifiers, and interface solutions. This research thus focuses on digital infrastructure in terms of internet connectivity, connectivity technology, communication channels and digital platforms.

Nguyen, Hargittai, and Marler (2021) conceptualize internet connectivity as part of the broader technology ecosystem, emphasizing that digital infrastructure must be supported by uninterrupted power supply and open access. Internet connections are generally categorized as wired or wireless, with Wi-Fi widely used globally (Beaunoyer, Dupéré & Guitton, 2020; Choudrie, Zamani & Obuekwe, 2022). In developed countries, households increasingly use Wi-Fi and are beginning to adopt Li-Fi, which uses light-based transmission and reduces potential harm (Beaunoyer et al., 2020; Choudrie et al., 2022). From a Network Theory perspective, these connections are crucial for enabling interactions among stakeholders and facilitating networked relationships (Moro Visconti, 2019). This section therefore further examines wireless connectivity, particularly mobile technologies, which are widely adopted globally.

Mobile communication has evolved from 1G to the current 5G due to advances in wireless technology (Salih et al., 2020; Houngbonon, Rossotto & Strusani, 2021). 1G supported voice calls only; 2G introduced messaging; 3G enabled multimedia and higher data transmission; 4G enhanced service quality through greater data transfer rates, capacity, and reliability; and 5G introduces IoT-enabled connectivity, expected to improve quality of service and enable extensive digital transformation (Houngbonon et al., 2021). Salih et al. (2020) further argue that 5G uses wider bandwidths, enhances real-time reliability, improves energy efficiency, and extends previous generations' limited functionalities. They suggest that emerging markets could benefit from 5G through improved digital connectivity, infrastructure efficiency, productivity, telemedicine expansion, and large-scale online education. However, Ismagilova et al. (2022) caution that global regulation and competition around 5G technologies may intensify, while Houngbonon et al. (2021) note that 5G connectivity may effectively rebrand 4G IoT solutions, indicating that "*connectivity for 5G could also mean 4G IoT*."

In organizational contexts, traditional communication tools such as noticeboards, posters, magazines, and corporate television have been replaced by digital channels such as social media, intranet portals, and email (Trenerry et al., 2021). Awan, Sroufe, and Shahbaz (2021) argue that digital communication environments are vital for societal well-being, facilitating communication, information transfer, interaction, and work flexibility. Nguyen, Hargittai, and Marler (2021) further emphasize that the persistence of the digital divide or inequalities in access and use of ICT across regions, households, individuals, and businesses, underscores the need for digital skills development and infrastructure expansion even in developed economies.

Kumar (2018) highlights the necessity of government involvement in establishing secure, robust infrastructure with diverse communication channels to support DT. Similarly, Tassabehji, Hackney, and Maruyama (2019) emphasize ICT's role in e-government as a strategy for poverty reduction and development in Sub-Saharan Africa. Swallehe (2021) identifies technological (ICT infrastructure), organizational (employee engagement), and environmental (policy and internet) factors as key determinants of social media marketing among SMEs. Elia, Margherita and Passiante (2020) argue that media houses and social platforms could play an essential role in disseminating climate change information, addressing a key information-sharing gap.

Digital platforms are central to economic and technological innovation. Benitez et al., (2022) define platforms as systems for collecting population data and feedback using digital technologies, emphasizing the role of governments in creating enabling conditions. Bonina et al., (2021) argue that digital platforms allow organizations to leverage distributed knowledge and collaborate effectively, categorizing platforms into seven types: problem-solving, ideation, co-creation, online marketplace, public outsourcing, collective intelligence, and freelance platforms. Moro Visconti (2019) further argues that platforms have revolutionized industries by facilitating interactions and value creation, with examples including Facebook, PayPal, and Uber (Durand et al., 2022). Hein et al., (2020) argue that platforms are organized around ownership, value creation, and autonomy, which collectively determine governance, benefit creation, and user flexibility. Moro Visconti (2019) also categorizes platforms into transaction platforms (e.g., Amazon, Uber), integrated platforms (e.g., Apple, Google), and innovation platforms (e.g., Microsoft), each contributing to growth and competitive advantage. In Sub-Saharan Africa, platforms such as Facebook and Uber are widely adopted, though digital infrastructure and capital constraints remain (David-West, Umukoro & Onuoha, 2018). In Tanzania, Mushi, Serugendo, and Burgi (2022) emphasize the need to design and implement digital platforms specifically for agriculture, enabling farmers to access market information and farm inputs.

Regulatory Frameworks

Regulatory frameworks have long been fundamental in organizing legal, economic, and social systems by ensuring order and protecting public welfare (Union, 2020). As ICT increasingly permeates daily life and the global economy, regulators face mounting pressure to manage the opportunities and threats presented by new digital technologies (Hohlov & Ershova, 2018). Innovations such as AI, blockchain, ML, and the IoT are transforming industries across sectors, ranging from manufacturing and commerce to finance, supply chain, and security, thus posing significant impediments for regulatory bodies (Constantinides, Henfridsson & Parker, 2018). As the digital landscape becomes more interconnected, there is a growing need to balance local concerns with global issues (Hanelt et al., 2021). While digital infrastructure has fueled global economic growth, it also underscores the need for adaptive and comprehensive regulatory frameworks capable of keeping pace with rapid technological advancements (CIOMS, 2023).

A key challenge in digital governance is the regulation of personal data to ensure consumer protection (Lobschat et al., 2021). The dominance of technology giants like Facebook and Google has intensified concerns around user privacy, personal data protection, and the need for regulators to defend digital rights (Union, 2020). In response, the European Union introduced the General Data Protection Regulation (GDPR), which has become a global benchmark by emphasizing transparency, informed consent, and individual control over personal information (Gupta, Ghosh & Sridhar, 2022). While the GDPR has strengthened data protection across the EU, it has also sparked debates about balancing privacy with innovation, especially regarding data collection practices (CIOMS, 2023). Its influence extends beyond the EU, as many non-EU countries have adopted similar frameworks to align with global standards (Gupta, Ghosh & Sridhar, 2022). However, these regulations create operational setbacks for businesses, including increased compliance costs and complexities in implementing consent mechanisms and detailed privacy notices (Lobschat et al., 2021). Although GDPR enforcement has improved organizational data governance, bottlenecks persist regarding cross-border data regulation and consistent enforcement (Irani et al., 2023). Further complicating the regulatory landscape are rising concerns about data sovereignty and localization, which add new layers of complexity (Irani et al., 2023).

In parallel, the concept of internet sovereignty has gained prominence, particularly in countries such as China and Russia, where strict data localization and censorship laws are framed as national security measures (Burri, 2021; Hufbauer & Jung, 2020; Gupta, Ghosh & Sridhar, 2022). These policies contribute to internet fragmentation and create tensions between national interests and the free flow of trade and information (Peng & Tao, 2022). As countries enforce more localized controls, concerns about digital protectionism grow, especially regarding the implications for cross-border data flows and global innovation (WTO, 2023). Joukhadar et al., (2023) warn that such regulatory divergence hampers international cooperation and undermines efforts to promote trade, digital innovation, and sustainable development.

Trade sanctions, often employed for political or security purposes, also have far-reaching consequences for global markets and technological innovation (Elia, Margherita & Passiante, 2020). While intended to limit economic advantages for target countries, sanctions can disrupt trade relationships and adversely affect critical sectors such as education, research, and technology (Smeets, 2018). Broad-based sanctions may harm both sanctioned and sanctioning countries, highlighting the need to carefully consider their long-term impacts (Elia, Margherita & Passiante, 2020). Krivko and Smutka (2020) argue that sanctions often redirect global trade patterns, encouraging affected nations to seek alternative markets and undermining strategic economic goals. In the ICT sector, sanctions can stifle innovation by restricting access to essential technologies and international collaborations (Hufbauer & Jung, 2020). This impact is clearly illustrated by Huawei's case, where sanctions limited its access to critical semiconductors and 5G infrastructure (Salih et al., 2020). Although such actions are often justified on national security grounds, they can isolate targeted nations from global technological ecosystems and hinder economic progress (Vimalkumar, Singh & Sharma, 2021). Moreover, sanctions can strain global supply chains and create shortages affecting both businesses and consumers, emphasizing the need for coherent international trade policies (Hufbauer & Jung, 2020). As a result, the WTO and the UN have advocated for a more nuanced approach to sanctions, acknowledging their unintended negative impacts on innovation and global trade (WTO, 2023).

Restrictions on trade and data flows, particularly through data sovereignty and localization laws, further disrupt industries reliant on seamless information exchange. Gupta, Ghosh and Sridhar (2022) argue that such restrictions increase operational costs and reduce competitiveness. While aimed at strengthening national control over data, these policies risk fragmenting global markets and hindering innovation (Burri, 2021). Research by Akbari and Hopkins (2022), Verhoef et al. (2021), and Zaki (2019) underscores the negative impact of localization rules, revealing how they obstruct cross-border data flows and introduce operational inefficiencies. Burri (2021) shows that such restrictions in regions like China and the EU reduce market efficiency and limit innovation, while Ritter and Pedersen (2020) emphasize their impact on global supply chains, highlighting the tension between national regulation and the benefits of open digital trade.

As digital technologies advance, ensuring cybersecurity and data protection has become a regulatory priority at both national and international levels (Hohlov & Ershova, 2018). The increasing frequency of cyberattacks targeting critical infrastructure calls for robust cybersecurity frameworks. For example, the EU's Network and Information Systems (NIS) directive mandates that providers of essential services implement rigorous security protocols (Wang et al., 2021). Data protection regulations like the GDPR have also reinforced individual rights, offering greater control over personal information (Hufbauer & Jung, 2020). However, as cyber threats evolve, regulators must remain agile and proactive, adopting policies to counter increasingly sophisticated attacks and prevent the misuse of emerging technologies.

In Africa, the rapid growth of ICT has prompted efforts to develop regulatory frameworks for the digital economy. Countries such as South Africa, Nigeria, and Kenya have enacted data protection and cybersecurity laws modeled after international standards such as the GDPR (Ritter & Pedersen, 2020). Nonetheless, enforcement gaps, infrastructure limitations, and regulatory misalignment continue to hinder regional digital integration (Rachinger & Muller, 2024). For instance, Tanzania has passed laws such as the Electronic and Postal Communications Act of 2010 and the Personal Data Protection Act of 2022, but enforcement remains a challenge (Ismagilova et al., 2022). Moreover, difficulties in regulating cross-border data flows limit these nations' potential as digital trade hubs (Ng'ombe & Nguvumali, 2023). These shortcomings underscore the urgent need for adaptable frameworks that promote innovation while protecting citizens and national security.

From a Dynamic Capability Theory perspective, regulatory frameworks represent institutional mechanisms that influence firms' ability to sense and seize digital opportunities. The dynamic capability to adapt to changing regulatory environments enables firms to remain competitive and resilient in the face of disruptive technologies. In contrast, Network Theory suggests that regulatory divergence shapes the structure and functioning of digital ecosystems. Regulatory fragmentation can weaken network linkages, reduce interoperability, and limit access to global innovation networks. Therefore, regulatory frameworks should be understood not only as governance mechanisms but also as strategic constraints and enablers within digital networks.

Hohlov and Ershova (2018) emphasize that the evolving digital regulatory environment demands a delicate equilibrium between promoting innovation and safeguarding security. The fast pace of technological advancement, compounded by geopolitical tensions, necessitates continual adaptation of governance structures (Schelenz & Schopp, 2018). International cooperation is essential to address cross-border data flow issues, data sovereignty, and digital protectionism (Ritter & Pedersen, 2020). Going forward, digital governance must be supported by flexible, robust policies capable of balancing national security, user protection, and economic development (Cichosz, Carl & Knemeyer, 2020). As ICT continues to drive transformation, regulators must evolve their approaches to safeguard both citizens and the digital ecosystem (Union, 2020).

Cybersecurity and data protection are increasingly critical as data breaches and privacy violations rise, making traditional security models inadequate for complex digital ecosystems (Cichosz, Carl & Knemeyer, 2020; Schelenz & Schopp, 2018). Adaptive, proactive frameworks are needed to identify and mitigate threats in real time (Hohlov & Ershova, 2018). Regulatory fragmentation across jurisdictions complicates security management, prompting calls for harmonized international standards. Weak cybersecurity infrastructure poses major economic risks, including financial losses, reputational damage, and reduced consumer trust, while strong data protection is essential for secure cross-border transactions and innovation (Cichosz, Carl & Knemeyer, 2020). Cybersecurity is framed as a governance challenge requiring multi-stakeholder collaboration, in critical sectors such as energy and healthcare (North, Aramburu & Lorenzo, 2020). Developing nations need enhanced capabilities and multilateral support, and emerging technologies demand resilient security models supported by robust regulatory frameworks.

Opportunities of Digital Transformation in International Trade

According to Verina and Titko (2019), DT encompasses several critical components, including business models, customers, data, employees, leadership, processes, and technologies. Van Veldhoven and Vanthienen (2022) and Djafarova and Foots (2022) further identified similar key elements. The business model component focuses on different business lines, operational models, and strategic approaches. The customer component emphasizes enhancing customer experience and meeting evolving needs, while the data component involves the use of analytics, big data, and large data sets. The employee component addresses workforce-related issues, and the leadership component concerns decision-making at various organizational levels, such as executives, managers, and owners. The process component pertains to business activities and operational workflows, while the technology component includes artificial intelligence (AI), cloud computing, cybersecurity, devices, and the Internet of Things (IoT). Verina and Titko (2019) concluded that the most critical areas for successful DT are processes, data, and business models. They identified three core enablers of effective transformation: (1) Technology, (2) Management/Processes, and (3) People.

Furthermore, Sebastian et al., (2017) highlighted three foundational components of DT: the formulation of a digital strategy - exemplified by the SMACIT framework (Social, Mobile, Analytics, Cloud, and IoT); which enables organizations to craft innovative value propositions. The second component is the operational backbone, which provides the infrastructure needed for consistent and efficient operations. The third is the digital service platform, which facilitates innovation by allowing organizations to design and deliver new digital services rapidly. In a similar vein, Gong and Ribiere (2021) identify three foundational elements of DT: a focus on customer experience guided by digital strategy, a strong operational backbone to ensure organizational effectiveness, and the enhancement of employee experience through digital platforms that support communication, collaboration, and productivity.

Moreover, DT is increasingly acknowledged as a critical catalyst for enhancing organizational performance and staying competitive in an increasingly fast-paced global market, evolving business environment (Verina & Titko, 2019). Gong and Ribiere (2021) found that DT positively impacts organizational outcomes by improving service quality, communication, and customer satisfaction. Similarly, Verhoef et al., (2021) argued that DT empowers firms to generate and capture value through innovative approaches, thereby supporting long-term success and sustainable competitive advantage. Additionally, Schrage, Muttreja and Kwan (2022) emphasized that DT fundamentally reshapes business operations and market engagement, driving greater operational efficiency and enhanced customer satisfaction.

The COVID-19 pandemic accelerated the necessity of embracing DT across industries, fundamentally modifying international business practices (Fahey & Hino, 2020; Coombs, 2020; Fu, 2020). Lockdowns and economic disruptions forced organizations to adopt digital solutions quickly (Fu, 2020), while also magnifying socio-economic disparities and leading to widespread job losses (Coombs, 2020). Fu (2020) noted that the extent of impact varied depending on human involvement in operations, digital maturity, and governmental responses. Fahey and Hino (2020) emphasized that the ability to adapt digitally has become essential for resilience and sustainability during the post-pandemic period.

In the global trade context, DT significantly contributes to enhancing connectivity, streamlining information sharing, and promoting cross-border commerce (George & Schillebeeckx., 2022). Meltzer (2020) highlighted that digital transformation boosts productivity and enables businesses, including those from developing nations, to access international markets.

This view is supported by Nadkarni and Prugl (2021), who assert that DT helps break down traditional trade barriers, enhances business performance, and reduces costs, thereby creating opportunities for new entrants in international markets. Moreover, Lee and Lee (2020) noted that digital transformation enhances service quality, raising quality standards and customer experience, contributing to firms' competitive advantage.

Numerous studies emphasize the link between digital strategy and enhanced global business operations (Khin & Ho, 2019; Rotblat, 2018). Key elements of DT, such as performance enhancement (Rossini et al., 2021), improving service quality through innovative models like the "*do-it-yourself*" approach (Lee, S. & Lee, D., 2020), and fostering better communication (Oduro, 2020), have been extensively studied. Enhancing customer experience through digital tools has become essential for competitiveness in global markets (Vadana et al., 2020).

In Africa, digital technologies are driving sustainable economic development, enhancing import/export activities and boosting the competitiveness of international trade (CIOMS, 2023). Volberda et al., (2021) argued that DT holds immense potential for unlocking new growth opportunities by enhancing information access, fostering product and service innovation, and improving operational efficiency. However, progress is hindered by limited infrastructure, digital illiteracy, and restrictive regulations (Union, 2020). Expanding digital infrastructure and promoting digital literacy are therefore vital for unlocking the full potential of DT for the growth in digital economy (Neumark, 2022).

In Tanzania, DT has advanced significantly in mobile technology, e-commerce, and financial services (Okeleke, 2019). Mobile phones and money services have expanded financial inclusion, especially among marginalized or disadvantaged communities (Naito, Ismailov & Kimaro, 2021). Yet, limited internet access and low digital skills in rural areas remain significant barriers (Mahenge, 2022). Continued investment in infrastructure and skills development is essential to promote inclusive economic growth and poverty reduction.

Rossini et al., (2021) and Rotblat (2018) highlight the substantial potential of digital technologies in boosting international trade by optimizing efficiency, lowering costs, and expanding market accessibility. Ipsmiller and Dikova (2021) emphasize that digital platforms help bridge geographic and cultural distances, enabling international trade stakeholders to access global markets more easily and reduce transaction costs. Buttolo (2021) explores how technologies like blockchain and AI foster transparency and security in international trade, mitigating fraud risks and optimizing payment processes. In addition, George and Schillebeeckx (2022) emphasize that digital tools in logistics, including real-time monitoring and predictive analytics, can streamline cross-border trade by reducing shipping times by 20-30% and driving substantial cost savings. Vaska et al., (2021) finds that digital tools in trade financing, such as e-invoicing and online payment systems, reduce transaction times by 40% and lower trade financing costs by 15%, thereby improving overall competitiveness. Conversely, Rossini et al., (2021) illustrate how digital technologies facilitate personalized marketing and tailored product offerings, minimizing delays and removing unnecessary bottlenecks. Rotblat (2018) suggests that digital technologies enhance supply chain operations via real-time data exchange helping to minimize delays and bottlenecks. Hai, Van and Thi Tuyet (2021) report that digital platforms have enabled Southeast Asian businesses to increase international sales by 50%, effectively reducing trade barriers in emerging markets. Lastly, Tabrizi et al., (2019) reveal that technologies like IoT and machine learning improve logistics efficiency, reducing freight costs and delays, while enhancing overall trade performance. Therefore, there is a need to explore more on how DT streamline international trade by enhancing efficiency in import/export activities and global competitiveness.

According to Hallencreutz and Parmler (2021) DT is reshaping and improving service quality in international trade, offering businesses the opportunity to enhance service delivery. AI, blockchain, and IoT are transforming global markets by enhancing service reliability, responsiveness, and efficiency of services in global markets (Grewal et al., 2020). These technologies streamline operations and improve the speed and accuracy of cross-border transactions, increasing transparency and trust in global trade processes (Rai et al., 2022). Digital tools like cloud computing and e-commerce platforms are critical in offering seamless, secure, and accessible services to customers worldwide, enhancing operational efficiency (Rymarczyk, 2021). Additionally, digital solutions allow firms to offer personalized services, which are essential for improving customer satisfaction (Mlepo & Zheng, 2023). Innovations in digital service models, such as automated customer support and virtual shopping experiences, enable businesses to exceed traditional service expectations (Bougie & Sekaran, 2019). The rise of "*untact*" (contactless) technologies, minimize human interaction and enhance service quality by empowering customers to independently manage transactions through "*Do-It-Yourself*" (DIY) models, improving both efficiency and satisfaction (Lee, S. & Lee, D., 2020). These '*untact*' technologies ensure that businesses can provide self-service options while maintaining high service quality, allowing customers to handle everything from product selection to payment without direct interaction (Lee, S. & Lee, D., 2020). However, Hallencreutz and Parmler (2021) highlight that businesses need to tackle cybersecurity threats and bridge the digital divide to maximize trade opportunities. The rise of technologies like 5G and advanced data analytics enables companies to enhance service quality, drive innovation, and better respond to the changing demands of global customers (Terfa Eticha, Brunninge & Kassa Tessema, 2024). Ultimately, leveraging DT and '*untact*' technologies improves service quality and strengthens competitiveness (Peng & Tao, 2022).

Improving communication and/or information sharing is viewed by Ipsmiller and Dikova (2021) as one of the opportunities brought by DT Verhoef et al., (2021) highlights that technologies such as instant messaging, email, and video conferencing enable real-time communication among international trade partners. Similarly, Garg et al., (2018) emphasize that digital tools facilitate better information sharing, real-time updates, and collaboration, which are essential for streamlining supply chain operations and meeting the demands of global markets. Awan, Sroufe and Shahbaz (2021) further argue that the application of digital communication platforms enhances decision-making by providing timely, accurate information, thus improving the overall efficiency of international trade processes. In addition, Rachinger and Muller (2024) note that digital communication tools enable businesses to manage cross-border operations more effectively by staying connected with international customers and partners, fostering stronger relationships and building trust. Integrating these tools with other technologies, like blockchain or the IoT, enhances security and transparency, simplifying the tracking of goods and payment management (Rachinger & Muller, 2024). Mwantimwa (2019) adds that digital communication allows businesses to access real-time market trends and consumer feedback, providing agility in adapting products and services to international market demands. Furthermore, communication technologies are integral to DT of international trade, offering faster information sharing, improved collaboration and greater responsiveness to market dynamics (Mwantimwa, 2019).

Gong and Ribiere (2021) further note that DT plays a crucial role in improving customer experience within international trade by enabling businesses to offer tailored, efficient, and seamless services across borders. Lee and Lee (2020) emphasize that digital platforms improve customer interactions through self-service options and real-time communication, while Grewal et al., (2020) note that AI and IoT enhance service speed and accuracy, offering more responsive and tailored experiences. Constantinides, Henfridsson and Parker (2018) argue that digital ecosystems strengthen connections with international customers, improving access to products, services, and support. Venkatesh (2020) asserts that DT helps businesses anticipate diverse customer needs, while Nadkarni and Prugl (2021) highlight the influence of digital tools in creating innovative services, such as virtual product demonstrations and real-time tracking. Moro Visconti (2019) underscores DT role in fostering agility and flexibility to meet evolving market demands, and Gong and Ribiere (2021) conclude that managing customer data through digital platforms enables businesses to offer proactive and personalized solutions. Ultimately, DT presents significant opportunities to elevate customer experience in international trade by delivering tailored and efficient services (Lee & Lee, 2020; Moro Visconti, 2019; Gong and Ribiere, 2021).

In addition, Gong and Ribiere (2021) argue that employee transformation is a significant driver of success of DT projects. They challenge the traditional notion of "*technology replacing jobs*" and instead propose that digital technology enhances employee performance and productivity by enabling faster, smarter, and safer work practices. Transforming the employee experience also prepares staff to cope with the rapid pace of DT, fostering a culture of continuous learning. Gong and Ribiere (2021) emphasize the importance of an agile talent pool with strong digital literacy to stay abreast of the fast-changing landscape of digital technologies. They introduce the concept of "*flexforcing*," which highlights the need for a workforce that can swiftly adapt to change, continuously acquire new skills, and stay resilient despite operational disruptions.

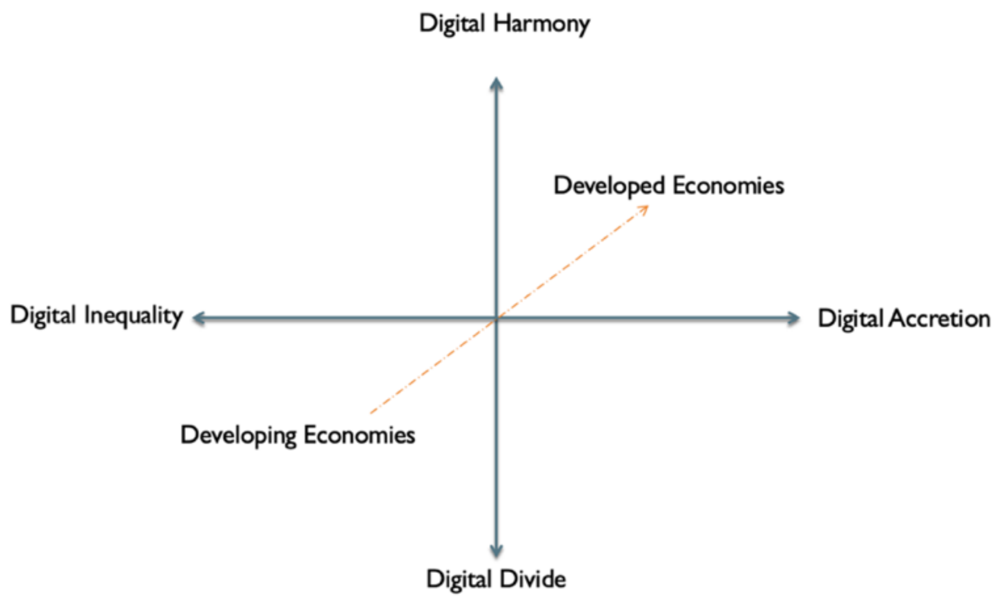
Another significant opportunity in international trade is access to global talent and resources. Companies can leverage diverse pools of expertise and specialized materials that may not be available in their home country. This is particularly valuable in sectors like technology, manufacturing, blue economy, and agriculture, where innovation and cost-effective solutions are essential. By collaborating with international suppliers and professionals, businesses can improve their operations and gain a competitive advantage in global markets (George & Schillebeeckx, 2022). Additionally, international trade facilitates access to foreign investment, enabling firms to secure financial resources for expansion and innovation. Foreign direct investment (FDI) and international joint ventures in seaports provide capital needed to grow and reduce the financial constraints that may exist, especially in emerging economies (Behdani et al., 2020).

Shibata (2020) highlights the significance of embracing technologies that shape workers' choices and opportunities, emphasizing the world's fascination with unexpected images and realities. Similarly, Morris, J., Morris, W. and Bowen (2022) argue that the future society should be influenced by the digital economy, digital democracy, and digital culture, making it inevitable for such a society to embrace networking and digitalization. Yau et al., (2020) view DT as a key driver for smart systems and artificial intelligence, which are increasingly replacing manual jobs with robots to enhance efficiency and competitive advantage.

Hai, Van and Thi Tuyet (2021) stress that DT is essential in both the corporate and governmental sectors. To ensure successful DT projects, they recommend investing in digital resources and implementing specific solutions aimed at improving leadership, promoting the sharing of digital data, and updating educational content. However, studies by Tabrizi et al., (2019) and Elia, Margherita and Passiante (2020) reveal that 70% of DT initiatives fail to meet their goals due to a lack of the right change mindset and organizational readiness. Their research provides five key lessons for successful DT adoption: (1) align business strategy with investment, as there is no "*one-size-fits-all*" solution; (2) leverage internal knowledge, as staff understand daily operations best; (3) design customer experiences from the outside in, focusing on customer needs; (4) address employee fears of job displacement, as overcoming this fear can improve the work environment and customer satisfaction; (5) adopt Silicon Valley's agile, rapid-prototyping, and flat-structure approach to foster success. Tabrizi et al., (2019) conclude that adopting flat organizational structures can reduce unnecessary bureaucracy and accelerate DT. Figure 4 synthesizes these success factors and illustrates the organizational enablers of effective DT.

Figure 4

The Future of Digital Transformation



Note: Adopted from Pollitzer (2018 p. 85).

The digital divide remains a major obstacle to economic participation and sustainability, particularly in Africa, where inadequate infrastructure, high costs, and limited digital literacy hinder inclusive development. Pollitzer (2018) underscores the urgency of addressing digital inequality to ensure long-term economic growth, warning that while developed countries benefit from ongoing digitalization, many African nations fall behind due to weak technology transfer and slow digital adoption. Akbari and Hopkins (2022) attribute the divide to both technological and socio-economic disparities, which compound inequalities in digital access and use. Alexopoulou

(2024) categorizes the digital divide into three levels: internet access, digital literacy, and digital usage, arguing that exclusion at any stage can restrict social mobility and economic opportunity. Vassilakopoulou and Hustad (2023) further highlight that rural populations and older individuals are particularly vulnerable to digital exclusion, a problem that is especially pronounced across Africa. This lack of digital inclusion not only deepens socio-economic inequality but also limits access to education, essential services, and global market participation. At the same time, advancements in digital technologies, particularly in logistics such as live tracking and automation, offer firms opportunities to streamline supply chains operations, reduce production costs, and accelerate time-to-market (Nguyen, Hargittai & Marler, 2021). Additionally, competitive benchmarking enables businesses to remain agile, track global trends, and adapt strategies in response to evolving technological and market conditions (Cichosz, Carl & Knemeyer, 2020).

DT drives opportunities in international trade while enhancing efficiency, service quality, and customer experience through technologies such as AI, IoT, and e-commerce (George & Schillebeeckx, 2022; Lee & Lee, 2020). Its core elements include leadership, digital data, technology, and processes, supported by strategic frameworks and agile structures that enable adaptability (Verina & Titko, 2019; Sebastian et al., 2017; Gong & Ribiere, 2021). This aligns with Dynamic Capability Theory (Teece, 2007) and the Network Theory perspective, in shaping DT and how firms connect stakeholders to seize opportunities in import/export activities (Behdani et al., 2020; Ipsmiller & Dikova, 2021). Despite its potential, DT initiatives often fail due to inadequate change management, poor infrastructure, unsupportive regulations, and lack of readiness (Tabrizi et al., 2019). In developing regions, limited infrastructure and low digital literacy deepen the digital divide, although digital tools can still help firms to perform and compete globally (Pollitzer, 2018; Alexopoulou, 2024; Nguyen et al., 2021; Cichosz et al., 2020).

Global Competitiveness and Efficiency in Import/Export Activities

In today's interconnected economy, maintaining competitiveness has become an essential priority for both nations and organizations (Gong & Ribiere, 2021). Competitiveness represents the capacity to provide high-quality offerings tailored to meet global market needs, while fostering economic growth and enhancing citizens' well-being and income. As trade barriers decline and consumer preferences shift rapidly, organizations must continuously adapt to stay relevant (Alexopoulou, 2024). Technological advancements and evolving customer expectations are reshaping the global landscape, positioning DT as a key driver of competitiveness and efficiency across sectors (Dedeoglu et al., 2020). DT involves seamlessly integrating digital technologies into key business functions, reshaping how organizations generate value, interacting with customers, and adapt to evolving market conditions (Gong & Ribiere, 2021). To stay competitive in today's fast-paced business world, organizations must adopt a digital-first strategy, with agility and innovation emerging as critical success factors (Furr, Ozcan & Eisenhardt, 2022).

DT is a key element for achieving global competitiveness and efficiency in import/export activities (Ngangaji, 2019). Companies in developed economies leverage advanced technologies such as AI, blockchain, and cloud computing to optimize supply chains, reduce transaction costs, and enhance operational efficiency in cross-border transactions (Mlepo & Zheng, 2023). These technologies enable import/export stakeholders to automate repetitive tasks, accelerate decision-making, and improve the accuracy of international logistics, thereby enhancing efficiency and competitiveness in global markets (Erhan, Uzunbacak & Aydin, 2022). From a Dynamic Capability view, digital investments help firms sense shifts and reconfigure resources (Teece, 2007), while Network Theory highlights how they strengthen connectivity and collaboration across trade networks. Automation further contributes to faster delivery, lower costs, and greater responsiveness to customer demands, reinforcing competitive advantage (Gong & Ribiere, 2021; Kiani Mavi et al., 2022).

Moreover, Ipsmiller and Dikova (2021) suggest that digital platforms enable businesses in developed countries to offer more customize offerings that foster stronger customer relationships. Customizing products and services to align with customers' unique preferences is essential for achieving a competitive edge in global markets, enhancing customer satisfaction and business success (Lee, S. & Lee, D., 2020). Rachinger and Muller, (2024) argue that the integration of blockchain and IoT technologies boosts efficiency by improving transparency, reducing risks and facilitating smoother cross-border transactions. These technologies offer real-time visibility into supply chains, ensuring timely deliveries, and reducing errors (Garg et al., 2018). Additionally, Wilson and Mergel (2022) highlights that DT allows firms in developed economies to stay flexible and quickly react to shifting market demands, ultimately improving their efficiency and competitiveness in global markets.

While DT offers significant opportunities to enhance both competitiveness and efficiency (Gong & Ribiere, 2021), its adoption in emerging economies is often constrained by issues such as infrastructure and a gap in digital literacy among the workforce (Hai, Van & Thi Tuyet, 2021). However, Mlepo & Zheng (2023) argue that businesses in these regions can still leverage digital tools like mobile technologies, e-commerce platforms, and cloud computing to reduce transaction costs, optimize supply chain management, and improve cross-border operations. Lee, S. and Lee, D. (2020) suggest that while the adoption of advanced technologies may be incremental, it ultimately drives substantial gains in efficiency and cost savings. Oduro (2020) emphasizes that digital transformation enables businesses in developing nations to create inclusive business models, allowing SMEs to access global markets and enhance their competitiveness. Furthermore, Tiwasing (2021) and Song et al., (2022) highlight that by connecting and building relationships with international suppliers and customers, SMEs can overcome geographical and infrastructural barriers, scale their operations, and improve service delivery.

Mwantimwa (2019) contends that digital tools equipped with data analytics enable firms in developing countries to better understand monitoring of consumer insights and market fluctuations, facilitating smarter decisions that enhance global competitiveness and optimizes import/export efficiency. Rachinger and Muller (2024) further argue that despite infrastructure gaps, technologies like blockchain and IoT can enhance efficiency by improving transaction transparency and traceability, thus reducing fraud and inefficiency in international trade. This increased trust in cross-border transactions further enhances competitiveness. Awan, Sroufe and Shahbaz (2021) emphasize that DT enables businesses in developing countries to become more flexible and adaptable, enabling them to respond swiftly to shifting market dynamics. This agility, combined with improved digital capabilities (Zoppelletto et al., (2023), helps businesses in LDCs to enhance both competitiveness and efficiency in the global market.

DT significantly contributes to the enhancement of global competitiveness and improving the efficiency of import/export activities (Amalesh et al., 2019). Ngangaji (2019) asserts that digital tools, including port automation, smart logistics, and real-time data analytics, have been key drivers in enhancing port operations. By combining human labor with automated systems for cargo handling, container tracking, and berth scheduling, ports can minimize delays and ship dwell time, reduce operational costs, and boost throughput, which ultimately strengthens their competitiveness (Butollo, 2021). Maury et al., (2020) further assert that ports that leverage digital technologies can enhance their efficiency by offering more reliable services to shipping lines and cargo owners. The authors further emphasized that 51% of Africa's seaport containers were managed by Morocco, Egypt, and South Africa, primarily due to their adoption of digital infrastructure and automation of which their East African counterparts are yet to implement.

The concept of DT in ports is also explored by Humphreys et al., (2019), who emphasize its role in helping ports become more flexible and responsive to shifting global trade demands. They note that the integration of technologies such as IoT, AI, and big data enhances coordination and resource management, reduces operational bottlenecks, and increases capacity utilization. Similarly, Li and Fei (2023) highlight that advanced port automation significantly reduces human error and operational delays, resulting in faster vessel turnarounds and improved service delivery for shipping companies and trade partners.

However, according to Humphreys et al., (2019) dwell time, which is the time vessels spend waiting in ports, remains a significant challenge, particularly in developing nations. Maury et al., (2020) compare dwell times in ports across Africa, where vessels often experience long delays due to inefficient processes, poor infrastructure and limited digitalization. This results in increased costs and reduced efficiency, impacting the competitiveness of African ports in global trade. In contrast, developed countries with advanced digital infrastructures benefit from reduced dwell times, as automation and digitalized workflows allow for faster processing of cargo and more efficient port operations (Li & Fei, 2023). The variation in dwell time between ports in both developed and developing countries, underscores the critical role of DT in enhancing efficiency and competitiveness through smart port initiatives. This is particularly important for developing nations, which must adopt digital tools to transform their ports into the preferred choice for customers by offering high-quality services and competitive packages (Tijan et al., 2021).

Scholars such as Gong and Ribiere (2021) and Erhan, Uzunbacak and Aydin (2022) argue that despite DT enhancing both competitiveness and efficiency in international trade, its impact varies between advanced and emerging economies. In developed economies, the widespread adoption of advanced digital technologies such as AI, blockchain, and IoT enables firms to automate operations, lower costs, and enhance decision-making processes (Gong & Ribiere, 2021). These technologies enhance operational efficiency while also boosting competitiveness by enabling firms to offer personalized services and respond swiftly to changing market demands (Ipsmiller & Dikova, 2021). In contrarily, Erhan, Uzunbacak and Aydin (2022) and Mwantimwa (2019) address the developing countries where businesses face significant barriers such as infrastructure limitations and technological gaps but still experience benefits from DT. Mlepo and Zheng (2023) note that digital tools help firms reduce transaction costs, improve efficiency and competitive advantage. Despite existing setbacks, the adoption of technologies such as blockchain and IoT continues to drive improvements in efficiency and competitiveness within developing countries (Rachinger & Muller, 2024).

Additionally, the DT of ports is crucial for enhancing competitiveness and efficiency in import/export operations (Maury et al., 2020). In developed nations, ports that adopt automation can provide faster and more efficient services, thereby becoming more appealing to international shippers (Ngangaji, 2019; Maury et al., 2020). Conversely, developing countries are adopting digital tools to streamline operations and reduce delays, improving competitiveness in shipping networks (Humphreys et al., 2019). Dwell time is a key issue affecting efficiency in ports, with African ports, for instance, struggling with delays due to underdeveloped infrastructure and limited digital adoption (Maury et al., 2020; Wang & Zhang, 2025). According to Humphreys et al., (2019, pp. 51-54), the average dwell time for containers in East African ports is estimated at 9 days, whereas in developed countries, it is typically less than 48 hours. The authors compare the average container dwell time, which includes both vessel and truck turnaround times, across various ports.

This comparison underscores significant inefficiencies in East African ports, which contribute to extended waiting times and reduced efficiency. In contrast, smart ports in developed countries have reduced dwell time while boosting both efficiency and competitiveness (Li & Fei, 2023).

Mlepo and Zheng (2023) provided port selection criteria which in developing economies, include port efficiency, cost competitiveness and geographical location. The port of DSM is a gateway for landlocked countries in East and Central Africa, but faces port inefficiencies, such as long dwell times and manual cargo handling (Humphreys et al., 2019). In contrast, according to Li and Fei (2023), developed ports, focus on automation, technological integration and high operational capacity, leading to faster turnaround times and greater efficiency the advancements, which DSM lags. The Union (2020) stresses both improving the physical and digital infrastructure, while the WTO (2023) underscores the significance of port modernization.

This research examines the role of DT in creating international trade opportunities for enhancing global competitiveness and efficiency in import/export activities, with its impact varying between developed and developing countries (Gong & Ribiere, 2021). In developed nations, businesses benefit significantly from the integration of advanced digital tools such as AI, blockchain, and the IoT. These technologies not only automate routine processes but also reduce operational costs, enhance decision-making capabilities, and support data-driven strategies, all of which contribute to improved productivity and competitiveness (Erhan, Uzunbacak & Aydin, 2022). On the other hand, developing countries face substantial impediments, including limited infrastructure and restricted access to advanced technologies, which hinder their ability to compete effectively and improve efficiency in import/export activities (Burri, 2021). These disparities highlight the need for targeted strategies to accelerate digital adoption in developing countries and strengthen their role in global trade (Wang & Zhang, 2025).

Extraneous Factors

According to Kumar (2018 p. 385) extraneous variables (EVs) refer to factors or variables that could "*affect the relationship between independent and dependent variables*" although they are not the primary subject of the study. As Cooper and Schindler (2014) explain, while almost infinite number of EVs may exist in any given study, most have minimal or no effect on the relationship being investigated. These variables are often excluded from the study, as their influence tends to occur randomly and does not significantly impact the primary relationship between variables. However, Morgan et al., (2019) raises the concerned that these variables may in some cases act as confrontation variables (CFVs) thus obscuring or distorting the relationship. Bougie and Sekaran (2019) stress the importance of controlling such variables to prevent bias and to safeguard the study's findings from interference by external influences. These extraneous factors can be included as control variables (CVs) in the analysis to isolate the impact.

Kumar (2018) notes that factors such as weather conditions and external political events, although peripheral to the central research problem, may still influence dependent variables. Similarly, Bougie and Sekaran (2019) argue that extraneous variables should be carefully managed to preserve a study's precision and internal validity. By incorporating such factors as control variables as potential confounders, researchers reduce the risk of biased conclusions arising from external influences (Cooper & Schindler, 2014; Morgan et al., 2019; Kumar, 2018). In line with this principle, the present study excludes several extraneous factors, including traditional trade practices, product availability, price disparities, and transportation logistics. Although these variables are relevant to global trade, they fall outside the scope of this investigation. Their exclusion allows for a clearer assessment of DT's specific contribution to trade efficiency and competitiveness in developing economies (Hill et al., 2021; Mandli & Ronkko, 2023).

Research Gaps and Summary of Literature Review

According to Sandeepanie et al., (2023) research gaps refer to areas within a field of study where existing knowledge, theories, or methodologies are insufficient or absent, presenting opportunities for further investigation. Identifying and addressing these gaps is essential for advancing the field, as they highlight important questions, overlooked issues, or emerging trends that need deeper exploration. In the context "*Opportunities of digital transformation in international trade: A study of import and export activities at DSM port in Tanzania*", several research gaps have emerged. For instance, Vassilakopoulou and Hustad (2023) emphasize the need for further understanding of how organizations manage DT, particularly the roles of leadership, organizational culture, employee literacy levels and customer experiences. Similarly, Herhausen et al., (2020) calls for more insight into the persistent results of DT. In the realm of artificial intelligence, Sabbaghtorkan, Batta and He (2020) identify a gap in the practical integration of intelligent systems and advanced data modeling for business decisions. These gaps are not just theoretical but also practical, requiring stakeholder engagement to address issues identified in the research. When a research gap requires stakeholder involvement it becomes prioritized as a critical gap. The research focused on the work of Sandeepanie et al., (2023) to explore six distinct categories of research. Lack of empirical proof (Evidence Gap), absence of real-world validation (Empirical Gap), research design limitations (Methodological Gap), informational deficiency (Knowledge Gap), theoretical insufficiency (Theoretical Gap), and demographic underrepresentation (Population Gap).

The evidence or contextual gap emerges from the limited number of studies conducted in Tanzania that focus on ICT adoption, digital innovation, and infrastructure development (David-West, Umukoro & Onuoha, 2018; Mwantimwa, 2019; Lwesya, 2021; Mushi, Serugendo & Burgi, 2022; Mwita & Jonathan, 2020; Ye & Ramadhani, 2020). While these studies have explored general aspects of digital development, they do not provide a holistic view of how digital infrastructure, regulatory frameworks, trade efficiency, and global competitiveness interact within the broader framework of DT in international trade. There is therefore a pressing need to contextualize DT within Sub-Saharan Africa, including Tanzania. George and Schillebeeckx (2022) identify the region as requiring more focused and context-specific research on digital trade to address its unique structural and transformational requirements.

The empirical gap in this study stems from the limited and fragmented research exploring the specific influence of DT on trade flows, operational efficiency, and competitiveness in developing economies like Tanzania. While existing literature acknowledges the transformative potential of DT, few studies provide concrete evidence linking digital infrastructure, regulatory frameworks, and technology adoption to measurable improvements in import/export activities (Burri, 2021; Gupta, Ghosh & Sridhar, 2022). Most prior research emphasizes general ICT usage or infrastructure development, without offering a holistic view of how DT directly influences international trade. Furthermore, the focus tends to be on short-term outcomes, with little attention given to the long-term sustainability and evolution of DT efforts (Brunetti et al., 2020; Lee, S. & Lee, D., 2020). Key tools such as e-commerce platforms and their role in reducing transaction costs, streamlining logistics, and expanding global market access remain underexamined (Ekman et al., 2020; Mergel, Edelmann & Haug, 2019). In the Tanzanian context, few studies integrate DT with trade-specific performance indicators, and there is a notable lack of research addressing sector-specific bottlenecks and/or opportunities in international trade, logistics, agriculture, and manufacturing. Moreover, crucial elements such as cybersecurity, data protection, and risk management in digital trade systems are often overlooked, despite their increasing relevance in a digitally connected global market (Rachinger & Muller, 2024; Ipsmiller & Dikova, 2021). This study seeks to bridge these empirical gaps by providing a focused analysis of how DT can enhance efficiency and competitiveness in international trade in Tanzania.

The methodological gap highlights the lack of robust empirical studies which employed quantitative and mixed method approaches to evaluate the real-world impact of DT on organizational performance. While qualitative studies are abundant, they often fall short of delivering measurable insights into key performance indicators like productivity, profitability, and customer satisfaction (Rossini et al., 2021; Rotblat, 2018). Additionally, there is a limited number of comparative studies that examine the influence of DT across different economic, legal, cultural settings and other disciplines. Such cross-national studies are essential for understanding regional variations and establishing best practices (Ritter & Pedersen, 2020; Halpern et al., 2021). By employing a mixed-method design, this study addresses this methodological gap, contributing a data-rich, context-sensitive approach to understanding DT in Tanzania which is an emerging digital economy that remains underrepresented in global research.

The knowledge gap persists in the fragmented understanding of how DT is applied across specific sectors such as logistics, finance, agriculture, and manufacturing. Despite being central to trade, these industries remain largely unexplored in terms of how they adapt to and benefit from digital transformation (Lee & Lee, 2020; Grewal et al., 2020). Additionally, while the digital divide is widely acknowledged, its implications for limiting trade access and hindering socio-economic mobility in underdeveloped regions remain insufficiently studied (Warf, 2019; Vassilakopoulou & Hustad, 2023). There is also a significant oversight in gender-based analysis. Although gender disparities in digital access are recognized, few studies examine how gender interacts with factors such as income, education, location, and sector-specific roles in influencing digital inclusion

(Union, 2020; George & Schillebeeckx, 2022). Addressing these gaps is essential for fostering inclusive and sustainable digital economies.

The theoretical gap is rooted in the lack of comprehensive models that integrate digital technologies seamlessly into business ecosystems. Although the transformative promise of DT is widely recognized, theoretical frameworks that explain how to embed these technologies into daily operations remain underdeveloped (Burri, 2021; Buttolo, 2021). Furthermore, existing theories often neglect the human and cultural dimensions of digital transformation, including its effects on employee engagement, job satisfaction, and organizational culture (Tabrizi et al., 2019; Gong & Ribiere, 2021). Another theoretical shortfall lies in the limited discussion on aligning DT initiatives with long-term strategic business goals (Sebastian et al., 2017). Additionally, ethical implications and stakeholder relationships within digital ecosystems are rarely incorporated into prevailing models. This study addresses these gaps by proposing an integrated theoretical framework that combines CARE, Dynamic Capability, and Network theories that offer a more holistic and contextually relevant understanding of DT in trade and organizational environments.

The population gap in the DT literature reflects the underrepresentation of specific groups and regions in developing economies like Tanzania where the influence of national and regional policies on DT remains largely unexamined (Miles, 2017). Most existing studies concentrate on developed countries, overlooking how government interventions in infrastructure, regulation, and skills development can either accelerate or impede DT in less advanced economies (Union, 2020; Volberda et al., 2021). In Tanzania, there is limited research exploring how public policies shape digital adoption and how developing nations, often dependent on technology transfer from advanced economies, can design effective regulatory frameworks. As emerging technologies such as AI, IoT, blockchain, and machine learning reshape global trade, regulatory bodies must evolve to ensure transparency, security, and fairness (George & Schillebeeckx, 2022; Buttolo, 2021). The population gap is further widened by the lack of targeted digital skills training for trade professionals in developing countries, where the digital divide is at its peak. Despite the pressing need for upskilling in areas like e-commerce, trade compliance, and digital supply chain management, tailored programs remain scarce (Mahenge, 2022). Moreover, the gender and digital inclusion gap is another critical but underexplored aspect, especially in relation to how gender intersects with factors such as income, education, and geography to affect digital participation in trade (Union, 2020; George & Schillebeeckx, 2022). Urban and rural populations are unequally affected by weak digital infrastructure, further deepening digital exclusion. Addressing these gaps calls for both public and private sector collaboration in crafting inclusive digital strategies that equip all societal groups; regardless of gender, location, or socioeconomic status; with the tools to participate in and benefit from digital trade.

This study explored the influence of DT in enhancing international trade (Kiani Mavi et al., 2022), with a particular focus on Tanzania's import/export activities while observing the influence of both digital infrastructure and regulatory frameworks on achieving competitiveness and efficiency. The study addresses key concepts of the road to the digital future such as digitization (converting analog data to digital), digitalization (applying digital technologies) and DT (societal and economic shifts driven by digital technologies). The literature indicates that DT can increase opportunities in international trade such as improving performance, ease communication, promote service quality and enhance customer experience (Mergel, Edelmann & Haug, 2019; Humphreys et al., 2019). On the flip side, disparities in digital access and infrastructure, especially in developing countries hinders the economic benefits and exacerbates the digital divide (Picatoste, Mesquita & González-Laxe, 2023; Tiwasing, 2021).

This study investigates how DT can strengthen competitiveness and improve operational efficiency in import and export processes, with a specific focus on Tanzania. Despite its favorable geographical position, the DSM port continues to face challenges due to the slow integration of digital technologies and limited automation, resulting in prolonged delays and increased dwell times for trucks and vessels (Mlepo & Zheng, 2023). To gain deeper insight into these barriers, the research is anchored in three complementary theoretical perspectives. Dynamic Capabilities theory explains how organizations can evolve and adapt internal resources to remain competitive in rapidly changing environments. Network theory highlights the importance of strong stakeholder relationships and seamless information flow in complex trade networks. Meanwhile, CARE theory emphasizes inclusive, ethical engagement and trust-building in digital adoption. Together, these frameworks offer a well-rounded lens for understanding how DT can reshape international trade outcomes (Amalesh et al., 2019; Leidner & Tona, 2021; Martin & Balestra, 2019).

According to Nayernia, Bahemia and Papagiannidis (2022), the field of international trade, particularly in developing economies like Tanzania, is undergoing significant transformation driven by the 4th industrial revolution. Tanzania, like many developing nations, faces constraints in leveraging digital revolution to improve global trade performance due the digital exclusion arising from unreliable digital infrastructure and regulatory frameworks (Warf, 2019). Although technologies such as AI, blockchain, and the IoT offer transformative potential, countries like Tanzania must enhance their digital capabilities to improve their competitiveness in trade (Gupta, Ghosh & Sridhar, 2022; AUC, 2021). Key sectors, including logistics, maritime freight, and supply chain management, can greatly benefit from digital integration, as it can optimize operations, reduce costs, and accelerate time-to-market for products within the global supply chain (Lobschat et al., 2021; Bougie & Sekaran, 2019).

According to (Warf, 2019), a major obstacle to DT in international trade for developing countries is the digital divide. This divide is evident in unequal access to digital tools and services, which is further exacerbated by factors such as income, geographic location, literacy levels, and gender (Herhausen et al., 2020). The COVID-19 pandemic has worsened these disparities, with marginalized groups, including low-income individuals, the elderly, and rural communities, facing significant barriers in accessing essential digital resources (Beaunoyer, Dupéré & Guitton, 2020). In regions like Africa, the digital divide is compounded by lack of digital infrastructure, limited internet access and low digital literacy (AUC, 2021). The digital infrastructure itself manifests disparities where most of the rural areas relate to 2G or 3G mobile technologies (Houngbonon, Rossotto & Strusani, 2021). To bridge this divide, targeted interventions such as digital literacy programs, infrastructure development and policy reforms are essential (Schelenz & Schopp, 2018).

According to Constantinides, Henfridsson and Parker (2018) digital infrastructure including reliable internet connectivity and communication technologies underpin in addressing the digital divide and enabling effective digital transformation. In many developing nations like Tanzania, reliable digital infrastructure is essential for connecting business entities and people to global markets, ensuring secure and efficient trade transactions (Hanelt et al., 2021; Houngbonon, Rossotto & Strusani, 2021). Investments in digital infrastructure can reduce operational costs, improve access to global markets, and enhance the overall competitiveness of industries (Mushi, Serugendo & Burgi, 2022). Governments must prioritize infrastructure development, ensuring that digital resources are accessible to underserved populations and regions to facilitate equitable participation in the global digital economy (Kumar, 2018; Pollitzer, 2018).

On the other hand, and with equal importance to digital infrastructure, regulatory frameworks that governs digital technologies and international trade need special attention

(Azmeh, Foster & Echavarri, 2020). Digital governance refers to the development of policies and regulations aimed at safeguarding data privacy and security while enabling seamless cross-border data flows (Cichosz, Carl & Knemeyer, 2020). Regulatory frameworks like the European Union's GDPR set important standards for data protection, but they also present limitations for innovation and cross-border trade (Gupta, Ghosh & Sridhar, 2022). Countries like China and Russia have introduced data localization laws, which prioritize national security and contribute to the fragmentation of global digital governance (Hufbauer & Jung, 2020). Trade sanctions and data flow restrictions further complicate international cooperation and disrupt the flow of goods and services, hindering global competitiveness (Elia, Margherita & Passiante, 2020).

Moreover, DT presents numerous opportunities for improving performance, service quality, communication and customer experience in international trade (Verhoef et al., 2021; Gong & Ribiere, 2021). The incorporation of tech innovations such as AI, block chain, online computing, and IoT can improve efficiency, shorten transaction times, and reduce costs, thereby boosting competitiveness in the global market Vaska et al., (2021). These technologies streamline processes like trade financing, customs clearance, and logistics management; enabling businesses to operate more efficiently and easily reach global markets (Verhoef et al., 2021). Additionally, the integration of "*untact*" technologies that refers to contactless or self-service solutions e.g. DIY—improves service delivery and customer satisfaction by providing faster, more convenient transaction methods (Lee, S. & Lee, D., 2020).

Furthermore, DT significantly enhances communication in international trade by enabling real-time interactions between global partners, which in turn improves decision-making and operational coordination (Verhoef et al., 2021). Digital platforms allow businesses to exchange timely, accurate market information, fostering greater transparency in supply chains and reducing errors in international transactions (Awan, Sroufe & Shahbaz, 2021). By integrating advanced communication technologies such as video conferencing, instant messaging, and collaborative digital platforms, businesses can more effectively coordinate with international suppliers, partners, and customers. These tools ensure smoother operations, facilitate quicker responses to market changes, and contribute to building trust across borders. As a result, DT not only streamlines global operations but also strengthens relationships between international stakeholders, promoting more efficient and reliable trade (Rachinger & Muller, 2024).

In the context of global competitiveness and operational efficiency, DT plays a pivotal role in enabling businesses to remain agile, responsive, and resilient in an increasingly interconnected and fast-paced global economy (Wilson & Mergel, 2022). Organizations that embrace DT often gain a strategic edge by streamlining operations, enhancing internal capabilities, and delivering more value-added services (Verhoef et al., 2021). The integration of digital platforms empowers firms to personalize offerings, anticipate customer needs, and elevate the customer experience, leading to stronger brand loyalty and sustained satisfaction (Lee, S. & Lee, D., 2020). Moreover, these innovations foster data-driven decision-making and real-time adaptability, both of which are essential for sustaining long-term growth and competitive advantage in the digital marketplace (Volberda et al., 2021). As global trade becomes increasingly digital, firms that leverage these capabilities are better positioned to thrive in complex and dynamic market environments.

Additionally, Lisinge (2020) highlights the significant progress African countries have made in strengthening regional economic integration through initiatives such as the African Continental Free Trade Area (AfCFTA). The key objectives of the AfCFTA are to establish a single African market for goods and services, promote intra-African trade, facilitate the free movement of people and investment, enhance industrialization and competitiveness, and accelerate economic integration across the continent. As Lisinge (2020) further explains, this ambitious agreement seeks not only to expand intra-African trade but also to deepen economic cooperation, reduce trade barriers, and harmonize policies, with the potential to fundamentally transform Africa's logistics and trade landscape.

In line with these developments, the researcher participated in the DIGILOGIC Webinar titled *The Potential of AfCFTA to Transform the Logistics Industry in Africa*, held in June 2023. The webinar provided a platform to critically examine how AfCFTA could unlock new opportunities in logistics modernization, trade facilitation, and cross-border cooperation, while contributing to sustainable economic growth across the continent. Discussions emphasized the strategic role of digital technologies in improving trade efficiency, strengthening logistics infrastructure, enhancing transparency, and promoting regulatory harmonization. The deliberations underscored AfCFTA's potential to drive structural transformation and foster a more integrated, resilient, and globally competitive African economy (DIGILOGIC, 2023, June 20).

In conclusion, DT holds significant potential to reshape international trade by enhancing performance, service quality, communication, and the customer experience (Gong & Ribiere, 2021). For countries like Tanzania, addressing the digital divide, investing in digital infrastructure, and developing comprehensive regulatory frameworks are crucial steps in ensuring that the full benefits of DT are realized. These efforts should enable the country to harness the opportunities that DT offers and foster sustainable economic growth. As businesses across the globe increasingly embrace DT, the ability to effectively leverage advanced technologies should remain a key determinant of competitiveness in an ever-evolving global economy (Burri, 2021). Therefore, the successful DT is not only essential for businesses but also for national economies striving to uphold competitiveness and drive innovation in the digital era.

CHAPTER 3: RESEARCH METHODOLOGY

Introduction

This chapter presents the research methodology and framework guiding the study, explaining the rationale for using a mixed-methods approach to examine the impact of DT on international trade. It outlines the research design, population and sample size determination, ethical considerations, data collection and analysis procedures, and evaluates the validity and reliability of the research model. Together, these components establish a solid foundation for understanding the role of DT in international trade.

The study was motivated by the need to explore the opportunities that DT offers for international trade. This motivation was reinforced by Pollitzer's (2018) work, "*Creating a Better Future: Four Scenarios for How Digital Technologies Could Change the World*," which highlights a significant global imbalance: while developed countries experience digital harmony and sustainable growth, developing nations continue to face digital inequality and a widening divide. Although DT reduces geographical barriers and improves efficiency (Butollo, 2021), developing countries continue to confront limited infrastructure, high technology costs, weak policy frameworks, and low levels of digital skills (Neumark, 2022; Hohlov & Ershova, 2018; Peprah, Atarah & Kumodzie-Dussey, 2024).While DT reduces geographical barriers and enhances efficiency (Butollo, 2021), developing nations face difficulties including limited infrastructure, high technology costs, insufficient policies, and low digital skills (Neumark, 2022; Hohlov & Ershova, 2018; Peprah, Atarah & Kumodzie-Dussey, 2024).

Globally, internet penetration and e-commerce are growing rapidly; from $2.3 trillion in 2017 to $5.8 trillion in 2023, projected at $7.9 trillion by 2027; but disparities remain, with only 44.4% of the populations in LDCs having internet access compared to 87% in developed nations

(Verhoef et al., 2021; Cui et al., 2025; Nguyen, Hargittai & Marler, 2021). DT can enhance trade competitiveness, operational efficiency, and market access, yet inadequate infrastructure, low digital literacy, and weak regulatory frameworks limit participation in global trade (Tabrizi et al., 2019; Peprah, Atarah & Kumodzie-Dussey, 2024; Furr, Ozcan & Eisenhardt, 2022).

The study adopts a mixed-methods approach that captures both quantitative trends and qualitative insights. Surveys collect numerical data on variables such as digital infrastructure, regulatory frameworks and operational efficiency (Gong & Ribiere, 2021), while interviews with key stakeholders provide context and capture lived experiences of DT (Plakoyiannaki & Budhwar, 2021; Bougie & Sekaran, 2019; Oduro, 2020). Triangulating these sources enhances validity and provides a holistic understanding of transformative impact. The study emphasizes how digital tools such as automated systems, AI, big data analytics, and blockchain; optimize trade operations, reduce costs, and improve efficiency. Adequate digital infrastructure and robust regulatory frameworks are critical to supporting secure, reliable, and efficient cross-border transactions (Nadkarni & Prugl, 2021; Azmeh, Foster & Echavarri, 2020).

DSM Port in Tanzania was selected to examine the practical application of DT in international trade. As the country's primary maritime gateway, it handles over 90% of Tanzania's global trade and serves neighboring landlocked countries, including Malawi, Zambia, DRC, Rwanda, Burundi, and Uganda (Humphreys et al., 2019). Its strategic regional role means that improvements in port operations can drive broader economic growth across East Africa.

As part of its transition toward a 'smart' port and enhanced competitiveness, the Tanzanian government has invested significantly in upgrading port infrastructure (Yau et al., 2020). These investments include the adoption of advanced digital technologies such as automated cargo tracking, real-time data analytics, and streamlined customs and clearance systems (Humphreys et al., 2019). Collectively, these innovations aim to improve operational efficiency, reduce delays, and lower costs associated with manual processes. By leveraging DT, the port is better positioned to accommodate growing trade volumes, strengthening Tanzania's role and competitiveness in international commerce (Humphreys et al., 2019).

The 30-year concessions awarded to DP World in 2023 and Adani in 2024 represent a significant milestone in the modernization of DSM Port, supported by initial investments exceeding USD 250 million and with the potential to reach USD 1 billion over the concession period (TIC, 23 October 2023; TIC, 4 June 2024). While these developments signal strong institutional commitment to port digitalization and operational reform, they were introduced during the course of this study, and the structural disparities in digital adoption and infrastructure identified earlier remain evident. The concessions are designed to optimize port operations, enhance regional and hinterland connectivity, and enable complementary developments such as rail-linked logistics, special economic zones, and temperature-controlled storage facilities. Against this backdrop, the present study evaluates the effectiveness of DSM Port's DT in improving trade efficiency and competitiveness, while examining the broader policy implications.

This chapter outlines the research methodology used to test the study's hypotheses and presents preliminary findings. It begins by discussing the research philosophy and underlying assumptions, followed by a description of the methodological approach and overall design. The chapter then defines the target population, geographic scope, sampling strategy, and justification for the sample size. It also explains the research instruments, operationalization of key variables, and ethical considerations observed throughout the study. Finally, it details the data collection and analysis procedures and assesses the reliability, validity, and model fit, providing a rigorous foundation for examining digital transformation's impact on international trade.

Research Philosophy, Paradigm, Design and Methods

This study is guided by a coherent philosophical and paradigmatic framework that ensures a rigorous and contextually grounded investigation of DT in international trade. Recognizing the multifaceted nature of DT, which encompasses technological, organizational, and socio-institutional dimensions, the study adopts a pragmatic approach that combines the strengths of positivist and interpretivist perspectives (Creswell, 2015; Benitez et al., 2022; Weyant, 2022). This orientation supports the use of a pragmatic research paradigm, allowing for methodological pluralism, abductive reasoning, and the alignment of ontological and epistemological assumptions with the study's practical objectives (Saunders et al., 2019; Creswell & Poth, 2016; Bougie & Sekaran, 2019). To operationalize this framework, the research employs a mixed methods design that captures both measurable outcomes and rich contextual insights, integrating causal, cross-sectional, and correlational strategies to examine how DT influences international trade (Fu, 2020; Fairbairn, Kish & Guthman, 2022; Sarstedt et al., 2018). Data collection integrated structured quantitative surveys with in-depth qualitative interviews, enabling the study to capture both measurable outcomes and rich, context-specific insights. The resulting data were analyzed using complementary statistical and thematic techniques, with triangulation employed to strengthen reliability, validity, and overall credibility. By connecting empirical evidence with the nuanced realities of trade practices, this approach generated actionable knowledge that could directly inform policy formulation, regulatory frameworks, and managerial decision-making in international trade. Furthermore, it provided a robust model for examining DT in resource-constrained and developing country contexts, effectively bridging the gap between theoretical constructs and practical application (Gong & Ribiere, 2021; Plakoyiannaki & Budhwar, 2021; Oduro, 2020; Creswell, 2015).

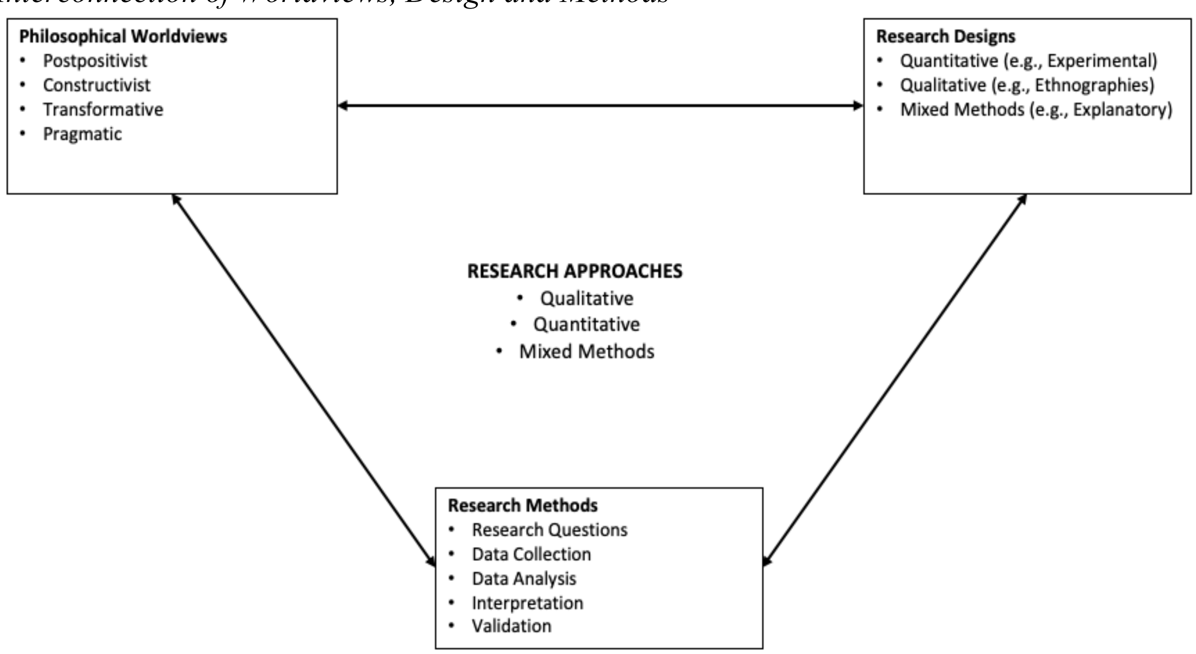
Research Philosophy

This study was grounded in a pragmatic research philosophy, which provided the foundational worldview guiding the investigation of DT in international trade. Pragmatism offered the flexibility to integrate the strengths of both positivist and empiricist perspectives, making it particularly suited for addressing complex, real-world phenomena (Creswell, 2015; Benitez et al., 2022; Weyant, 2022). Positivism emphasizes the existence of an objective reality that can be measured and quantified, supporting structured quantitative methods, hypothesis testing, and statistical analysis to generate generalizable knowledge (Kumar, 2018; Siponen & Tsohou, 2021). Empiricism, by contrast, grounds knowledge in observable phenomena and sensory experience, facilitating systematic data collection and interpretation to inform theory (Nielsen et al., 2020; Yue, 2022; Powell, 2020).

While both positivism and empiricism support scientific inquiry, they differ significantly in their ontological and epistemological assumptions. Positivism assumes a singular, objective reality that exists independently of the observer and can be measured, quantified, and analyzed to produce generalizable knowledge, emphasizing structured methodologies, hypothesis testing, and statistical verification as primary tools for understanding phenomena (Rabetino, Kohtamäki & Federico, 2021; Creswell & Poth, 2016). Empiricism, in contrast, views knowledge as constructed through observation, sensory experience, and interpretation, recognizing that human understanding is shaped by context, perception, and interaction with the environment (Kumar, 2018). It encourages systematic data collection and reflection to develop insights closely tied to lived experiences and practical realities. Pragmatism reconciles these perspectives by valuing both measurable, objective outcomes and contextually grounded, interpretive understanding. This integrative stance is particularly critical for studying DT, which encompasses complex technological innovations, organizational processes, and socio-institutional dynamics that cannot be fully captured through purely quantitative or qualitative methods alone.

Building on this philosophical foundation, the study adopts a mixed-methods research design that integrates quantitative and qualitative approaches to capture both numerical trends and contextual insights. Structured surveys generate statistically analyzable data, while in-depth interviews provide a nuanced understanding of behaviors, perceptions, and institutional dynamics. Data are analyzed using complementary statistical and thematic techniques and triangulated to enhance reliability, validity, and credibility. This integrated approach yields empirically robust and theoretically informed insights, bridging the gap between theory and practice while ensuring that the findings are grounded in the realities of Tanzania and other resource-constrained, developing-country contexts. Figure 5 presents the interconnection of worldviews, research design, and methods employed in this study.

Figure 5
Interconnection of Worldviews, Design and Methods



Note: Adapted from Creswell (2015 p. 3)

Research Paradigm

The research paradigm serves as the philosophical lens through which the study is conceptualized, structured, and analyzed. It encompasses assumptions about ontology (the nature of reality) and epistemology (the nature and acquisition of knowledge) which collectively guide methodological choices and the interpretation of findings (Creswell & Poth, 2016; Kourti, 2021). Positivism assumes a single, objective reality that can be observed and measured, typically employing quantitative techniques to test hypotheses and produce generalizable knowledge (Mauthner, 2019). In contrast, interpretivist, constructivist, and transformative paradigms recognize multiple, socially constructed realities and prioritize subjective understanding, often through qualitative methods (Bougie & Sekaran, 2019).

This study adopts a pragmatic paradigm, bridging positivist and interpretivist perspectives and enabling methodological pluralism while emphasizing practical problem solving (Creswell, 2015; Benitez et al., 2022; Weyant, 2022). Pragmatism allows the selection of methods that best align with research objectives, emphasizing contextual relevance, actionable insights, and applicability in real-world settings. Aligned with this paradigm, the study employs abductive reasoning, integrating inductive exploration with deductive testing to identify patterns, refine theoretical constructs, and develop contextually grounded insights (Saunders et al., 2019; Creswell & Poth, 2016). Abductive reasoning is particularly suited to the study of DT, enabling the researcher to explore complex organizational and social dynamics while constructing empirically informed conceptual models. Situating the study within a pragmatic paradigm ensures that methodological choices (whether surveys, interviews, or statistical analyses) are coherent with ontological and epistemological assumptions, enhancing the credibility, interpretive depth, and practical relevance of the research (Bougie & Sekaran, 2019).

Research Design

Building on the philosophical and paradigmatic foundations, the study adopts a research design that operationalizes the investigation. Research design is a structured plan that aligns research questions, data collection procedures, and analytical strategies with the study's objectives and underlying philosophical stance (Kumar, 2018; Powell, 2020). In social science research, designs are commonly categorized as qualitative, quantitative, or mixed methods, with each offering distinct advantages. Quantitative designs emphasize measurement and statistical testing, qualitative designs focus on in-depth exploration of meanings and processes, and mixed methods designs integrate both to address complex research questions more comprehensively (Creswell, 2015; Bougie & Sekaran, 2019).

Given the study's dual focus on measurable outcomes and contextual dynamics of DT in Tanzania's import/export sector, particularly at DSM Port, a mixed-methods research design was adopted (Fu, 2020; Weyant, 2022). This design combines a causal approach, which examines cause-and-effect relationships such as the impact of DT on operational efficiency, competitiveness, and trade performance (Fairbairn, Kish & Guthman, 2022), with a cross-sectional descriptive approach, which provides a snapshot of current practices, technological adoption, and institutional arrangements (Sarstedt et al., 2018; Fu, 2020). Descriptive correlational techniques are also applied to explore relationships between predictor and outcome variables, offering insight into how DT shapes trade outcomes (Jarvenpaa et al., 2019; Johnson et al., 2023). This design ensures coherence between research objectives, philosophical stance, and methodological strategy, providing a robust framework for investigating the multifaceted nature of DT

Research Methods

Aligned with the pragmatic philosophy, the study employed a mixed-methods approach to capture both structural drivers and experiential dimensions of DT in international trade (Weyant, 2022). This approach allowed the integration of quantitative and qualitative methods within a single study, providing both breadth and depth of understanding. Quantitative data were collected through structured surveys to examine relationships among key variables, including digital transformation, digital infrastructure, regulatory frameworks, international trade opportunities, global competitiveness, and efficiency in import/export activities, with competition and efficiency included as moderator variables. Statistical analyses were conducted to test hypotheses and assess potential causal effects, ensuring both rigor and generalizability (Gong & Ribiere, 2021).

Qualitative data were collected through semi-structured interviews with stakeholders to capture lived experiences, perceptions, and organizational, institutional, and social dynamics often inaccessible to quantitative approaches (Plakoyiannaki & Budhwar, 2021; Bougie & Sekaran, 2019). Thematic analysis identified recurring patterns, meanings, and contextual factors shaping digital transformation practices (Weyant, 2022). These qualitative findings were then integrated with quantitative results to enable triangulation, enhancing the credibility, reliability, and validity of the study (Oduro, 2020).

By combining a pragmatic philosophy, a mixed-methods approach, and causal and cross-sectional descriptive designs, the study established a coherent and rigorous framework. This approach ensured that research questions, data collection, and analyses were both philosophically grounded and practically relevant, generating empirically robust and actionable insights for DT in international trade and supporting evidence-based policy and managerial decision-making (Creswell, 2015; Bougie & Sekaran, 2019; Benitez et al., 2022).

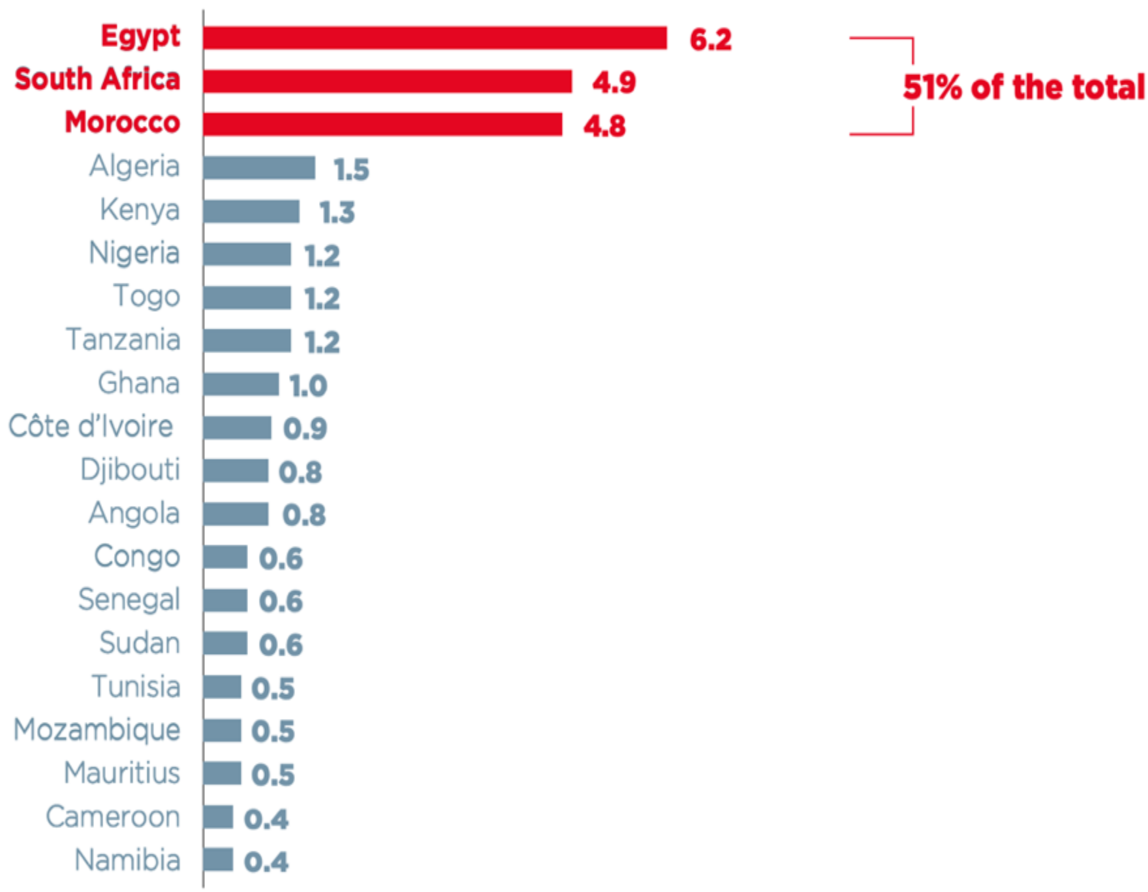
Population and Sample

DT in the import/export activities plays a pivotal role in facilitating international trade by improving efficiency, lowering operational costs, and supporting economic growth (Yau et al., 2020; Tiwasing, 2021; Saarikko, Westergren & Blomquist, 2020). Efficient port operations enable economic operators to conduct import/export activities using digital technology solutions, thereby enhancing trade facilitation and economic performance. Maritime shipping accounts for more than 80% of global cargo transportation, positioning ports as critical hubs in the international trade system (Yau et al., 2020). Within this context, the Dar es Salaam (DSM) Port has a strategic importance in international trade. The port serves as the gateway for over 90% of Tanzania's international trade and provides import/export access to several hinterland countries, including Malawi, Zambia, Burundi, Rwanda, Uganda, and the eastern Democratic Republic of Congo (Humphreys et al., 2019). Given the central role of ports in global trade and the dominance of maritime transport, DSM Port provides an appropriate setting for examining opportunities for DT in international trade and cross-border business activities.

According to Maury et al. (2020), the Port of DSM ranks among the five largest container-handling ports in Eastern Africa, alongside Mombasa, Djibouti, Port Louis, and Beira. Containerization has significantly enhanced port services and efficiency by enabling economies of scale, and digitalization which has further boosted port performance. Despite this progress, East African ports collectively manage only 14% of Africa's container traffic, which is comparatively low next to Egypt (20%), South Africa (16%), and Morocco (15%), whose ports together account for over half of the continent's container throughput. These leading countries benefit from more advanced digital infrastructure, integrated logistics systems, and higher operational efficiency, providing them with a substantial competitive advantage in global maritime trade. The disparity highlights the critical role of continued investment in digital and physical port infrastructure in East Africa, as well as the need for innovative policies and management practices to enhance throughput, reduce turnaround times, and strengthen regional trade competitiveness in the global shipping ecosystem (Maury et al., 2020). Figures 6 and 7 provide a comparative overview of container volumes handled by Africa's leading ports and the world's top container ports, highlighting regional disparities in throughput.

Figure 6

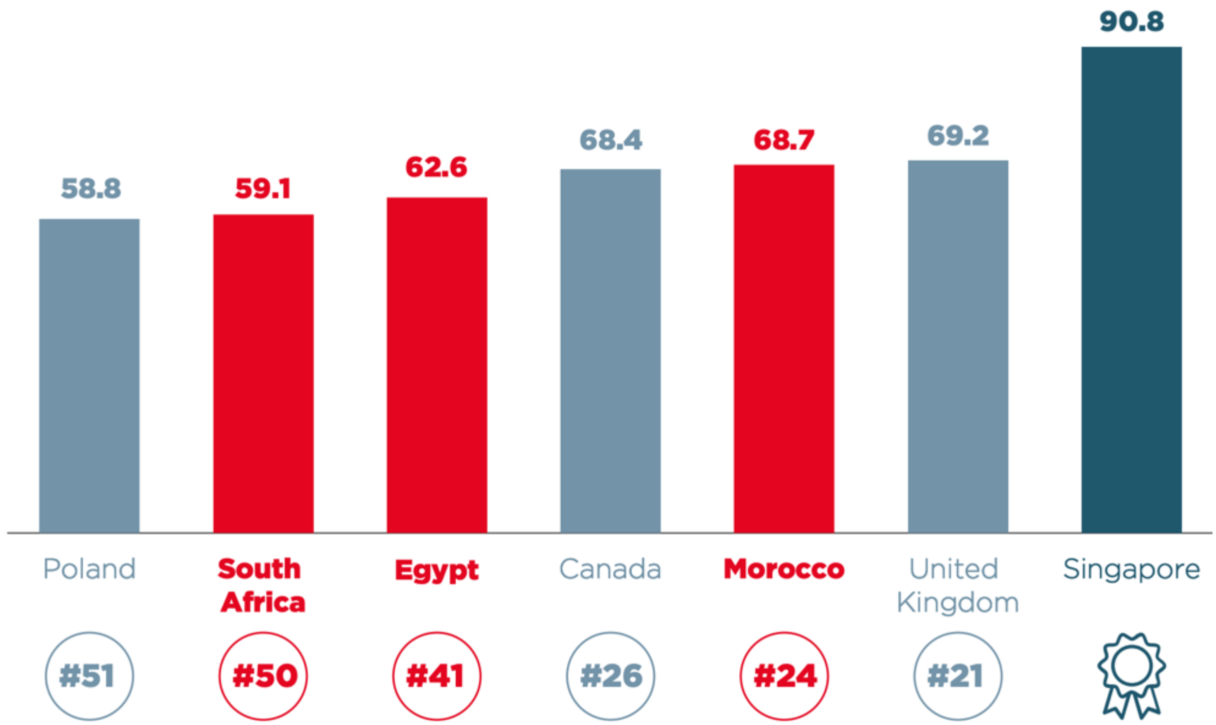
Containers transported by Africa's top 20 ports (in million TEU)



Note. Adapted from Maury et at., 2020, p. 12

Figure 7

Containers transported by World's top 20 ports (in million TEU)



Note. Adapted from Maury et at., 2020, p. 12

Ports in Morocco, Egypt, and South Africa stand out as highly efficient and competitive, ranking among the world's top 50 ports (Maury et al., 2020). Their superior performance is largely attributed to advanced digitalized infrastructure, which enables them to overcome operational constraints and achieve higher levels of efficiency. This comparison highlights the performance gap between these ports and those in East Africa and underscores the importance of digitalization as a strategic tool for improving competitiveness at the DSM Port.

Despite its strategic importance, the DSM Port faces significant shortcomings, including low efficiency, long vessel dwell times, high costs, limited sea and land connectivity, skills shortages, and governance constraints (Humphreys et al., 2019). The authors further highlight challenges for importers, such as skilled labor shortages, corruption, prolonged dwell times, limited maritime access, and technical inefficiency. These constraints continue to hinder trade facilitation and port performance, underscoring the need for DT to improve efficiency, reduce trade barriers, and enhance competitiveness.

The motivations for port digitalization, as outlined by Maury et al., (2020), include reducing turnaround times, lowering operational costs, improving overall performance, and integrating advanced technologies. These innovations are intended to streamline processes, enhance data collection and utilization, and support digitalized port operations. However, persistent shortcomings in East African ports such as low operational efficiency, high costs, prolonged dwell times, and inadequate connectivity; continue to limit their capacity to capture a larger share of Africa's growing container traffic.

Given the complexity of international trade operations and the involvement of multiple actors, clearly defining the study population and adopting an appropriate sampling strategy are essential to ensure the validity, reliability, and generalizability of the research findings (Cooper & Schindler, 2014). The study population comprises individuals and organizations that share characteristics relevant to the research objectives and are therefore suitable for addressing the study aims (Creswell, 2015; Hidalgo et al., 2020). Sampling refers to the systematic selection of a representative subset of this population for detailed analysis, enabling valid and reliable inferences to be drawn about the broader population while accounting for practical constraints such as time and resources (Cooper & Schindler, 2014; Oribhabor & Anyanwu, 2019). In the context of examining DT in import/ export activities at the Port of DSM, where interactions among public and private stakeholders are central, the following section defines the study population and identifies the key stakeholder groups that inform the sampling strategy adopted in this research.

The Study Population

In mixed-methods research, the study population is defined to support both quantitative measurement and qualitative exploration of the research phenomenon, ensuring that data collection captures not only statistical patterns but also contextual insights. A population refers to a set of individuals, organizations, or entities that share characteristics relevant to a particular research inquiry (Hidalgo et al., 2020). Bougie and Sekaran (2019, p. 236) define it as "*the entire group of people, events, or things that the researcher desires to investigate*," while Creswell (2012, p. 142) describes it as "*a group of individuals who have the same characteristics*." In this study, the population was defined to encompass stakeholders whose operational roles, experiences, and institutional responsibilities provide both measurable indicators and rich, in-depth perspectives on the processes and opportunities associated with DT in international trade at the DSM Port. This approach ensures that the research captures not only quantifiable data on DT outcomes but also the contextual, operational, and institutional dynamics that shape import/export activities.

Consistent with mixed-methods principles, the target population comprised organizations and individuals directly involved in import/export activities at the DSM Port. This population was defined along three key dimensions. The first, the unit of analysis, specified whether data were collected for quantitative measurement or qualitative exploration. The second, the geographical scope, was limited to the DSM Port and its immediate operational ecosystem, capturing stakeholders within the direct operational context of international trade. The third, the temporal scope, included stakeholders who were actively engaged in import/export activities during the data collection period, ensuring that the findings reflected current operational realities and practices. These parameters ensured that the population was appropriate for generating both statistically relevant data and rich, contextually grounded qualitative insights. According to Cooper and

Schindler (2014, pp. 665–667), the target population consists of "*those people, events, or records that contain the desired information for the study*," whereas the sampling frame is defined as "*a list of elements in the population from which the sample is actually drawn*." According to Gakuu, Kidombo, and Keiyoro (2016), the accessible population consists of those individuals from the target population who can be realistically reached and are willing to take part in either quantitative, qualitative, or both components of the study. Accessibility was assessed with respect to the sampling frame through survey administration and key informant interviews. Accordingly, the accessible population for this study comprised importers, exporters, Clearing and Forwarding Agents (CFAs), port employees, customs officials, private sector representatives, and officials from relevant government ministries and agencies operating within the DSM Port ecosystem.

In this study, the inclusion and exclusion criteria were carefully developed to support both components of the mixed-methods design. Stakeholders were included based on their roles, responsibilities, and operational experiences relevant to the research topic, "*Opportunities of Digital Transformation in International Trade: A Study of Import and Export Activities at the Port of Dar es Salaam in Tanzania*." Importers, exporters, and CFAs were included if they were actively engaged in import/export activities at the DSM Port and had at least two years of operational experience, as verified using data from the Tanzania Revenue Authority (TRA) database for 2021/2022. Private sector experts, port employees, customs officials, and representatives from relevant government ministries and institutions were included primarily for qualitative exploration of regulatory, managerial, and institutional dimensions of DT. Stakeholders not directly involved in import/export activities, those lacking active operational engagement during the data collection period, or with less than two years of relevant experience were excluded, ensuring methodological consistency and enhancing the validity, reliability, and credibility of the study findings.

The study population was contextually and geographically bounded by the DSM Port and institutionally limited to organizations directly involved in import/export activities. Temporally, it focused on stakeholders who were actively engaged in these operations during the data collection period, ensuring that the findings reflected current practices and operational realities. These boundary conditions provided a clear framework for comparing quantitative results with qualitative insights, enabling the effective integration of findings in accordance with the mixed-methods design. Ethical considerations were rigorously observed throughout the study. Participation was voluntary, informed consent was obtained from all respondents, and confidentiality and anonymity were maintained. Ethical approval was secured prior to data collection, with detailed procedures provided in the ethics section of the study.

Importers and exporters constituted the primary target group as the principal users of the import/export digital systems. Although these actors can be further categorized into local and hinterland traders, they were treated as a single aggregated group for analytical purposes due to their shared functional roles, comparable operational processes, and similar interactions with digital trade platforms. Importers, exporters, and CFAs participated in quantitative surveys, providing data on DT, digital infrastructure, regulatory frameworks, and the opportunities arising within the international trade ecosystem. Private sector experts, port employees, customs officials, and representatives from other government departments and ministries were engaged primarily through qualitative (key informant) interviews to provide insights into institutional, regulatory, and operational dimensions, while relevant policies, guidelines, and operational procedures were reviewed to contextualize and triangulate these findings. By clearly defining and mapping the study population in this way, the research ensured methodological alignment, providing a solid foundation for the subsequent sampling strategy, techniques, and sample size determination.

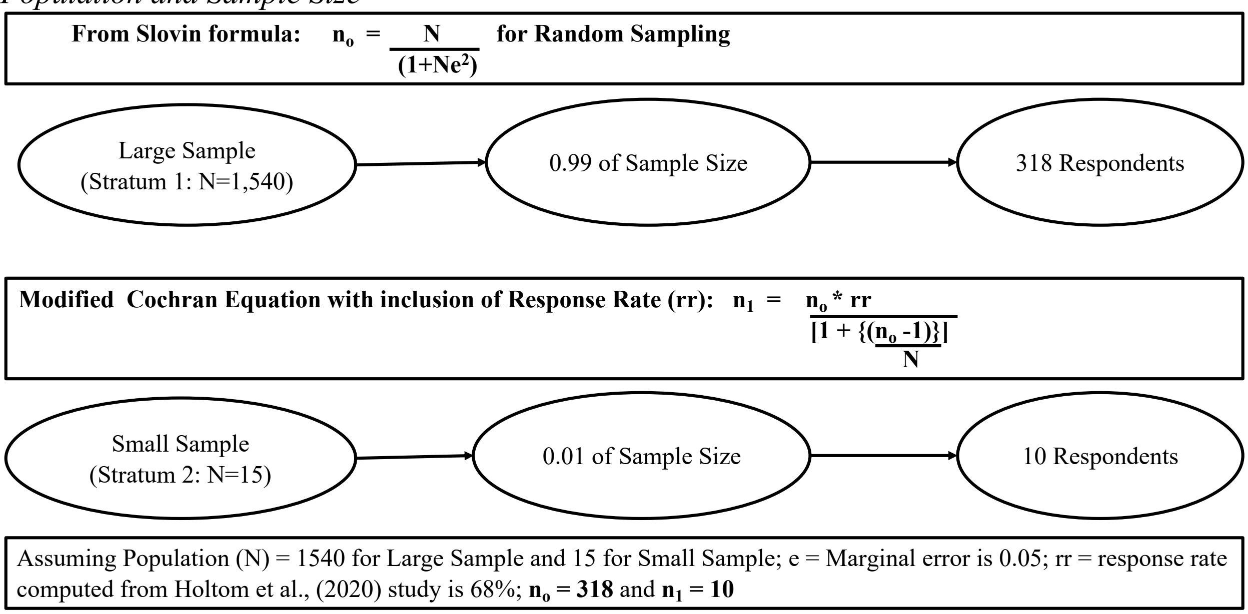
Sampling and Sample Size Determination

Sampling is the systematic process of selecting a subset of individuals, units, or observations from a larger population to participate in a research study, enabling researchers to draw conclusions about the entire population (Cooper & Schindler, 2014; Oribhabor & Anyanwu, 2019). The sample size refers to the number of respondents or units chosen for inclusion in the study, representing the portion of the population actually examined to generate findings that are both statistically reliable and contextually meaningful (Cooper & Schindler, 2014). In this study, which involved a diverse population of stakeholders engaged in international trade at DSM Port, the sampling strategy was carefully designed to ensure that all relevant perspectives were captured. By combining probability and non-probability sampling techniques, the study ensured methodological alignment, enabling the collection of quantitative data on DT and emerging opportunities in international trade, alongside qualitative insights into the institutional and operational dynamics influencing these outcomes.

For the quantitative component, probability sampling was applied using stratified random sampling, a technique selected to reduce sampling error and control variance in a heterogeneous population (Weyant, 2022). The sampling frame was divided into three strata: (i) importers and exporters, (ii) Clearing and Forwarding Agents (CFAs), and (iii) other trade-related stakeholders. Stratification ensured that all relevant subgroups were adequately represented and that the sample reflected the diversity of operational roles and experiences within the DSM Port ecosystem. Within each stratum, simple random sampling was applied using Excel's RAND() function to minimize selection bias and provide each eligible participant with an equal chance of inclusion (Sarstedt et al., 2018; Yi et al., 2022). This approach ensured that the quantitative data collected were robust, representative, and suitable for analyzing patterns, relationships, and operational outcomes associated with digital trade systems. Figure 8 illustrates the study population and sample size used for the quantitative analysis.

Figure 8

Population and Sample Size



Note. Adapted from Creswell (2015 p.145)

For the qualitative component, non-probability purposive sampling was employed to select key informants with specialized knowledge, professionals, authority, and extensive operational experience in DSM Port activities (Oribhabor & Anyanwu, 2019). Selected participants included customs officials, port authorities, senior representatives from government ministries, and private sector experts. Selection was based on professional role, technical expertise, and direct involvement in import/export operations, ensuring that the information collected provided rich, context-specific insights into institutional, regulatory, and operational dimensions of DT. This purposive approach complemented the quantitative surveys by allowing for in-depth exploration of opportunities, and procedural dynamics, while also supporting triangulation through the review of relevant policy documents, operational reports, and guidelines. Together, the quantitative and qualitative sampling strategies provided a comprehensive foundation for generating integrated, reliable, and meaningful findings on DT in international trade at the DSM Port.

The total population for the quantitative survey consisted of 1,540 stakeholders drawn from the 2021/2022 TRA database, including 517 importers/exporters, 1,023 customs agents, and 15 other stakeholders. The required sample size was determined using Taro Yamane's (1967) formula, a refined version of the Slovin formula (Suyono, 2012), with a margin of error of 5%:

$$\mathbf{n_o} = \frac{\mathbf{N}}{\mathbf{(1+Ne^2)}}$$

Where:

n_o = required sample size

N = population size

e = margin of error (0.05)

Substituting the study values: $n_o = 1{,}540 / (1+1{,}540 \text{ x } 0.052)$

$n_o = 1{,}540 / (1+1{,}540 \text{ x } 0.052) = 318$

The minimum required quantitative sample size for this study was determined to be 318 respondents. To ensure this threshold was achieved and to account for potential non-response, 482 structured questionnaires were distributed electronically via Google Forms, based on an anticipated response rate of approximately 68% (Holtom et al., 2022). A total of 409 valid responses were received, exceeding the minimum requirement by a substantial margin. This surplus strengthened the robustness of the dataset, reduced the risk of non-response bias, and enhanced confidence in the representativeness of the sample, thereby providing a solid empirical basis for reliable quantitative analysis and generalizable findings related to stakeholders involved in import and export activities at the DSM Port (Hair et al., 2021).

Determining an appropriate sample size is a complex methodological decision influenced by research objectives, desired precision, acceptable confidence levels, population variability, and practical constraints (Bougie & Sekaran, 2019). In quantitative studies employing SEM, sample size adequacy is further guided by established methodological rules and statistical power considerations due to the complexity of simultaneously estimating multiple parameters. Prior literature commonly recommends a minimum sample size of approximately 200 cases for SEM using maximum likelihood estimation, along with at least 10–20 observations per estimated parameter or observed variable for models of moderate complexity (Hair et al., 2021; Paul & Barari, 2022). The quantitative analysis in this study was based on a sample of 409 respondents, which clearly exceeds these recommended benchmarks. Given the number of latent constructs, observed indicators, and structural paths specified in the proposed model, this sample size supports stable parameter estimation and reduces the likelihood of estimation bias.

Considerations of statistical power further support the adequacy of the sample size. Statistical power refers to the likelihood of detecting true effects when they exist, and larger samples increase this likelihood by yielding more precise and stable parameter estimates (Cohen, 2013). In the context of SEM, inadequate sample sizes can result in unstable estimates, inflated standard errors, inconsistent findings across samples, and a reduced capacity to identify significant relationships, ultimately compromising model validity (Hair et al., 2021). Methodological research indicates that SEM models of moderate complexity typically require between 300 and 400 observations to achieve sufficient power and permit reliable assessment of overall model fit (MacCallum et al., 1996; Wolf et al., 2013). With 409 valid responses, the present study exceeds these recommended thresholds, ensuring adequate power to detect meaningful effects, rigorously test hypotheses, and produce robust, reliable, and generalizable conclusions regarding the relationships specified in the proposed mode.

For the qualitative component, the target population of key informants consisted of 15 individuals. The Modified Cochran formula was applied to adjust the quantitative sample size for a small population, taking into account the expected response rate:

$$\mathbf{n_1} = \frac{\mathbf{n_o * rr}}{\left[1 + \left\{\frac{(\mathbf{n_o} - 1)}{\mathbf{N}}\right\}\right]}$$

Where: n_o = calculated sample size for large population; n_1 = required sample size for small population; N = size of the small population; rr = response rate

Substituting the values: $n_1 = 318 * 68\%) / [1+((318 - 1)/15]$

$n_1 = 216.24 / 22.133 = 9.77$ which is rounded to 10

The qualitative sample size was guided by the principle of data saturation, defined as the point at which additional interviews no longer yield new themes or analytical insights (Guest, Bunce, & Johnson, 2006). Accordingly, eleven key informants were purposively selected to capture diverse yet complementary perspectives on DT at the DSM Port. Purposive sampling ensured the inclusion of participants with direct knowledge, decision-making authority, and operational experience related to DT initiatives within the port environment. The informants represented critical stakeholder groups involved in DT implementation and governance, including customs officials, port authorities, relevant government ministries and departments, and private sector actors. This composition enabled the study to capture institutional, regulatory, operational, and commercial perspectives, thereby supporting a comprehensive and contextually grounded understanding of DT and international trade opportunities at the port.

The inclusion of participants across multiple institutional levels and functional roles enhanced the breadth and depth of the data and supported triangulation of perspectives within the port ecosystem. Consistent with prior methodological research, saturation in focused organizational and policy-oriented qualitative studies is typically achieved with between 10 and 15 in-depth interviews, particularly when participants are information-rich and the research context is clearly defined (Bouncken, Czakon, & Schmitt, 2025; Guest, Bunce, & Johnson, 2006). In this study, saturation was observed during the later stages of data collection, as recurring themes and stable patterns emerged across interviews, with no substantively new insights identified. The achieved qualitative sample size provided sufficient analytical depth to generate rich, context-sensitive findings and enhanced the credibility and trustworthiness of the qualitative analysis.

However, as noted by Viglia, Zaefarian & Ulqinaku (2021) in mixed-methods research, the sample size is generally guided by the requirements of the quantitative component, which demands a larger and more statistically representative sample. This view is reinforced by Fainshmidt et al., (2020), who argue that the quantitative sample size should take precedence, when the study aims to draw generalizable conclusions. At the same time, Paul & Barari (2022) stress the importance of maintaining a balanced approach between the quantitative and qualitative components, aligning the sampling strategy with the specific objectives of the research. Supporting this approach, Nielsen et al., (2020) advocate for methodological triangulation to strengthen the credibility and validity of research findings. Accordingly, this study collected and analyzed quantitative and qualitative data separately, with each method fulfilling a unique but complementary role. The findings were subsequently triangulated to offer a holistic understanding of the research problem, allowing qualitative insights to deepen and contextualize the quantitative results.

Materials/Instrumentation of Research Tools

Research instruments, also referred to as research tools, constitute the methodological mechanisms through which empirical data are generated, measured, and interpreted within a scientific inquiry. They provide the operational link between abstract theoretical constructs and observable empirical evidence, thereby enabling researchers to address research questions systematically and rigorously. In social science research, instruments may be used to measure outcomes, assess competencies, observe behavior, capture perceptions and attitudes, or elicit experiential and institutional insights through interviews (Weyant, 2022). As the primary vehicles for data generation, research instruments play a decisive role in determining the quality, credibility, and interpretability of study findings. Consequently, their selection, design, and application must be guided by methodological rigor, contextual relevance, and alignment with the objectives.

The selection of appropriate research instruments requires careful consideration of validity, reliability, and practicality. Validity refers to the extent to which an instrument accurately measures the construct it is intended to capture, ensuring that empirical observations meaningfully reflect the underlying theoretical concept rather than extraneous influences (Gakuu, Kidombo & Keiyoro, 2016). Reliability concerns the consistency and stability of measurement outcomes across time, contexts, and populations, such that repeated application under comparable conditions yields similar results (Weyant, 2022). Practicality, on the other hand, involves assessing the feasibility of deploying the instrument within the constraints of available resources, time, technological infrastructure, and participant accessibility (Kumar, 2018). These considerations are particularly important in applied research settings, such as studies examining DT and international trade, where respondents often operate within institutional and operational constraints.

Research methodology is inherently context-dependent; as such, there is no universally applicable instrument suitable for all research problems. Pandey and Pandey (2021, p. 35) describe a research instrument as a mechanism that "*builds a bridge between the problem and the location of empirical evidence that may solve the problem*." This conceptualization underscores the instrumental role of data collection tools in linking theory to evidence. Researchers may adopt existing standardized instruments where these are theoretically sound and empirically validated for the study context, or they may adapt and refine such tools to enhance contextual relevance. In situations where existing instruments are inadequate, the development of context-specific tools becomes necessary, provided that systematic procedures are followed to establish their validity and reliability (Gakuu, Kidombo & Keiyoro, 2016).

In line with this methodological orientation, the present study adopted a concurrent mixed methods design to capture both the quantitative and qualitative dimensions of the research problem. This approach was considered particularly suitable given the complexity and multidimensionality of DT and its implications on the import/export activities. Quantitative data were collected using structured questionnaires to facilitate systematic measurement and statistical analysis of relationships among key variables, while qualitative data were generated through semi-structured and unstructured interviews to provide contextual depth and institutional insight that could not be fully captured through standardized instruments alone (Weyant, 2022). The integration of these tools enabled the study to balance analytical breadth with interpretive depth, thereby enhancing the robustness and explanatory power of the findings.

The quantitative component of the study focused on examining the relationships among digital transformation, international trade opportunities, and the moderating influence of efficiency and competition. These constructs were operationalized through carefully designed questionnaire items aligned with the study's conceptual framework and research questions. Questionnaires are among the widely used instruments in social science due to their efficiency, standardization, and suitability for collecting data from large and geographically dispersed populations. They consist of a structured series of questions or statements to which respondents provide written or electronic responses (Grassini & Laumann, 2020). Depending on their design, questionnaires generate quantitative data through closed-ended, qualitative data through open-ended questions, or a combination of both in mixed-format instruments (Magsamen-Conrad & Dillon, 2020).

The questionnaire developed for this study comprised two dichotomous questions, two open-ended questions, eight multiple-choice questions, and twelve Likert-scale items encompassing a total of forty-eight sub-questions. Likert-scale response options included *"Disagree," "Agree," and "Neutral,"* as well as ordinal measures of intensity such as *"Low Extent," "Moderate Extent," and "High Extent."* This combination of question formats was intentionally selected to enhance measurement precision while allowing respondents sufficient flexibility to express nuanced perspectives. The questionnaire was structured into four main sections: informed consent and respondent background information; assessment of the dependent variable, international trade; examination of independent variables related to digital transformation; and evaluation of the combined influence of digital infrastructure and regulatory frameworks. Issues of competitiveness and operational efficiency were integrated across relevant sections to reflect their cross-cutting role in shaping trade performance, while moderating effects were addressed within subsections of the primary constructs (see Appendix A).

To ensure content validity and methodological rigor, the questionnaire underwent peer review by experts in digital trade, public policy, and research methodology. In addition, a pilot test was conducted with a subset of respondents drawn from the target population to assess clarity, relevance, and comprehensibility. Feedback from this process informed minor refinements to item wording and structure, thereby enhancing the instrument's reliability and reducing potential measurement error.

Research questionnaires may be disseminated using several established approaches, including mail surveys, group-administered surveys, and household drop-off surveys (Magsamen-Conrad & Dillon, 2020). Mail surveys, which are commonly administered through electronic means such as email, represent the most frequently used mode due to their cost-effectiveness, scalability, and capacity to reach large numbers of respondents across wide geographic areas. Despite their advantages, mail surveys are inherently impersonal and are often associated with relatively lower response rates. Nevertheless, they allow researchers to efficiently collect large volumes of data, ensure standardized administration, and minimize logistical costs. Group-administered questionnaires, by contrast, are distributed to respondents who are physically or virtually assembled for a specific purpose and are typically associated with higher response rates due to the immediacy of participation (Kumar, 2018). Household drop-off surveys represent a hybrid approach, combining features of mail and group-administered methods; questionnaires are delivered in person and collected at a later stage, allowing researchers to clarify ambiguous items and improve response accuracy (Grassini & Laumann, 2020).

In the present study, questionnaires were administered electronically using Google Forms and disseminated via email to importers, exporters, and customs agents. The researcher compiled a comprehensive list of respondent email addresses obtained from the Tanzania Revenue Authority (TRA) database, which constituted the study's sampling frame. This approach was considered appropriate given the professional profile of respondents and the increasing digitization of trade-related operations. Response rates for mail-distributed questionnaires have been widely discussed in the literature. Holtom et al., (2022) report average response rates of 48%, 53%, 56%, and 68% for the years 2005, 2010, 2015, and 2020, respectively. Taking these benchmarks into account and considering both the phenomenon of technological leapfrogging and the comparatively lower internet penetration rates in Africa relative to developed regions, the researcher estimated a plausible response rate for Tanzania in 2023 to be similar to Holtom et al., (2022) results of 2020 which was at 56%.

While questionnaires facilitated systematic quantitative analysis, interviews were employed to complement and extend these findings by capturing detailed, sensitive, and context-specific information that structured instruments alone are often unable to elicit (Weyant, 2022). Interviews are particularly valuable in addressing language barriers, clarifying ambiguities, and exploring complex institutional dynamics that respondents may be reluctant or unable to articulate in written form. According to Bougie and Sekaran (2019), interviews may be conducted through face-to-face interactions, focus groups, or telephone conversations, making them suitable for both localized and geographically dispersed participants. Furthermore, interviews may incorporate structured, semi-structured, and unstructured elements, allowing researchers to balance consistency with flexibility and to probe emerging themes in depth (Kumar, 2018).

Despite their strengths, interviews present methodological limitations, including higher time and resource demands, scheduling constraints, and potential concerns regarding anonymity. Focus group interviews, in particular, require careful moderation to manage divergent or conflicting responses (Weyant, 2022). Nevertheless, interviews are especially appropriate for complex research contexts, for collecting in-depth and supplementary information, and for clarifying issues that questionnaires may inadequately capture (Kumar, 2018). Empirical experience suggests that respondents often provide limited qualitative detail in open-ended survey questions, reinforcing the importance of interviews as a complementary data collection technique.

In this study, interviews were intentionally used to collect data from government departments and institutions directly involved in import and export activities at the DSM port that were not included in the questionnaire survey. Comprehensive key informant interviews were conducted with eleven participants drawn from government ministries, regulatory agencies, and private sector associations. These included officials from the Ministry of Finance (MoF), the Ministry of Industry, Trade, and Investment (MITI), the Tanzania Revenue Authority (TRA), and private sector bodies such as the Tanzania Private Sector Foundation (TPSF). A structured checklist guided the interviews, focusing on digital infrastructure, regulatory and policy frameworks, trade facilitation mechanisms, and the adoption of digital technologies. These interviews provided expert insights into trends, efficiency gains, competitive dynamics, and emerging opportunities associated with DT at the DSM port, thereby complementing and contextualizing the quantitative survey results.

Effective data collection procedures are fundamental to ensuring the reliability, consistency, and credibility of research outcomes (Bougie & Sekaran, 2019). As emphasized by Creswell and Poth (2016), adherence to ethical standards during data collection is paramount. In alignment with these principles, this study ensured voluntary participation, equitable treatment of participants, respect for power dynamics, and protection against exploitation. All interview participants provided signed informed consent prior to data collection, and confidentiality and anonymity were rigorously maintained.

In the digital age, data have become a central strategic asset, driving organizational decision-making, operational efficiency, innovation, and long-term competitiveness (Dash & Paul, 2021). Beyond a by-product of operations, data enable organizations to monitor performance, evaluate policy, anticipate market and regulatory shifts, and respond proactively to emerging setbacks. As DT accelerates, both public and private organizations increasingly rely on high-quality, timely data to optimize processes, identify trends, enhance transparency, and improve service delivery (Ghasemaghaei & Calic, 2020). In digitally enabled international trade, effective data use is crucial for reducing transaction costs, streamlining cross-border procedures, strengthening stakeholder coordination, and enhancing competitiveness. Recognizing this, the study followed established data collection and management frameworks to ensure accuracy, relevance, completeness, and timeliness, supporting evidence-based analysis of trade facilitated by DT (Volberda et al., 2021). Analytical rigor was further enhanced through methodological triangulation, pilot testing, validation procedures, and rigorous data cleaning, collectively improving data quality and reducing bias.

Best practices in data governance were strictly observed to ensure data integrity, security, and ethical compliance, including the use of encryption, anonymization, and strict confidentiality protocols in line with internationally recognized standards (Janssen et al., 2020). Acknowledging the evolving nature of DT initiatives, data collection procedures were designed to be flexible and forward-looking, incorporating emerging methodological best practices and relevant technological advancements (Grewal et al., 2020; Kumar, 2018). Through the integration of structured survey data and semi-structured interview insights within a robust ethical and data governance framework, the study produced a comprehensive, methodologically sound analysis of the impact of DT on international trade at the DSM port.

Operationalization of Variables

Operationalization of variables provide specific insights into how abstract concepts are measured or manipulated in the study (Gakuu, Kidombo & Keiyoro, 2016). The operational definitions provide clarity which allows researchers to transform theoretical constructs into practical measurable variables (Hair et al., 2021; Dedeogl et al., 2020). According to Morgan et al., (2019 p.1); operational definition of variables is described "*in terms of the operations or techniques used to make it happen or measure it*". Through defining the operational variables, enhanced clarity and replicability of the study was obtained hence making it simpler for others to understand and apply the replicate findings in various settings.

This research which concentrated on the assessment of the "*Opportunities of digital transformation in international trade: A study of import and export activities at DSM port in Tanzania*" was conducted by observing constructs such as Digital Transformation (DT), International Trade Opportunities (ITO), Digital Infrastructure (DI) and Regulatory Frameworks (RF). Other constructs namely Efficiency in Import/Export activities (EIM) and Global Competitiveness (GLC) and the moderator variables of Competition (COM) and Efficiency (EFF) were observed, and the operational definitions of each construct are discussed below.

Vaska et al., (2021, p. 1) define DT as the integration and application of digital technologies in day-to-day business processes. The relationship between DT and ITO was examined under the influence of both DI and RF. In research terminology, variables that drive change are referred to as independent variables, while those that represent outcomes or effects are known as dependent variables. Extraneous variables are unmeasured factors that may influence the causal relationship, potentially introducing bias. Meanwhile, intervening variables serve as intermediate, linking the effect of one variable to another within the causal pathway.

Construct 1. Digital Transformation (DT)

Vaska et al., (2021, p.1) view DT as the adoption of digital technologies and practice into day-to-day processes. Similarly, Akram et al., (2022) describe DT involves embedding digital tools into fundamental business functions, leading to a fundamental shift in how these processes function and how the organization delivers value. According to Martínez-Caro, Cegarra-Navarro and Alfonso-Ruiz (2020), DT entails reassessing and embedding digital technologies to boost organizational effectiveness, enrich customer interactions, streamline communication, and enhance service standards, all within the framework of nurturing a digital mindset. Within the scope of this study, this definition supports the translation of DT into measurable components, including readiness, innovation, leadership, and the knowledge and skills that propel change. DT is the predictor variable in this study, expected to influence outcomes or bring about change (Kumar, 2018, p.66). In this research, the DT variable is represented as an average score derived from four sub-constructs: digital readiness, digital innovation, digital leadership, and digital knowledge and skills.

Digital readiness is understood to the extent to which an organization is prepared to adopt, use, assimilate, and take advantage of digital technologies in leadership, innovation, learning, and other operations (Machado et al., 2021, p.172). It reflects an organization's readiness to embrace technology across all areas (Jafari-Sadeghi et al., 2021). Digital innovation refers to the development of novel products, services, processes, or business models through the application of information technology (Zhang, Xu, & Ma, 2022). According to Opland et al., (2022), digital innovation is essential for organizations, as the growing demand to embed digital technologies into operations, offerings, and services is critical to maintaining a competitive edge. Digital leadership, according to Klein and Todesco (pp. 886–887), replaces classical leadership approaches during digital transformation and guides organizations into the digital era. This leadership style combines transformational leadership principles with the encouragement of virtual technologies. Additionally, Erhan, Uzunbacak and Aydin (2022) assert that digital leaders must possess skills and qualifications that go beyond traditional behavioral and organizational competencies.

Seufert, Guggemos and Sailer (2021) define digital transformation knowledge and skills as the competencies required to effectively navigate and utilize digital technologies across various contexts. Volberda et al., (2021) emphasize that digital knowledge and skills are fundamental drivers of digital transformation, arguing that without these capabilities, organizations cannot fully take advantage of the opportunities it offers. Similarly, Seufert, Guggemos and Sailer (2021) distinguish between knowledge as the theoretical understanding of digital transformation and skills as the practical ability to apply that understanding effectively. Therefore, digital transformation literacy, which encompasses both knowledge and skills, is essential for succeeding in the modern workplace, keeping pace with technological advancements, and making a significant impact on the organization's digital transformation strategy.

In this study, the four sub-constructs of digital transformation were measured using a Likert scale. The scale assessed the perceived likelihood of digital readiness, innovation, leadership, and literacy contributing to seizing opportunities, enhancing competitiveness and efficiency in Tanzania's import/export sector. Respondents could select from "*Not Likely [1]*," "*Neutral [2]*," or "*Probably [3]*," where "*Probably [3]*" indicated the highest perceived likelihood, "*Neutral [2]"* reflected uncertainty or moderate likelihood, and "*Not Likely [1]"* represented the lowest. According to Cooper and Schindler (2014), effective research should adhere to ethical, transparent, and reproducible methodologies, ensuring that objectivity remains a guiding principle throughout the entire research process.

Construct 2: International Trade Opportunities (ITO)

Based on Pananond, Gereffi and Pedersen (2020), International Trade Opportunities (ITO) is referred to the potential benefits and avenues for businesses to engage in cross-border trade. Such opportunities arise due to the ability of the business entity or individual to buy, sell and/or lease products/services in foreign markets (Silver & Stoll, 2022). Buying, selling and/or leasing in international markets provide benefits of market expansion, enhance competitive advantage, learning from others and leveraging the e-commerce platforms (Tolstoy, Nordman & Vu, 2022). In this study, the operational definition provided measurable aspects of ITO which included but not limited to improving performance, service quality, communication and customer experience. ITO is the predicted, outcome or dependent variables of the study which is believed to change based manipulation of the independent variable(s). ITO variable was obtained by computing the average of ITO related questions which are further discussed below.

According to scholars such as Peng and Tao (2022), Trischler and Li-Ying (2023), Rachinger and Muller (2024), Voipio et al., (2023), Lacka, Chan and Wang (2020), and Gupta, Ghosh and Sridhar (2022), DT significantly enhances various aspects of enterprise performance, including Service Quality (SQ), Communication (CO), Customer Experience (CE), and overall Performance (P). DT improves organizational outcomes by increasing efficiency, supporting data-driven decision-making, and promoting a customer-centric approach (Trischler & Li-Ying, 2023). It enables organizations to drive sustainable growth and strengthen their performance in an increasingly dynamic and competitive market environment (Rachinger & Muller, 2024).

According to Voipio et al., (2023) argue that digital transformation improves Service Quality (SQ) across various sectors by automating processes, offering self-service options, and ensuring round-the-clock availability, all of which contribute to more efficient operations.

Improved digital service quality is vital for maintaining competitiveness, increasing customer satisfaction, and fostering long-term loyalty which all together contribute significantly to business success (Hallencreutz & Parmler, 2021). Raza et al., (2020) further emphasize in the digital economy, high service quality plays a pivotal role in driving customer satisfaction, making it crucial for gaining and preserving competitive advantage

Communication (CO) is another important dimension of international trade opportunities that is enhanced by digital transformation. It enables clearer negotiations, streamline logistics, improves customer engagement, and fosters global networking with partners, clients, and suppliers (Vadakkepatt et al., 2021). According to Lacka, Chan, and Wang (2020), enhanced communication in international trade strengthens strategic planning, improves collaboration, and facilitates more effective negotiations which are essential for succeeding in the global marketplace. Ghosh et al., (2022) also assert that businesses prioritizing effective communication are better positioned to boost global competitiveness and operational efficiency in today's evolving trade landscape.

Customer Experience (CE) is significantly improved in digital environments by leveraging advanced technologies that streamline business processes, enhance service delivery, and personalize customer interactions. These improvements ultimately provide greater value to customers (Gupta, Ghosh & Sridhar, 2022). The strategic use of technology allows businesses to meet (and often exceed) customer expectations, which fosters stronger loyalty and deeper, long-term engagement (Rai et al., 2022). In this study, the constructs of SQ, CO, P, and CE were evaluated through survey questions 14d, 14e, 14f, and 14c, respectively. Participants were presented with three response options: "*Disagree [1]", "Neutral [2]",* and "*Agree [3]*", providing a standardized approach to assessing perceptions related to each construct.

Construct 3: Digital Infrastructure (DI)

Digital Infrastructure (DI) is defined as "*computing and network resources that allow multiple stakeholders to orchestrate their service and content needs*" (Constantinides, Henfridsson & Parker, 2018, p. 381). DI strengthens digital information flows, supports the dynamics of digital information search, and facilitates interactions among and between knowledge components, which can result in increased complexity (Lanzolla, Pesce & Tucci, 2021). In other words, DI consists of foundational technologies and systems that support the creation, manipulation, storage, transfer, e-commerce, communication, data analytics, and management of digital information. Furthermore, DI plays a critical role in shaping international trade by reducing transaction costs, improving connectivity, and simplifying payment systems (Morris, J., Morris, W. & Bowen, 2022). Tiwasing (2021) highlights how digital infrastructure enables firms to manage cross-border payments and logistics more efficiently. Similarly, Ipsmiller and Dikova (2021) demonstrate how DI facilitates trade by enhancing export performance and reducing fraud through technologies such as blockchain and AI-powered logistics systems, thereby lowering trade costs. In this context, countries that invest in digital infrastructure gain a competitive edge in international trade by supporting seamless cross-border operations, reducing logistical barriers, and driving value creation in the global value chain (Tiwasing, 2021; Nadkarni & Prugl, 2021).

Internet connectivity refers to the ability to access the internet, which is essential for connecting to online services, resources, and digital communication tools. According to Pivoto et al., (2021), internet connectivity is a basic yet critical component of digital infrastructure that enables real-time access to digital environments. Ismagilova et al., (2022) describe internet connectivity as an integral part of the broader digital ecosystem, highlighting how individuals and organizations are linked to the internet through various means. Common forms of internet access include broadband, mobile networks, and satellite internet, all of which are vital for ensuring seamless digital interaction and engagement.

Connectivity technology is defined as the technical mechanism that allows devices to link and communicate over networks. Oughton et al., (2021) explain that connectivity technologies provide the physical and wireless infrastructure necessary for networked communication, citing examples such as Wi-Fi, Bluetooth, and Ethernet. These technologies are the foundational enablers of device-to-device and system-to-system communication, supporting a range of applications from local networking to global internet access.

Communication channels refer to the routes through which data is transmitted between devices, whether via public or private means (Constantinides, Henfridsson & Parker, 2018). These channels play a central role in enabling digital interactions across platforms and systems. Effective communication channels ensure that data is delivered reliably and securely. Although not all sources define them distinctly, their role is embedded within the broader discourse on digital infrastructure, as they support the real-time transfer of information that underpins collaborative digital environments (Oughton et al., 2021).

Digital platforms are digitally integrated software environments that provide a wide range of tools and services designed to facilitate communication, collaboration, coordination, and value creation across organizational and user networks. These platforms act as enablers of digital interaction, allowing users to engage in activities such as content sharing, data exchange, and business process integration. According to Jovanovic, Sjödin and Parida (2022), digital platforms are central to the modern digital economy, empowering firms to streamline operations, enhance internal and external knowledge sharing, and drive continuous innovation. Chang, Iakovou and Shi (2020) emphasize that these platforms offer scalable, adaptive, and flexible digital solutions that support a wide variety of organizational functions, from supply chain management to customer relationship services. Constantinides, Henfridsson and Parker (2018, p. 381) describe digital platforms as evolving resources rooted in digital infrastructure, which facilitate value-creating interactions among users and stakeholders. Furthermore, Jovanovic, Sjödin and Parida (2022, p. 4) note that "*digital platforms support firms to deepen the knowledge search within current knowledge structures*," underscoring their pivotal role in advancing learning, innovation, and competitive advantage in digitally driven environments.

Digital Infrastructure encompasses the core technologies and network systems that enable the creation, exchange, and management of digital information, playing an important role in streamlining operations, enhancing communication, and facilitating global trade. Its key components which include internet connectivity, connectivity technologies, communication channels, and digital platforms which have a great impact in DI when working together to ensure real-time access, secure data transmission, and collaborative digital environments (Pivoto et al., 2021; Oughton et al., 2021; Jovanovic, Sjödin and Parida, 2022). These technologies not only drive innovation and efficiency within organizations but also strengthen international trade by reducing transaction costs, improving logistics, and enabling advanced tools such as blockchain and AI (Morris et al., 2022; Tiwasing, 2021; Ipsmiller and Dikova, 2021). In this study, digital infrastructure was measured by averaging participants' responses to survey items related to its key components, following standard practice for quantifying perceptions in research (Hair Jr, Howard & Nitzl, 2020). Specifically, responses were averaged for the components of internet connectivity (IC), connectivity technology (CT), communication channels (CC), and digital platforms (DP). For each component, respondents were asked to select one of three options: "*High Extent [3]*," "*Moderate Extent [2],*" or "*Least Extent [1]*" for questions 17a, 17b, 17c, and 17d, respectively.

Construct 4: Regulatory Frameworks (RF)

Regulatory frameworks (RF) refer to the structured set of principles, policies, and regulations that govern activities within a specific sector (Ouyang, Li & Du, 2020). It plays a critical role in ensuring compliance, promoting fair competition, protecting stakeholder interests, and maintaining standards of safety and quality (Benohr, 2020). According to Damayanti and Matasik (2021), essential components of a regulatory frameworks include laws and regulations, enforcement agencies, mechanisms for regulatory compliance, and systems that encourage transparency and accountability. These elements collectively support market fairness and operational integrity.

In the era of digital transformation, regulatory frameworks have become more complex, encompassing policies that regulate access, usage, protection, and the flow of data. Such regulations are vital to the delivery of secure, competitive, and legally compliant digital services (Ding et al., 2023). As digital technologies continue to evolve, these frameworks must be adapted to address issues arising in the arena of data governance and digital service provision. Gupta, Ghosh, and Sridhar (2022) identify four key dimensions of digital regulatory frameworks: ICT and regulatory policy, trade sanctions, data flow restrictions, and security and protection. These dimensions shape how digital ecosystems function, influence cross-border data exchanges, and determine how digital services are regulated and safeguarded.

ICT and regulatory policies are the backbone of regulatory frameworks, deciding the way digital transformation is deployed and used with the aim of balancing innovation with compliance, ensuring fair and secure digital environment (Benohr, 2020). Furthermore, Lobschat et al., (2021) view digital technologies adopting four corporate digital responsibilities of technology creation and capturing data, decision making and operation, impact assessment and inspection as well as data and technology refinement. According to Morgan et al., (2019) trade sanctions refer to prohibitions, penalties, or restrictions imposed that violate or threaten international and/or national laws and/or security. In addition, trade sanctions may impose restrictions to import/export, financing, travel and contracts cancellations (Hufbauer & Jung, 2020). On the other hand, Gupta, Ghosh and Sridhar (2022), view Data Flow Restrictions as laws and/or policies which prohibit the movement of data between borders or limit the way data is stored, handled or transferred to support businesses, government and/or individuals. International trade agreements and treaties are among the examples of regulating the way data can be transferred between countries (Burri, 2021). Based on Terfa Eticha, Brunninge and Kassa Tessema (2024), some types of data may be encrypted or restricted for reasons of security which are often tied to trade sanctions. Finally, security and protection are central to digital regulatory frameworks providing a shield to businesses from digital threats such as cyberattacks, data breaches, fraud and other forms of digital risks (Saura, Ribeiro-Soriano & Palacios-Marques, 2021). In contrast, Terfa Eticha, Brunninge and Kassa Tessema (2024) highlight that regulatory frameworks need to address critical concerns to ensure equitable digital transformation across the continent while emphasizing the harmonization of policies across African nations to promote cross-border trade. In this study, all RF1, RF2, RF3, RF4 and RF5 were used to assess the regulatory frameworks construct.

The influence of RF in this study, was assessed using research questions 21a, 21b, 21c, 21d and 22d where respondents choose one out of "*High Extent [3]*", "*Moderate Extent [2]*" and "*Low Extent [1]*" or "*Agree [3]*", "*Neutral [2]*" or "*Disagree [1]*" for research question 22d. The obtained results from the above measurements were then computed to achieve an average score for all the research construct which confirmed the existence or absence of the influence of RF in DT in seizing the international trade opportunities while minimizing the digital divide problem.

Construct 5: Global Competitiveness (GLC)

According to Sarker et al., (2024), global competitiveness (GLC) refers to the ability of a country or organization to create and sustain an enabling environment for the production of goods and services that meet international standards while enhancing productivity and income levels. It reflects not only market performance but also the structural, technological, and institutional capacities that support long-term participation in the global economy. Ding et al., (2023) further emphasize that global competitiveness is shaped by critical enablers such as digital infrastructure, digital literacy, innovation capability, and supportive regulatory systems. The effective integration of these elements promotes adaptive innovation, strengthens resilience to external shocks, and enhances the capacity of firms and trade systems to respond proactively to evolving global market demands. In the context of international trade and port operations, GLC therefore encompasses improvements in efficiency, service quality, compliance with international standards, smart port initiatives, and integration into global value chains.

In this study, global competitiveness is conceptualized as the principal outcome variable, predicted by the effects of digital transformation (DT) on international trade opportunities (ITO), under the influence of digital infrastructure (DI) and regulatory frameworks (RF), with or without moderating effects. The operationalization of GLC was grounded in measurable perceptions of competitiveness improvements within the trade ecosystem. Specifically, GLC was computed by averaging responses to six structured questionnaire items (Questions 14b, 18a, 18e, 18f, 22e, and 22f). Respondents evaluated each item using a three-point Likert scale: "*Agree [3]",* "*Neutral [2]",* and/or "*Disagree [1]"*. The calculated mean score produced a composite competitiveness index, providing a quantifiable measure of how DT initiatives contribute to enhanced global competitiveness within the study context.

Construct 6: Efficiency in Import/Export Activities (EIM)

Efficiency in import/export activities (EIM) refers to the extent to which resources such as time, labor, technology, and capital are effectively utilized to achieve desired outcomes in international trade operations (Varadarajan, 2020). High EIM indicates streamlined processes, reduced delays, minimized costs, and optimized use of logistics and administrative resources, ultimately enhancing the overall competitiveness of trading entities. DT play a crucial role in strengthening EIM by automating workflows, improving documentation and customs processes, enabling real-time tracking of shipments, and supporting data-driven decision-making, all of which reduce operational bottlenecks and increase throughput. Moreover, broader systemic factors, such as economic freedom, regulatory clarity, investments in trade-enabling infrastructure, and human capital development, further facilitate efficient import/export operations by creating an environment conducive to smooth cross-border trade (Ofori, Figari & Ojong, 2023).

In this study, EIM serves as a key outcome variable, operationalized to quantify how DT initiatives and organizational capabilities translate into tangible improvements in trade operations. Similar to global competitiveness, EIM is hypothesized to be influenced by digital transformation (DT) under the effects of digital infrastructure (DI) and regulatory frameworks (RF), with or without moderating variables. Measurement was conducted using five specific questionnaire items: Questions 15, 18b, 19, 22a, and 22b. Questions 15 and 19 employed a binary scale (*"Yes [1]"* or *"No [2]"),* whereas questions 18b, 22a, and 22b used a three-point Likert scale *("Agree [3]," "Neutral [2]," "Disagree [1]").* Responses were averaged to generate a composite EIM score, providing a quantifiable and reliable indicator of the efficiency of import/export activities within the study's context. This operationalization allows for an empirical assessment of how DT and its enabling factors directly influence trade efficiency outcomes.

Construct 7 (Moderator): Competition (COM)

According to Riswanto (2021), the research model demonstrates that the intensity of market rivalry is significantly shaped by innovation within dynamic marketing capabilities. These capabilities create an environment that supports the production of goods and services that meet international standards, which is crucial for maintaining or enhancing income levels. In today's digital era, competition is further influenced by critical factors such as digital infrastructure, workforce knowledge and skills, and ongoing innovation efforts (Ding et al., 2023). The combination of these elements with DT enables organizations to generate adaptive innovations, allowing them to effectively respond to disruptions in the competitive business landscape. This adaptability is essential for sustaining a competitive advantage in rapidly evolving markets.

In this research, the competition construct acts as a moderator variable, influencing how DT impacts import/export trade outcomes. To operationalize competition, the study utilized five specific indicators, COM_1, COM_2, COM_3, COM_4, and COM_5, each derived from responses to research questions 12, 14a, 14g, 20, and 22c, respectively. These items were combined by calculating their average score to create a comprehensive measure of market competition intensity as perceived by respondents.

This methodological approach provides a robust and quantifiable means of assessing competition's moderating role in the relationship between DT and international trade opportunities. By integrating market rivalry into the research model, the study acknowledges that competition is not a static backdrop but an active force shaping organizational behavior and outcomes in the context of digital trade transformation. This nuanced understanding is critical for developing strategies that leverage competitive pressures to drive innovation, improve operational performance, and strengthen positioning in global markets.

Construct 8 (Moderator): Efficiency (EFF)

Digital technologies play a crucial role in enhancing social services by improving accessibility, efficiency, and inclusivity, as highlighted by Alexopoulou (2024). They help overcome geographic and bureaucratic barriers while maintaining a citizen-centered approach, which is essential for equitable service delivery (Mwantimwa, 2019; Ye & Ramadhani, 2020). Efficiency, as defined by Varadarajan (2020), involves the effective use of resources to achieve desired outcomes. Leveraging digital technologies enables organizations to reduce operational costs (Benitez et al., 2022) and enhance the speed and accuracy of trade transactions (Rai et al., 2022), thereby boosting efficiency in import/export activities (Ghosh et al., 2022). DT not only improves operational efficiency but also contributes to overall organizational performance and effectiveness, which are critical in competitive trade environments.

In this study, efficiency (EFF) is conceptualized and operationalized as a moderating variable to explore the influence of DT on international trade opportunities. The moderating role of efficiency suggests that higher levels of operational effectiveness can strengthen the positive impact of digital initiatives on import/export performance. To quantify this construct, the study averages responses from four specific indicators: EFF_1, EFF_2, EFF_3, and EFF_4, corresponding to research questions 16, 18c, 18d, and 22e respectively. This approach captures multiple dimensions of efficiency, including resource utilization, transaction speed, accuracy, and cost-effectiveness, providing a comprehensive measure that reflects its critical role in facilitating successful DT in trade logistics. By integrating efficiency as a moderator, the research highlights its pivotal function in amplifying the benefits of DT in international trade.

Exclusions: Extraneous Variables

Extraneous variables are "*variables which affect or influence the link between cause-and-effect variables*". These variables are not measured in the study; but "*may increase or decrease the magnitude or strength of the relationship between independent and dependent variables*" (Kumar, 2018 p.66). According to Hill et al., (2021) and Mandli and Ronkko (2023), extraneous variables could affect the dependent variable, potentially confounding the results and leading to misleading conclusions if not addressed, and can be categorized as: confounding variables (that directly affect variables), situational variables (can impact the study outcomes, e.g., noise, lighting), participant variables (individual differences between participants, e.g., age, experience), and experimental variables (elements of the experimental design).

In this research, extraneous variables such as traditional trade, product availability, price differences, and transportation were identified and controlled to prevent them from introducing bias into the results and leading to inaccurate conclusions. By managing these variables, the researchers aimed to ensure that they did not act as confounding factors, which could obscure the true relationship between the variables under investigation. Traditional trade, for example, is considered an extraneous variable in this context, as it could influence international trade outcomes, such as trade volume and costs, without being the primary focus of the study. If left unaccounted for, traditional trade could distort the observed effect of DT on international trade by introducing interactions that obscure the genuine impact of digital tools on trade dynamics (Zaki, 2019). Similarly, product availability, price difference and transportation may influence the outcomes without being the primary focus of the study by providing market access, changes to sales trend and supply chain disruptions which could lead to misinterpretations.

Study Procedures and Ethical Assurances

Based on Hansen, Steinmetz and Block (2022) study procedures refer to the step-by-step processes used to conduct a research study. These procedures ensure that the research is systematic, organized, and follows ethical and scientific standards (Gakuu, Kidombo & Keiyoro, 2016). While the specific procedures may differ based on the research type, there are common elements shared by most studies, including research design, ethics and approval, sampling and recruitment, data collection, and the presentation and interpretation of study results (Hansen, Steinmetz, & Block, 2022). The study procedures were carefully designed to ensure that the research is consistent, reproducible, unbiased, and adheres to ethical standards.

Lopez Jimenez, Dittmar and Vargas Portillo (2021) defined ethics in business research as the "*code of conduct*" or rules of "*correct*" behaviors of the business activity which set a standard for behavior. The researcher has a responsibility for considering the established norms related to the research activity such as informed consent, data accuracy, safety and security, confidentiality, anonymity, and protection. Furthermore, procedural ethics offers a checklist, which reminds researchers to consider potential risks to respondents, to balance the positive and negative results of the research, ensuring confidentiality while conducting the research and remaining focused on security and protection aspects of the collected data (Lemken, 2021). The use of ethics checklists is helpful in guiding the research project to remain ethical throughout the study. Thekdi and Aven (2024) and Alexopoulou (2024) highlight growing ethical concerns related to artificial intelligence and propose practical measures to mitigate associated risks while safeguarding fundamental human rights. They emphasize key ethical principles, including ensuring strict confidentiality, protecting personal data and privacy, clearly defining research objectives, respecting research participants, and obtaining informed consent prior to data collection.

Taking into consideration that this research received approval from the University Research Ethical Committee (UREC) and Commission for Science and Technology (COSTECH). In addition, the study also considered the ethical checklist where issues related to seeking research permission, voluntary participation, informed concert, anonymity and safety, confidentiality, and privacy as well as the role of the researcher were addressed as discussed below (Thekdi & Aven, 2024). The Institutional Review Board (IRB) which is based on global principle, provides ethical guidelines, safeguarding the integrity of the research and the well-being of participants (Gakuu, Kidombo & Keiyoro, 2016; Cooper & Schindler, 2014). In addition, while the IRB system is founded on global ethical principles designed to protect participants, the operational specifics (such as composition, review process, and regulatory requirements) can differ from one country to another. Therefore, while the ethical core is universal, the implementation of IRBs is often country-specific, shaped by local regulations and laws. For example, In Europe, the European Medicines Agency (EMA) and EU regulations govern ethical review of research; in Kenya, the National Council for Science and Technology (NACOSTI) oversees ethical reviews while in Tanzania, the Commission for Science and Technology (COSTECH) is the public institution responsible for Science and Technology advisory organ to the Government on all matters relating to scientific research, innovation, and technology. The request for COSTECH approval was done immediately after receiving the letter from UNICAF, however the institution was undergoing system migration which delayed issuing research permits though the researcher was introduced to the government institution and allowed to proceed with data collection after payment and receipt of the research clearance receipt (refer Annex B(i)). This approval was necessary for conducting fieldwork, particularly with stakeholders involved in international trade.

Ethical Assurances

Ethical assurances are fundamental safeguards that uphold the safety, rights, and responsibilities of research participants while reinforcing the integrity and trustworthiness of the research process (Lemken, 2021). These measures involve strict compliance with established ethical standards and protocols, ensuring that participants are treated with respect, their autonomy is honored, and their privacy is safeguarded (Thekdi & Aven, 2024). While ethical principles may differ across disciplines, they generally emphasize minimizing harm and risk, ensuring participant safety and confidentiality, and promoting transparency and honesty in the research process. Such ethical guidelines are vital for fostering trust in research and ensuring that the benefits of the study outweigh any potential risks (Thekdi & Aven, 2024).

Informed consent is a cornerstone of ethical research, requiring participants to voluntarily acknowledge their understanding of the potential risks and benefits involved in their participation (Bougie & Sekaran, 2019). In this study, participants were provided with comprehensive information regarding the research objectives and procedures, along with clear and detailed explanations before any data collection began. Consent was obtained through both written forms and verbal agreements, with participants signing consent documents after being fully informed. The researcher used the official UNICAF research consent form, making necessary additions to ensure participants' full understanding of their involvement.

Confidentiality refers to the management of sensitive information shared within a trusted relationship, where researchers commit to limiting the dissemination of data to only those who need to know (Martin & Balestra, 2019). Webler and Tuler (2020) further stress that confidentiality, whether oral or written, is an ethical obligation that helps build trust between researchers and participants. Privacy, on the other hand, involves the protection of individual rights and security, balancing the value of data with its responsible use (Lobschat et al., 2021). The authors also highlight that while confidentiality pertains to the data itself, privacy concerns the protection of individuals and their personal information. Cooper and Schindler (2014) highlights that protecting participants' confidentiality is significant not only for safeguarding their rights but also for preserving the integrity of the research process. In this study, all necessary precautions were taken to maintain confidentiality by separating personal identifiers from the collected data and securing it against unauthorized access. Participants retained ownership of their responses and had the freedom to withdraw at any point, with the assurance that their data would only be used in reports in a manner that protects their rights and privacy. Terfa Eticha, Brunninge, and Kassa Tessema (2024) emphasize that researchers should clearly communicate confidentiality protocols and ensure participants are fully informed about how their data will be handled, stored, and used throughout the research process.

Anonymity in research involves ensuring that participants' identities remain unlinked to the data collected (Anwar & Graham, 2022). This is typically achieved by removing identifying details from research records, such as names or other personal information that could connect participants to their responses (Peng, Strijker & Wu, 2020). Anonymization techniques, such as data masking or aggregation, are employed to protect participants' identities (Solarino & Aguinis, 2021). In this study, the researcher took specific steps to maintain anonymity by ensuring that personal information was kept private, and access was restricted to authorized personnel. However, as Bougie and Sekaran (2019) note, maintaining anonymity should not come at the cost of data quality. While it is crucial to protect participant identity, researchers must also ensure that the data remains accurate and complete. Care was also taken in selecting third-party service providers (e.g., Gmail, Google Forms), which have their own privacy and security policies, ensuring the research platform adhered to the highest standards of data protection. Terfa Eticha, Brunninge and Kassa Tessema (2024) emphasize the importance of researchers carefully selecting tools and platforms that strike a balance between maintaining anonymity and ensuring secure, accurate data collection.

Data accuracy and integrity are fundamental to the trustworthiness of research findings, ensuring that the data is both reliable and valid (Lobschat et al., 2021; Casella et al., 2019). While data accuracy pertains to the precision of the information collected, data integrity relates to preserving its consistency and dependability throughout the research process (Holton et al., 2022). Cooper and Schindler (2014) emphasize that maintaining data integrity is crucial not only for upholding credibility but also for drawing valid and trustworthy conclusions. In this study, the researcher took deliberate steps to ensure that the data accurately represented participants' perspectives, providing them with the opportunity to clarify or retract their responses as needed. Additionally, the researcher remained committed to unbiased reporting, refraining from manipulating data to support preconceived ideas. Bougie and Sekaran (2019) highlight that transparency and accountability are essential to data integrity, requiring researchers to disclose any potential limitations or biases that might influence data interpretation and to present findings that truthfully reflect the research process.

Data protection and security are crucial for protecting sensitive information from unauthorized access and/or misuse (Gupta, Ghosh, & Sridhar, 2022). Burri (2021) notes that data protection involves regulatory measures that limit the use, collection, and sharing of data while ensuring transparency and participant accountability. Data security involves the use of practices, technologies, and policies designed to restrict unauthorized access, loss, or theft of data (Ismagilova et al., 2022). In addition, effective data security is vital for maintaining the confidentiality, integrity, and availability of information (Peng, Strijker & Wu, 2020). However, stringent security measures can sometimes hinder access to valuable information, which may negatively affect decision-making (Ismagilova et al., 2022). Bougie and Sekaran (2019) stress that data security should be balanced with the need for collaboration and knowledge sharing, ensuring that security measures do not inhibit the flow of information necessary for research progress. The researcher ensured data security by restricting public access to research materials, preventing plagiarism, and implementing physical and psychological safety measures during participant interviews. Additionally, secure platforms were used for uploading and storing data to further protect participant information (Leidner & Tona, 2021). Terfa Eticha, Brunninge and Kassa Tessema (2024) highlight the importance of not only digital security but also physical security, such as securely storing hard copies of data, to further protect participant confidentiality.

Ethical assurances protect participants and uphold research integrity through informed consent, confidentiality, anonymity, and ensuring data accuracy, integrity, and security, thereby maintaining credibility and ethical standards of the study (Lemken, 2021). Informed consent ensures that participants fully understand the study and voluntarily agree to participate (Bougie & Sekaran, 2019). Confidentiality and privacy protect personal information, ensuring that data is used responsibly (Martin & Balestra, 2019). Anonymity further safeguards participant identity by removing identifying details from the data (Anwar & Graham, 2022). Data accuracy and integrity are fundamental for ensuring reliable findings and upholding objectivity (Lobschat et al., 2021; Cooper & Schindler, 2014), while data protection and security measures prevent unauthorized access to sensitive information (Gupta, Ghosh, & Sridhar, 2022; Bougie & Sekaran, 2019). Ethical conduct ensures that research is credible, fair, and aligned with ethical standards. It protects participants' rights, promotes integrity throughout the research process and the outcome of such studies contributes to academic and practical understanding (Thekdi & Aven, 2024).

Assumptions, Limitations and Delimitations

In scholarly research, explicitly presenting the assumptions, limitations, and delimitations of a study is fundamental to ensuring transparency about its conceptual foundations, constraints, and scope. Assumptions consist of conditions that are accepted as true for the purpose of undertaking the research and that underpin the analytical framework of the study (Bougie & Sekaran, 2019). Limitations refer to circumstances beyond the researcher's control that may influence the interpretation, validity, or broader applicability of the results (Cooper & Schindler, 2014). Delimitations, on the other hand, reflect intentional decisions made by the researcher to restrict the scope of the inquiry, including choices related to the research setting, population, or variables, in order to maintain analytical clarity and practical feasibility (Creswell & Poth, 2016). Clearly distinguishing among these elements help to acknowledge unavoidable constraints while providing a reasoned justification for the study's design and focus.

This research is guided by a series of theoretically informed assumptions regarding DT in international trade in developing economies. It is assumed that the adoption and effective application of digital solutions, particularly e-commerce platforms and digital payment systems, can strengthen Tanzania's trade ecosystem by reducing transaction costs, improving operational efficiency, increasing transparency, and expanding access to domestic and international markets. This assumption is supported by existing empirical and theoretical literature that identifies digitalization as a critical mechanism for trade facilitation, economic integration, and enhanced competitiveness in developing country contexts (Coombs, 2020; Zaki, 2019). The study further assumes that ongoing national policies and institutional initiatives in Tanzania are progressively addressing the limitations related to the digital divide, thereby enabling wider and more inclusive participation in digital trade activities. Additionally, it is assumed that key trade stakeholders, including port authorities, importers, exporters, clearing and forwarding agents, and regulatory institutions, possess sufficient levels of digital literacy and access to appropriate technological infrastructure to engage effectively with digital systems. In line with assumptions commonly applied in SEM using Amos, the study also assumes that unique variables (defined as unobserved exogenous) influencing only one other variable, are uncorrelated with one another and with other exogenous variables, while non-unique exogenous variables are assumed to be interrelated (Surucu, Sesen and Maslakci, 2023). Collectively, these assumptions establish the analytical foundation for examining the effects of DT on international trade opportunities.

While the study offers valuable insights, several limitations must be acknowledged when interpreting its findings. A primary limitation stems from the rapidly changing nature of digital technologies, as ongoing innovations and evolving regulatory environments may constrain the long-term applicability of the results. The continuous emergence of new digital platforms, automation technologies, and trade-related policies has the potential to alter digital trade practices, which may, over time, affect the relevance of certain findings. Furthermore, the context-specific focus of the study limits the extent to which the results can be generalized beyond Tanzania, as differences in institutional capacity, digital infrastructure, levels of digital literacy, regulatory frameworks, and broader economic conditions across countries may lead to varying outcomes in other settings. The study was also constrained by time and data availability, as only information accessible during the designated research period could be collected and analyzed. For example, at the time data collection commenced, the DSM Port was operated by the Government of Tanzania and had not yet undergone privatization involving DP World and Adani, developments that may have influenced stakeholder perceptions as well as the overall focus of the research. In addition, constraints related to time and resource availability limited the scope and depth of data collection and analysis. Collectively, these limitations are characteristic of research conducted in dynamic, technology-driven trade environments and are consistent with obstacles documented in related studies (Nguyen, Hargittai and Marler, 2021; Oyebanjo and Tengeh, 2021).

The study is deliberately delimited to the DSM Port in Tanzania to allow for a focused and in-depth analysis of digital technology adoption within a strategically significant trade and logistics hub. Restricting the study to a single port enables detailed examination of operational processes, stakeholder interactions, and digital trade facilitation mechanisms. Other ports, regions, and broader national or regional trade systems are intentionally excluded to preserve analytical focus and ensure the feasibility of the research within available time and resource constraints. As delimitations define the boundaries of the investigation, the applicability of the findings is confined to the specified study context (Pandey. P. and Pandey. M., 2021). This delimitation is methodologically justified given the central role of the DSM Port in Tanzania's trade and logistics network, and a narrowly defined scope strengthens internal validity while allowing for a nuanced and context-specific interpretation of the results (Nguyen, Hargittai and Marler, 2021)

This study carefully considers its assumptions, limitations, and delimitations to provide a clear framework for understanding the conceptual foundations, contextual boundaries, and inherent constraints of the research. By explicitly defining these elements, the study clarifies the conditions under which its findings should be interpreted and justifies the chosen scope and focus, thereby enhancing methodological rigor and credibility. Recognizing these boundaries ensures that the results are contextualized appropriately while highlighting areas where caution is needed in generalization. Building on this framework, the next section presents the research methodology, focusing on the data collection and analysis procedures employed to empirically investigate the impact of DT on international trade at the DSM Port.

Data Collection and Analysis

Venkatesh (2020) underscores the importance of organizing, managing, retrieving, and delivering data to make it meaningful and actionable for research. Effective data management begins with careful organization, allowing easy access and interpretation, which is essential for timely decision-making and improving research workflow. Clear and contextual presentation of data is critical for communicating findings to stakeholders, policymakers, and the public, ensuring impactful research outcomes that contribute significantly to existing knowledge.

Data collection is a structured process designed to gather and analyze information to address research questions and assess outcomes (Rojon, Okupe & McDowall, 2021), providing reliable evidence, identifying patterns or trends, and highlighting gaps for future research (Locke, Feldman & Golden-Biddle, 2022). This study employed both primary and secondary data sources, with primary data collected through a structured questionnaire developed by the researcher, consisting of 23 items across four sections: respondent demographics, use of digital technologies in international trade, and the influence of digital infrastructure and regulatory frameworks on DT. Pandey and Pandey (2021, p.70) define data analysis as a series of steps involving processing, organizing, and summarizing data to enable meaningful interpretation. This begins with cleaning and transforming raw data to remove inaccuracies, followed by organizing it into structured formats such as databases to identify patterns and relationships. The summarization phase condenses the data into statistical summaries or visual aids, highlighting key findings and trends, and in this study, it also ensured that responses were meaningful while supporting the repeatability and reliability of the research.

While data collection is essential, data quality remains a challenge for many organizations (Akbari & Hopkins, 2022). Data cleaning, an important stage in ensuring data accuracy and reliability, involves detecting errors, correcting inconsistencies, validating the data and documenting variables (Kumar, 2018). This systematic process enhances the reliability of findings and supports robust statistical analysis. Paul and Barari (2022)) stress the need for data cleansing to address issues like errors, inconsistencies and transformation problems. Techniques tailored to specific types of data are used to identify and correct these anomalies (Ritter & Pedersen, 2020).

For quantitative data, the researcher used SPSS to create a database and applied rigorous measures such as outlier detection, handling of missing data, normality and multicollinearity checks, reliability testing, and factor analysis; to ensure accuracy, consistency, and validity of the dataset. Morgan et al., (2019) emphasized the critical importance of consistent units of measure in quantitative research. In this study, outliers were meticulously identified and normalized to enhance data accuracy. SPSS was further employed to categorize data into distinct groups such as age ranges and experience levels. Complementary tools like spreadsheets (e.g., Microsoft Excel, Google Sheets) were also used for calculations, data management, and storage.

To maintain data consistency, the researcher ensured that variable names were aligned with the research questions and adopted standardized coding for responses (e.g., "*Ye*s"=2, "*No*"=1). For qualitative data, NVivo software played a vital role in transcribing and analyzing interviews. Coding and theme development guided the qualitative data analysis, providing structured insights.

The researcher also prioritized data security by creating backup files in SPSS-readable format and securely storing them for future use. Data collection occurred in DSM, Tanzania. Notably, respondents to the questionnaire were not required to be physically present in DSM, as the questionnaires were disseminated online, allowing for broader participation.

Quantitative Data Analysis

Quantitative analysis adopts a systematic approach to the collection and interpretation of numerical data with the objective of identifying patterns, relationships, and trends among variables. As emphasized by Creswell (2015), clearly articulated research questions, hypotheses, and data collection procedures are essential to ensuring the validity and reliability of quantitative inquiry. Core statistical techniques, including regression and multivariate analysis, are widely used to examine relationships between variables and test theoretical propositions. In the social sciences, quantitative research commonly relies on surveys, experiments, and secondary data analysis to enable objective measurement and evaluation of phenomena (Gakuu, Kidombo & Keiyoro, 2016). However, recent scholars highlights emerging limitations associated with quantitative analysis, particularly the management of large datasets and the need for precise statistical interpretation to avoid erroneous conclusions (Opland et al., 2022). Consequently, the use of reliable and valid measurement instruments is critical to accurately capturing the constructs under investigation (Bougie & Sekaran, 2019). Advances in analytical techniques, such as factor analysis, path analysis, and SEM, have further enhanced researchers' ability to examine complex, multidimensional relationships among variables (Arbuckle, 2022; Hair et al., 2021).

Structural Equation Modelling (SEM) is grounded in a set of methodological assumptions that must be satisfied to ensure valid parameter estimation, robust inference, and meaningful interpretation of results (Hair et al., 2021). Central to SEM is the requirement that the proposed model is theoretically grounded and correctly specified, such that hypothesized relationships reflect the study's conceptual logic. In this research, the structural model was derived from CARE theory (Leidner & Tona, 2021), Dynamic Capability theory (North, Aramburu & Lorenzo, 2020), and Network theory (Moro Visconti, 2019), providing a strong theoretical basis for the modeled relationships. SEM further assumes linear relationships among variables and an adequate sample size relative to model complexity to yield stable and unbiased estimates (Hair et al., 2021). For covariance-based SEM, multivariate normality of observed indicators is generally assumed, as deviations may affect standard errors and goodness-of-fit indices, thereby necessitating robust estimation techniques when appropriate (Surucu, Sesen & Maslakci, 2023). The method also presumes independence of observations and the absence of excessive multicollinearity among exogenous constructs, as high intercorrelations can weaken estimation accuracy and complicate interpretation (Ritter & Pedersen, 2020). Moreover, SEM requires that latent constructs are measured through indicators demonstrating adequate reliability and validity, including acceptable levels of internal consistency and evidence of convergent and discriminant validity (Bougie & Sekaran, 2019). Measurement errors are assumed to be random unless explicitly modeled, and the structural model must be statistically identifiable with sufficient degrees of freedom to permit unique parameter estimation (Cooper & Schindler, 2014). Finally, SEM assumes homoscedastic error variances and the absence of influential outliers that could distort covariance structures and bias results (Gakuu, Kidombo & Keiyoro, 2016). Adherence to these assumptions enhances analytical rigor and strengthens the credibility of the study's conclusions.

In this study, SEM was employed as the primary quantitative technique to examine the complex relationships between observed and latent variables associated with DT and international trade. SEM is particularly suited for testing theory-driven models involving multiple dependent and independent variables, allowing for the simultaneous estimation of direct and indirect effects (Creswell, 2015). Its capacity to model latent constructs and account for measurement error distinguishes SEM from traditional regression approaches, thereby improving the precision and validity of empirical findings (Hair et al., 2021). The analysis was conducted using SPSS Amos, which facilitates model specification, estimation, and evaluation through an intuitive graphical interface (Arbuckle, 2022). SPSS Amos also provides comprehensive diagnostics, including goodness-of-fit indices and residual analysis, which are essential for assessing model adequacy and refining model structure (Bougie & Sekaran, 2019).

Within the scope of this research, SEM was applied to assess the impact of DT on international trade, with particular emphasis on import/export activities at the DSM Port. DT was conceptualized across three dimensions: organizational, technological, and social and the model examined their relationships with key trade-related constructs, including digital infrastructure, regulatory frameworks, competitiveness, and operational efficiency. The SEM process followed a structured sequence, beginning with construct definition and instrument pre-testing, followed by Confirmatory Factor Analysis (CFA) to validate the measurement model. Construct validity was assessed to ensure that observed indicators accurately represented their corresponding latent variables and aligned with the study's theoretical foundation.

Model fit was evaluated using multiple fit indices to provide a comprehensive assessment of model adequacy. Although the chi-square statistic was initially examined, its sensitivity to sample size necessitated reliance on additional indices, including the Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Normed Fit Index (NFI), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), and Root Mean Square Error of Approximation (RMSEA). These indices offered a more nuanced evaluation of the model's alignment with the observed data and informed iterative refinements to improve both theoretical coherence and empirical fit (Hair Jr, Howard & Nitzl, 2020). Descriptive statistics, including means, variances, standard deviations, and frequencies, were also computed to summarize key characteristics of the dataset.

The final nested SEM model incorporated all core constructs which are DT, digital infrastructure, regulatory frameworks, global logistics connectivity, efficiency of import management, and international trade outcomes along with competition and efficiency as moderating variables. This integrated framework enabled the simultaneous examination of multiple interdependencies within a single, cohesive and comprehensive analytical model. By jointly modeling latent constructs and their observed indicators, SEM enhanced the precision, reliability, and explanatory power of the analysis (Yaslioglu & Yaslioglu, 2020). The application of SPSS Amos further strengthened the analysis through advanced estimation methods, including maximum likelihood estimation and bootstrapping, which supported robust inference under varying data conditions (Arbuckle, 2022; Hair et al., 2021).

This study employed SEM as the primary quantitative technique, applied systematically to ensure that findings were both theoretically grounded and statistically robust. Using SPSS Amos enabled the modeling of complex relationships among observed and latent variables, incorporation of moderation effects, and application of flexible estimation methods appropriate to the data. Comprehensive model fit diagnostics and multiple goodness-of-fit indices enhanced the reliability, validity, and interpretability of results, while iterative evaluation and refinement ensured alignment between theoretical expectations and empirical evidence. By following a structured SEM process encompassing model formulation, identification, estimation, evaluation, and refinement, the analysis achieved a high level of internal coherence and analytical rigor. This quantitative approach facilitated a rigorous assessment of the mechanisms through which DT influences international trade at the DSM Port, providing nuanced insights into both direct and indirect effects. The findings contribute to empirical scholarship while offering evidence-based guidance for policy formulation and strategic decision making (Arbuckle, 2022; Hair et al., 2021).

Demographic Profile of Quantitative Respondents

This section presents and discusses the profile of questionnaire respondents, with particular emphasis on key demographic characteristics including age group, gender, marital status, ethnicity, role, and experience level. The respondents' profile is summarized in Table 1 below.

Table 1

Respondents Profile

Variable	Categories	Frequency	Percent	Cumulative Percent
Age Group	Young Adult	7	1.7	1.7
	Middle Adult	163	39.9	41.6
	Adult	211	51.6	93.2
	Older Adult	27	6.6	99.8
	Elderly	1	0.2	100.0
	Total	**409**	**100.0**	
Gender	Male	276	67.5	67.5
	Female	128	31.3	98.8
	Not Willing to Disclose	5	1.2	100.0
	Total	**409**	**100.0**	
Marital Status	Married	249	60.9	60.9
	Divorced	24	5.9	66.7
	Widowed	20	4.9	71.6
	Never Married	116	28.4	100.0
	Total	**409**	**100.0**	
Ethnicity	Black	317	77.5	77.5
	Indian	43	10.5	88.0
	Arabic	40	9.8	97.8
	Chinese	7	1.7	99.5
	European	1	0.2	99.8
	Other	1	0.2	100.0
	Total	**409**	**100.0**	
Role	Importer	31	7.6	7.6
	Exporter	13	3.2	10.8
	ImpEx	24	5.9	16.6
	CFA	341	83.4	100.0
	Total	**409**	**100.0**	
Experience Level	Intermediate	77	18.8	18.8
	Mid-level	173	42.3	61.1
	Senior	159	38.9	100.0
	Total	**409**	**100.0**	

Note. Field Results

The survey results reveal that the majority of respondents are aged between 35 and 44 years (52.6%), followed by those in the 25 to 34 age group (39.9%), indicating that mid-career professionals constitute the largest segment of the workforce. Older adults (45 to 60 years) made up 6.6%, and younger adults (18 to 24) only 1.7%, with the elderly (over 60) being the least represented at 0.2%. This age distribution highlights a workforce shaped largely by the experiences and perspectives of midlife adults, which could influence trends in import/export activities. Gender-wise, 67.5% of respondents were male, and 31.3% were female. Most respondents (60.9%) were married, with 28.4% never married. Ethnically, 77.5% identified as Black, followed by 10.5% Indian and 9.8% Arabic, reflecting a diverse demographic in trade and logistics.

A significant majority of respondents (83.4%) were clearing and forwarding agents (CFAs), emphasizing their pivotal role in import/export activities, cross-border logistics and trade facilitation. The remaining participants included importers (7.6%), exporters (3.2%), and individuals engaged in both importing and exporting (5.9%). In terms of professional experience, 42.3% had between 5 to 10 years of experience, representing a strong group of mid-level professionals, while 38.9% had over 10 years of experience, reflecting a substantial base of senior experts. This distribution ensured that the study drew insights from respondents with considerable industry knowledge. Junior professionals with less than two years of experience were excluded from the data collection phase, as the email contacts used were sourced from the 2021 customs database, which did not include recent entrants. This approach helped maintain a focus on seasoned industry practitioners. Overall, the demographic profile covering age, gender, ethnicity, and professional experience provides a holistic perspective of the trade and logistics workforce, contributing to a deeper and more meaningful interpretation of the study’s findings.

Cross-tabulation Analysis

Cross-tabulation analysis is a vital statistical technique for exploring relationships among categorical variables (Gakuu, Kidombo & Keiyoro, 2016). This method organizes data into a matrix, enabling effective comparison of different demographic groups and uncovering patterns that simpler summaries might miss. Recent studies emphasize crosstab analysis's ability to reveal complex associations among variables, enhancing data interpretation across various fields (Bougie & Sekaran, 2019). In this research, cross-tabulation was used to visualize relationships among population characteristics, including ethnicity and gender, age group, marital status, and participants' roles. The focus on ethnicity is essential considering its significant impact on socioeconomic status, education, health outcomes, and cultural practices (Ritter & Pedersen, 2020; Thekdi & Aven, 2024). By examining these relationships, the study enhances understanding of how demographic factors influence participants' experiences and perceptions, thereby supporting more informed conclusions and recommendations.

The analysis indicates that 317 (77.5%) of the participants were Africans, which is consistent with Tanzania's national demographic profile and suggests that the sample provides a reliable representation of the study context. According to the 2012 census, about 99% of the population identifies as Black, with Indian and Arab communities constituting roughly 1% and 0.1%, respectively. These population characteristics underscore the importance of understanding the cultural and social dynamics shaped by the predominance of the Black ethnicity in Tanzania. It highlights the necessity of exploring how the values, traditions, and social norms of this majority influence diverse dimensions of human experience, including economic activities, education, and healthcare. Additionally, recognizing the roles played by minority communities is essential, as they contribute to the nation's cultural richness and diversity, thus fostering a more inclusive perspective on Tanzania's social fabric. Furthermore, the analysis indicates 208 (75.4%) of male respondents and 106 (82.8%) of female respondents were of African ethnicity indicating both genders were actively participating in the import/export activities. Table 2 presents a cross-tabulation of ethnicity and gender among the respondents.

Table 2

*Cross-tabulation: Ethnicity * Gender*

		Male		Female		Not willing to disclose		Total	
		N	%	N	%	N	%	N	%
Ethnicity	Black	208	75.4	106	82.8	3	60.0	317	77.5
	Indian	32	11.6	10	7.8	1	20.0	43	10.5
	Arabic	30	10.9	10	7.8	0	-	40	9.8
	Chinese	5	1.8	2	1.6	0	-	7	1.7
	European	0	-	0	-	1	20.0	1	0.2
	Other	1	0.4	0	-	0	-	1	0.2
Total		276	100.0	128	100.0	5	100.0	409	100.0

Note. Researcher's Conception

The adult age group had the highest participation, with 211 respondents, predominantly from the African (Black) ethnic group, which comprised 168 (79%) of the total. The Indian ethnic group also showed notable involvement with 21 (10%) respondents. Interestingly, the Arabic ethnic group had the highest number of participants in the Middle Age category, suggesting that many are engaged in family businesses and entered the workforce soon after completing their education. Notably, the only respondent over 60 still actively working was from the Arabic ethnic group, raising questions about work dynamics and retirement patterns influenced by cultural or economic factors. Furthermore, the results show the age distribution of African ethnicity was even for each category (Young Adult 6 (85%), Middle adult 120 (73%), Adult 168 (79%) and older adult 23 (83%) whereas there was no representation for the elderly age group. Overall, these findings illustrate the varying levels of engagement across different ethnic groups and age categories, enriching the understanding of the demographic landscape relevant to the research.

Table 3 presents a cross-tabulation of ethnicity and age groups, providing insights into the demographic distribution of the respondents.

Table 3

*Cross-tabulation: Ethnicity * Age Group*

		Young Adult		Middle Adult		Adult		Older Adult		Elderly		Total	
		N	%	N	%	N	%	N	%	N	%	N	%
Ethnicity	Black	6	85.0	120	73.0	168	79.0	23	85.0	0	0.0	317	77.0
	Indian	0	0.0	18	11.0	21	10.0	4	14.0	0	0.0	43	10.0
	Arabic	1	14.0	23	14.0	15	7.0	0	0.0	1	100.0	40	9.0
	Chinese	0	0.0	2	1.0	5	2.0	0	0.0	0	0.0	7	1.0
	European	0	0.0	0	0.0	1	0.0	0	0.0	0	0.0	1	0.0
	Other	0	0.0	0	0.0	1	0.0	0	0.0	0	0.0	1	0.0
Total		7	100.0	163	100.0	211	100.0	27	100.0	1	100.0	409	100.0

Note. Researcher's Conception

The cross-tabulation of age group, gender, and marital status reveals several significant demographic patterns among the respondents. First, a substantial proportion of participants are never married (249; 60.9%), indicating a notable shift toward singlehood that may be influenced by broader societal, economic, or cultural dynamics. This finding may also reflect changing career priorities, delayed marriage due to professional aspirations, or evolving family structures within the study context. Second, the data indicates a gender imbalance in older age groups, with women appearing to exit the logistics workforce at higher rates as they age. This trend raises concerns about gender-based barriers such as caregiving responsibilities, workplace discrimination, or limited opportunities for career advancement, which may disproportionately affect female professionals in the sector. Additionally, the high number of widowed respondents (116; 28.4%) across multiple age groups highlights potential vulnerabilities in social support systems and suggests the need for deeper inquiry into underlying causes, including health bottlenecks, economic hardship, or other socio-demographic factors. Collectively, these findings underscore the importance of understanding how marital status, age, and gender intersect to shape individuals' personal and professional experiences, and how these dynamics may influence participation and progression in the import/export activities. Table 4 therefore provides a comprehensive view of the interaction between age, gender, and marital status, highlighting demographic patterns that are important for interpreting the study's findings and shaping recommendations.

Table 4

*Cross-tabulation: Age Group * Gender * Marital Status*

				Never Married	Married	Divorced	Widowed	Total
Age Group	Young Adult	Gender	Male	1	0	0	3.0	4
			Female	0	0	0	3.0	3
			Not willing to disclose	0	0	0	0	0
			Total	1	0	0	6.0	7
	Middle Adult	Gender	Male	55	0.0	0	46.0	101
			Female	31	3.0	1	26.0	61
			Not willing to disclose	0	0	0	1.0	1
			Total	86	3.0	1	73.0	163
	Adult	Gender	Male	94	14.0	12	25.0	145
			Female	46	5.0	1	10.0	62
			Not willing to disclose	2	0.0	0	2.0	4
			Total	142	19.0	13	37.0	211
	Older Adult	Gender	Male	20	1.0	4	0	25
			Female	0	1.0	1	0	2
			Not willing to disclose	0	0	0	0	0
			Total	20	2.0	5	0	27
	Elderly	Gender	Male	0	0	1	0	1
			Female	0	0	0	0	0
			Not willing to disclose	0	0	0	0	0
			Total	0	0	1	0	1
	Total	Gender	Male	170	15.0	17	74.0	276
			Female	77	9.0	3	39.0	128
			Not willing to disclose	2	0	0	3.0	5
			Total	249	24.0	20	116.0	409

Note. Researcher's Conception

The cross-tabulation of ethnicity and respondent roles reveals notable trends within the workforce at the Port of DSM, particularly the dominance of CFAs. A significant majority of respondents, totaling 341, identified as CFAs reflects their central role and intensive involvement in day-to-day import/export activities. CFAs typically engage directly with documentation, clearance processes, cargo handling coordination, and stakeholder communication, placing them at the core of port logistics. This prominent representation may also indicate the high accessibility of CFAs to the researcher during data collection, given their frequent presence at the port and regular interaction with various public and private entities. Furthermore, the cross-tabulation suggests that other stakeholder groups are comparatively underrepresented, which may reflect differences in workforce size or engagement with DT initiatives. These patterns underscore the importance of role-based perspectives, as CFAs' experiences may strongly shape insights into port operations and DT. Table 5 presents the cross-tabulation of ethnicity and respondent role.

Table 5

*Cross-tabulation: Ethnicity * Role of Respondent*

		Importer		Exporter		ImpEx		CFA		Total	
		N	%	N	%	N	%	N	%	N	%
Ethnicity	Black	21	67.0	9	69.0	15	62.0	272	79.0	317	77.0
	Indian	6	19.0	3	23.0	8	33.0	26	7.0	43	10.0
	Arabic	2	6.0	0	0.0	0	0.0	38	11.0	40	9.0
	Chinese	1	3.0	1	7.0	1	4.0	4	1.0	7	1.0
	European	1	3.0	0	0.0	0	0.0	0	0.0	1	0.0
	Other	0	0.0	0	0.0	0	0.0	1	0.0	1	0.0
Total		31	100.0	13	100.0	24	100.0	341	100.0	409	100.0

Note. Researcher's Conception

The black ethnicity accounted for the highest number of respondents, with 317 participants (77%), reflecting their strong involvement in on-the-ground port activities and familiarity with the setbacks associated with non-digitalized processes. The results also show notable representation from Indian (43, 10%), Arabic (40, 9%), and Chinese (7, 1%) ethnic groups in import/export activities at the Port of DSM, despite their smaller population sizes. In contrast, individuals of African descent showed lower participation relative to their population dominance, indicating uneven engagement across ethnic groups. This disparity suggests potential barriers that may limit access to opportunities. The higher representation of non-African ethnicities could reflect differences in access to resources, networks, or opportunities that facilitate entry into import/export activities at DSM port.

Data Preparation

While data collection is essential, ensuring high data quality remains a significant challenge for many organizations and research studies (Akbari & Hopkins, 2022). Data cleaning is therefore a critical step in securing the accuracy, consistency, and reliability of research data. This process involves identifying and correcting errors, resolving inconsistencies, validating data entries, and meticulously documenting variables to ensure transparency and reproducibility throughout the research process (Kumar, 2018). By systematically addressing issues such as missing values, outliers, and anomalies, data cleaning significantly enhances the integrity and credibility of research findings and reduces the risk of biased or misleading results.

Paul and Barari (2022) emphasize the foundational role of data cleansing as a prerequisite for meaningful data analysis. They highlight key tasks including data coding and editing, screening for missing data, removing duplicates, assessing normality, and conducting factor loading analysis. These steps are essential for identifying and correcting errors, addressing inconsistencies, and resolving issues that could otherwise distort the results or compromise the validity of the analysis. Specialized techniques and statistical procedures are applied to detect and correct anomalies, ensuring that the dataset is reliable and suitable for rigorous analysis. The specific data cleaning procedures used in this study, including detailed steps and decision rules, are discussed in the following sections (Ritter & Pedersen, 2020).

Removing Duplicates and Unreliable Items

Hansen, Steinmetz and Block (2022) recommend that the screening process adopt a systematic approach, beginning with the removal of duplicate cases. In line with this, identifying and addressing duplicates is a critical step in the data cleaning process, particularly in software like SPSS, to ensure the accuracy and reliability of the analysis (Paul & Barari, 2022). Duplicates can distort results by artificially inflating the sample size or introducing bias, potentially leading to misleading conclusions. In this study, one duplicate case was identified and removed using the "*Identify Duplicate Cases*" function in SPSS, under the Data menu. As a result, the sample size decreased from 409 to 408 participants.

Furthermore, a reliability analysis was conducted to evaluate the internal consistency of the data and the validity of the measurement instrument. This analysis helped to identify and suggest the exclusion of items that were unnecessary or negatively affected the reliability of the data. Specifically, demographic variables such as country of business (CB), participant role (RO), experience level (EL), and level of application use (AL) were excluded from the analysis. This process ensured that only the most relevant and consistent data remained, enhancing the overall quality of the study and helping to eliminate any inconsistencies that could have compromised its findings (Gakuu, Kidombo & Keiyoro, 2016).

Data Coding and Editing

The collected data were meticulously coded and edited to prepare them for analysis (Hair et al., 2021). Each response to the research questions was assigned a unique code, enabling efficient identification, classification, and alignment with the relevant research constructs. To enhance analytical rigor, the coding process also involved the creation of new variables by combining multiple individual items into composite constructs, as well as the inclusion of moderation variables to examine their potential influence on the relationships under investigation. This systematic approach not only ensured consistency and accuracy in the dataset but also supported robust analysis through clearer construct measurement and improved data organization. The resulting coding and cleaning decisions provided a transparent foundation for subsequent statistical analysis and interpretation. Table 6 presents the specific codes applied and the cleaning decisions made in this study.

Table 6

Items Coding and Cleaning Decision

Construct	Item Code	Item Description/Reference	Cleaning Decision
DEMO	GD	Gender	Maintained
	AG	Age Group	Maintained
	ET	Ethnicity	Maintained
	CB	Country of Business	Removed
	MS	Marital Status	Maintained
	RO	Role	Removed
	EL	Experience Level	Removed
	AL	Application Level	Removed
DT	DT_1	DT_RE_13a	Maintained
	DT_2	DT_IN_13b	Maintained
	DT_3	DT_LD_13c	Removed
	DT_4	DT_KS_13d	Maintained
DI	DI_1	DI_IC_17a	Maintained
	DI_2	DI_CT_17b	Maintained
	DI_3	DI_CC_17c	Maintained
	DI_4	DI_DP_17d	Maintained
RF	RF_1	RF_IRP_21a	Maintained
	RF_2	RF_TS_21b	Maintained
	RF_3	RF_DFR_21c	Removed
	RF_4	RF_SP_21d	Removed
	RF_5	RF_SP_22d	Maintained
GLC	GLC_1	GLC_14b	Removed
	GLC_2	GLC_18a	Removed
	GLC_3	GLC_18f	Maintained
	GLC_4	GLC_18e	Maintained
	GLC_5	GLC_22f	Maintained
ITO	ITO_1	PE_14c	Maintained
	ITO_2	SQ_14d	Removed
	ITO_3	CO_14e	Maintained
	ITO_4	CE_14f	Maintained
EIM	EIM_1	EIM_15	Maintained
	EIM_2	EIM_18b	Maintained
	EIM_3	EIM_19	Removed
	EIM_4	EIM_22a	Removed
	EIM_5	EIM_22b	Maintained
COM	COM_1	COM_12	Removed
	COM_2	COM_14a	Maintained
	COM_3	COM_14g	Maintained
	COM_4	COM_20	Removed
	COM_5	COM_22c	Maintained
EFF	EFF_1	EFF_16	Removed
	EFF_2	EFF_18c	Maintained
	EFF_3	EFF_18d	Maintained
	EFF_4	EFF_22e	Maintained

Note. Researcher's Conception

Missing Data Analysis

As Popovich (2025) explains, missing data occurs when there is an absence of responses, value or incomplete information for variables or observations within a dataset. This issue, even when minimal, can present significant barriers in survey research by complicating the analysis process and compromising the study's outcomes. Furthermore, the author emphasizes that poorly managed missing data can result in biased estimates, reduced statistical power, and inaccurate conclusions, ultimately compromising the validity and reliability of the findings. Effectively addressing missing data is therefore critical to maintaining research integrity and ensuring the results accurately reflect the underlying patterns within the dataset. Using SPSS, through the "*Analyze*" function followed by "*Missing Value Analysis*," this study found no missing data or information and therefore proceeded with the next steps, as the data was deemed reliable and valid.

Testing of Normality

According to Bougie and Sekaran (2019), achieving a normal distribution in research data is largely dependent on the sample size and the method of sample selection. When a sufficiently large and carefully selected sample is obtained, the sampling distribution of the means tends to approximate normality, regardless of the shape of the underlying population distribution. This principle is grounded in the Central Limit Theorem, which supports the use of parametric statistical methods even when the original data distribution is not perfectly normal. In this study, therefore, testing for normality was an essential preliminary step to ensure the validity and reliability of the SEM results. Normality assessment was crucial because SEM relies on multivariate statistical assumptions; violating these assumptions can lead to biased parameter estimates, incorrect standard errors, and unreliable goodness-of-fit statistics. Univariate normality was assessed by examining skewness and kurtosis values for each variable. For the purpose of this study, skewness and kurtosis values were expected to fall within the acceptable range of -1.96 to +1.96. Values within this range suggest that the distribution does not significantly deviate from normality, thus supporting the use of SEM.

In addition, based on Surucu, Sesen and Maslakci (2023); graphical methods such as histograms, Q-Q plots, and boxplots were used to visualize data distribution and detect any deviations from normality. Histograms provide an overview of the distribution shape, Q-Q plots compare observed data to a theoretical normal distribution, and boxplots highlight potential outliers and skewness. When the data violated normality assumptions, bootstrapping techniques were applied to address non-normality and enhance the robustness of the analysis. Bootstrapping allows researchers to generate multiple resamples from the original dataset, producing more reliable standard errors and confidence intervals without relying strictly on normality assumptions.

Surucu, Sesen, and Maslakci (2023) further explain that SPSS Amos enables the testing of multiple models within a single integrated framework. This capability supports model comparison through various statistical tests, including assessments of univariate and multivariate normality and detection of potential outliers. In the present study, normality was evaluated by analyzing skewness, kurtosis, and their critical ratios for the variables in the dataset. The results indicated that several variables demonstrated significant deviations from normality. For example, GLC_18e exhibited marked negative skewness and kurtosis, reflecting a left-skewed distribution with light tails, while GLC_18a showed slight positive skewness with significant negative kurtosis. Similarly, EIM_22a displayed negligible skewness but substantial negative kurtosis, and variables such as EIM_15 and RF_IRP_21a showed pronounced skewness and negative kurtosis. Many variables had critical ratios for skewness and kurtosis exceeding ±2, confirming departures from normality and highlighting the need for corrective measures such as bootstrapping or robust estimation techniques. Table 7 presents the normality test results for the items analyzed using SPSS Amos, supporting that the data required careful handling to ensure valid SEM outcomes.

Table 7

Normality Test for Items in SPSS Amos

Item	min	max	skew	c.r.	kurtosis	c.r.
GLC_18e	1	3	-0.419	-3.452	-1.593	-6.567
GLC_18a	1	3	0.212	1.747	-1.911	-7.878
DT_LD_13c	1	3	-0.111	-0.919	-1.797	-7.408
EIM_22a	1	3	0.020	0.161	-1.920	-7.917
EIM_15	1	2	-1.365	-11.256	-0.137	-0.564
EIM_19	1	2	-0.707	-5.831	-1.500	-6.185
DT_RE_13a	1	3	0.063	0.519	-1.806	-7.447
DI_CT_17b	1	3	0.033	0.272	-1.284	-5.294
RF_DFR_21c	1	3	0.257	2.119	-1.197	-4.936
CE_14f	1	3	-0.584	-4.813	-1.428	-5.887
GLC_22f	1	3	-0.622	-5.126	-1.372	-5.658
RF_SP_22d	1	3	-0.540	-4.451	-1.475	-6.080
RF_SP_21d	1	3	0.148	1.218	-1.098	-4.529
DT_KS_13d	1	3	-0.160	-1.320	-1.775	-7.319
EIM_22b	1	3	-0.689	-5.680	-1.134	-4.676
SQ_14d	1	3	-0.557	-4.597	-1.474	-6.076
DI_CC_17c	1	3	0.131	1.079	-1.133	-4.670
RF_TS_21b	1	3	0.118	0.971	-1.021	-4.211
DT_IN_13b	1	3	-0.313	-2.583	-1.698	-7.002
EIM_18b	1	3	-0.973	-8.023	-0.686	-2.828
PE_14c	1	3	-0.204	-1.679	-1.739	-7.171
CO_14e	1	3	-0.569	-4.692	-1.403	-5.784
GLC_14b	1	3	-0.749	-6.179	-1.103	-4.547
GLC_18f	1	3	-0.595	-4.902	-1.414	-5.828
RF_IRP_21a	1	3	0.474	3.907	-0.880	-3.630
DI_IC_17a	1	3	0.504	4.159	-1.041	-4.294
DI_DP_17d	1	3	0.069	0.573	-1.154	-4.757
Multivariate					-1.885	-0.481

Note. Researcher's Conception

In addition, Normality was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests; where multiple regression analysis examined the relationship between several predictors (DT, DI, RF) and the dependent variables ITO, GLC and EIM. The constant term was significant ($p < .001$). DT did not have a significant effect on ITO ($p = 0.996$), whereas DI and RF demonstrated significant positive relationships with ITO ($p < .001$ for DI; $p = 0.035$ for RF). Collinearity diagnostics indicated no severe multicollinearity, with tolerance values above 0.1 and VIF values below 10, supporting the stability and reliability of the regression estimates. Table 8 summarizes the Kolmogorov–Smirnov and Shapiro–Wilk normality test results, indicating that the data satisfy the normality assumptions required for the multiple regression analysis.

Table 8

Assessment of Normality using Kolmogrov and Shapiro

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	0.526	0.142		3.711	<.001		
	DT	0	0.045	0.000	-0.004	0.996	0.799	1.252
	DI	0.211	0.054	0.194	3.909	<.001	0.693	1.444
	RF	0.168	0.08	0.138	2.113	0.035	0.399	2.508
	EIM	0.145	0.087	0.100	1.666	0.097	0.472	2.118
	GLC	0.292	0.056	0.283	5.249	<.001	0.589	1.699

a Dependent Variable: ITO

Note. Researcher's Conception

Such deviations create significant challenges for conducting statistical analyses in SPSS Amos, especially in techniques like confirmatory factor analysis (CFA) and structural equation modeling (SEM). Both methods rely heavily on the assumption that the data are normally distributed, and violations of this assumption can affect the accuracy and validity of the results. To mitigate these issues, bootstrapping techniques were employed as a corrective measure to enhance model reliability and ensure robust conclusions, given the non-normal nature of the data.

Identification of Outliers

Bougie and Sekaran (2019) define an outlier as an observation that differs substantially from other data points. Outliers may arise from data entry errors or measurement mistakes, but they can also represent valid, unusual observations that reflect true variability in the data. Regardless of their origin, outliers can significantly affect research findings, potentially skewing results or distorting relationships among variables. Therefore, it is essential to carefully identify and examine outliers before conducting analysis. For nominal and ordinal data, this is typically done by reviewing minimum and maximum values and frequency distributions. Beyond outlier detection, Bougie and Sekaran (2019) emphasize the importance of homogeneity as an indicator of internal consistency, showing how well items within a scale collectively measure the same underlying construct. Items should function cohesively, with each contributing meaningfully to the overall measurement. Ensuring this alignment promotes consistent interpretation by respondents and strengthens the reliability, accuracy, and validity of the collected data (Paul & Barari, 2022). Proper attention to both outliers and homogeneity is therefore critical for producing robust and trustworthy research results.

Several items in this study exhibited standardized residual covariance values exceeding the ±3 threshold, indicating significant deviations from expected relationships and potential outliers. To enhance the reliability and validity of the analysis, eight such item pairs were either removed or further scrutinized to maintain model integrity. Notable outliers included DT_3 with DT_LD_13c (3.632) within the Digital Transformation (DT) construct; RF_3 with RF_DFR_21c (4.299) and RF_4 with RF_SP_21d (3.451) within the Regulatory Framework (RF); EIM_3 with EIM_19 (-3.129) and EIM_4 with EIM_22a (5.309) within the Efficiency in Import/Export Activities (EIM) construct; GLC_1 with GLC_14b (4.994) and GLC_2 with GLC_18a (3.750) within the Global Competitiveness (GLC) construct; and ITO_2 with SQ_14d (-3.801) within the Import/Export Outcome (ITO) construct. This rigorous identification and management of outliers ensured that anomalous data points did not bias parameter estimates or compromise the overall model fit, thereby strengthening the robustness and credibility of the research findings. These results are detailed in Table 9.

Table 9

Standardized Residual Covariance

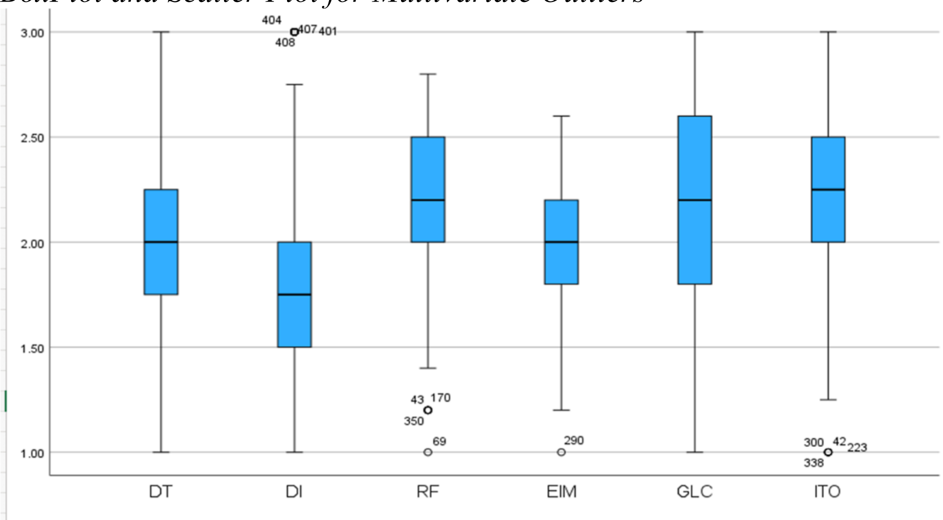
Construct	Item	Reference	Outlier Value
DT	DT_3	DT_LD_13c	3.632
RF	RF_3	RF_DFR_21c	4.299
	RF_4	RF_SP_21d	3.451
EIM	EIM_3	EIM_19	(3.129)
	EIM_4	EIM_22a	5.309
GLC	GLC_1	GLC_14b	4.994
	GLC_2	GLC_18a	3.750
ITO	ITO_2	SQ_14d	(3.801)

Note. Researcher's Analysis

As noted by Pallant (2020), boxplots and scatter plots provide valuable insights into the distribution of continuous variables and the effects of categorical or clustered variables. A boxplot visually summarizes data spread by illustrating the interquartile range (IQR), which contains the central 50% of the data, with a line inside the box representing the median. The whiskers extend to the smallest and largest observations within 1.5 times the IQR, while points beyond this range are marked as outliers, each labeled with its case ID. In IBM SPSS, extreme outliers are defined as points extending beyond three box-lengths from the edges of the box (Sukri & Yusoff, 2021). Boxplots allow researchers to quickly assess variability, detect asymmetry, and identify unusual observations for individual variables. Scatter plots complement this by visually representing bivariate relationships, highlighting points that deviate from general patterns or clusters. When combined with multivariate techniques such as Mahalanobis distance or principal component analysis (PCA), these visual tools enable the detection of complex outliers across multiple variables simultaneously. Figure 9 presents the boxplot and scatter plot used in this study, providing a robust exploratory method to detect both univariate and multivariate outliers, thereby safeguarding the integrity and reliability of the dataset for subsequent analyses.

Figure 9

BoxPlot and Scatter Plot for Multivariate Outliers

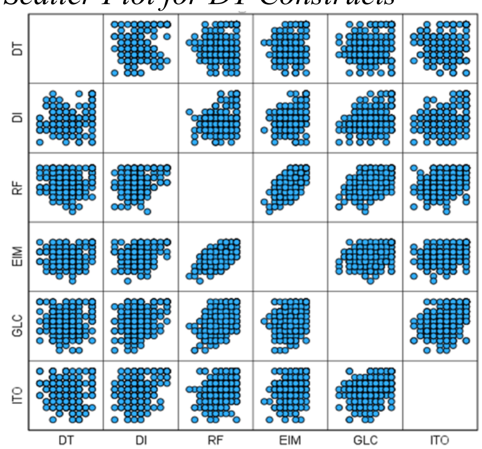


Note. Researcher's Analysis

For interval and ratio data, scatter plots are particularly effective in detecting outliers and examining relationships between continuous variables. In this study, scatter plots were employed, following Pallant's (2020) recommendations, to explore interactions between variables and identify extreme observations that could distort analysis. Each point on a scatter plot represents an individual observation, positioned according to two variables, which allows for the identification of patterns, correlations, and deviations from expected trends. Scatter plot matrices further extend this analysis by displaying multiple variable pairs simultaneously, offering a more comprehensive understanding of the data structure and potential anomalies. Within this study, each point represents a DT-related observation, providing a visual inspection of multidimensional interactions among indicators that might otherwise be hidden in summary statistics. This approach aids in identifying outliers that could disproportionately affect regression estimates or latent variable modeling. Moreover, it highlights clustering patterns and linear or nonlinear associations, supporting the refinement and validation of measurement models. By mapping these relationships across multiple variables, the scatter plot matrix ensures that the DT construct accurately represents the underlying concept and that any anomalies are addressed prior to advanced statistical analyses. Consequently, Figure 10 serves as an essential tool for safeguarding data integrity, detecting multivariate outliers, and enhancing construct validity.

Figure 10

Scatter Plot for DT Constructs



Note. Researcher's Analysis

According to Bougie and Sekaran (2019), homogeneity is a key indicator of internal consistency, reflecting how well items within a scale consistently measure the same underlying concept. This consistency ensures that respondents interpret items, similarly, thereby enhancing the reliability and validity of the collected data (Paul & Barari, 2022). Assessing homogeneity typically involves examining correlations among individual items and subsets of items, with common methods including inter-item consistency and split-half reliability tests, which help identify potential weaknesses that could affect measurement precision. In this study, the assumption of homogeneity of variance was evaluated to determine whether variances among groups were consistent for each variable, a fundamental requirement for many parametric analyses such as ANOVA and regression. Levene's test was employed to assess whether variance within male and female groups was equivalent across all measured variables, including Import/Export Outcomes (ITO), Digital Transformation (DT), Digital Infrastructure (DI), Regulatory Framework (RF), Efficiency in Import/Export Activities (EIM), Global Competitiveness (GLC), Competition (COM), and Efficiency (EFF). The significance values (p-values) for all variables, ITO (0.458), DT (0.344), DI (0.264), RF (0.494), EIM (0.681), GLC (0.625), COM (0.457), and EFF (0.371), all exceeded the conventional threshold of 0.05. This indicates that there were no statistically significant differences in variance across the groups, confirming that the assumption of homogeneity of variances was met. Establishing equal variance across genders is particularly important for accurately identifying outliers, as it ensures that extreme deviations can be distinguished reliably from normal variability within the data. By meeting this assumption, the analysis reduces the risk of bias in subsequent parametric tests, such as ANOVA or regression, and strengthens the interpretability of results. Table 10 presents these findings, validating the research methodology and supporting reliable, unbiased group comparisons.

Table 10

Levene's Test of Homogeneity of Variance (Male and Female Groups)

	Levene Statistic	df1	df2	Sig.
ITO	0.783	2	405	0.458
DT	1.069	2	405	0.344
DI	1.336	2	405	0.264
RF	0.706	2	405	0.494
EIM	0.384	2	405	0.681
GLC	0.471	2	405	0.625
COM	0.784	2	405	0.457
EFF	0.993	2	405	0.371

Note. Researcher's Analysis

Descriptive Statistics and Correlation Matrix

Authors like Bougie and Sekaran (2019) emphasize the Pearson correlation matrix as a valuable statistical tool for assessing the direction, strength, and significance of relationships between variables. This technique examines how variations in one variable relate to changes in another. In this study, the correlation matrix was utilized to explore the interrelationships among several key constructs, including DT, DI, RF, EIM, GLC, ITO, COM, and EFF.

The results revealed moderate to strong correlations between variables. DT and DI showed a moderate positive correlation of 0.381, while RF and EIM were more strongly correlated at 0.682, indicating a significant relationship between RF and EIM. The strongest correlation was observed between DT_COM and ITO_COM (0.494), reflecting a robust link between DT and import/export outcomes. DT_COM also correlated strongly with DI (0.521) and EIM (0.434), highlighting notable interconnections among these constructs. In contrast, EFF (0.256) and COM (0.282) showed weaker associations, suggesting less pronounced relationships with DT_COM. Correlation matrices are fundamental for examining variable relationships (Paul & Barari, 2022). Table 11 presents the descriptive statistics and the correlation matrix for all constructs.

Table 11

Descriptive Statistics and Correlation Matrix for Constructs

	DT	DI	RF	EIM	GLC	ITO	COM	EFF	DT_COM	ITO_COM	DT_EFF	ITO_EFF
DT	--											
DI	0.381	--										
RF	0.198	0.378	--									
EIM	0.320	0.422	0.682	--								
GLC	0.281	0.425	0.579	0.359	--							
ITO	0.213	0.408	0.444	0.378	0.481	--						
COM	0.282	0.455	0.271	0.330	0.438	0.420	--					
EFF	0.152	0.275	0.160	0.220	0.121	0.193	0.282	--				
DT_COM	0.431	0.521	0.400	0.434	0.426	0.451	0.346	0.256	--			
ITO_COM	0.494	0.432	0.291	0.389	0.297	0.210	0.250	0.187	0.446	--		
DT_EFF	0.340	0.287	0.303	0.278	0.299	0.273	0.299	0.020	0.475	0.292	--	
ITO_EFF	0.273	0.280	0.192	0.254	0.214	0.206	0.200	0.027	0.274	0.450	0.256	--

Note. Researcher's Analysis

Items in Constructs with Loading Values

According to Howard (2023), factor loadings reflect the strength of the association between an observed variable and its underlying latent factor in Exploratory Factor Analysis (EFA). High factor loadings indicate a strong connection between variables and their respective constructs, making these variables important indicators. These loadings are essential for assessing construct validity and refining measurement models by guiding the selection of the most relevant variables for inclusion in the analysis.

Dash and Paul (2021) emphasize that achieving good model fit can be particularly challenging when working with primary data. Poor model fit can arise from factors such as model complexity, sample size, or data quality issues. To address these limitations, a common approach during data cleaning and refinement is to evaluate the factor loadings of indicators associated with latent variables. Items with factor loadings below 0.6 (Dash & Paul, 2021, p. 8) or 0.5 (Habibi et al., 2021, p. 548) are generally considered weak and are excluded to improve model fit. After eliminating such items, the model is reassessed to ensure better alignment with the data.

In this study, the DT construct showed strong loadings on DT_1 (0.959), DT_2 (0.970), and DT_3 (0.994), indicating excellent representation of the construct. The DI construct also displayed high loadings, with DI_2 (0.994) and DI_3 (0.996), confirming robust associations with the latent variable. Similarly, the RF construct items RF_2 (0.924) and RF_4 (0.974) reliably captured the concept of resource flexibility, while GLC items GLC_1 (0.956) and GLC_5 (0.991) effectively reflected key dimensions of global competitiveness. In the ITO construct, ITO_2 (0.984) and ITO_3 (0.986) demonstrated very high loadings, highlighting their strong representation of perceived international trade opportunities. These high factor loadings indicate that the indicators accurately capture their respective constructs, supporting the reliability and validity of the measurement model. Table 12 presents the items with their respective factor loadings, illustrating the strength of each indicator's relationship with its underlying latent construct and guiding the refinement of the model.

Table 12

Items with Loadings

	Construct							
Item	**DT**	**DI**	**RF**	**GLC**	**ITO**	**EIM**	**COM**	**EFF**
DT_1	0.9590							
DT_2	0.9700							
DT_3	0.9940							
DT_4	0.9580							
DI_1		0.9620						
DI_2		0.9940						
DI_3		0.9960						
DI_4		0.9860						
RF_1			0.8810					
RF_2			0.9240					
RF_3			0.8900					
RF_4			0.9740					
RF_5			0.9310					
GLC_1				0.9560				
GLC_2				0.8760				
GLC_3				0.9630				
GLC_4				0.9630				
GLC_5				0.9910				
ITO_1					0.9360			
ITO_2					0.9840			
ITO_3					0.9860			
ITO_4					0.9690			
EIM_1						0.9880		
EIM_2						0.9000		
EIM_3						0.9890		
EIM_4						0.9610		
EIM_5						0.9690		
COM_1							0.9880	
COM_2							0.9410	
COM_3							0.9620	
COM_4							0.9450	
COM_5							0.9750	
EFF_1								0.9760
EFF_2								0.9920
EFF_3								0.9760
EFF_4								0.9690

Note. Researcher's Analysis

In the RF construct, items such as RF_4 (loading = 0.974) and RF_2 (loading = 0.924) exhibit strong standardized loadings, indicating a high correlation with the underlying latent construct and confirming their reliability in capturing the concept of resource flexibility. Similarly, the GLC (Global Competitiveness) construct is well-represented by items like GLC_1 (0.956) and GLC_5 (0.991), whose exceptionally high loadings underscore their effectiveness in reflecting key dimensions of global competitiveness and reinforcing the construct's internal consistency. Likewise, in the ITO (International Trade Opportunities) construct, items such as ITO_2 (0.984) and ITO_3 (0.986) demonstrate very high loadings, highlighting their strong representation of the latent variable and their reliability in assessing perceived international trade opportunities.

The EIM (Efficiency in Import/Export Activities) construct demonstrates strong measurement reliability, as evidenced by high factor loadings for items such as EIM_1 (0.988) and EIM_3 (0.989), which indicate that these observed variables are highly representative of the underlying construct. Similarly, the COM (Communication) construct shows robust loadings, with COM_1 registering a value of 0.988, further supporting the strength of its measurement indicators. In addition, the EFF (Efficiency) construct is well-captured by items like EFF_2 (0.992), highlighting a strong association between these observed measures and the latent variable they intend to reflect. The consistently high factor loadings, each surpassing the commonly accepted benchmark of 0.7, provide robust evidence for both the reliability and convergent validity of the measurement model. This indicates that the indicators reliably reflect their intended constructs. Collectively, these findings demonstrate that each construct is accurately and meaningfully represented by its associated indicators, thereby strengthening the overall structural validity and coherence of the model. This level of measurement precision is crucial for ensuring the credibility of subsequent analyses and interpretations based on the model.

Model Constructs and Variables

This study employed SEM to explore the relationships among five key variables representing critical dimensions of DT in international trade. In this research, DT is viewed as the degree to which businesses and stakeholders integrate digital technologies into their trade operations. The model included Digital Infrastructure (DI), which refers to the availability, accessibility, and reliability of digital resources. A robust DI is essential for facilitating smooth digital operations in international trade (Venkatesh, 2020). Additionally, the Regulatory Frameworks (RF) was included to assess the role of policies, laws and regulations governing DT in the trade sector. This construct highlights the role of government and regulatory bodies in providing legal support for businesses to adopt digital trade (Paul & Barari, 2022). The study also considered International Trade Opportunities (ITO), reflecting the perceived benefits of DT (Locke, Feldman & Golden-Biddle, 2022). Lastly, Global Competitiveness (GLC) and Efficiency in import/export activities (EIM) examined the impact of DT and ITO with/without moderation of competition and efficiency (Rojon, Okupe & McDowall, 2021).

The study utilized SEM to investigate both direct pathways and indirect effects between the variables, providing meaningful insights into the multifaceted nature of DT within international trade. It highlighted the significant role of the regulatory frameworks (RF) and digital infrastructure (DI) in driving DT, aligning with findings by Schmiedel, Müller and Vom Brocke (2019). The findings offer valuable insights into how DT is transforming global trade patterns by improving efficiency and strengthening competitive advantage (Pandey & Pandey, 2021). Drawing on these insights, the study presents actionable guidance for policymakers, business executives, and trade participants to successfully manage and capitalize on the opportunities arising from DT in international commerce (Giermindl et al., 2022).

Model Fit Analysis

Evaluating model fit is a critical step in determining how well a proposed statistical model aligns with the observed data, thereby reinforcing the validity and credibility of the research findings. This study applied a two-stage SEM approach using SPSS Amos. The first stage consisted of CFA to ensure that the observed variables effectively represented their respective latent constructs. The second stage involved structural modeling to examine the hypothesized relationships among variables. SPSS Amos supported this process by providing a variety of established model fit indices to comprehensively assess the model's suitability.

Key model fit indices were employed to assess the adequacy of the structural model. The Chi-Square test served as a primary indicator, where non-significant values suggest a strong alignment between the proposed model and the observed data. Particular attention was given to the RMSEA, with values below 0.05 indicating a close fit and values between 0.05 and 0.08 representing a reasonable approximation. Additional indices included the CFI and the TLI, both of which evaluate model fit relative to a baseline model; values above 0.90, and exceeding 0.95, were considered indicative of a well-fitting model. The GFI and the AGFI were also applied to assess the proportion of variance explained by the model, with acceptable thresholds set at 0.90 or higher. Finally, the SRMR was used to evaluate the discrepancy between the observed and predicted covariance matrices, with values below 0.08 signifying an acceptable fit.

Collectively, these fit indices offered a comprehensive framework for assessing the model's adequacy. The consistently strong results across multiple metrics confirmed that the model was not only theoretically sound but also empirically robust. This thorough evaluation significantly reinforced the validity of the findings, particularly in the context of exploring the strategic implications and opportunities presented by DT in international trade.

Confirmatory Factor Analysis (CFA)

CFA is a statistical technique used to determine whether observed variables accurately represent the latent constructs defined within a theoretical framework. Widely used in fields such as social sciences, international trade, psychology, and business research, CFA is essential for validating the measurement model by assessing the strength and consistency of the relationships between observed indicators and their respective constructs. In this study, CFA was instrumental in confirming that each observed variable corresponded appropriately to its intended latent construct. To enhance the reliability and interpretability of the model, items with low factor loadings were removed, retaining only those with strong and meaningful associations for both the CFA and subsequent SEM analysis. As a core component of SEM, CFA ensured alignment between the theoretical model and the empirical data (Hair Jr et al., 2021), thereby reinforcing the measurement model's overall validity. This rigorous approach ensured that the constructs were clearly and accurately defined, contributing to the robustness of the model and supporting meaningful interpretation of the interrelationships explored in the study (Volberda et al., 2021).

In this analysis, six key constructs were examined within the model: Digital Transformation (DT), Digital Infrastructure (DI), Regulatory Frameworks (RF), International Trade Opportunities (ITO), Global Competitiveness (GLC) and Efficiency in import/export activities (EIM). Furthermore, the moderator constructs of competition (COM) and efficiency (EFF) were also examined in this study. Each of these variables was represented by several observable indicators derived from the survey data. CFA validated the measurement model by ensuring that the observed variables accurately represented the latent constructs, focusing on six key constructs—DT, DI, RF, ITO, GLC, and EIM—and moderator variables COM and EFF, with strong associations between indicators and construct.

CFA Process

Confirmatory Factor Analysis (CFA) is a precise statistical approach employed to assess whether a collection of measured variables reliably captures the underlying theoretical concepts they are meant to represent. The process begins with model specification, where latent constructs are defined based on existing theory, and their associated indicators (observed variables) are identified. In this study, latent variables such as Digital Transformation (DT), Digital Infrastructure (DI), Regulatory Frameworks (RF), International Trade Opportunities (ITO), Global Competitiveness (GLC), and Efficiency in Import/Export Activities (EIM) were specified, each linked to theoretically grounded measurement items.

Following specification, the model undergoes parameter estimation, which involves calculating factor loadings, variances, and covariances using empirical data. These values provide essential insights into the strength and accuracy of the relationships between the observed indicators and their associated latent constructs. Following this, the model's overall fit is assessed using key indices, including the RMSEA, CFI, and SRMR. When these indices fall within established thresholds, they indicate a strong correspondence between the hypothesized model and the observed data. If the initial model fit is inadequate, adjustments such as removing low-loading indicators may be made to improve fit. However, any adjustments must remain theoretically justified and aligned with the conceptual framework guiding the research. This systematic, multi-step process supports the measurement model’s validity, reliability, and conceptual soundness, thereby enhancing its appropriateness for subsequent structural equation modeling and rigorous empirical investigation (Dash & Paul, 2021; He et al., 2023).

The model estimation phase follows, where the estimates of the CFA model, such as factor weights, variances, and covariances, are calculated (Dash & Paul, 2021). These parameters reflect the intensity of the associations between latent constructs and their respective indicators, as well as the extent of shared variance among the constructs (Bougie & Sekaran, 2019). Maximum Likelihood Estimation (MLE), a widely used method in SEM, is typically employed for its efficiency and accuracy in handling large datasets (Yaslioglu, M. & Yaslioglu, D., 2020). In this study, parameters were estimated using AMOS, a software extension of SPSS that provides powerful tools for SEM analysis (Dash & Paul, 2021, p.4).

During the model fit evaluation phase, researchers examine how well the proposed model corresponds with the observed data using a range of fit indices (Bougie & Sekaran, 2019). These indices, like Chi-Square (χ^2) goodness-of-fit test, CFI, RMSEA, and TLI, are used to assess the extent to which the theoretical structure aligns with the empirical data (Yaslioglu, M. & Yaslioglu, D., 2020). A strong model fit indicates that the hypothesized relationships are well-supported, while a poor fit suggests the need for adjustments to the model (He et al., 2023). In this research, the fit indices demonstrated an acceptable model fit, with all values falling within recommended thresholds, thereby confirming the consistency and strength of the measurement model.

The CFA process involves specifying the model, estimating parameters, and evaluating model fit, making it a crucial step in validating the measurement model. In this research, the CFA confirmed that the observed variables reliably represented the underlying latent constructs, thereby justifying the subsequent examination of structural relationships. This validation ensured that the measurement model was consistent with the theoretical framework, establishing a robust foundation for exploring the dynamics of DT and international trade opportunities (Bougie & Sekaran, 2019). By employing this rigorous methodological approach, the study enhances the credibility of its findings and strengthens the overall reliability and validity of the research, allowing for more accurate and insightful interpretations of the data.

Presentation of Research Data

Responses to the questionnaire's research questions were obtained from participants, who offered valuable insights grounded in their own experiences and perspectives. After completion of collection, the data was systematically tabulated for analysis. This process involved organizing the data into a structured format, typically through SPSS software, where each response could be categorized and quantified. The organization of results facilitated a streamlined review of participant responses and helped researchers uncover trends and patterns within the data. By aggregating responses, researchers can calculate frequencies, percentages, and other statistical measures that illuminate key findings. This quantitative analysis is essential for drawing meaningful conclusions and tackling the research questions presented at the outset of the study. Furthermore, presenting the results in a structured format facilitated the use of visual aids, such as graphs and charts, which enhanced the clarity and accessibility of the findings for the broader research community. Overall, this systematic approach to data organization was critical in ensuring consistency, credibility, and precision of the study's results.

When participants responded to Question 12, which explored the impact of successful DT on creating opportunities for digital harmony and growth in international trade, 280 participants (68.5%) agreed, 85 (20.8%) disagreed, and 44 (10.8%) remained neutral. These results indicate that a clear majority recognize DT as beneficial for enhancing international trade opportunities, while a significant minority remain skeptical or uncertain. The variation in responses suggests that perceptions of DT's effectiveness may be influenced by factors such as organizational readiness, availability of digital infrastructure and technological capability.

The findings emphasize the importance of understanding the underlying reasons for disagreement or neutrality, as these could reflect real barriers to successful DT initiatives.

Investigating these factors could help identify strategies to improve digital adoption, optimize trade processes, and enhance the overall impact of DT on international business activities. The results underscore the need for targeted interventions, training programs, or support mechanisms to address the concerns of those who remain unconvinced. Table 13 presents the detailed distribution of responses for Question 12, providing a clear overview of participant perceptions regarding the role of DT in promoting opportunities within international trade.

Table 13

Question 12: the impact of successful DT

		Frequency	Percent	Cumulative Percent
Valid Qn. 12	Neutral	44	10.8	10.8
	Disagree	85	20.8	31.5
	Agree	280	68.5	100.0
	Total	409	100.0	

Note. Researcher's Conception

Participants evaluated the potential impact of various strategies for enhancing competitiveness and efficiency in Tanzania's import/export activities, focusing on DT readiness, innovations and leadership, and DT knowledge and experience. The results indicated that 168 participants (41.1%) believed that DT readiness would likely contribute to improvements, while 209 (49.9%) expressed similar confidence in the role of DT innovations and leadership. Additionally, 190 participants (46.5%) supported the idea that DT knowledge and experience would positively influence these outcomes. These findings suggest that many respondents recognize the importance of DT initiatives and leadership in driving efficiency and competitiveness, although the levels of optimism vary across different dimensions.

However, a substantial proportion of participants expressed doubt about the effectiveness of these strategies. Specifically, 176 respondents (43.0%) felt that DT readiness would be unlikely to drive improvements, 139 (34.0%) were skeptical about the impact of DT innovations and leadership, and 153 (37.4%) questioned the influence of DT knowledge and experience. Neutral responses accounted for approximately 65 (15.9%) and 66 (16.1%) for the respective items, highlighting a diverse range of opinions and varying levels of certainty regarding the effectiveness of these strategies. This variation underscores that while many stakeholders see potential benefits in DT-focused interventions, perceived challenges, gaps in experience, or organizational limitations may temper confidence in their impact. Table 14 presents the distribution of responses for Question 13, providing a comprehensive overview of participants' perceptions regarding the strategies for enhancing competitiveness and efficiency in Tanzania's import/export sector.

Table 14

Question 13:the impact of strategies for enhancing competitiveness and efficiency

		Frequency	Percent	Cumulative Percent
Valid Qn. 13a	Neutral	65	15.9	15.9
	Not Likely	176	43.0	58.9
	Probably	168	41.1	100.0
	Total	409	100.0	
Valid Qn. 13b	Neutral	66	16.1	16.1
	Not Likely	139	34.0	50.1
	Probably	204	49.9	100.0
	Total	409	100.0	
Valid Qn. 13c	Neutral	66	16.1	16.1
	Not Likely	139	34.0	50.1
	Probably	204	49.9	100.0
	Total	409	100.0	
Valid Qn. 13d	Neutral	66	16.1	16.1
	Not Likely	153	37.4	53.5
	Probably	190	46.5	100.0
	Total	409	100.0	

Note. Researcher's Conception

Similarly, respondents were invited to rate their agreement (Agree, Disagree, or Neutral) with a series of statements about the impact of DT on international trade. These research questions were designed to capture participants' perspectives covering multiple dimensions, such as the digital divide, competitiveness and efficiency, performance, service quality, communication, and customer experience. The statements presented were: 14a. "*DT is essential for achieving digital harmony and digital accretion,*" 14b. "*DT drives efficiency in import/export activities*," 14c. "*DT enhances performance in international trade," 14d. "DT improves service quality in international trade*," 14e. "*DT facilitates better communication in international trade,*" 14f. "*DT enriches the customer experience in international trade*," and 14g. "*Privatization of DSM port operations can enhance digital transformation and generate increased international trade output."*

The responses revealed varying levels of agreement across the statements related to digital infrastructure, indicating mixed perceptions among participants. Specifically, 181 (44.3%) agreed with statement 14a, 240 (58.7%) with 14b, 202 (49.4%) with 14c, 231 (56.5%) with 14d, 224 (54.8%) with 14e, 232 (56.7%) with 14f, and 230 (56.2%) with 14g. These results suggest that a majority of respondents recognized the importance of digital infrastructure in supporting import/export activities, particularly in relation to statements 14b, 14d, 14e, 14f, and 14g, where agreement exceeded 50%. However, disagreement was also notable for several statements, indicating that a significant portion of respondents did not share the same level of confidence in the adequacy or effectiveness of digital infrastructure; for example, 198 (48.4%) disagreed with 14a, 90 (22.0%) with 14b, 134 (32.8%) with 14c, 116 (28.4%) with 14d, 109 (26.7%) with 14e, 112 (27.4%) with 14f, and 134 (32.8%) with 14g. A smaller proportion of participants remained neutral, reflecting uncertainty or ambivalence toward certain statements, with neutral responses including 30 (7.3%) for 14a, 79 (19.3%) for 14b, 73 (17.8%) for 14c, 62 (15.2%) for 14d, 76 (18.6%) for 14e, 65 (15.9%) for 14f, and 45 (11.0%) for 14g. The variation in responses reflects differing perceptions of DT's role in international trade and port operations, likely shaped by individual experience and exposure. The notable levels of disagreement and neutrality indicate skepticism or uncertainty, underscoring the need for targeted education and stakeholder engagement to build a clearer understanding of DT's benefits. Addressing these divergent views is essential for developing inclusive strategies that support effective DT implementation across the sector. Table 15 presents the distribution of responses for Question 14 on digital infrastructure.

Table 15

Question 14: levels of agreement with respect to digital infrastructure

		Frequency	Percent	Cumulative Percent
Valid	Neutral	30	7.3	7.3
Qn. 14a	Disagree	198	48.4	55.7
	Agree	181	44.3	100.0
	Total	409	100.0	
Valid	Neutral	79	19.3	19.3
Qn. 14b	Disagree	90	22.0	41.3
	Agree	240	58.7	100.0
	Total	409	100.0	
Valid	Neutral	73	17.8	17.8
Qn. 14c	Disagree	134	32.8	50.6
	Agree	202	49.4	100.0
	Total	409	100.0	
Valid	Neutral	62	15.2	15.2
Qn. 14d	Disagree	116	28.4	43.5
	Agree	231	56.5	100.0
	Total	409	100.0	
Valid	Neutral	76	18.6	18.6
Qn. 14e	Disagree	109	26.7	45.2
	Agree	224	54.8	100.0
	Total	409	100.0	
Valid	Neutral	65	15.9	15.9
Qn. 14f	Disagree	112	27.4	43.3
	Agree	232	56.7	100.0
	Total	409	100.0	
Valid	Neutral	45	11.0	11.0
Qn. 14g	Disagree	134	32.8	43.8
	Agree	230	56.2	100.0
	Total	409	100.0	

Note. Researcher's Conception

In Question 15 of the research questionnaire, participants were asked whether digital infrastructure influences DT in international trade. A significant 321 (78.5%) of participants agreed that digital infrastructure is crucial for enabling successful DT and improving trade processes. This strong consensus highlights the importance of robust digital systems, such as automated tools and real-time tracking, in streamlining operations and reducing bottlenecks. Rachinger and Müller (2024) emphasize that investing in digital infrastructure is essential for optimizing global trade activities. In contrast, 88 (21.5%) of participants disagreed, reflecting a minority viewpoint that may stem from differing interpretations or limited access to such infrastructure. These findings underscore the foundational role of digital infrastructure in driving DT within international trade and suggest that addressing infrastructure gaps should be a priority for policymakers and industry leaders. Table 16 presents the responses to Question 15 on the extent to which digital infrastructure can improve performance.

Table 16

Question 15: extent to which digital infrastructure improve performance

		Frequency	Percent	Cumulative Percent
Valid Qn. 15	No	88	21.5	21.5
	Yes	321	78.5	100.0
	Total	409	100.0	

Note. Researcher's Conception

In response to Question 16 of the research questionnaire, participants were asked to rank the extent to which they believe digital infrastructure (DI) can improve performance in international trade, using a Likert scale where 3 represented the Highest Extent, 2 the Moderate Extent, and 1 the Least Extent. The results showed that 150 (36.7%) of participants selected the Highest Extent, indicating a strong belief in the significant positive impact of DI on trade performance. Meanwhile, 143 (35.0%) rated it as having a Moderate Extent of influence, suggesting that although they recognize its benefits, they may view its effectiveness as dependent on other supporting factors. Notably, 116 (28.4%) of respondents selected the Least Extent, reflecting concerns or skepticism about the direct relationship between DT, digital infrastructure, and trade performance. These findings highlight the range of participant perceptions and varying levels of confidence in the role of DI in enhancing international trade through DT. Understanding these diverse views can offer valuable insights for policymakers and stakeholders seeking to optimize digital infrastructure investments, accelerate DT, bridge the digital divide, and ultimately maximize performance in international trade. Table 17 presents the responses to Question 16 regarding the extent to which digital infrastructure influences DT.

Table 17

Question 16: extent to which digital infrastructure influence DT

		Frequency	Percent	Cumulative Percent
Valid Qn. 16	Least Extent	116	28.4	28.4
	Moderate Extent	143	35.0	63.3
	Highest Extent	150	36.7	100.0
	Total	409	100.0	

Note. Researcher's Conception

Participants were asked to assess the extent to which they believe various factors of digital infrastructure influence DT in international trade, selecting from High Extent, Moderate Extent, or Least Extent. This inquiry aimed to explore the perceived importance of digital infrastructure in facilitating DT within international trade. The insights gathered included: 17a. "*Internet connectivity*" (e.g., hotspots, broadband, cloud services), which provides the foundational network infrastructure necessary for seamless digital operations; 17b. "*Connectivity technology*" (e.g., 2G, 3G, 4G, 5G), which highlights advancements in mobile and wireless communication that enhance data transmission speeds and accessibility; 17c. "*Communication channels*" (e.g., SMS, emails, voice calls), representing various methods of information exchange that influence collaboration and decision-making processes; and 17d. "*Digital platforms*" (e.g., social media, Uber, YouTube), which reflect the evolving digital ecosystem shaping consumer behavior and facilitating trade interactions. By analyzing participants' perceptions of these factors, the study seeks to uncover critical areas that either drive the successful implementation of digital initiatives in international trade or pose significant barriers to their growth and effectiveness. This insight should help organizations to identify actionable strategies for overcoming the barriers and capitalizing on international trade opportunities.

The responses revealed a broad range of opinions regarding the factors influencing DT in international trade. Notably, 74 (18.1%) of participants rated internet connectivity (17a) as having a high extent of influence, underscoring its foundational role in enabling effective digital operations. Similarly, 117 (28.6%) assigned high importance to connectivity technology (17b), reflecting confidence in the role of advancements such as 4G and 5G in improving trade efficiency. Regarding communication channels (17c), 95 (23.2%) acknowledged their importance in facilitating information exchange and collaboration with decision-makers, while 102 (24.9%) recognized the influence of digital platforms (17d), pointing to the growing relevance of social media and other digital services in shaping international trade dynamics.

Conversely, a considerable proportion of participants expressed disagreement with the influence of these factors, indicating skepticism about their actual impact. Specifically, 150 (36.7%) disagreed with the importance of internet connectivity (17a), 169 (41.3%) with connectivity technology (17b), 187 (45.7%) with communication channels (17c), and 188 (46.7%) with digital platforms (17d). These high levels of dissent suggest that many participants remain unconvinced about the direct correlation between these technological elements and the success of DT initiatives, possibly due to limited exposure to digital tools, prior negative experiences, or lack of awareness. This highlights the need for more focused education, training, and stakeholder engagement to build confidence in DT.

In addition to disagreement, a significant number of respondents expressed uncertainty. A total of 185 (45.2%) were unsure about the impact of internet connectivity (17a), 123 (30.1%) about connectivity technology (17b), 127 (31.1%) about communication channels (17c), and 119 (29.1%) about digital platforms (17d). This widespread indecision suggests that many participants lack consistent experience or clear information regarding how these technologies contribute to DT. While some respondents recognize the potential of digital tools to enhance efficiency and integration, others remain hesitant, citing concerns about implementation, accessibility, or long-term sustainability. The lack of consensus points to a broader knowledge gap and highlights the importance of targeted initiatives to improve understanding and trust in DT efforts. Table 18 presents the responses to Question 17 on factors influencing DT in international trade.

Table 18

Question 17: factors influencing DT in international trade

		Frequency	Percent	Cumulative Percent
Valid Qn. 17a	Least Extent	185	45.2	45.2
	Moderate Extent	150	36.7	81.9
	High Extent	74	18.1	100.0
	Total	409	100.0	
Valid Qn. 17b	Least Extent	123	30.1	30.1
	Moderate Extent	169	41.3	71.4
	High Extent	117	28.6	100.0
	Total	409	100.0	
Valid Qn. 17c	Least Extent	127	31.1	31.1
	Moderate Extent	187	45.7	76.8
	High Extent	95	23.2	100.0
	Total	409	100.0	
Valid Qn. 17d	Least Extent	119	29.1	29.1
	Moderate Extent	188	46.0	75.1
	High Extent	102	24.9	100.0
	Total	409	100.0	

Note. Researcher's Conception

In question 18, respondents were asked to express their level of agreement (Agree, Disagree, or Neutral) with several statements regarding the opportunities presented by DT in international trade. The statements included: 18a. "*Internet connectivity is essential for enabling DT in international trade,*" 18b. "*Connectivity technology influences the speed of DT*," 18c. "*Communication channels facilitate DT in international trade*," 18d. "*Digital platforms enhance competitiveness and efficiency in international trade*," 18e. "*Weak digital infrastructure leads to digital inequality and a digital divide*," and 18f. "*Privatization of DSM port operations can improve digital infrastructure*." This inquiry aimed to gauge participants' perceptions of how these factors impact the success of DT in the trade sector.

The findings illustrate a variety of perspectives regarding statements about DT opportunities in international trade. Specifically, 177 (43.3%) of respondents agreed with statement 18a, which asserts that "*Internet connectivity is crucial for enabling DT in international trade.*" An even larger portion, 259 (63.3%), supported statement 18b, highlighting that "*Connectivity technology affects the pace of digital transformation*." Additionally, 192 (46.9%) affirmed statement 18c, noting that "*Communication channels aid in facilitating digital transformation in international trade*," while 245 (59.9%) agreed with statement 18d, which asserts that "*Digital platforms improve competitiveness and efficiency in international trade*." These results suggest that while participants generally recognize the importance of digital tools and technologies, they place varying emphasis on specific aspects of digital infrastructure. Furthermore, 214 (52.3%) endorsed statement 18e, which discusses the implications of inadequate digital infrastructure, indicating concerns about existing gaps and their potential impact on trade performance. Similarly, 231 (56.5%) concurred with the assertion that "*Privatization of DSM port operations can enhance digital infrastructure,*" reflecting a belief that strategic reforms and technology transfer from developed countries could strengthen the port's digital capabilities. Table 19 presents the responses to Question 18 on perspectives of DT opportunities in international trade.

Table 19

Question 18: perspectives of DT opportunities in international trade

		Frequency	Percent	Cumulative Percent
Valid	Neutral	17	4.2	4.2
Qn. 18a	Disagree	215	52.6	56.7
	Agree	177	43.3	100.0
	Total	409	100.0	
Valid	Neutral	75	18.3	18.3
Qn. 18b	Disagree	75	18.3	36.7
	Agree	259	63.3	100.0
	Total	409	100.0	
Valid	Neutral	72	17.6	17.6
Qn. 18c	Disagree	145	35.5	53.1
	Agree	192	46.9	100.0
	Total	409	100.0	
Valid	Neutral	64	15.6	15.6
Qn. 18d	Disagree	100	24.4	40.1
	Agree	245	59.9	100.0
	Total	409	100.0	
Valid	Neutral	70	17.1	17.1
Qn. 18e	Disagree	125	30.6	47.7
	Agree	214	52.3	100.0
	Total	409	100.0	
Valid	Neutral	66	16.1	16.1
Qn. 18f	Disagree	112	27.4	43.5
	Agree	231	56.5	100.0
	Total	409	100.0	

Note. Researcher's Conception

In addition, Table 19 shows a notable level of disagreement among participants regarding various statements about DT, highlighting diverse perceptions. For instance, 215 (52.6%) rejected the idea that internet connectivity is essential for facilitating DT, reflecting skepticism about its necessity. Conversely, only 75 (18.3%) disagreed with the statement emphasizing the importance of connectivity technology in enhancing the speed of DT, indicating a stronger consensus on this point. Notably, 145 (35.5%) opposed the assertion that communication channels facilitate DT, suggesting divided opinions on this issue. Additionally, 100 (24.4%) were skeptical about the effectiveness of digital platforms in boosting competitiveness and efficiency, while 125 (30.6%) expressed concerns regarding digital inequality, pointing to a widening gap in access to resources. Finally, 112 (27.4%) disagreed with the potential benefits of privatizing port operations. This spectrum of disagreement illustrates the complex attitudes toward DT and the various factors shaping stakeholders' beliefs in the domain of global commerce.

Despite the fact that many participants agreed that DT creates opportunities in international trade through internet connectivity, connectivity technology, communication channels, and digital platforms, a significant number also expressed uncertainty. This is evident in statement 18a, where 17 (4.2%) were undecided about the necessity of internet connectivity, and in 18b, where 75 (18.3%) questioned the impact of connectivity technology. Additionally, 72 (17.6%) were neutral on the role of communication channels in 18c, and 64 (15.6%) were undecided about the effectiveness of digital platforms in 18d. Uncertainty also emerged regarding the implications of weak digital infrastructure in 18f, where 70 (17.1%) were undecided, and the benefits of port privatization in 18g, where 66 (16.1%) were neutral. These findings indicate a complex array of opinions among stakeholders, emphasizing the need for further investigation into perceptions of DT's influence on international trade to inform effective strategies and enhance stakeholder engagement.

When participants responded to Question 19 of the research questionnaire, which explored the influence of regulatory frameworks on DT in international trade, a significant majority of respondents (274; 67.0%) expressed agreement, while 135 (33.0%) disagreed. These results emphasize the pivotal role that robust regulatory frameworks play in driving successful DT within the trade sector. Strong regulatory frameworks provide the legal foundation and structural support necessary to foster innovation, ensure compliance, and cultivate trust among stakeholders. By setting clear guidelines and operational standards, they enable businesses to navigate the complexities of digital adoption with greater confidence. Moreover, such frameworks create a stable and predictable environment that reduces uncertainty and promotes the seamless integration of digital technologies into existing trade practices. This regulatory stability encourages investment in digital solutions, as companies can rely on consistent policies that protect digital infrastructure and intellectual property. Ultimately, this environment not only streamlines trade processes but also enhances efficiency, transparency, and overall competitiveness in international trade. The positive impact of strong regulatory frameworks extends beyond immediate trade processes, fostering long-term growth by facilitating innovation, improving digital connectivity, and ensuring the sustainability of digital initiatives across borders. Table 20 presents the responses to Question 19 regarding the role of robust regulatory frameworks.

Table 20

Question 19: the role of robust regulatory frameworks

		Frequency	Percent	Cumulative Percent
Valid	No	135	33.0	33.0
	Yes	274	67.0	100.0
	Total	409	100.0	

Note. Researcher's Conception

In addressing Question 20 of the research questionnaire, participants were asked to evaluate the extent to which they believe regulatory frameworks contribute to improving performance in international trade, using a Likert scale where 3 indicated the Highest Extent, 2 represented a Moderate Extent, and 1 signified the Least Extent. The results revealed that 144 (35.2%) of respondents selected the Highest Extent, reflecting strong confidence in the positive impact of regulatory frameworks on trade performance. Conversely, 176 (43.0%) rated its influence as Moderate Extent, suggesting that while they recognize its benefits, they may view its effectiveness as dependent on additional factors. Additionally, 89 (21.8%) chose Least Extent, indicating concerns about the direct connection between DT, regulatory frameworks, and international trade outcomes. These findings illustrate a range of opinions among participants, highlighting differing levels of confidence in the regulatory framework's ability to enhance international trade through DT. Table 21 presents the responses to Question 20 regarding how regulatory frameworks contribute to improving performance.

Table 21
Question 20: how regulatory frameworks contribute to improving performance

		Frequency	Percent	Cumulative Percent
Valid	Least Extent	89	21.8	21.8
	Moderate Extent	176	43.0	64.8
	Highest Extent	144	35.2	100.0
	Total	409	100.0	

Note. Researcher's Conception

In Question 21 of the research questionnaire, participants evaluated the influence of various regulatory factors on the advancement of DT in international trade. Responses were categorized into three levels: "*High Extent*", "*Moderate Extent*", and "*Least Extent*", and focused on ICT and regulatory policy (e.g., National ICT Policy), trade sanctions (import/export restrictions), data flow restrictions, and security and protection measures. The purpose of capturing these perceptions was to identify the key regulatory factors that might shape the DT landscape in global trade contexts.

The results of the analysis reveal a notable trend where all four regulatory categories received the highest percentage of responses under the "*Least Extent*" option. This suggests that many participants do not view these regulatory factors as significantly advancing DT. For example, ICT and regulatory policy received a "*Least Extent*" response from 176 (43.0%) of participants, while trade sanctions, data flow restrictions, and security and protection received 129 (29.6%), 150 (36.7%), and 128 (31.3%), respectively. These findings indicate that while these regulatory factors are acknowledged, they are not generally perceived as strong drivers of DT. This perception could reflect a gap in awareness or understanding of the role regulatory frameworks play in fostering digital progress. Regulations such as policies on internet connectivity, communication channels, digital platforms, and broader legislative frameworks are often viewed as having a limited or indirect impact on advancing DT. This could be due to a lack of clarity in their implementation, inconsistent application across sectors, or an insufficient focus on how these regulatory elements are integral to digital infrastructure development. As a result, the failure to align regulatory policies with the needs of DT may hinder international trade opportunities. To address this, clearer communication, more robust engagement with stakeholders, and supportive policies are needed to demonstrate the strategic importance of regulatory support in accelerating DT within international trade.

In contrast, the "*Moderate Extent*" category displayed notably stronger scores across all assessed areas, indicating a more nuanced perspective among participants. Specifically, ICT and regulatory policy achieved a score of 174 (42.5%), trade sanctions garnered 201 (49.1%), data flow restrictions reached 169 (41.3%), and security and protection concluded with 190 (46.5%). This viewpoint may reflect cautious optimism regarding the ability of regulations to shape DT in international trade, suggesting that participants believe these frameworks can facilitate progress but do not view them as the key drivers of change in this evolving digital economy.

Lastly, the scores for the "*High Extent*" category were notably lower across the board, with ICT and regulatory policy at 59 (14.4%), trade sanctions at 87 (21.3%), data flow restrictions at 90 (22.0%), and security and protection at 91 (22.2%). This indicates that very few participants believe these regulatory elements significantly accelerate DT. Most respondents view regulatory frameworks as barriers rather than enablers, with trade sanctions and data flow restrictions seen as examples that may slow the adoption of digital technologies. The data underscore the complexity of the regulatory environment and suggest a limited understanding of its impact, especially given that DT is still in its infancy stages in Tanzania. Engaging stakeholders in further discussions could help clarify their potential roles in enhancing DT in international trade. Table 22 presents the responses to Question 21 regarding regulatory factors perceived as strong drivers of DT.

Table 22

Question 21: regulatory factors perceived as strong drivers of DT

		Frequency	Percent	Cumulative Percent
Valid Qn. 21a	Least Extent	176	43.0	43.0
	Moderate Extent	174	42.5	85.6
	Highest Extent	59	14.4	100.0
	Total	409	100.0	
Valid Qn. 21b	Least Extent	121	29.6	29.6
	Moderate Extent	201	49.1	78.7
	Highest Extent	87	21.3	100.0
	Total	409	100.0	
Valid Qn. 21c	Least Extent	150	36.7	36.7
	Moderate Extent	169	41.3	78.0
	Highest Extent	90	22.0	100.0
	Total	409	100.0	
Valid Qn. 21d	Least Extent	128	31.3	31.3
	Moderate Extent	190	46.5	77.8
	Highest Extent	91	22.2	100.0
	Total	409	100.0	

Note. Researcher's Conception

Lastly, the last question of the questionnaire (question number 22) asked participants to indicate their level of agreement or disagreement with a series of statements regarding the impact of various regulatory factors on DT in international trade. The statements included: 22a. "*Regulatory frameworks influence DT in international trade,*" 22b. "*Sanctions restrict* *performance in international trade*,” 22c. “*Data flow restrictions are bottlenecks to DT in international trade*,” 22d. “*Security and protection are required to mitigate risks associated with DT*,” 22e. “*Regulatory frameworks provide opportunities for competitiveness and efficiency in international trade*,” and 22f. “*Privatization of DSM port operations can improve regulatory efficiency and competitiveness*.” This section of the questionnaire was designed to capture a broad spectrum of perspectives on how the regulatory environment shapes the implementation and effectiveness of DT in the context of international trade.

The results reveal a wide range of perspectives among participants regarding the impact of various regulatory factors on DT in international trade, indicating that views on regulation are neither uniform nor straightforward. Nearly half of the respondents, 188 (46.0%), agreed that regulatory frameworks influence DT in international trade (22a), suggesting a moderate recognition of the role that policies and legal structures play in shaping DT. A larger proportion, 227 (55.5%), agreed that sanctions can negatively impact performance in international trade (22b), reflecting stronger consensus that restrictive trade measures may hinder efficiency, innovation, and digital progress. Similarly, 203 (49.6%) of participants viewed data flow restrictions as significant obstacles to DT (22c), highlighting concerns about limitations on information exchange and cross-border data movement. In addition, 225 (55.0%) believed that security and protection measures are necessary to mitigate risks associated with DT (22d), underscoring awareness of cybersecurity and data protection as critical enablers of digital trust. Furthermore, 219 (53.5%) agreed that regulatory frameworks can provide opportunities for competitiveness and efficiency in international trade (22e), while 233 (57.0%) believed that the privatization of DSM port operations could improve efficiency and competitiveness (22f), suggesting optimism toward structural reforms and private-sector involvement in enhancing regulatory effectiveness.

Alongside these agreements, notable levels of disagreement were also evident, reflecting divided opinions among stakeholders. Specifically, 191 (46.7%) of participants disagreed with statement 22a, indicating nearly equal proportions of agreement and disagreement regarding the influence of regulatory frameworks on DT. This division suggests differing experiences or perceptions of how regulations are implemented in practice. For statement 22b, 88 (21.5%) disagreed, implying that a minority of respondents do not perceive sanctions as significantly constraining international trade performance. The highest level of disagreement was recorded for statement 22c, where 133 (32.5%) felt that data flow restrictions do not constitute major obstacles to DT, possibly reflecting limited exposure to cross-border digital operations or sector-specific differences. Additionally, 116 (28.4%) disagreed that security and protection measures are necessary to mitigate DT-related risks (22d), 117 (28.6%) disagreed that regulatory frameworks provide opportunities for competitiveness and efficiency (22e), and 109 (26.7%) disagreed that privatization of DSM port operations can enhance efficiency and competitiveness (22f), indicating persistent skepticism toward both regulatory effectiveness and privatization initiatives.

In addition to agreement and disagreement, a noticeable proportion of respondents expressed uncertainty across all statements, further emphasizing the complexity of regulatory perceptions. For statement 22a, 30 (7.3%) were undecided, while uncertainty increased substantially for statement 22b, with 94 (23.0%) unsure about the impact of sanctions. Regarding data flow restrictions (22c), 73 (17.8%) of participants were uncertain, suggesting ambiguity about their practical implications for DT. Similarly, undecided responses were recorded for statements 22d, 22e, and 22f at 68 (16.6%), 73 (17.8%), and 67 (16.4%), respectively. This level of indecision highlights gaps in understanding and varying levels of exposure to regulatory frameworks, underscoring the need for further investigation, awareness building, and stakeholder engagement to clarify how regulatory factors influence DT in international trade. Table 23 presents the responses to Question 22 on the impact of regulatory factors on DT in international trade.

Table 23

Question 22: the impact of regulatory factors on DT in international trade

		Frequency	Percent	Cumulative Percent
Valid	Neutral	30	7.3	7.3
	Disagree	191	46.7	54.0
Qn. 22a	Agree	188	46.0	100.0
	Total	409	100.0	
Valid	Neutral	94	23.0	23.0
	Disagree	88	21.5	44.5
Qn. 22b	Agree	227	55.5	100.0
	Total	409	100.0	
Valid	Neutral	73	17.8	17.8
	Disagree	133	32.5	50.4
Qn. 22c	Agree	203	49.6	100.0
	Total	409	100.0	
Valid	Neutral	68	16.6	16.6
	Disagree	116	28.4	45.0
Qn. 22d	Agree	225	55.0	100.0
	Total	409	100.0	
Valid	Neutral	73	17.8	17.8
	Disagree	117	28.6	46.5
Qn. 22e	Agree	219	53.5	100.0
	Total	409	100.0	
Valid	Neutral	67	16.4	16.4
	Disagree	109	26.7	43.0
Qn. 22f	Agree	233	57.0	100.0
	Total	409	100.0	

Note. Researcher's Conception

The survey results reveal a broad range of perspectives on the role of DT in international trade, reflecting differing levels of awareness, experience, and confidence among participants. As shown in Table 13, a significant majority of respondents, 280 (68.5%), believed that successful DT fosters digital harmony, indicating strong support for its transformative potential, although 85 (20.8%) expressed skepticism. When assessing strategies to enhance competitiveness and efficiency in Tanzania's import and export sector (Table 14), 168 (41.1%) supported DT readiness as a key driver, while others questioned its likely impact, suggesting mixed expectations regarding implementation outcomes. Similarly, Table 16 highlights strong consensus on the importance of digital infrastructure, with 321 (78.5%) of participants recognizing its critical role in enabling DT and creating international trade opportunities. In relation to governance, Table 20 shows that 274 (67.0%) of respondents agreed that regulatory frameworks influence DT, while 135 (33.0%) disagreed, reflecting varied perceptions of regulatory effectiveness.

The final phase of the questionnaire, presented in Table 23 (Question 22), further explored participants' views on specific regulatory factors influencing DT and revealed even more diverse opinions. While 188 (46.0%) agreed that regulatory frameworks influence DT, a larger proportion, 227 (55.5%), believed that sanctions hinder trade performance. In contrast, fewer participants, 73 (17.8%), viewed data flow restrictions as significant obstacles to DT. Notable levels of disagreement and uncertainty across these regulatory dimensions highlight gaps in understanding and differing interpretations of how regulations shape DT outcomes in international trade.

The quantitative analysis revealed mixed but informative perceptions regarding DT and regulatory frameworks. Although many respondents acknowledged the importance of DT in enhancing efficiency and competitiveness, substantial disagreement and neutrality point to uneven digital readiness and digital literacy concerns among stakeholders. Similarly, while regulatory frameworks were broadly recognized as influential, specific regulatory elements were perceived as constraints rather than enablers, suggesting gaps in policy clarity, implementation, and alignment with DT objectives. In line with Hohlov and Ershova (2018), these findings underscore the need for clearer and better-aligned policies to effectively support DT in international trade. Building on these quantitative insights, the next section presents the qualitative analysis, which provides deeper context and explores stakeholders' experiences and perceptions in greater detail.

Qualitative Data Analysis

Qualitative data analysis is a methodological approach aimed at examining complex phenomena by generating rich, in-depth descriptions and interpreting participants' lived experiences. According to Creswell (2015), qualitative research is particularly well suited for exploring the meanings that individuals or groups assign to social or human issues. This approach typically employs methods such as interviews, observations, and document analysis to capture nuanced insights within real-world contexts. Expanding on this, Creswell and Poth (2016) emphasize the importance of a structured approach to qualitative inquiry, advocating for rigorous data coding, thematic development, and reflexivity throughout the research process. Opland et al. (2022) further contribute to this discussion by addressing contemporary challenges in qualitative interpretation, particularly in contexts involving large or unstructured datasets, and highlight the value of technology-assisted analysis to maintain validity. Similarly, Yaslioglu and Yaslioglu (2020) argue that qualitative methods provide deeper insight into human behavior and decision-making, especially when exploring complex organizational or cultural dynamics. Together, these scholars underscore the importance of methodological rigor, contextual awareness, and interpretive depth in conducting effective qualitative research.

In this study, qualitative data analysis employed both content analysis and thematic analysis techniques to interpret broader meanings and patterns emerging from textual data. Following Creswell's (2015) guidance, the researcher began by immersing in the data through repeated readings and reflections to gain a deep understanding of the content. This process was followed by manual coding to identify recurring themes, concepts, and expressions. Codes were then grouped into categories based on shared patterns and underlying meanings. As outlined by Creswell and Poth (2016), reflexivity was incorporated throughout the analysis to ensure that interpretations were grounded in participants' perspectives rather than influenced by the researcher's personal biases. Thematic analysis was particularly useful in identifying patterns related to the adoption of digital tools in trade operations, while content analysis allowed for a structured examination of how frequently and in what context specific themes appeared. In line with Opland et al., (2022), the study also utilized NVivo software to assist with sorting and organizing qualitative data, improving accuracy and traceability in the analysis.

This section presents the qualitative findings of the study on the opportunities of DT in international trade, with specific emphasis on import/export activities at the DSM port in Tanzania. Data were collected through key informant interviews with stakeholders involved in port operations and trade facilitation. Thematic analysis was employed to systematically examine the interview data. Themes and codes were developed to capture recurring patterns related to ICT use, benefits of DT, DT strategies, digital infrastructure, and regulatory frameworks. The findings were presented using a thematic structure and were supported by participants' narratives to illustrate key insights and experiences.

The thematic analysis generated five major themes and corresponding codes that reflect the key dimensions of DT in port operations. The first theme, ICT use, captures the various technological tools and systems employed in daily import/export activities, including computer use, trade software, electronic documentation, and communication tools. This theme illustrates the extent of technology adoption and highlights how stakeholders rely on digital systems to manage operational tasks, information exchange, and documentation processes. The second theme, DT benefits, describes the positive outcomes associated with digitalization, such as time efficiency, cost reduction, accuracy, transparency, and faster clearance. These benefits demonstrate how DT improves operational performance by reducing delays, eliminating bureaucracy, minimizing errors, and increasing accountability in trade processes. The third theme, DT strategies, emphasizes the strategic actions necessary to enhance competitiveness, including automation, system integration, online platforms, and competitiveness improvement. This theme shows that stakeholders recognize the need for deliberate and coordinated digital initiatives to strengthen trade efficiency. The fourth theme, DT infrastructure, underscores the importance of reliable digital infrastructure as an enabler of DT, encompassing internet reliability, system availability, infrastructure adequacy, and operational efficiency. This theme highlights that without stable and robust digital infrastructure, digital tools and systems cannot function effectively, leading to disruptions in trade operations. Finally, the regulatory frameworks theme illustrates how supportive policies and efficient regulations can either facilitate or hinder digital adoption. Together, these themes and codes provide a comprehensive framework for understanding the opportunities of DT at the DSM port, as summarized in Table 24.

Table 24
Themes and Codes

Theme	Codes
ICT use	Computer use, trade software, electronic documentation, communication tools
DT benefits	Time efficiency, cost reduction, accuracy, transparency, faster clearance
DT strategies	Automation, system integration, online platforms, competitiveness improvement
DT Infrastructure	Internet reliability, system availability, infrastructure adequacy, operational efficiency
Regulatory Frameworks	Supportive policies, regulatory efficiency, ease of compliance, trade facilitation

Note. Researcher's Conception

The qualitative findings of this study indicate that DT at DSM port is driven by the adoption of ICT tools, which facilitate trade operations through improved documentation, communication, and process management. This observation aligns with CARE theory, which emphasizes the need to support human dignity and ethical considerations in research and practice, particularly through informed consent, anonymity, and compliance with regulatory requirements. In the context of this study, participants signed informed consent forms before data collection, anonymity was ensured, and the study complied with the ethical requirements provided by both the UREC and COSTECH, demonstrating adherence to ethical research standards.

The findings also highlight strategic digital initiatives such as automation, system integration, and online platforms, which are viewed as essential for improving competitiveness. This aligns with dynamic capability theory, which emphasizes that organizations must continuously sense and seize opportunities by adapting, integrating, and reconfiguring internal and external resources to respond to changing environments. DT at DSM port can thus be understood as a dynamic capability that enables stakeholders to reconfigure processes, integrate systems across agencies, and adapt to evolving trade demands. The findings further emphasize the importance of digital infrastructure, including reliable internet and system availability, which enables the port to maintain continuity in operations. This is consistent with dynamic capability theory, which stresses the need for organizations to develop internal capabilities (such as ICT infrastructure) that allow them to sense and respond to environmental changes.

Moreover, the study underscores the significance of regulatory frameworks and inter-organizational collaboration in facilitating DT. This is in line with network theory, which highlights the importance of relationships and interactions among stakeholders (nodes) in achieving collective outcomes. The port environment involves multiple actors, including customs, shipping agents, clearing agents, government officials, private sector experts and port authorities, who must coordinate activities through integrated systems and shared digital platforms. The findings show that supportive policies and regulatory efficiency enable smoother digital adoption and enhance trade facilitation, reinforcing network theory's argument that effective coordination and shared governance structures improve collective performance. The identified drawbacks, such as skills gaps, high costs, and resistance to change, reflect barriers that can disrupt network coordination and hinder the development of dynamic capabilities.

The findings indicate that DT at DSM port is not only a technological shift but also a strategic capability that depends on connectivity, infrastructure, regulatory support, and collaborative networks. Integrating CARE theory, dynamic capability theory, and network theory provides a comprehensive understanding of how DT enhances international trade opportunities, improves competitiveness, and drives efficiency in import/export activities at DSM port. This theoretical integration also aligns with existing literature, which emphasizes that successful DT requires both technological adoption and strategic adaptation supported by robust infrastructure and collaborative stakeholder networks (Creswell & Poth, 2016; Opland et al., 2022).

The qualitative findings provided detailed insights into the DT landscape at the DSM port, with participants highlighting how digital technologies enhance operational efficiency and create international trade opportunities. These insights complemented the quantitative results by explaining the underlying mechanisms and contextual factors behind observed trends. The integration of qualitative and quantitative findings facilitated pattern recognition, trend analysis, and a more comprehensive evaluation of variables related to DT. By combining narrative insights with numerical evidence, the study adopted a mixed-methods approach, which is particularly effective for exploring complex phenomena (Creswell & Poth, 2016). This approach enabled a deeper and more nuanced understanding of how DT enhances international trade opportunities while improving competitiveness and efficiency in import/export activities at DSM port.

Summary of Chapter 3

Chapter three presents the research methodology and design employed to investigate the impact of DT on international trade in Tanzania, with a specific focus on import/export activities at the DSM Port. The chapter examines the opportunities that DT presents for developing countries, while also identifying key constraints such as high technology costs, limited policy frameworks, and inadequate digital infrastructure that hinder the realization of the full potential of international trade, particularly in underserved regions (Tiwasing, 2021).

Recognizing that developing countries remain disadvantaged by a widening digital divide despite global advancements in trade digitalization, the study examines the role of digital infrastructure and regulatory frameworks in enhancing efficiency and competitiveness in Tanzania (Peprah, Atarah & Kumodzie-Dussey, 2024). To address the complexity of DT within the international trade system, the research adopts a mixed methods approach, integrating quantitative and qualitative data to provide a comprehensive and context-sensitive understanding of DT processes at DSM Port. Methodological triangulation is used to strengthen analytical rigor and to generate robust insights into strategies for bridging the digital divide (Zhang, Xu & Ma, 2022).

The study employs a mixed methods research design that leverages the complementary strengths of quantitative and qualitative methodologies. This design is particularly suitable for analyzing DT, which involves multidimensional interactions among technological, institutional, and human factors. By combining cross-sectional and causal analytical techniques, the research examines statistical relationships while also capturing in-depth stakeholder perspectives related to trade operations (Sarstedt et al., 2018). This integrated design facilitates the identification of patterns and trends in digital trade and enables an assessment of how digital infrastructure and regulatory frameworks influence international competitiveness and trade efficiency.

A total sample of 409 respondents was drawn from key stakeholder groups within Tanzania's trade ecosystem, including importers, exporters, customs agents, port employees, private-sector representatives, and government officials. The study employed stratified random sampling to ensure representation across major trade sectors, complemented by purposive sampling to target individuals with specialized expertise and influence in DT and trade policy. This approach enhanced the representativeness and analytical depth of the dataset, capturing diverse experiences and perspectives relevant to DT in import and export activities (Sarstedt et al., 2018; Oribhabor & Anyanwu, 2019).

Data collection involved the use of both questionnaires and interviews to capture quantitative and qualitative insights. The questionnaire comprised multiple-choice, Likert-scale, and closed-ended questions designed to measure participants' perceptions and experiences of DT. In contrast, interviews provided qualitative depth by exploring stakeholder views on opportunities in digital trade (Farquhar, Michels & Robson, 2020; Grassini & Laumann, 2020). Both instruments were pre-tested to ensure clarity and consistency, with pilot testing conducted to refine the tools prior to full deployment (Weyant, 2022; Kumar, 2018).

The study operationalized its key constructs which include Digital Transformation (DT), Digital Infrastructure (DI), Regulatory Frameworks (RF), International Trade Opportunities (ITO), Global Competitiveness (GLC), and Efficiency in Import/Export Activities (EIM) to ensure conceptual clarity and empirical rigor (Vaska et al., 2021). These constructs were defined in direct alignment with the study's objectives and contextualized to the Tanzanian trade environment to facilitate a robust examination of the interrelationships among digital infrastructure, regulatory frameworks, and trade outcomes. For instance, Digital Infrastructure (DI) was defined as the physical and technological resources that support digital trade, while Regulatory Frameworks (RF) encompassed the policies, laws, procedures, standards, and ICT-related practices governing digital trade. Rigorous operationalization was essential to ensuring construct validity and enabling the reliable replication of the research design in comparable contexts (Cooper & Schindler, 2014).

Prior to analysis, the dataset underwent comprehensive cleaning to address inconsistencies, remove irrelevant information, and ensure participant anonymity. Ethical standards were rigorously upheld throughout the research process, including informed consent, confidentiality, and data security. Ethical approval was obtained from the University Research Ethics Committee (UREC) and the Tanzania Commission for Science and Technology (COSTECH), ensuring full compliance with institutional and national research ethics requirements (Bougie & Sekaran, 2019; Lemken, 2021; Martin & Balestra, 2019).

Quantitative data analysis was conducted using Structural Equation Modeling (SEM), a robust technique for examining complex relationships among observed and latent variables (Yaslioglu & Yaslioglu, 2020). Using SPSS Amos, SEM enabled the assessment of both direct and indirect relationships among DT, DI, RF, ITO, GLC, and EIM. Model adequacy and validity were evaluated using established goodness-of-fit indices, including chi-square statistics, the Goodness-of-Fit Index (GFI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA), ensuring the reliability and robustness of the analytical model (Arbuckle, 2022; Hair Jr., Howard & Nitzl, 2020).

The qualitative component of the study employed thematic analysis, supported by NVivo software, to identify recurring themes and patterns from stakeholder interviews (Opland et al., 2022). Integrating qualitative findings with SEM results enabled a holistic interpretation of the research problem and strengthened the credibility and trustworthiness of the conclusions through methodological triangulation (Zhang, Xu & Ma, 2022).

The study tested six core hypotheses to examine the influence of digital transformation (DT) on international trade opportunities in Tanzania. These hypotheses assessed the direct effects of DT on international trade opportunities (ITO), global competitiveness (GLC), and efficiency in import/export activities (EIM), as well as the moderating roles of competition and operational efficiency in shaping these relationships (Humphreys et al., 2019). In addition, selected hypotheses challenged conventional assumptions regarding the necessity of robust digital infrastructure and comprehensive regulatory frameworks for successful DT, proposing that institutional support, human capital, and market dynamics may play a decisive role in the Tanzanian context (Bonina et al., 2021). The moderating role of efficiency was specifically examined to determine whether variations in operational efficiency amplify or constrain the effects of DT on ITO and, subsequently, on GLC and EIM. Examining these moderating mechanisms is essential for understanding the contextual conditions that influence the effectiveness of DT initiatives and for informing targeted policy and strategic interventions.

Overall, the methodological framework provides a rigorous and coherent basis for assessing DT within a developing-country trade environment. By integrating SEM based quantitative analysis with qualitative thematic insights, the study generates empirically grounded and policy-relevant evidence on the relationships among DT, digital infrastructure, regulatory frameworks, and trade performance. The findings provide a strategic roadmap for enhancing international trade through DT by identifying the institutional, technological, and operational conditions necessary for effective implementation. Chapter 4 presents a comprehensive empirical analysis of the results, while Chapter 5 synthesizes the key findings into coherent conclusions and offers strategic policy and practice-oriented recommendations to guide governance, industry stakeholders, and future digital trade initiatives.

CHAPTER 4: STUDY FINDINGS

Introduction

This chapter presents a rigorous and systematic analysis of the empirical findings arising from the investigation of DT and its impact on Tanzania's international trade, with particular emphasis on import/export activities at the DSM Port. Anchored in the conceptual framework and hypotheses developed in Chapter 1, informed by the critical literature review in Chapter 2, and grounded in the mixed methods research design outlined in Chapter 3, this chapter constitutes the core empirical contribution of the study.

The analysis integrates quantitative results derived from SEM with qualitative insights obtained from in-depth stakeholder interviews. This integrated approach enables a nuanced examination of both the structural relationships among key constructs of digital transformation, digital infrastructure, regulatory frameworks, international trade opportunities, global competitiveness, and efficiency in import/export activities and the contextual factors shaping their manifestation within Tanzania's trade ecosystem. By triangulating statistical evidence with experiential perspectives, the chapter advances a comprehensive and contextually grounded understanding of how DT operates in a developing-country setting.

The chapter begins by establishing the trustworthiness and robustness of the empirical evidence. Reliability and validity assessments, together with triangulation and member checking, are presented to demonstrate the consistency, credibility, and analytical integrity of the data. This preliminary assessment provides a solid foundation for interpreting the study's findings and ensures that subsequent analyses are empirically sound and methodologically defensible.

Following this validation, the chapter systematically examines the study's core findings in alignment with the stated research objectives and hypotheses. First, it analyses the extent to which

DT creates international trade opportunities, focusing on enabling dimensions such as digital readiness, innovation, leadership, knowledge and skills development. This section evaluates Tanzania's preparedness to leverage digital technologies within trade processes and assesses whether existing capabilities are sufficient to translate DT initiatives into tangible trade outcomes.

The chapter then investigates the moderating roles of operational efficiency and competition, examining how these factors shape the relationships between DT, international trade opportunities, global competitiveness, and efficiency in import/export activities. This analysis reveals how efficiency and competitive pressures influence the effectiveness of DT initiatives in reducing costs, streamlining trade processes, and accelerating operational performance.

Subsequent sections focus on the structural enablers of DT, specifically digital infrastructure and regulatory frameworks. The findings illuminate the extent to which limitations in digital infrastructure constrain the realization of DT benefits, while also identifying areas where targeted investment could significantly enhance trade performance. Similarly, the analysis of regulatory frameworks examines how existing policies, institutional arrangements, and governance mechanisms either facilitate or impede digital trade adoption, with particular attention to issues of policy coherence, data governance, cybersecurity, and cross-border coordination.

Finally, the chapter examines the combined impact of DT and international trade opportunities on global competitiveness and efficiency in import/export activities. The findings demonstrate that digital adoption enhances transparency, reduces lead times, improves decision-making, and strengthens Tanzania's competitive position in international trade. This chapter offers a comprehensive, evidence-based analysis of DT's influence on Tanzania's international trade, effectively linking the findings to relevant theory and policy. It also lays the groundwork for the ensuing discussion of implications, recommendations, and conclusions in Chapter 5.

Trustworthiness of Data

This study emphasizes the important role of ethical considerations in research, particularly in protecting personal data and upholding human dignity. This focus aligns with the CARE Theory, which advocates ethical responsibility and respect for participants within the research process (Leidner & Tona, 2021). The study also utilizes dynamic capabilities theory, which underscores the importance for organizations to identify, capture, and adjust their resources to effectively respond to fast-changing opportunities. This flexibility is essential for maintaining a competitive advantage in an increasingly dynamic and unpredictable trade landscape (Teece, 2018). Furthermore, the study expands on Network Theory (Moro Visconti, 2019), which posits that firms should not be examined in isolation but in relation to the networks and partnerships they form. Network Theory suggests that collaboration within these networks which is characterized by network density, betweenness centralization and the average cluster coefficient; is key to fostering global competitiveness and operational efficiency, thereby improving performance (Amalesh, et. al., 2019). By incorporating these theoretical frameworks, the research highlights the vital connection between ethical practices, organizational adaptability, and collaborative networks in achieving success in an ever evolving and globalized trade environment.

The research embraced an integrated methodological framework that merges qualitative insights with quantitative analysis to gain a comprehensive perspective on trustworthiness. The qualitative methods provided detailed and layered understanding of participants' experiences and viewpoints, allowing for a more thorough investigation into the intricate nature of ethical practices and the human aspects. In contrast, the quantitative methods provided a solid framework for measuring and analyzing specific variables, adding rigor and precision to the findings through statistical validation (Creswell, 2015). This combination of methods ensured that ethical considerations were integrated throughout the entire research process, from data collection and analysis to the reporting of findings. By emphasizing ethical standards and leveraging a mixed-methods approach, the study sought to build trust among stakeholders, fostering a more responsible and equitable approach to the generation of knowledge.

While "*trust*" and "*trustworthiness*" are often used interchangeably, they denote distinct concepts. Trust is generally understood as the absence of risk or the willingness to take risks based on faith in an individual or institution's fairness, reliability, ethics, competence, and non-threatening demeanor (Lopez Jimenez, Dittmar & Vargas Portillo, 2021). In contrast, trustworthiness encompasses the collective perceptions that foster trust. Recent research by Wang et al., (2021) describes trustworthiness as aligned with realities, while Burri (2021) view it as a process of certification and explanation. Furthermore, Bougie and Sekaran (2019) characterize trustworthiness in quantitative research as the degree of information accuracy to which individuals, organizations, or firms can be relied upon to act consistently, ethically, and competently.

Wang et al., (2021) identified credibility, transferability, dependability and confirmability as the four essential factors that contribute to the trustworthiness of qualitative research. Credibility refers to the extent to which the findings accurately represent participants' perspectives. Transferability relates to the applicability of the findings in other contexts, supported by rich, detailed descriptions of the research setting. Dependability focuses on the consistency and repeatability of the research process, maintained through comprehensive documentation and audit trails. Confirmability ensures that the findings are shaped by participants' input rather than researcher bias, achieved through reflective practices and transparent reporting. Together, these elements enhance the overall validity and reliability of qualitative research.

To validate the information obtained from questionnaires, qualitative data was gathered from key informants in the import/export sector, including representatives from government ministries, public institutions, and private organizations. NVivo software, a robust tool for qualitative data analysis, was utilized in this study to efficiently organize, analyze, and visualize unstructured data (Opland et al., 2022). The use of NVivo facilitated effective coding and categorization, allowing for a thorough examination of relationships, themes, and patterns related to DT. NVivo's advanced features, such as its ability to manage large datasets and perform complex queries, ensured that the qualitative insights were systematically analyzed and coherently organized. As noted by Creswell and Poth (2016), software like NVivo enhances the rigor and depth of qualitative analysis by providing a more structured and comprehensive approach to interpreting textual data. Figure 11 presents the word frequency map generated in NVivo, illustrating the most prominent themes and terms identified from the qualitative dataset.

Figure 11
Word Frequency Map

Note. Researcher's Conception

The word frequency analysis revealed key terms prominently associated with the study, including "*digital*," "*transformation*," "*infrastructure,*" "*regulatory*," "*framework*," "*government*," "*import/export*," "*digitalization*," "*opportunities*," "*competitiveness*," "*efficiency*," "*readiness*," "*innovation*," "*leadership*," and "*skills*." These terms were prominently displayed in larger fonts on the word frequency map, indicating their high frequency and highlighting their significance within the research context, in reference to DT in international trade.

Following the coding phase and identification of key patterns, thematic analysis was employed to interpret the qualitative data. This approach offered analytical flexibility, allowing emerging themes to be aligned with the study's theoretical framework and research objectives (Appio et al., 2021). The analysis followed an iterative process in which themes were continually reviewed and refined to ensure they accurately represented participants' perspectives and contributed to a coherent narrative (Kiani Mavi et al., 2022). Additionally, thematic analysis complemented the quantitative findings by providing deeper contextual insights, helping to address limitations inherent in quantitative methods alone. This integrative strategy enabled the results to capture the complexity and relevance in relation to the study's (Oduro, 2020).

To strengthen the study's credibility and trustworthiness, triangulation was used as a core strategy to enhance reliability and validity. This involved integrating multiple data sources and combining qualitative and quantitative methods to verify the findings and ensure methodological consistency (Creswell & Poth, 2016). Bougie and Sekaran (2019) emphasize triangulation's role in validating qualitative findings through diverse perspectives, while Creswell and Poth (2016) highlight its capacity to reduce researcher bias. By drawing on varied sources and methods, triangulation supported a more comprehensive and balanced understanding of the research problem, thereby strengthening the robustness and credibility of the study's conclusions.

The study employed four types of triangulation: methodological triangulation, data triangulation, theoretical triangulation, and investigator triangulation to enhance analytical rigor and minimize potential research bias (Zhang, Xu, & Ma, 2022). Each form contributed to a more comprehensive understanding of the research objectives. Study validity was evaluated through multiple analyses, supporting both internal and external validity (Creswell & Poth, 2016). This strengthened the generalizability of the findings across populations and contexts, thereby reinforcing their reliability and credibility (Bougie & Sekaran, 2019). By integrating diverse data sources and methodological approaches, the study yielded a nuanced understanding of DT and validated the findings through systematic triangulation (Creswell & Poth, 2016).

This research obtained quantitative data by administering structured questionnaires, while qualitative insights were obtained from key informant interviews. A pilot test was conducted at Tanga Port in northeastern Tanzania which was used to allow essential refinements to the research instruments, including rephrasing some questions, eliminating redundancies and improving the consent process based on feedback from participants. During the pilot phase, questionnaires were distributed to 15 participants as part of the research; however, only 5 responses were received, resulting in a response rate of 33%. This rate is considerably lower than the response averages reported by Holtom et al., (2022), who documented rates of 48%, 53%, 56%, and 68% in similar studies conducted in 2005, 2010, 2015, and 2020, respectively. The low response rate was attributed by various factors, including market dynamics and the relatively low rates of internet penetration in developing countries, which stand at 44.4% compared to 86.7% in developed countries (Nguyen, Hargittai & Marler, 2021). Despite these limitations, the researcher assumed a response rate of 56% (Holtom et al., 2022) to determine the appropriate sample size for qualitative participants in the research.

Reliability and validity of data

Paul and Barari (2022) and Gakuu, Kidombo and Keiyoro (2016) discussed reliability as the "*consistency, stability, or dependability of the data*" and suggested using the correlation coefficient to assess its degree. According to Bru-Luna et al., (2021), reliability reflects the stability of a measurement, indicating the consistency of results obtained when the same instrument is used repeatedly under similar conditions. In parallel, Weyant (2022) and Gakuu, Kidombo, and Keiyoro (2016, p. 207) define validity as "*the extent to which a test measures what it claims to measure.*" Bru-Luna et al., (2021) further emphasize that both reliability and validity are essential characteristics of any measuring instrument. Table 25 presents the acceptable values used to evaluate these measurement properties, providing clear criteria for determining whether the instrument meets the required standards.

Table 25
Acceptable Values

Cronbach's Alpha	Internal Consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Note. Adopted from Rey et al., (2020 pp. 4-5)

To assess the dependability of the data collection instrument, scale reliability testing was conducted using SPSS. The primary metric for assessing internal consistency was Cronbach's alpha (α), which evaluates the degree to which items within a scale are related by comparing their covariance with the overall variance. This measure indicates how effectively the items collectively capture the underlying construct. As described by Rey et al., (2020), Cronbach's alpha is calculated using the formula $\alpha = N\bar{c} / [\bar{v} + (N - 1) \times \bar{c}]$, where N represents the number of items, $\bar{c}$ is the average covariance amongst pairs of items, and $\bar{v}$ denotes the average variance. This standardized formula provides a clear and reliable basis for evaluating scale reliability, with higher alpha values reflecting stronger internal consistency and greater measurement stability (Rey et al., 2020).

In addition to reliability testing, the survey instrument was validated through pre-testing and pilot testing. Kumar (2018) describes pre-testing as a method for validating survey instruments and their measurements, while pilot testing serves as a "*dress rehearsal*" for survey administration and procedures. These stages enable researchers to identify ambiguities, unclear wording, missing responses, respondent reluctance, and potential technical or procedural challenges prior to full-scale data collection. Moreover, pre-testing assists in estimating response time, refining questionnaire design, familiarizing data collectors with real-world conditions, and sensitizing respondents to experimental factors (Pandey & Pandey, 2021). Consequently, it serves as an "e*x-ante*" strategy for enhancing data quality and provides firsthand insight into potential data inconsistencies (Tolstoy, Nordman, & Vu, 2022).

In this study, the questionnaire underwent both pre-testing and pilot testing at Tanga Port in northeastern Tanzania to ensure its clarity, relevance, and suitability to the specific study context. These preliminary stages enabled the researcher to assess respondents' understanding of the questions as well as the overall structure and logical flow of the instrument. Feedback and observations gathered during pre-testing and piloting provided valuable insights that informed minor yet necessary revisions to the wording, structure, and sequencing of the questionnaire items. Following the successful completion of these stages, the instrument was refined and finalized for use in the actual data collection process, thereby strengthening its reliability and enhancing the overall quality of the data collected.

To further assess the reliability of the measurement instrument, internal consistency was examined using Cronbach's alpha. This statistic evaluates the extent to which items within a scale are consistently measuring the same underlying construct. According to Hair Jr, Howard and Nitzl (2020), a Cronbach's alpha (α) value approaching +1.0 or –1.0 reflects a perfect positive or negative correlation among items, whereas a value of 0.0 suggests no internal consistency between the variables. In the present study, the reliability of the measurement instrument was assessed in two stages, as detailed in the Reliability Test Results (Table 26) below.

Table 26
Reliability Test Results

Reliability Test Reference	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
All items	0.829	0.858	56
Removed Demographics	0.870	0.888	48

Note. Researcher's Analysis

The reliability analysis showed strong internal coherence for the full 56-item instrument, with a Cronbach's Alpha of 0.829, which increased to 0.858 when standardized. After removing demographic items of limited relevance to the research focus, the alpha rose to 0.870 and further increased to 0.888 when standardized, indicating a more focused and reliable measurement of the primary constructs. Split-half reliability analysis divided the instrument into two equal halves of 28 items. The first half, containing sociodemographic variables such as gender, age, and ethnic identity, recorded a low alpha of 0.4923, suggesting weak internal consistency and misalignment with the core constructs of the study. In contrast, the second half, focused on the key research dimensions, yielded a strong alpha of 0.8233, demonstrating consistency and close alignment with the research objectives. These results underscore the importance of refining data collection instruments by removing less relevant items to improve both reliability and construct validity. The findings support the stability and effectiveness of the instrument in measuring the intended variables. Table 27 presents the split-half reliability results.

Table 27
Split-Half Reliability

Cronbach's Alpha	Part 1	Value	0.4923
		N of Items	28[a]
	Part 2	Value	0.8233
		N of Items	28[b]
	Total N of Items		56
Correlation Between Forms			0.6812
Spearman-Brown Coefficient	Equal Length		0.8104
	Unequal Length		0.8104
Guttman Split-Half Coefficient			0.7695
a. The items are: GD, AG, ET, CB, MS, RO, EL, AL, DT_1, DT_2, DT_3, DT_4, DI_1, DI_2, DI_3, DI_4, RF_1, RF_2, RF_3, RF_4, RF_5, EIM_1, EIM_2, EIM_3, EIM_4, EIM_5, COM_1, COM_2.			
b. The items are: COM_3, COM_4, COM_5, EFF_1, EFF_2, EFF_3, EFF_4, GLC_1, GLC_2, GLC_3, GLC_4, GLC_5, ITO_1, ITO_2, ITO_3, ITO_4, DT, DI, RF, EIM, GLC, ITO, COM, EFF, DT_COM, ITO_COM, DT_EFF, ITO_EFF.			

Note. Researcher's Analysis

The split-half reliability analysis showed a correlation of 0.6812 between the two halves, indicating moderate to strong internal consistency. Part 2 demonstrated higher reliability in measuring the intended constructs, while Part 1, which mainly included demographic items, showed lower reliability. The Spearman-Brown Coefficient (0.8104) and Guttman Split-Half Coefficient (0.7695) indicate acceptable to good reliability, supporting the instrument's overall stability. However, refining or removing less relevant items could further improve consistency and precision. These results align with prior research emphasizing the need for rigorous reliability analysis, especially when Cronbach's alpha values are lower (Chen, Ding, & Liu, 2023).

Construct Reliability and Validity

Fotiadis, Abdulrahman and Spyridou (2019) define Construct Reliability (CR) as a measure of the consistency of results obtained from analyzing items across similar tests. Hair Jr, Howard and Nitzl (2020) describe Composite Reliability as a measure of internal consistency for indicator variables loaded on a latent variable. Both authors recommend that reliability values, (Cronbach's Alpha - α), should exceed 0.70. They further note that if both CR and α exceed 0.95, they are likely to measure the same concept and can become redundant. Additionally, factor loadings (λ) indicate the degree of association between observed indicators and their corresponding latent constructs, with values above 0.70 suggesting a strong relationship and indicating that the constructs effectively represent the data (Hair Jr et al., 2021). Error variance (ε) refers to the proportion of variance not explained by the model, where lower values imply a better model fit and enhanced predictive accuracy (Henseler & Schuberth, 2023). To assess internal consistency, Cronbach's alpha (α) was calculated, with values greater than 0.70 considered acceptable, demonstrating that the scales are reliable (Hair Jr et al., 2021). Similarly, Composite Reliability (CR) values exceeding 0.70 reflect strong overall reliability (Hair Jr et al., 2021). Average Variance Extracted (AVE) captures the amount of variance explained by a construct in relation to measurement error, with values above 0.50 deemed desirable (Henseler & Schuberth, 2023). For establishing discriminant validity, both the Maximum Shared Variance (MSV) and Average Shared Variance (ASV) should be lower than the AVE, confirming that constructs are distinct from one another (Hair Jr et al., 2021; Henseler & Schuberth, 2023). Collectively, these statistical measures ensure the measurement model's robustness, reliability, and validity, confirming that the constructs are accurately, consistently, and independently assessed.

Digital Transformation (DT) Construct

The DT construct is measured using four items (DT_1, DT_2, DT_3, DT_4), all demonstrating strong internal consistency. Each item's Cronbach's Alpha exceeds 0.8, indicating that they reliably contribute to the construct. Specifically, DT_1 has an alpha of 0.8251, DT_2 is 0.8267, and both DT_3 and DT_4 have alphas of 0.8270. Table 28 presents the reliability and validity results for the DT items.

Table 28

Reliability and Validity of DT Items

Construct	Item	Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha if Item	Loading (λ)	λ^2	ε	CR	AVE	MSV	ASV
DT	DT_1	1.9681	0.9175	0.3002	0.8251	0.9590	0.9197	0.0803	**0.9847**	**0.9416**	**0.6839**	**0.6830**
	DT_2	2.1569	0.9031	0.2365	0.8267	0.9700	0.9409	0.0591				
	DT_3	2.0564	0.9163	0.2261	0.8270	0.9940	0.9880	0.0120				
	DT_4	2.0809	0.9117	0.2246	0.8270	0.9580	0.9178	0.0822				
	DT	**2.0656**	**0.4940**	**0.5409**	**0.8229**	**3.8810**	**3.7664**	**0.2336**				

Note. Researcher's Analysis

The DT construct, measured using four items (DT_1 to DT_4), demonstrates strong reliability and validity. With mean scores ranging between 1.97 and 2.16 and low standard deviations of approximately 0.90, the results indicate consistent responses across participants. Corrected between individual items and the total scale score ranged from 0.22 to 0.30, indicating moderate associations with the overall construct. Despite the moderate correlations, each item contributes positively to Internal consistency was confirmed, with Cronbach's Alpha values consistently above 0.82. Factor loadings are notably high, between 0.958 and 0.994, confirming strong relationships between each item. The construct demonstrates excellent convergent validity, with an AVE of 0.9416, and strong internal consistency, as shown by a CR of 0.9847. Discriminate validity is also supported, with both the MSV of 0.6839 and the ASV of 0.6830 falling below the AVE. Overall, the DT construct effectively captures its intended dimensions and serves as a valid and reliable measure (Hair Jr, Howard, & Nitzl, 2020).

Digital Infrastructure (DI) Construct

The Digital Infrastructure (DI) construct was measured using four items—DI_1, DI_2, DI_3, and DI_4—all of which demonstrated strong internal consistency. Cronbach's Alpha values ranged from 0.8214 to 0.8283, indicating that each item reliably captures key aspects of the underlying construct. Table 29 presents the reliability and validity results for the DI items.

Table 29

Reliability and Validity of DI Items

Construct	Item	Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted (α)	Loading (λ)	λ^2	ε	CR	AVE	MSV	ASV
DI	DI_1	1.8928	0.4451	0.7077	0.8214	0.8540	0.7293	0.2707	**0.9245**	**0.7542**	**0.6860**	**0.6798**
	DI_2	1.7059	0.6987	0.5113	0.8214	0.8010	0.6416	0.3584				
	DI_3	1.9191	0.7120	0.2172	0.8270	0.9240	0.8538	0.1462				
	DI_4	1.8480	0.7527	0.1541	0.8283	0.8900	0.7921	0.2079				
	DI	**1.9044**	**0.7273**	**0.1872**	**0.8276**	**3.4690**	**3.0168**	**0.9832**				

Note. Researcher's Analysis

The DI construct includes four items: DI_1 to DI_4. The average scores for these items fall between 1.7059 and 1.9191, with standard deviations between 0.4451 and 0.7527, suggesting consistent responses across participants. The Corrected Item-Total Correlation values range from 0.1541 to 0.7077, with DI_1 showing the strongest correlation at 0.7077, indicating a strong relationship with the total score. Cronbach's Alpha values for all items are above 0.82, indicating that each item makes a meaningful contribution to the internal consistency of the DI construct. The factor loadings range from 0.8010 to 0.9240, all surpassing the commonly accepted 0.70 benchmark, which reflects strong linkages between the observed variables and the underlying DI construct. An AVE of 0.7542 supports solid convergent validity, while the Composite Reliability (CR) score of 0.9245 reflects a high level of internal consistency. Additionally, both the Maximum Shared Variance (MSV) and Average Shared Variance (ASV) are lower than the AVE, reinforcing the construct's discriminant validity. These results confirm that the DI construct is reliable, valid, and effectively captures the dimensions of DI.

Regulatory Frameworks (RF) Construct

The RF construct is measured using five items (RF_1, RF_2, RF_3, RF_4, RF_5), all of which demonstrate strong internal consistency. Cronbach's Alpha values for each item exceed 0.8, indicating strong reliability. Specifically, RF_1 has an alpha of 0.8261, RF_2 is 0.8250, RF_3 is 0.8271, RF_4 is 0.8216, and RF_5 is 0.8259, showing that each item reliably contributes to the construct. Table 30 presents the reliability and validity results for the RF items.

Table 30

Reliability and Validity of RF Items

Construct	Item	Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted (α)	Loading (λ)	λ^2	ε	CR	AVE	MSV	ASV
DI	DI_1	1.8928	0.4451	0.7077	0.8214	0.8540	0.7293	0.2707	0.9245	0.7542	0.6860	0.6798
	DI_2	1.7059	0.6987	0.5113	0.8214	0.8010	0.6416	0.3584				
	DI_3	1.9191	0.7120	0.2172	0.8270	0.9240	0.8538	0.1462				
	DI_4	1.8480	0.7527	0.1541	0.8283	0.8900	0.7921	0.2079				
	DI	**1.9044**	**0.7273**	**0.1872**	**0.8276**	**3.4690**	**3.0168**	**0.9832**				

Note. Researcher's Analysis

The RF construct comprises five items: RF_1 to RF_5 with mean values ranging from 2.2083 to 2.3015 and standard deviations between 0.4684 and 0.8857. The Corrected Item-Total Correlation values range from 0.2191 to 0.6609, with RF_4 exhibiting the strongest correlation at 0.6609, indicating a strong relationship with the overall score. Cronbach's Alpha values for all items are greater than 0.82, indicating that each item significantly enhances the consistency of items within the RF construct. The factor loadings, which varied between 0.9360 and 0.9990, all well above the 0.70 benchmark, reflecting strong relationships with the underlying RF construct. The AVE stands at 0.9422, substantially exceeding the 0.50 threshold, which affirms robust convergent validity. The CR score of 0.9879 further signifies excellent internal consistency. Additionally, both the MSV and ASV fall below the AVE value, providing evidence for the construct's discriminant validity. Overall, these findings affirm that the RF construct is both reliable and valid, effectively capturing the intended dimensions.

International Trade Opportunities (ITO) Construct

The ITO construct comprises four items (ITO_1 to ITO_4), each demonstrating strong internal consistency. Cronbach's Alpha values are 0.8261 for ITO_1, 0.8233 for ITO_2, 0.8279 for ITO_3, and 0.8263 for ITO_4, all exceeding 0.8 and indicating reliable measurement across items. Average item scores range from 1.6667 to 2.4485, with standard deviations between 0.4720 and 0.9637, reflecting some variation in participants' responses. Corrected item-total correlations range from 0.1595 to 0.3700, with ITO_2 showing the highest correlation. All items have Cronbach's Alpha if item deleted values above 0.82, confirming that each item positively contributes to the construct's internal consistency. Table 31 presents these results.

Table 31

Reliability and Validity of ITO Items

Construct	Item	Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha if Item	Loading (λ)	λ^2	ε	CR	AVE	MSV	ASV
	ITO_1	2.4485	0.7852	0.2590	0.8261	0.9000	0.8100	0.1900				
	ITO_2	1.9902	0.9637	0.3700	0.8233	0.9890	0.9781	0.0219				
ITO	ITO_3	1.6667	0.4720	0.1595	0.8279	0.9610	0.9235	0.0765	0.9766	0.9127	0.6855	0.6821
	ITO_4	2.3382	0.8104	0.2520	0.8263	0.9690	0.9390	0.0610				
	ITO	2.0451	0.3349	0.6244	0.8239	3.8190	3.6506	0.3494				

Note. Researcher's Analysis

The factor loadings (λ) for the items range from 0.9000 to 0.9890, all surpassing the 0.70 threshold, indicating strong relationships between the observed variables and the underlying construct. This level of consistency reinforces the validity of the items in assessing international trade opportunities. The AVE for the ITO construct is 0.9127, well above the accepted minimum of 0.50, confirming solid convergent validity. The CR is 0.9766, reflecting excellent internal consistency among the items. Additionally, the MSV and ASV are 0.6855 and 0.6821, respectively, both of which are lower than the AVE, providing clear evidence of strong discriminant validity (Hair Jr, Howard & Nitzl, 2020). Taken together, these results confirm that the ITO construct exhibits high reliability and strong validity.

Global Competitiveness (GLC) Construct

The Global Competitiveness (GLC) construct consists of five items (GLC_1 to GLC_5), all demonstrating strong internal consistency. Cronbach's Alpha values range from 0.8222 to 0.8271, indicating reliable measurement across items. Specifically, GLC_1 has an alpha of 0.8249, GLC_2 has 0.8222, GLC_3 has 0.8261, GLC_4 has 0.8250, and GLC_5 has 0.8271, all reflecting strong reliability. Table 32 presents the reliability and validity results for the GLC items.

Table 32

Reliability and Validity of GLC Items

Construct	Item	Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha if Item	Loading (λ)	λ^2	ε	CR	AVE	MSV	ASV
GLC	GLC_1	2.3603	0.8206	0.3144	0.8249	0.9560	0.9139	0.0861	**0.9791**	**0.9036**	**0.6840**	**0.6807**
	GLC_2	1.8946	0.9745	0.4126	0.8222	0.8760	0.7674	0.2326				
	GLC_3	2.2892	0.8697	0.2595	0.8261	0.9630	0.9274	0.0726				
	GLC_4	2.2083	0.8857	0.3082	0.8250	0.9630	0.9274	0.0726				
	GLC_5	2.3015	0.8641	0.2191	0.8271	0.9910	0.9821	0.0179				
	GLC	**2.2108**	**0.4684**	**0.6609**	**0.8216**	**4.7490**	**4.5181**	**0.4819**				

Note. Researcher's Analysis

The GLC construct consists of items with mean values ranging from 1.8946 to 2.3603 and standard deviations between 0.8206 and 0.9745, reflecting some variation in participants' responses. The Corrected Item-Total Correlation values, ranging from 0.2191 to 0.4126, highlight strong item relevance to the construct. Cronbach's Alpha values computed for all items exceeded 0.82, demonstrating that each item contributes significantly to the internal consistency of the scale. All factor loadings fell within the range of 0.8760 to 0.9910, well above the recommended minimum of 0.70, confirming strong associations with the underlying GLC construct. The AVE is 0.9036, well above the 0.50 benchmark, indicating strong convergent validity. The CR value of 0.9791 further reflects excellent internal consistency. Additionally, both the MSV and ASV are less than the AVE, the results confirm adequate discriminant validity. Overall, results indicate that GLC construct meets the criteria for reliability and validity in measuring global competitiveness.

Efficiency in Import/Export Activities (EIM) Construct

The Efficiency in Import/Export Activities (EIM) construct includes five indicators (EIM_1 to EIM_5), which demonstrate a high degree of internal consistency. Cronbach's Alpha values range from 0.8233 to 0.8280, indicating that the items consistently measure the intended construct. Table 33 presents the reliability and validity results for the EIM items.

Table 33

Reliability and Validity of EIM Items

Construct	Item	Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha if Item	Loading (λ)	λ^2	ε	CR	AVE	MSV	ASV
EIM	EIM_1	1.7819	0.4135	0.1592	0.8280	0.9880	0.9761	0.0239	0.9841	0.9253	0.6856	0.6828
	EIM_2	2.4485	0.7852	0.2590	0.8261	0.9000	0.8100	0.1900				
	EIM_3	1.9902	0.9637	0.3700	0.8233	0.9890	0.9781	0.0219				
	EIM_4	1.6667	0.4720	0.1595	0.8279	0.9610	0.9235	0.0765				
	EIM_5	2.3382	0.8104	0.2520	0.8263	0.9690	0.9390	0.0610				
	EIM	2.0451	0.3349	0.6244	0.8239	4.8070	4.6267	0.3733				

Note. Researcher's Analysis

The Efficiency in Import/Export Activities (EIM) demonstrates solid psychometric properties based on various statistical measures. The items exhibited mean scores ranging from 1.6667 to 2.4485, accompanied by standard deviations of 0.4135 to 0.9637, reflecting a moderate variability among responses. Item-Total Correlation coefficients varied between 0.1592 and 0.3700, suggesting moderate to low associations between individual items. Each item's "*Cronbach's Alpha if deleted*" value exceeds 0.82, confirming that all items positively contribute to internal consistency. All factor loadings fell between 0.9000 and 0.9880, significantly exceeding the 0.70 cutoff, reflecting strong associations with the underlying construct. The AVE is 0.9253, demonstrating excellent convergent validity. The Critical Ration (C.R) value of 0.9841 signifies a high degree of internal consistency among the items. MSV (0.6856) and ASV (0.6828) are both below the AVE, thereby providing evidence of robust discriminant validity. These findings confirm that the EIM construct is both reliable and valid, effectively capture efficiency in import/export activities at DSM port.

Moderators: Competition (COM) and Efficiency (EFF) Construct

The Competition (COM) construct comprises five items (COM_1 to COM_5) with Cronbach's Alpha values ranging from 0.8222 to 0.8351, indicating strong internal consistency. Mean scores range from 2.0809 to 2.3480, with standard deviations between 0.4432 and 0.9027, showing variability in responses. Corrected item-total correlations range from –0.1217 to 0.6448, with COM_4 showing a negative value, suggesting weaker alignment with the overall scale. Despite this, all factor loadings fall between 0.9650 and 0.9980, exceeding the 0.70 threshold and confirming strong item-construct relationships. The construct's AVE (0.9629) and CR (0.9924) indicate excellent convergent validity and reliability. Table 34 presents these results.

Table 34
Reliability and Validity of COM and EFF Items

Construct	Item	Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha if Item	Loading (λ)	λ^2	ε	CR	AVE	MSV	ASV
COM	COM_1	2.1691	0.8913	0.3031	0.8251	0.9750	0.9506	0.0494	0.9924	0.9629	0.6975	0.6842
	COM_2	2.1882	0.4432	0.6448	0.8222	0.9980	0.9960	0.0040				
	COM_3	2.0809	0.8028	0.2518	0.8263	0.9760	0.9526	0.0474				
	COM_4	2.1029	0.9027	(0.1217)	0.8351	0.9920	0.9841	0.0159				
	COM_5	2.3480	0.8508	0.2280	0.8268	0.9650	0.9312	0.0688				
EFF	EFF_1	2.0809	0.8028	0.2518	0.8263	0.9760	0.9526	0.0474	0.9889	0.9570	0.6975	0.6867
	EFF_2	2.1029	0.9027	(0.1217)	0.8351	0.9920	0.9841	0.0159				
	EFF_3	2.3480	0.8508	0.2280	0.8268	0.9760	0.9526	0.0474				
	EFF_4	2.2475	0.8727	0.2459	0.8264	0.9690	0.9390	0.0610				

Note. Researcher's Analysis

The Efficiency (EFF) construct includes four items (EFF_1 to EFF_4), with Cronbach's Alpha values ranging from 0.8263 to 0.8351, indicating strong internal consistency. Mean values span 2.0809 to 2.3480, with standard deviations from 0.8508 to 0.9027, reflecting response variability. Corrected Item-Total Correlation values range from –0.1217 to 0.2280, with EFF_2's negative value suggesting the need for further review. Nonetheless, Cronbach's Alpha if item deleted remains above 0.82, showing item reliability. Factor loadings (0.9650 to 0.9920) exceed 0.70, confirming strong item-construct alignment. The AVE is 0.9570, and CR is 0.9889, ensuring convergent validity and internal consistency.

Descriptive Statistics of Independent and Dependent Variables

Further to confirming the validity and reliability of the constructs, descriptive statistics for both the independent and dependent variables were also provided to summarize the data distribution and central tendencies. Table 35 presents these descriptive statistics.

Table 35
Descriptive statistics for independent and dependent variables

Construct	N	Minimum	Maximum	Mean	Std. Deviation	Variance
DT	409	1.000	3.000	2.0656	0.4940	0.2440
DI	409	1.000	3.000	1.8928	0.4451	0.1981
RF	409	1.000	2.800	2.2044	0.3974	0.1579
EIM	409	1.000	2.600	2.0451	0.3349	0.1122
GLC	409	1.000	3.000	2.2108	0.4684	0.2194
ITO	409	1.000	3.000	2.2347	0.4834	0.2336

Note. Researcher's Analysis

Descriptive statistics serve a foundational role in research by enabling effective organization, summarization, and interpretation of data. They offer insights into overall patterns and trends within a population by using measures such as the mean, median, and mode to represent central tendency, alongside standard deviation, variance, and range to capture variability (Bougie & Sekaran, 2019; Coyne et al., 2020). These metrics help researchers better understand how responses are distributed across a sample. Complementing these descriptive tools, regression analysis addresses issues such as central tendency bias where responses gravitate toward the average by allowing for a more refined and thorough examination of variable interrelations (Crosetto et al., 2020). When combined, descriptive and inferential statistical approaches enable a thorough analysis, improving the precision and richness of the results.

The data summarized in Table 35 indicates that respondents generally hold moderately positive perceptions of several key constructs, including DI, RF, DT, ITO, and GLC. The mean values range from 1.89 (DI) to 2.23 (ITO), suggesting a favorable inclination toward these factors, though with varying degrees of agreement. For instance, DT exhibits a mean of 2.07 and a standard deviation of 0.4940, reflecting positive views but with noticeable differences among respondents. DI, with the lowest mean value of 1.89, suggests that participants perceive room for improvement in digital infrastructure. Regulatory frameworks, scoring a mean of 2.20, points to a reasonably positive assessment of the current regulatory frameworks, though not without some reservations. Similarly, the EIM construct, with a mean of 2.05, indicates a consensus around moderate efficiency in trade operations. The GLC construct shows a mean of 2.21, implying a cautiously optimistic view of competitiveness, while ITO achieves the highest mean score of 2.23, reflecting strong optimism about international trade prospects. However, the spread in responses suggests that opinions differ, especially regarding GLC and ITO. Regulatory frameworks have the lowest variance (0.1579), signifying the highest level of agreement among respondents, whereas higher variance in other constructs suggests a broader range of opinions. These findings reflect a consensus on the significance of these constructs while also pointing to areas where further improvements and strategic attention may be needed.

The integration of descriptive statistics and regression analysis offers a comprehensive insight into the data, revealing both general patterns and deeper relationships among variables. The results from Table 35 highlight a generally positive perception of digital constructs among respondents, with key areas such as DI, RF, and ITO showing promise, though not without noted variability. While most constructs received favorable evaluations, the differing levels of variance and central tendency scores emphasize the role of iterative progress and deliberate strategic efforts. These findings provide a meaningful basis for policymakers and stakeholders seeking to strengthen DI, DT, RF, EIM, and GLC within the framework of international trade.

Results of the Analysis

Inferential statistics is crucial in research as it allows researchers to make predictions, draw conclusions, and extrapolate findings from the sample in relation to the broader population. This approach is particularly crucial when studying the entire population is impractical, and smaller, representative samples are employed to infer broader trends (Gakuu, Kidombo, & Keiyoro, 2016). Unlike descriptive statistics, which summarize data characteristics like mean, median, mode, and standard deviation, inferential statistics go beyond simply summarizing data by testing hypotheses and evaluating relationships between variables (Bougie & Sekaran, 2019). These techniques help determine whether observed patterns are likely to reflect reality or are merely due to random.

A fundamental component of inferential statistics is hypothesis testing, through which researchers use statistical methods—such as t-tests, ANOVA, and chi-square tests—to determine whether sufficient evidence exists to reject the null hypothesis (Tolstoy, Nordman, & Vu, 2022). This process is essential for establishing the statistical significance of research findings. Additionally, inferential techniques allow researchers to estimate a range of plausible values for population parameters based on sample data. Among these techniques, regression analysis plays a crucial role in predicting outcomes and evaluating the strength and direction of these associations.

In this research, inferential analysis was carried out through SEM, which served to measure the magnitude and direction of the associations between the constructs. SEM also helped assess the influence of predictors on outcomes and confirmed the reliability of the study's conclusions. By providing empirical evidence supporting the proposed theoretical model, SEM contributed to deeper insights into the data's underlying patterns. In this research, inferential analysis was carried out through SEM, which was utilized to assess both the magnitude and direction of the relationships among the constructs (Hair Jr. et al., 2021; Akbari & Hopkins, 2022).

Results Based on Demographic of Respondents

Respondents rated their agreement with the effectiveness of DT strategies in achieving digital integration and promoting growth in international trade (Pollitzer, 2018). Responses were analyzed using crosstabulation to examine how perceptions varied across demographic groups such as ethnicity, gender, and age. This method revealed significant trends and differences in support and resistance to DT strategies among different groups, offering insights that can guide future initiatives. By identifying these patterns, organizations can tailor DT strategies to better address the diverse needs and concerns of various population segments, potentially enhancing participation and inclusiveness in international trade (Butollo, 2021). Table 36 presents the crosstabulation of ethnicity, gender, age group, and Question 12.

Table 36

*Ethnicity * Gender * Age Group * Question 12*

		Neutral	%	Disagree	%	Agree	%	% Agreed	Total	%
Ethnicity	Black	34	77.3	61	71.8	222	79.3	0.70	317	77.5
	Indian	5	11.4	11	12.9	27	9.6	0.63	43	10.5
	Arabic	4	9.1	11	12.9	25	8.9	0.63	40	9.8
	Chinese	1	2.3	2	2.4	4	1.4	0.57	7	1.7
	European	0	0.0	0	0.0	1	0.4	1.00	1	0.2
	Other	0	0.0	0	0.0	1	0.4	1.00	1	0.2
Total		44	100.0	85	100.0	280	100.0	0.68	409	100.0
Gender	Male	29	65.9	55	64.7	192	68.6	0.70	276	67.5
	Female	15	34.1	30	35.3	83	29.6	0.65	128	31.3
	Not willing to disclose	0	0.0	0	0.0	5	1.8	1.00	5	1.2
Total		44	100.0	85	100.0	280	100.0	0.68	409	100.0
Age Group	Young Adult	2	4.5	2	2.4	3	1.1	0.43	7	1.7
	Middle Adult	18	40.9	28	32.9	117	41.8	0.72	163	39.9
	Adult	20	45.5	51	60.0	140	50.0	0.66	211	51.6
	Older Adult	3	6.8	4	4.7	20	7.1	0.74	27	6.6
	Elderly	1	2.3	0	0.0	0	0.0	0.00	1	0.2
Total		44	100.0	85	100.0	280	100.0	0.68	409	100.0

Note. Researcher's Conception

Among the 409 participants, 280 (68%) agreed with the proposed DT strategies, 85 (21%) disagreed, and 44 (11%) were undecided. Agreement varied by ethnicity: 222 (70%) Black respondents, 27 (63%) Indian respondents, 25 (63%) Arabic respondents, 4 (57%) Chinese respondents, and 1 (100%) European and other ethnic respondents supported the strategies. These differences suggest that cultural context and individual experiences shape perceptions of DT initiatives, highlighting the need for tailored communication and outreach to improve acceptance across diverse groups.

Age-group analysis also revealed notable patterns when comparing like for like: 20 (74%) older adults and 117 (72%) middle-aged adults agreed, compared to 140 (66%) adults and only 3 (43%) young adults. This may indicate that younger respondents are more skeptical or less engaged with DT initiatives. Gender differences showed that 192 (70%) males and 83 (65%) females agreed, while all respondents who did not disclose their gender supported the strategies. These findings emphasize the complex interplay of age, ethnicity, and gender in shaping engagement with DT, underscoring the importance of inclusive and context-sensitive DT strategies

The crosstabulation analysis of ethnicity, gender, and age group examined participants' agreement with the view that DT significantly enhances competitiveness and efficiency in international trade. This study aimed to evaluate the impact of contemporary digital methods on traditional trade processes (Zaki, 2019). After collecting responses, crosstabulation revealed meaningful patterns linking demographic factors to perceptions of DT, highlighting the importance of considering diverse viewpoints when designing effective digital strategies. Tailoring DT initiatives to the needs and concerns of different demographic segments can improve their effectiveness and promote more inclusive international trade practices.

Among 409 respondents, 240 (57%) agreed that DT enhances competitiveness, 90 (22%) disagreed, and 79 (21%) were neutral. Agreement varied by ethnicity: 187 (59%) Black respondents, 26 (60%) Indian respondents, 23 (58%) Arabic respondents, 3 (43%) Chinese respondents, and 1 (100%) European respondent endorsed this view. These differences suggest that cultural and contextual factors shape perceptions of DT. The strong support from European respondents may reflect more advanced digital trade adoption, highlighting the need for tailored approaches across ethnic groups.

Age-group analysis revealed significant trends: 22 (81%) older adults and 126 (60%) adults agreed that DT enhances competitiveness, compared to 87 (53%) middle-aged adults and 4 (57%) young adults. The high agreement among older adults, with only one neutral response, may reflect cautiousness rooted in reliance on traditional trade practices (Zaki, 2019). Table 37 presents the crosstabulation of ethnicity, gender, age group, and Question 14

Table 37
*Ethnicity * Gender * Age Group * Question 14*

		Neutral	%	Disagree	%	Agree	%	% Agreed	Total	%
Ethnicity	Black	62	140.9	68	80.0	187	66.8	0.59	317	77.5
	Indian	8	18.2	9	10.6	26	9.3	0.60	43	10.5
	Arabic	9	20.5	8	9.4	23	8.2	0.58	40	9.8
	Chinese	0	0.0	4	4.7	3	1.1	0.43	7	1.7
	European	0	0.0	0	0.0	1	0.4	1.00	1	0.2
	Other	0	0.0	1	1.2	0	0.0	0.00	1	0.2
Total		79	179.5	90	105.9	240	85.7	0.59	409	100.0
Gender	Male	53	120.5	58	68.2	165	58.9	0.60	276	67.5
	Female	26	59.1	32	37.6	70	25.0	0.55	128	31.3
	Not willing to disclose	0	0.0	0	0.0	5	1.8	1.00	5	1.2
Total		79	179.5	90	105.9	240	85.7	0.59	409	100.0
Age Group	Young Adult	2	4.5	1	1.2	4	1.4	0.57	7	1.7
	Middle Adult	37	84.1	39	45.9	87	31.1	0.53	163	39.9
	Adult	38	86.4	47	55.3	126	45.0	0.60	211	51.6
	Older Adult	2	4.5	3	3.5	22	7.9	0.81	27	6.6
	Elderly	0	0.0	0	0.0	1	0.4	1.00	1	0.2
Total		79	179.5	90	105.9	240	85.7	0.59	409	100.0

Note. Researcher's Conception

Furthermore, the gender analysis revealed that 165 (60%) of male participants and 70 (55%) of female participants agreed with the statement, indicating a generally balanced perspective between the sexes. Similarly, the those who agreed based on age group were 4 (57%), 87 (53%), 126 (60%) and 22 (81%) for Young Adult, Middle Adult, Adult and Order Adult respectively. However, this slight disparity points to nuanced differences in how each gender perceives the impact of DT, suggesting that factors such as personal experience, professional background, or even societal expectations may influence their views. These subtle variations merit further exploration, as understanding them may yield valuable guidance on how to tailor DT efforts to resonate with different demographic segments.

Participants were asked whether they believed that Digital Infrastructure (DI) influences DT in international trade. Of the 409 respondents, 321 (79%) agreed, while 88 (21%) disagreed. Crosstabulation by ethnicity, gender, and age group revealed notable differences in perceptions. Agreement was highest among Chinese respondents (100%), followed by Indian (81%), Black (79%), and Arabic (70%) participants. Individuals from other ethnic backgrounds also largely supported the statement. These findings indicate a broad consensus on the importance of DI in enabling DT, with varying levels of agreement across demographic groups. Table 38 presents the crosstabulation of ethnicity, gender, age group, and Question 15.

Table 38

*Ethnicity * Gender * Age Group * Question 15*

		No	%	Yes	%	% Agreed	Total	%
Ethnicity	Black	68	154.5	249	292.9	0.79	317	77.5
	Indian	8	18.2	35	41.2	0.81	43	10.5
	Arabic	12	27.3	28	32.9	0.70	40	9.8
	Chinese	0	0.0	7	8.2	1.00	7	1.7
	European	0	0.0	1	1.2	1.00	1	0.2
	Other	0	0.0	1	1.2	1.00	1	0.2
Total		88	200.0	321	377.6	0.78	409	100.0
Gender	Male	59	134.1	217	255.3	0.79	276	67.5
	Female	29	65.9	99	116.5	0.77	128	31.3
	Not willing to disclose	0	0.0	5	5.9	1.00	5	1.2
Total		88	200.0	321	377.6	0.78	409	100.0
Age Group	Young Adult	3	6.8	4	4.7	0.57	7	1.7
	Middle Adult	37	84.1	126	148.2	0.77	163	39.9
	Adult	41	93.2	170	200.0	0.81	211	51.6
	Older Adult	6	13.6	21	24.7	0.78	27	6.6
	Elderly	1	2.3	0	0.0	0.00	1	0.2
Total		88	200.0	321	377.6	0.78	409	100.0

Note. Researcher's Conception

Age group analysis showed agreement levels of 81% (adults), 78% (older adults), 77% (middle-aged adults), and 57% (young adults), indicating variation across life stages. Gender analysis was balanced, with 79% of males and 77% of females agreeing.

Participants were asked whether regulatory frameworks (RF) influence DT in international trade. Of 409 respondents, 274 (67%) agreed and 135 (33%) disagreed. Agreement was highest among Chinese respondents (86%), followed by Indian (70%), Black (66%), and Arabic (65%) participants, with 100% agreement from European and other ethnic groups. These findings highlight the need for inclusive and adaptable regulatory frameworks that address diverse demographic perspectives. Table 39 presents the crosstabulation results.

Table 39

*Ethnicity * Gender * Age Group * Question 19*

		No	%	Yes	%	% Agreed	Total	%
Ethnicity	Black	107	0.79	210	0.77	0.66	317	77.5
	Indian	13	0.10	30	0.11	0.70	43	10.5
	Arabic	14	0.10	26	0.09	0.65	40	9.8
	Chinese	1	0.01	6	0.02	0.86	7	1.7
	European	0	0.00	1	0.00	1.00	1	0.2
	Other	0	0.00	1	0.00	1.00	1	0.2
Total		135	1.00	274	1.00	0.67	409	100.0
Gender	Male	94	0.70	182	0.66	0.66	276	67.5
	Female	40	0.30	88	0.32	0.69	128	31.3
	Not willing to disclose	1	0.01	4	0.01	0.80	5	1.2
Total		135	1.00	274	1.00	0.67	409	100.0
Age Group	Young Adult	2	0.01	5	0.02	0.71	7	1.7
	Middle Adult	62	0.46	101	0.37	0.62	163	39.9
	Adult	63	0.47	148	0.54	0.70	211	51.6
	Older Adult	8	0.06	19	0.07	0.70	27	6.6
	Elderly	0	0.00	1	0.00	1.00	1	0.2
Total		135	1.00	274	1.00	0.67	409	100.0

Note. Researcher's Conception

The analysis revealed diverse opinions across age and gender groups regarding the RF influence on DT. Seventy percent of adults, older adults, and young adults agreed, with 100% of elderly participants supporting the statement. Gender-wise, 66% of males, 69% of females, and 80% of non-disclosed respondents agreed, indicating broad consensus across demographics.

Structural Equation Modeling (SEM)

This research utilized SEM to explore the complex interrelationships among key factors influencing the implementation of DT within the domain of international trade (Hallencreutz & Parmler, 2021). SEM is a sophisticated multivariate analytical technique that enables researchers to simultaneously examine intricate relationships between observed variables and their corresponding latent constructs (Hair Jr et al., 2021). Its ability to identify both direct and indirect pathways makes it well-suited for capturing the multifaceted nature of DT. By uncovering how various elements interact and influence one another, SEM provides a more comprehensive and nuanced understanding of the dynamics that drive the adoption of digital technologies (Fu, 2020).

Among the primary benefits of SEM is its power to model both measurement and structural relationships, which includes assessing the moderation effects of variables such as competition and efficiency in this study. This capability allows researchers to test and validate the hypothesized connections between constructs, ensuring that the relationships identified in the data are both reliable and meaningful (Dash & Paul, 2021). Moreover, SEM accounts for measurement errors, providing more accurate estimates of latent constructs, thereby strengthening the credibility and stability of the results. By employing SEM, this study gains a thorough and more discerning interpretation of the primary drivers of DT in international trade, revealing insights into how these drivers interact and influence the broader dynamics of global trade (Volberda et al., 2021).

Through the application of SEM, the study refines existing knowledge on DT by identifying key variables and their interconnections, offering a clearer view of the complex processes that shape the digital landscape in international trade. This holistic method supports the creation of more impactful strategies and frameworks to promote the uptake of digital technologies in international trade.

CFA Model Fit Results

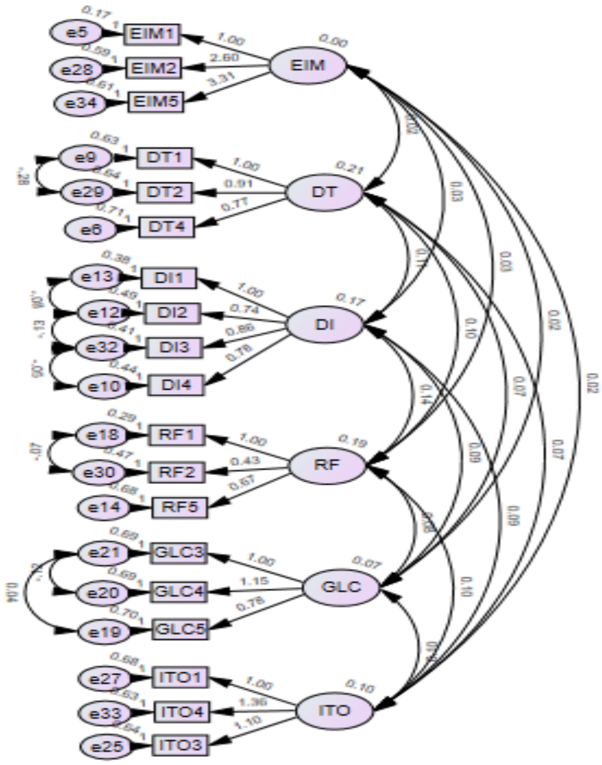
Assessing model fit in Confirmatory Factor Analysis (CFA) is essential for determining how closely the theoretical model matches the observed outcomes, thereby supporting its reliability and validity (Bougie & Sekaran, 2019). A range of fit indices is used in this assessment, each offering distinct perspectives on how well the model mirrors the inherent structure of the observed data. Commonly utilized indices such as the Chi-square (χ^2) test, GFI, AGFI, CFI, RMSEA, SRMR, and TLI were employed to evaluate the model fit, providing a comprehensive assessment of how well the proposed structural model aligns with the observed data.

The Chi-square (χ^2) review appraises the degree of discrepancy between the model-implied covariance matrix and the one obtained from the observed data, where lower χ^2 values reflect a more favorable model fit. However, the Chi-square (χ^2) test is sensitive to sample size, often yielding significant results even when the model demonstrates a good fit. Its accuracy tends to improve as the dataset size increases (Yaslioglu & Yaslioglu, 2020). To address this limitation, researchers typically supplement the Chi-square test with additional fit indices such as the RMSEA and the TLI. RMSEA values below 0.08 are generally considered to indicate an acceptable fit, while values below 0.05 suggest a good fit (Dash & Paul, 2021). The TLI, which approaches 1.0 as the model fit improves, is another key indicator of adequacy (Erhan, Uzunbacak & Aydin, 2022). In addition, the CFI, which is used to assess model fit, should exceed 0.90 to be considered acceptable, further supporting the model's validity.

By using a combination of these indices, researchers can reduce the potential bias introduced by sample size, providing a more accurate and comprehensive assessment of model fit. This multi-index approach ensures a reliable evaluation of the model, strengthening the evidence for its appropriateness and supporting the credibility of the study's results (He et al., 2023). A rigorous evaluation is crucial for confirming the model’s adequacy and ensuring the robustness of the analysis, leading to a stronger trustworthiness of the findings. The CFA process was conducted after data cleaning, and Figure 12 provides a summary of the analysis results.

Figure 12

CFA with loading and model fit results



DF=130, GFI=.957. AGFI=.937, CFI=.901, TLI=.870, IFI=.908, RFI=.663

RMR=.028, RMSEA=.032,FMIN=.452

Note. Researcher’s Analysis

Several additional fit indices were employed to evaluate the adequacy of the model. The χ²/df assesses model fit relative to its complexity, with values ranging from 2 to 5 generally considered acceptable (Dash & Paul, 2021). The RMR and RFI evaluate discrepancies between observed and model-implied covariance matrices, where lower RMR values indicate a better fit (Yaslioglu, M. & Yaslioglu, D., 2020). The IFI, which compares the proposed model to a null model, reflects improved model performance through higher values (Dash & Paul, 2021).

CMIN (Chi-Square) Results

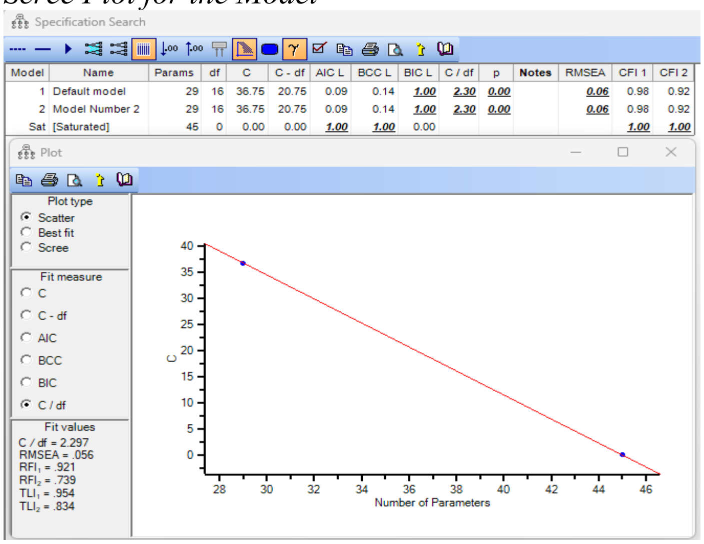
Evaluating model fit is essential for determining how well the model aligns with the observed data observed (Dash & Paul, 2021). A critical aspect of model evaluation is DF, which quantifies the balance between data complexity and parameter estimation (Bougie & Sekaran, 2019). In this study, the default model has 130 DF, indicating a moderately complex model with several parameters estimated. The Chi-square (CMIN) statistics are used to determine model adequacy through a comparison of actual observations and model-predicted values. An important related measure is the CMIN/DF ratio, which assesses model fit in relation to its complexity. A ratio of 1.416, falling within the recommended span of 1 to 3, suggests that the model fits the data well without excessive complexity. As values below 3 are typically considered acceptable, this result indicates a solid and well-balanced model fit.

In contrast, the saturated model, with 190 parameters, fits the data perfectly. However, its complexity poses the risk of "*overfitting*" the data, making it less practical for broader applications. While the saturated model fits the data exactly, its high complexity reduces its generalizability. The Independence Model, on the other hand, assumes zero correlation among the variables, and estimates only 19 parameters. It shows a poor fit, with a high CMIN/DF ratio of 4.206, demonstrating that the model falls short in representing patterns present in the observed data.

Furthermore, a p-value of 0.001 for the default model indicates statistical significance, suggesting that the discrepancies between the observed data and the model's predicted values are unlikely to have occurred by chance. This low p-value strengthens the assumption that the model meaningfully represents the data. Furthermore, the CMIN/DF ratio of 1.416 supports the model's overall adequacy, reflecting a well-balanced fit that maintains both precision and simplicity. It demonstrates that the model is not overly simplified or excessively complicated but instead provides a reliable and appropriate representation of the data. These findings strengthen the model's validity and robustness, confirming its ability to make accurate, evidence-based inferences and to represent the underlying data structure. As a result, the model is both statistically sound and practically relevant for analyzing DT opportunities in international trade. Figure 13 presents the scree plot used to determine the model's factor structure.

Figure 13

Scree Plot for the Model



Note. Researcher's Analysis

The scree plot analysis indicates that the model effectively balances complexity and goodness of fit, featuring 60 estimated parameters and 130 degrees of freedom. With a CMIN of 184.0703 and a CMIN/DF ratio of 1.416, the model demonstrates a reasonable fit. The p-value of 0.0013 indicates statistical significance, suggesting the model reliably represents the observed data. In contrast, the null models perform poorly; for example, Null Model 1 shows a high CMIN of 719.1976 and a CMIN/DF ratio of 4.2058, indicating a poor fit. Although the saturated model fits perfectly with a CMIN of 0.0000, its complexity risks overfitting. Therefore, the default model is preferred, as it strikes the optimal balance between fit and complexity.

Fit Indices Results in SEM

The fit indices deliver an in-depth analysis of how well a model captures the patterns in the observed data, shedding light on its overall effectiveness. One important index, the Root Mean Square Residual (RMR), reflects the average gap between the observed values and those predicted by the model. A lower RMR signifies a better fit. In this study, the default model's RMR is 0.028, a low value that suggests a good fit, indicating the model accurately captures relationships between variables with minimal error (Yaslioglu, M. & Yaslioglu, D., 2020). The RMR quantifies the average of the squared deviations between the actual and model-predicted correlation values, with values below 0.05 generally deemed acceptable. In this case, the RMR value demonstrates an excellent fit, reflecting minimal discrepancies between predictions and observations, and highlighting the model's precision and accuracy (Hair et al., 2021; Dash & Paul, 2021).

Another important fit measure is the Goodness-of-Fit Index (GFI), which evaluates how well the model explains the variance observed in the data (Dash & Paul, 2021). A GFI value close to 1 indicates that the model accounts for a large proportion of the variance, signifying a strong fit (Hair et al., 2021). In this study, the default model achieved a GFI of 0.957, suggesting that it explains approximately 95.7% of the variance in the observed relationships (Dash & Paul, 2021). This high value demonstrates the model's effectiveness in capturing the underlying patterns among the variables (Yaslioglu, M. & Yaslioglu, D., 2020).

The Adjusted Goodness of Fit Index (AGFI), a refinement of the GFI, adjusts for the model's complexity by penalizing unnecessary parameters. This adjustment helps prevent overfitting, where a model might fit the data well but be overly complicated. The AGFI offers a more conservative estimate of fit by considering both the model's explanatory power and simplicity (Dash & Paul, 2021). An AGFI value exceeding 0.90 is typically considered indicative of a good model fit. The default model's AGFI of 0.937 indicates a strong fit even after adjusting for model complexity, suggesting that the model explains the data well without overfitting (Yaslioglu & Yaslioglu, 2020). Table 40 presents a summary of the model fit indices results.

Table 40
Summary of Model fit indices results

CONSTRUCT	ACCEPTABLE FIT	ACHIEVED FIT	COMMENTS
CMIN		184.07	Ok
DF		130	Ok
CMIN/DF	≤ 3: an acceptable fit ≤ 5: a reasonable fit	1.416	Acceptable fit
RMSEA	≤ 0.05: excellent ≤ 0.08: acceptable	0.032	Ok
GFI	≥ 0.90: reasonable fit ≥ 0.95: an excellent fit	0.957	Reasonable fit
AGFI	≥ 0.90: reasonable fit ≥ 0.95: an excellent fit	0.937	Reasonable fit
CFI	≥ 0.90: reasonable fit ≥ 0.95: an excellent fit	0.901	Reasonable fit
TLI	≥ 0.90: reasonable fit ≥ 0.95: an excellent fit	0.870	Below threshold
IFI	≥ 0.90: reasonable fit ≥ 0.95: an excellent fit	0.908	Reasonable fit
NFI	≥ 0.90: reasonable fit ≥ 0.95: an excellent fit	0.744	Below threshold
RFI	≥ 0.90: reasonable fit ≥ 0.95: an excellent fit	0.663	Below threshold
RMR	≤ 0.08: reasonable fit ≤ 0.05: an excellent fit	0.032	Excellent fit
FMIN	Close to zero: Better fit	0.452	Above range
X2 = Chi-Square; DF = Degree of Freedom; CMIN/DF = Chi-square/DF; GFI = Goodness of Fit Index; AGFI = Adjusted Goodness of Fit Index; CFI = Comparative Fit index; TLI = Tucker-Lewis Index; IFI = Incremental Fit Index; RFI = Relative Fit Index; RMR = Root Mean Square Residual; FMIN = Function Minimum Fit Function.			

Note. Researcher's Analysis

Fit indices such as the Normed Fit Index (NFI), Relative Fit Index (RFI), Incremental Fit Index (IFI), Tucker-Lewis Index (TLI), and Comparative Fit Index (CFI) play a key role in evaluating model adequacy within SEM, where higher values typically reflect a stronger fit (Dash & Paul, 2021). The NFI value for the default model, recorded at 0.744, indicates that the model falls below the commonly accepted benchmark of 0.90, suggesting that further refinement may be necessary to achieve an optimal fit. The RFI value of 0.663 points to potential overcomplexity in the model, implying that simplifying the model might improve the fit without losing its explanatory power or predictive strength (Bougie & Sekaran, 2019).

Conversely, the IFI value of 0.908 demonstrates a satisfactory fit, whereas the TLI score of 0.87 indicates a moderate fit. This suggests that although the model adequately represents the data, there remains room for further refinement and simplification (Hair et al., 2021). Additionally, the CFI value of 0.901 points to a robust overall fit, confirming that the model effectively captures the underlying data structure. However, the lower NFI and RFI values suggest that model complexity might be limiting its overall fit. The CFI, which accounts for both sample size and model complexity, with values above 0.90 typically indicating excellent fit, supports the conclusion that the model explains more variance than the null model. This highlights the model's strong predictive accuracy and theoretical robustness (Dash & Paul, 2021).

The Root Mean Square Error of Approximation (RMSEA) of 0.032 indicates that the model fits well, staying within the acceptable threshold for fit (Yaslioglu, M. & Yaslioglu, D., 2020). This suggests the model avoids overfitting while effectively capturing the relationships between variables. Additionally, the Function Minimum Fit Index (FMIN) value of 0.452 further reinforces the finding that the model provides a good fit, with only slight differences between the observed and predicted covariance matrices (Hair et al., 2021).

Model Grouping Results

In SPSS Amos, when conducting a gender-based analysis, the model is typically grouped by creating separate groups for each gender (e.g., male and female) within the dataset. This is achieved by specifying a multi-group analysis, which allows for the comparison of structural relationships across the groups. Once the groups are defined, the analysis is performed to evaluate whether the hypothesized model fits similarly for both genders.

In this study, the results indicate that outcomes for both genders were comparable. This finding indicates that the associations among the observed and underlying latent constructs, as well as the overall model fit, were consistent across gender groups. These results suggest that gender do not have a significant impact on or modify the relationships within the model, and the structural paths remain stable across both genders. By employing this approach, the study ensures that the model's validity is rigorously tested across diverse demographic groups. The sample included 275 males, 129 females, and 5 individuals who chose not to disclose their gender. In overall, the results for the grouping model at different levels of constraints are presented and discussed below:

Unconstrained Model: An unconstrained or a saturated model represents a theoretical framework with the maximum number of parameters, allowing it to perfectly replicate the data. This model serves as a benchmark against which the fit of constrained models is evaluated. Essentially, the closer a constrained model's fit aligns with that of the saturated model, the better its overall suitability. In this study, the CMIN is 518.635 with 390 degrees of freedom, resulting in a CMIN/DF ratio of 1.330. This value is well within the acceptable range (below 3) and indicates a robust fit to the data. The RMR value of 0.038 indicates a small discrepancy between the observed and predicted covariance matrices, reinforcing the model's reliability and overall fit. The GFI of 0.940 and the AGFI of 0.912 indicate a strong fit, with the AGFI adjusting for model complexity. However, the NFI of 0.674 and the RFI of 0.571 suggest there is room for improvement, as both fall below the optimal range. On the other hand, the IFI of 0.893, TLI of 0.843, and CFI of 0.881 point to a generally good fit, though higher values would be more favorable. Notably, the RMSEA value of 0.020 indicates an excellent fit, demonstrating strong consistency between the model's predictions and the empirical data. Table 41 presents the model grouping analysis results.

Table 41

Model Grouping Analysis Results

Model	CMIN	DF	CMIN/DF	RMR	GFI	AGFI	NFI	RFI	IFI	TLI	CFI	RMSEA
Unconstrained	518.635	390	1.330	0.038	0.940	0.912	0.674	0.571	0.893	0.843	0.881	0.020
Measurement weights	537.396	416	1.292	0.039	0.938	0.915	0.662	0.583	0.897	0.861	0.887	0.019
Structural covariances	566.591	458	1.237	0.041	0.936	0.920	0.644	0.601	0.904	0.887	0.899	0.017
Measurement residuals	581.352	510	1.140	0.042	0.933	0.926	0.635	0.632	0.934	0.933	0.934	0.013

Note. Researcher's Analysis

Measurement Weights Model: For this model, the CMIN is 537.396 with 416 DF, yielding a CMIN/DF ratio of 1.292, which signifies a satisfactory model fit. The RMR is 0.039, and the GFI stands at 0.938, both indicating a strong fit. The AGFI is 0.915, showing a slight improvement compared to the unconstrained model. The NFI and RFI are 0.662 and 0.583, respectively, reflecting modest enhancements. The IFI, TLI, and CFI increase to 0.897, 0.861, and 0.887, respectively, demonstrating better overall fit. The RMSEA is 0.019, indicating a good fit, though marginally higher than that of the unconstrained model.

Structural Covariances Model: The CMIN for this model is 566.591 with 458 degrees of DF, resulting in a CMIN/DF ratio of 1.237, which indicates a good model fit. The RMR is 0.041, and the GFI is 0.936, both showing a solid fit, though the GFI is slightly lower than in the previous model. The AGFI increases to 0.920, demonstrating a better fit than the previous models. The NFI and RFI improve to 0.644 and 0.601, indicating further improvements in fit. The IFI, TLI, and CFI also show improvement, rising to 0.904, 0.887, and 0.899, respectively. The RMSEA is 0.017, reflecting a strong model fit, slightly better than the Measurement Weights model.

Measurement Residuals Model**:** In this model, the CMIN is 581.352 with 510 degrees of freedom (DF), resulting in a CMIN/DF ratio of 1.140, the best ratio among all the models, indicating the best overall fit. The RMR is 0.042, and the GFI slightly decreases to 0.933, still indicating a good fit. The AGFI improves further to 0.926, reflecting the strongest fit among all models. The NFI and RFI improve to 0.635 and 0.632, showing a more balanced and improved fit. The IFI, TLI, and CFI all reach 0.934, indicating an excellent fit across all indices. The RMSEA is 0.013, the best among all models, confirming this model as the strongest fit.

The study assessed several models to evaluate their fit. The Unconstrained Model serves as a solid benchmark, showing a good overall fit with a CMIN/DF ratio of 1.330 and an RMSEA of 0.020. However, there is room for improvement, particularly in the NFI and RFI values, which fall below the ideal threshold. The Measurement Weights Model demonstrated slight improvements, particularly in model complexity, with a CMIN/DF ratio of 1.292, an AGFI of 0.915, and an RMSEA of 0.019, indicating a better fit, though the improvements are modest. The Structural Covariances Model showed further enhancement, with a CMIN/DF ratio of 1.237, an AGFI of 0.920, and an RMSEA of 0.017, reflecting greater refinement and a more reliable model fit. Finally, the Measurement Residuals Model provided the best overall fit, featuring the lowest CMIN/DF ratio of 1.140, the highest AGFI of 0.926, and the best RMSEA of 0.013. This model performed the strongest of all fit indices, making it the most reliable and optimal choice. The Measurement Residuals Model is ultimately the best fit due to its superior fit measures, offering the most accurate and consistent representation of the constructs of DT identified in this study.

Overview of Hypothesis Test

The hypothesis test results from SPSS Amos Models offers important insights into the dynamics of the relationships among the research constructs. In this research, a set of were formulated and tested to understand the relationship between DT and various business outcomes, specifically focusing on how competition and efficiency moderate these relationships. The hypotheses tested include the broad statement that DT adoption does not unfold international trade opportunities ($H1_0$), along with several moderated hypotheses examining the impact of competition (COM) and efficiency (EFF) on these relationships. For instance, Hypothesis $H2A_0$ suggests that competition does not moderate the relationship between DT and international trade opportunities (ITO), while $H2C_0$ posits that competition does not moderate the relationship between ITO and global competitiveness (GLC). Similarly, $H2E_0$ claims that competition does not moderate the relationship between ITO and efficiency in import/export (EIM). On the efficiency side, hypotheses such as $H2B_0$, $H2D_0$, and $H2F_0$ explore whether efficiency moderates the relationships between DT and ITO, ITO and GLC, or ITO and EIM, respectively. Other hypotheses include testing the direct influences of robust digital infrastructure ($H3_0$), supportive regulatory frameworks ($H4_0$), and the relationships between DT and ITO with global competitiveness ($H5_0$) and efficiency in import/export activities ($H6_0$).

Without the presence of a moderator, the relationship between ITO and DT ($H1_0$) is positive and substantial. Furthermore, the association between DT and DI ($H3_0$) is also significant, while the relationship between DT and RF ($H4_0$) is not significant. Additionally, DT and ITO positively influence global competitiveness ($H5_0$) and efficiency in import/export activities ($H6_0$), both of which are accepted based on the significance of the estimates. Table 42 details the test results for each hypothesis, followed by an in-depth discussion in this section.

Table 42

Tested Hypothesis for Each Research Question

Question	**Hypothesis**	**Hypothesis Description**	**Tested Variables**
RQ1	$H1_o$	Adoption of DT does not unfold ITO	ITO <--- DT
RQ2	$H2A_o$	Competition does not moderate DT and ITO (DT_COM)	ITO <--- DT_COM
	$H2B_o$	Efficiency does not moderate DT and ITO (DT_EFF)	ITO <--- DT_EFF
	$H2C_o$	Competition does not moderate ITO and GLC (ITO_COM)	GLC <--- ITO_COM
	$H2D_o$	Efficiency does not moderate ITO and GLC (ITO_EFF)	GLC <--- ITO_EFF
	$H2E_o$	Competition does not moderate ITO and EIM (ITO_COM)	EIM <--- ITO_COM
	$H2F_o$	Efficiency does not moderate ITO and EIM (ITO_EFF)	EIM <--- ITO_EFF
RQ3	$H3_o$	Robust DI does not influence DT in creating ITO	DT <--- DI
RQ4	$H4_o$	Supportive RF do not influence DT in creating ITO	DT <--- RF
RQ5	$H5_o$	DT and ITO have no influence on GLC	GLC <--- ITO
RQ6	$H6_o$	DT and ITO have no influence on EIM	EIM <--- ITO

Note. Researcher's Analysis

According to Hair et al., (2021), several important components are fundamental in hypothesis testing. The value represents the size and orientation of the association between constructs. Meanwhile, the standard error (S.E.) measures the amount of variability or uncertainty surrounding the estimate. Furthermore, the C.R. and p-value are key indicators for determining the significance of the proposed relationships. A Critical Ratio greater than 1.96 indicates that the estimate significantly differs from zero. Similarly, a p-value below 0.05 indicates statistical significance, suggesting that the observed relationship is unlikely to be due to random variation.

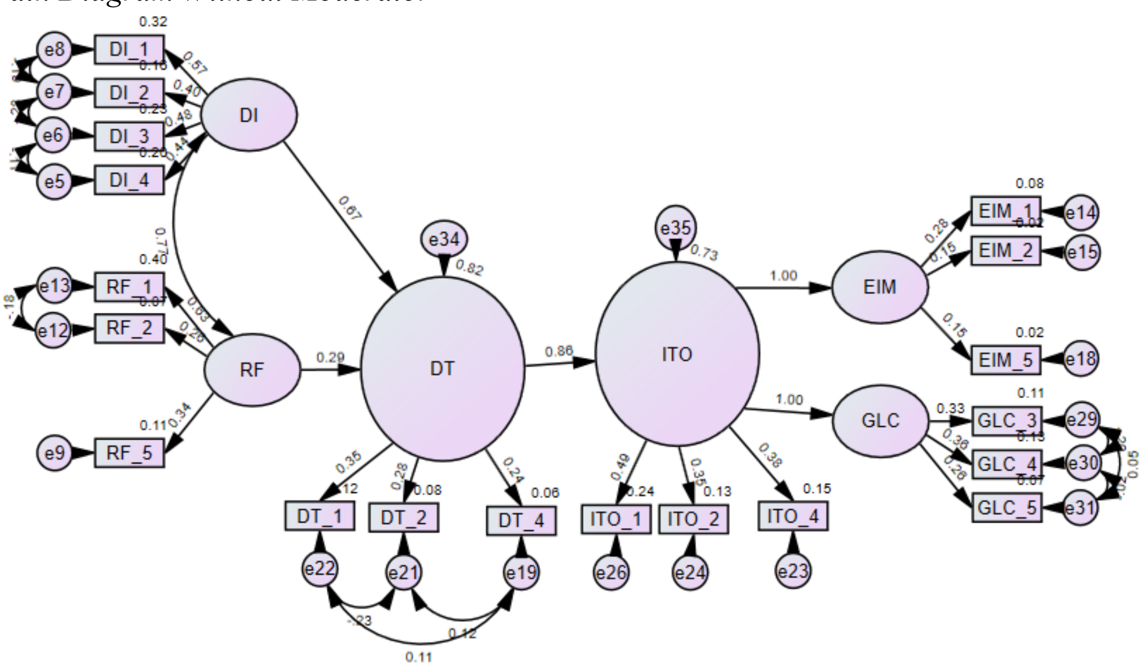
Research Question 1/Hypothesis

The principal objective of this hypothesis was to explore how DT creates opportunities to promote digital harmony in international trade. To explore this, the researcher developed a research question focused on understanding how DT contributes to digital harmony in international trade and formulated the following research hypotheses:

H_o: Adoption of DT does not unfold ITO for fostering digital harmony.

The H1 path hypothesis test indicates a significant positive relationship between digital transformation (DT) and international trade opportunities (ITO). The path coefficient is 1.204, with a standard error of 0.333 and a critical ratio (C.R.) of 3.615, exceeding the 1.96 threshold for statistical significance. The p-value is highly significant (***), supporting rejection of the null hypothesis. Figure 14 presents the path diagram illustrating the relationship between DT and ITO without the moderator.

Figure 14
Path Diagram Without Moderator



Note. Researcher's Analysis

The findings across different moderating conditions consistently demonstrate a strong and statistically significant relationship between DT and ITO. When moderated by DT_COM, the path coefficient for H1 is 1.039, with a standard error of 0.317 and a Critical Ratio (C.R.) of 3.273. The associated p-value of 0.001 is well below the 0.05 significance level, confirming the robustness of this relationship. Under the DT_EFF moderator, the estimate increases to 1.226, alongside a standard error of 0.353 and a C.R. of 3.478, further supporting the significance of the effect. The highly significant p-value (***) further supports the robustness of this result. Likewise, under the ITO_COM moderator, the H1 path shows an estimate of 0.551, a S.E. of 0.182, and a C.R. of 3.035, with a p-value of 0.002 indicating a statistically meaningful relationship. Lastly, when moderated by ITO_EFF, the estimate reaches 1.183, with a S.E. of 0.351 and a C.R. of 3.365. The p-value (***) again confirms the strength of the relationship.

The analysis verified that DT exerts a significant positive influence on International Trade Opportunities (ITO) under all moderating conditions, resulting in the acceptance of the alternative hypothesis (H_a) and rejection of the null hypothesis (H_0). These findings align with the study's aim to examine the relationship between DT and ITO, showing advancements in DT enhance international trade opportunities. Low standard errors (S.E.) across path coefficients suggest high estimate precision and reliability, reducing the likelihood of measurement error. Furthermore, Critical Ratios (C.R.) far exceeded the 1.96 significance threshold, reinforcing the robustness of the relationships identified. The exceptionally low p-values (all below 0.001) offer strong statistical evidence that these findings are not due to chance. In line with Bougie and Sekaran (2019) and Hair et al., (2021), these results underscore DT's critical role in fostering ITO by narrowing the digital divide and supporting economic integration in the global marketplace.

Research Question 2/Hypothesis

Another key objective was to determine the moderation impact of competition (COM) and efficiency (EFF) in digital transformation (DT) for creating international trade opportunities (ITO), improving global competitiveness (GLC) and efficiency in import/export (EIM) activities. As noted by Banalieva and Dhanaraj (2019), the outcomes of network theory are heavily influenced by individual choices, including behaviors, attributes, and beliefs, which in turn shape success and are often measured by performance or rewards. In this study, organizational performance was found to be significantly affected by factors such as competitiveness and efficiency in import/export activities. DT empowered organizations monitor and optimize key performance indicators (KPIs) in real time, providing valuable insights that help drive competitiveness and efficiency in global trade activities. Schrage et al., (2021) assert that digital capabilities not only streamline operational workflows but also enable organizations to adapt more effectively to rapidly evolving market conditions, providing them with a competitive advantage in the global trade arena. Ultimately, digitalization emerged as a catalyst for improving organizational effectiveness, competitiveness and efficiency while enabling healthier decision-making, and enhancing overall trade performance (Union, 2020). This finding emphasizes the critical function of DT in supporting global competitiveness and efficiency in import/export activities.

This study primarily investigated the influence of digital transformation (DT) on international trade opportunities (ITO), with a focused examination of the moderating effects of competition (COM) and efficiency (EFF). The study sought to examine how digital technologies contribute to enhancing trade operations by streamlining processes, lowering costs, and improving overall performance in areas such as global competitiveness (GLC) and import/export efficiency (EIM). Specifically, the study analyzed how DT impacts critical components of trade under varying levels of competition and efficiency, offering a nuanced understanding of these relationships (Akbari & Hopkins, 2022). By incorporating these moderating variables, the research provided deeper insights into the strategic role of digital solutions in reshaping international trade dynamics, highlighting how businesses can leverage digital tools to optimize trade activities, improve responsiveness in global markets, and strengthen their competitive position in the evolving digital economy.

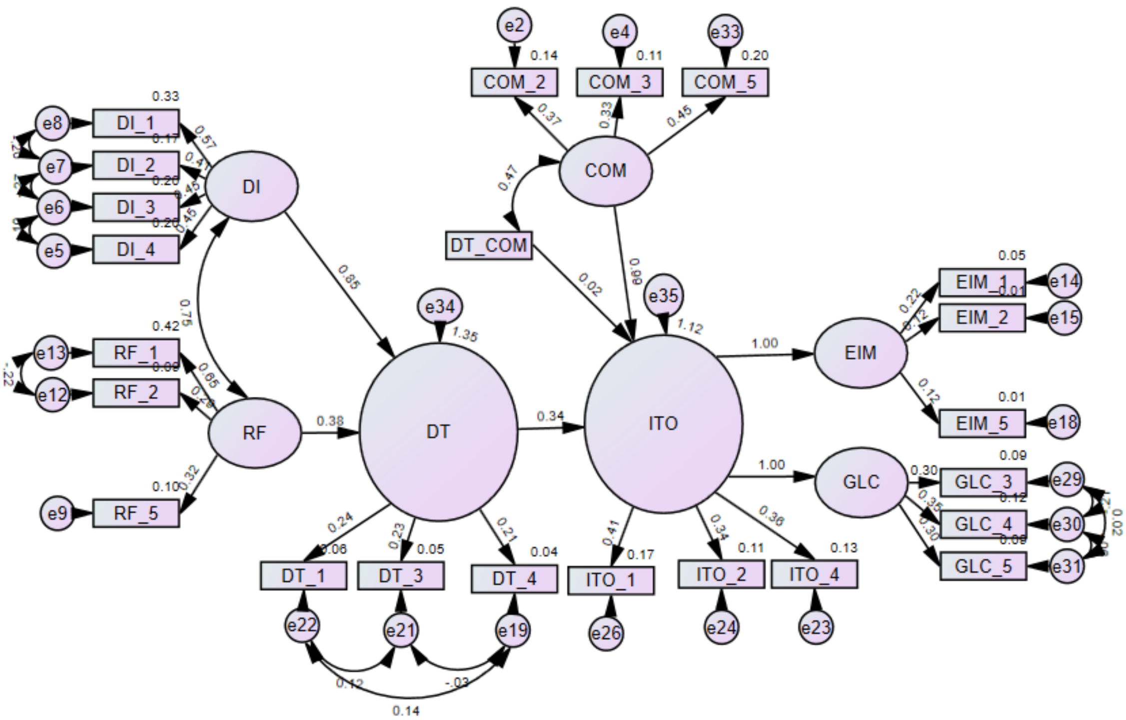
To examine how competition (COM) and efficiency (EFF) moderate the relationship between digital transformation (DT) and international trade opportunities (ITO), each moderator was tested separately in this study. This approach helped avoid potential confusion or misleading interpretations that could arise from analyzing multiple moderators within a single model. As a result, six distinct models were developed. New interaction variables (DT_COM) and (DT_EFF) were generated and analyzed using SPSS and SPSS-Amos to evaluate the moderation effects. This allowed for a clearer understanding of how COM and EFF influence the impact of DT on ITO, specifically addressing hypotheses H2A and H2B.

Similarly, additional moderating variables, ITO_COM and ITO_EFF, were developed to explore how competition and efficiency affect the relationship between international trade opportunities (ITO) and key trade performance outcomes, specifically import/export efficiency (EIM) and global competitiveness (GLC). These variables were used to test hypotheses H2C, H2D, H2E, and H2F. This approach enabled a deeper exploration of how competition and efficiency moderate the effects of ITO on trade outcomes, offering a more detailed understanding of their impact. Corresponding hypotheses were formulated for each path, and the resulting findings are systematically presented. The sub-hypotheses related to the moderating effects, along with their respective results, are examined in detail in the subsequent sections.

H2A₀: Competition (COM) does not moderate DT and ITO

Hypothesis H2A examines the relationship between DT and ITO, with competition (COM) acting as a moderating variable. The moderation test evaluates the interaction term (DT × COM) to determine whether competition strengthens or weakens the effect of DT on ITO. Figure 15 presents the path diagram illustrating competition as the moderator (DT_COM).

Figure 15
Path Diagram Competition as Moderator (DT_COM)

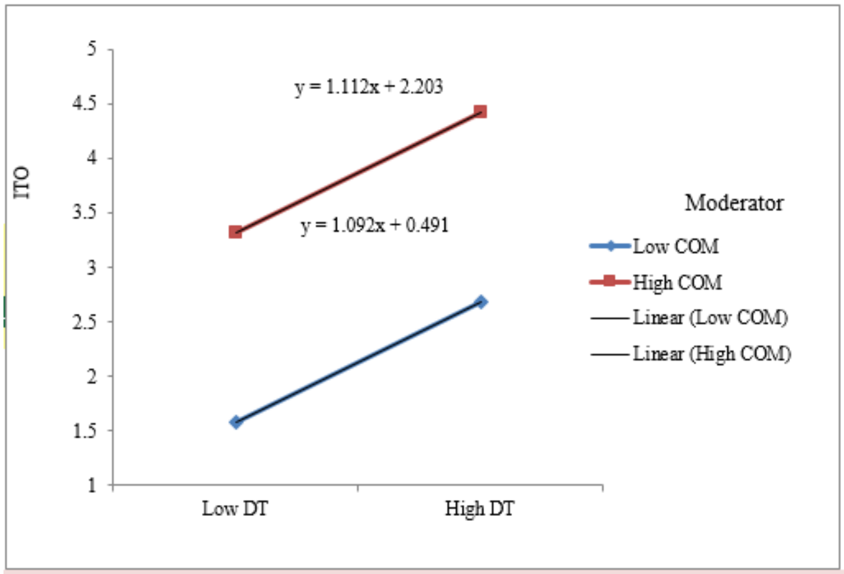


Note. Researcher's Analysis

The moderation test yields a path coefficient of 0.005, indicating a negligible positive relationship between the variables. The standard error (S.E) of 0.038 suggests reasonable precision, but the critical ratio (C.R.) of 0.126 is well below the 1.96 threshold for statistical significance. The p-value of 0.900 confirms that the interaction effect is not statistically significant. These results indicate that competition does not significantly moderate the relationship between

DT and international trade opportunities. Figure 16 illustrates the moderation effect of competition on the DT–ITO relationship.

Figure 16
COM Moderation on DT and ITO



COM strengthens the positive relationship between DT and ITO.

Note. Researcher's Analysis

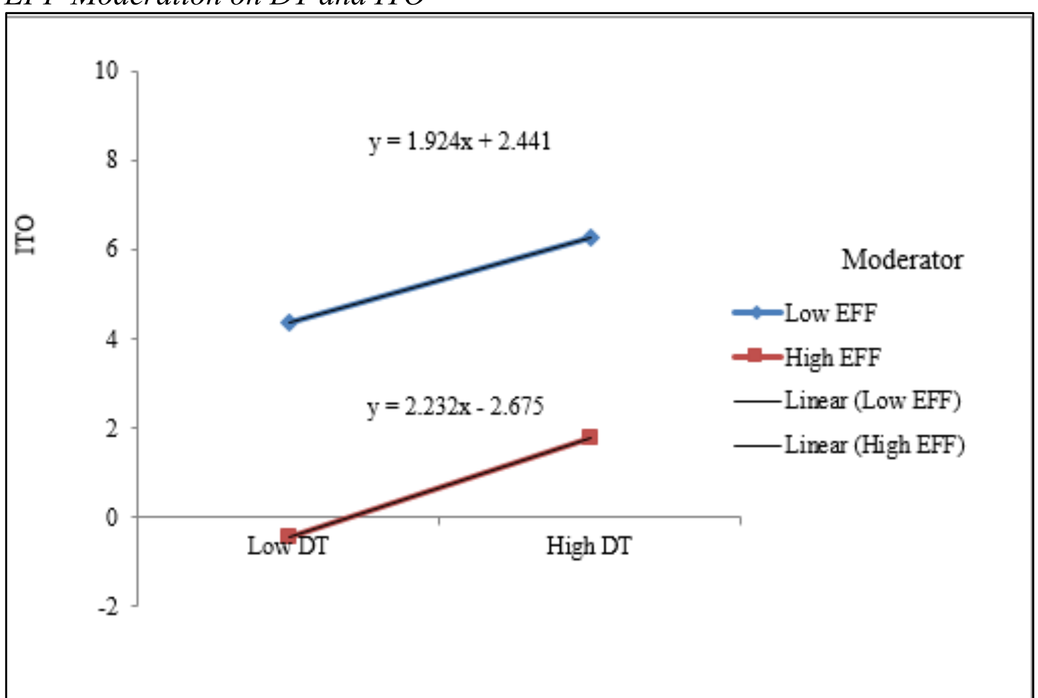
Although Figure 16 visually suggests a positive strengthening effect between DT and ITO, the SEM results reveal that this association lacks statistical significance. Despite the graphical representation indicating a potential effect, the results do not confirm a robust association between the variables. The analysis also presents the results at both elevated and diminished moderator levels, with the formula for the high moderator effect Y = 1.112x + 2.203 and for the low moderator effect Y = 1.092x + 0.491. These results suggest that, even under varying levels of competition, the relationship between DT and ITO remains weak and statistically insignificant. Consequently, the hypothesis proposing that competition (COM) moderates the relationship between DT and ITO is rejected. Based on these findings, this study concludes that competition does not significantly moderate the impact of DT on international trade opportunities.

H2B₀: Efficiency (EFF) does not moderate DT and ITO.

Hypothesis H2B examines the relationship between DT and international trade opportunities (ITO), with efficiency (EFF) as a moderating variable. The interaction term (DT × EFF) is tested to determine whether efficiency significantly alters the strength or direction of the DT–ITO relationship. The moderation analysis yields a path coefficient of 0.077 with a standard error of 0.023, indicating a moderately positive interaction effect. The critical ratio (C.R.) of 3.35 exceeds the 1.96 threshold, and the p-value is less than 0.001, demonstrating that the moderating effect is statistically significant. These findings suggest that higher levels of efficiency amplify the positive impact of DT on international trade opportunities. Figure 17 illustrates this positive moderating effect of efficiency on the DT–ITO relationship, consistent with the SEM results.

Figure 17

EFF Moderation on DT and ITO



EFF strengthens the positive relationship between DT and ITO.

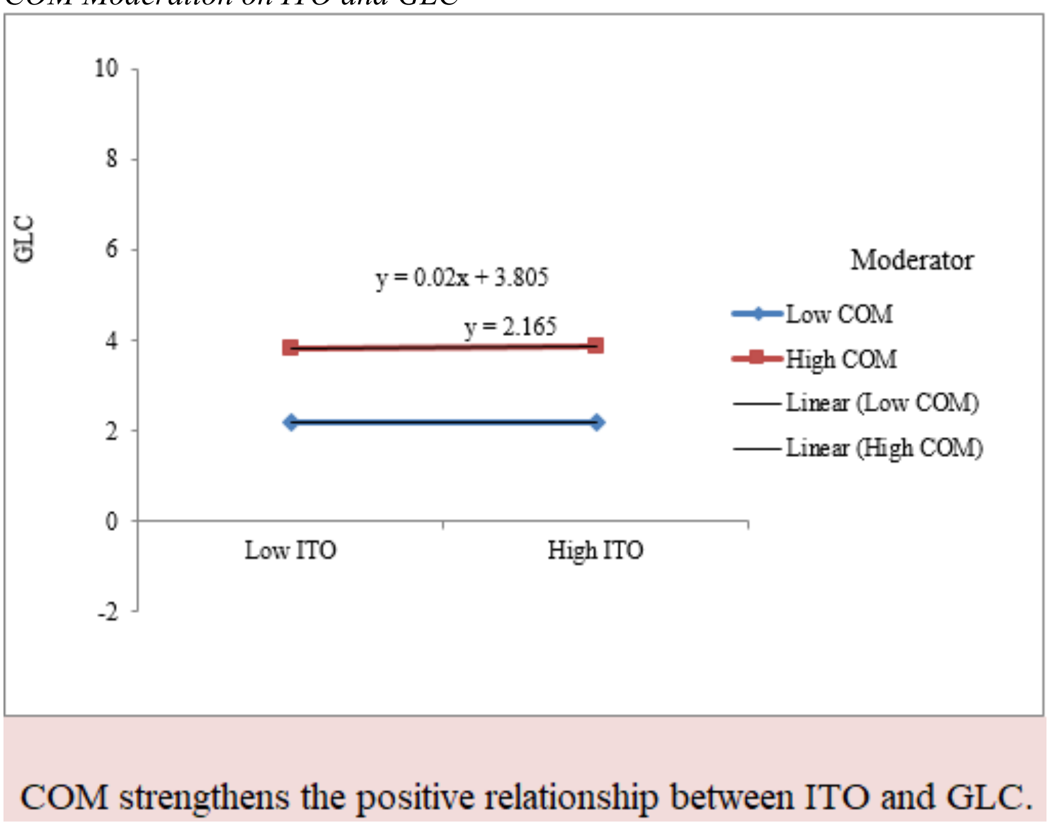
Note. Researcher's Analysis

$H2C_0$: Competition (COM) does not moderate ITO and GLC.

The H2C hypothesis examines whether competition (COM) moderates the relationship between international trade opportunities (ITO) and global competitiveness (GLC). The moderation test yields a path coefficient of −0.037, indicating a slight negative interaction effect, though the magnitude is minimal. The standard error of 0.033 suggests a reliable estimate, but the critical ratio (C.R.) of −1.149 is below the 1.96 threshold for statistical significance. The p-value of 0.251 further confirms that the moderating effect is not significant. Therefore, competition does not significantly influence the relationship between ITO and GLC. Figure 18 illustrates the interaction effect of competition on the ITO–GLC relationship, showing a weak relationship that is not statistically supported by the SEM results, leading to rejection of the hypothesis.

Figure 18

COM Moderation on ITO and GLC



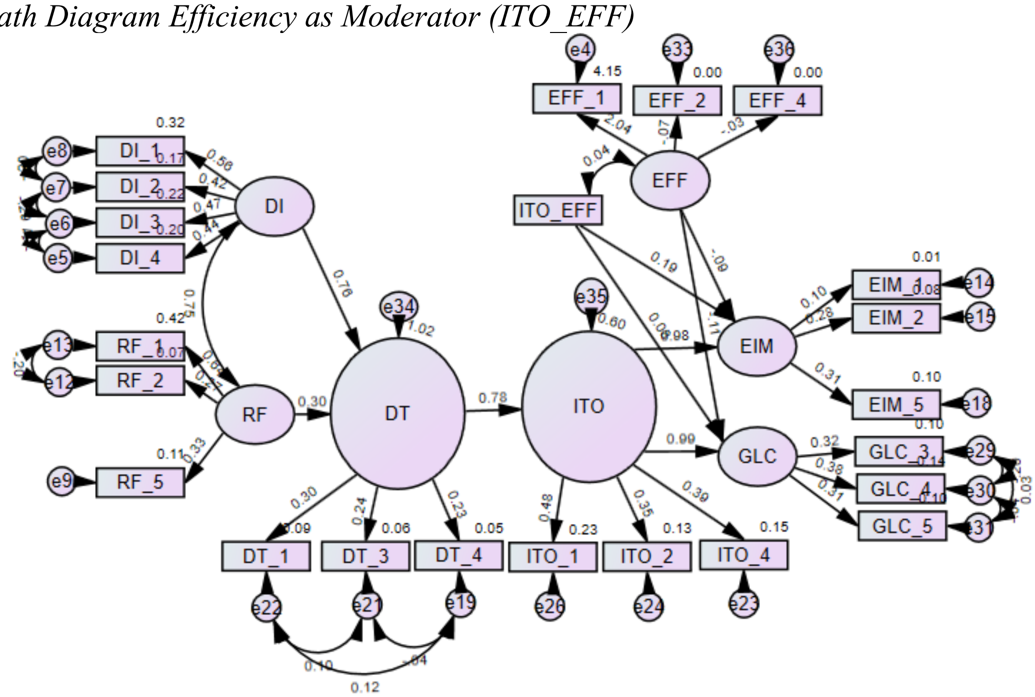
Note. Researcher’s Analysis

H2D₀: Efficiency (EFF) does not moderate ITO and GLC

The H2D models test the relationship between ITO and GLC with Efficiency (EFF) as a moderator, focusing on the interaction term (ITO * EFF) to assess whether efficiency alters the degree of connection between ITO and GLC. This approach explores whether higher levels of efficiency enhance the impact of ITO on GLC, suggesting that more efficient environments may amplify the benefits of ITO in improving global logistics capabilities. Conversely, lower efficiency could weaken the relationship between ITO and global competitiveness (GLC), suggesting that ITO may have less impact when efficiency is low. By testing this interaction, the model aims to determine whether efficiency significantly moderates the effect of ITO on GLC. Figure 19 presents the path diagram illustrating efficiency as a moderator in the ITO–GLC relationship (ITO_EFF).

Figure 19

Path Diagram Efficiency as Moderator (ITO_EFF)



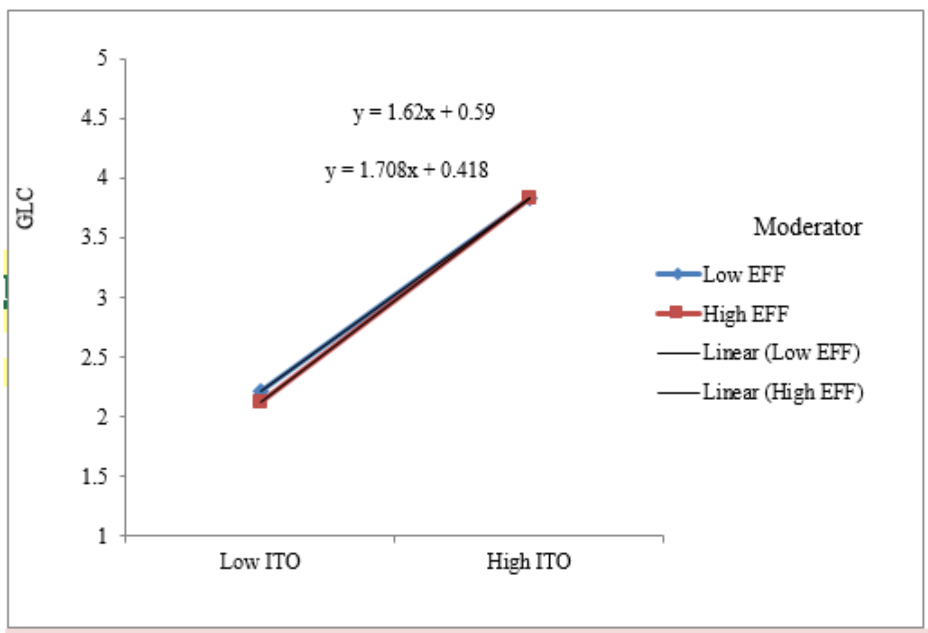
Note. Researcher’s Analysis

The moderation analysis results reveal a path coefficient of 0.008, pointing to a minimal positive association. This implies that efficiency has a minimal effect on the relationship between

ITO and GLC, with its impact being both small and statistically insignificant. The standard error of 0.007 reflects a precise estimate with minimal variability, implying that the coefficient is stable and reliable. However, the critical ratio (C.R.) of 1.221 is well below the threshold of 1.96, and the p-value of 0.222 is significantly higher than the benchmark 0.05 level for determining statistical significance. The results indicate that the relationship between ITO and GLC is not statistically significant, and the moderating effect of efficiency (EFF) is negligible. Consequently, efficiency does not significantly alter the ITO–GLC relationship. Figure 20 visually depicts the interaction effect of efficiency, suggesting a potential strengthening of the ITO–GLC relationship. However, the structural SEM analysis does not support this trend statistically, highlighting the importance of relying on statistical evidence rather than visual interpretation. As such, the hypothesis proposing a significant moderating effect of efficiency is rejected.

Figure 20

EFF Moderation on ITO and GLC



EFF strengthens the positive relationship between ITO and GLC.

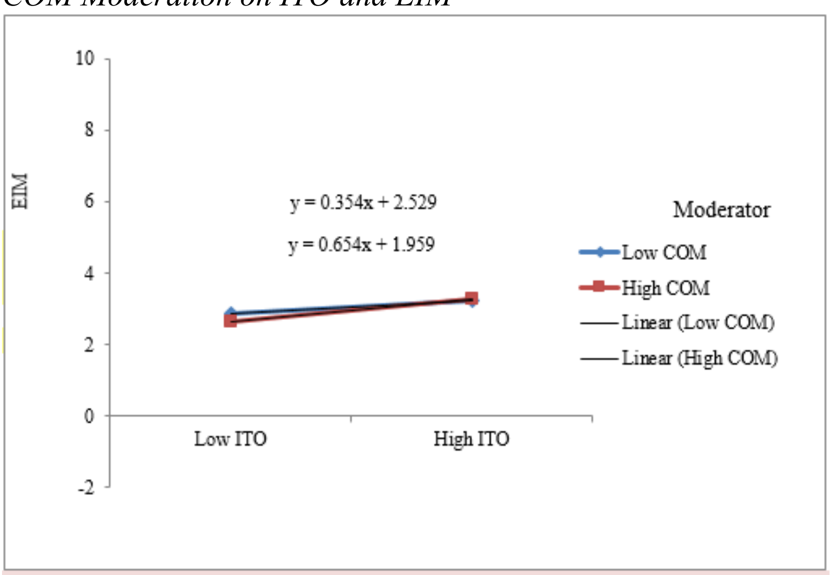
Note. Researcher's Analysis

$H2E_0$: Competition (COM) does not moderate ITO and EIM

Hypothesis H2E examines the relationship between ITO and import/export efficiency (IEM), with competition (COM) acting as a moderating variable. The interaction term (ITO × COM) tests whether competition significantly influences the strength of the ITO–IEM relationship. The SEM analysis of the moderated relationship, using the interaction variable ITO_COM, yields a path coefficient of 0.075, indicating a positive moderating effect. The standard error of 0.017 reflects high precision and minimal variability in the estimate. The critical ratio (C.R.) of 4.391 exceeds the 1.96 threshold, and the p-value (***) confirms a highly significant relationship. Figure 21 presents the graphical representation of the model, illustrating the moderating role of competition in the relationship between ITO and import/export efficiency. Collectively, the statistical and graphical results support acceptance of the hypothesis, demonstrating that competition plays a meaningful and robust moderating role in enhancing efficiency in import and export activities.

Figure 21

COM Moderation on ITO and EIM



COM strengthens the positive relationship between ITO and EIM.

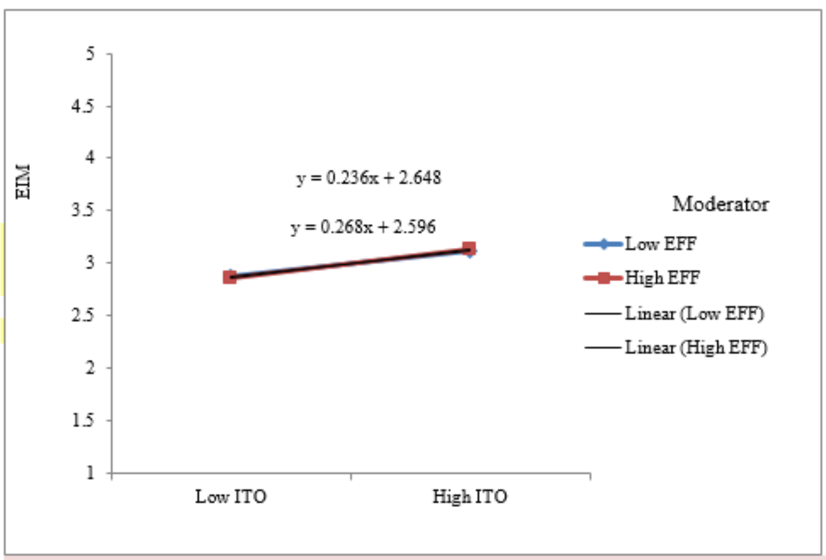
Note. Researcher's Analysis

H2F$_0$: Efficiency (EFF) does not moderate ITO and EIM

Hypothesis H2F examines the relationship between ITO and import/export efficiency (EIM), with efficiency (EFF) as the moderating variable. The interaction term (ITO × EFF) tests whether efficiency significantly influences the ITO–EIM relationship. The SEM results yield a path coefficient of 0.022, indicating a weak positive interaction effect, with a standard error of 0.024 reflecting reasonable estimation precision. However, the critical ratio (C.R.) of 0.900 falls below the 1.96 threshold, and the p-value of 0.368 exceeds the 0.05 significance level, indicating that the moderating effect is not statistically significant. Figure 22 presents the graphical representation of the model, which visually suggests a strengthening effect of efficiency on the ITO–EIM relationship; however, this pattern is not supported by the SEM results. Accordingly, the hypothesis is rejected, and the findings indicate that efficiency does not significantly moderate the relationship between ITO and import/export efficiency.

Figure 22

EFF Moderation on ITO and EIM



EFF strengthens the positive relationship between ITO and EIM.

Note. Researcher's Analysis

Based on the results of the analysis, hypotheses H2B2 and H2C2 were accepted, whereas hypotheses H2D2, H2F2, H2A2, and H2E2 were rejected. These outcomes underscore the pivotal role of digital transformation (DT) in enhancing international trade opportunities (ITO) and global competitiveness (GLC). The accepted hypotheses demonstrate that DT exerts a statistically significant and positive influence on trade-related outcomes, particularly in improving efficiency within import and export activities at the DSM Port. This finding confirms the centrality of DT as a key driver of performance improvements in complex trade and logistics environments.

The robustness of these findings is further supported by the relatively low standard errors associated with the estimated path coefficients, indicating a high degree of precision and stability in the results and suggesting that the estimates are not substantially affected by sampling variability (Bougie & Sekaran, 2019). In addition, the high critical ratios observed for the accepted hypotheses provide strong empirical justification for rejecting the null hypotheses and affirming the substantive influence of DT on international trade opportunities, port competitiveness, and the mitigation of inefficiencies in import and export operations (Hair Jr. et al., 2021).

Moreover, the exceptionally low p-values, all below the 0.001 threshold, offer compelling statistical evidence that DT has a significant and positive impact on international trade opportunities. Beyond statistical validation, these findings carry important practical implications. They highlight the potential of effective DT initiatives to enhance operational efficiency, improve process integration, and streamline import/export activities. For organizations and stakeholders operating at the DSM Port, the results emphasize the strategic importance of leveraging digital technologies to achieve sustainable competitive advantage, strengthen international trade performance, and improve service delivery across the trade ecosystem.

The analysis examined the moderating roles of competition (COM) and efficiency (EFF) in the relationships among digital transformation (DT), international trade opportunities (ITO), global competitiveness (GLC), and efficiency in import/export activities. The findings indicate that competition does not exert a statistically significant moderating effect on the DT–ITO relationship. However, both efficiency and competition play complementary roles in strengthening the positive impact of DT on international trade opportunities, suggesting that favorable organizational and market conditions can amplify the benefits of digital transformation.

Further results show that competition significantly enhances the relationship between international trade opportunities and efficiency in import/export activities. This suggests that competitive pressures motivate firms and institutions to respond more effectively to emerging trade opportunities by improving operational processes, optimizing resource utilization, and adopting more efficient practices. In contrast, efficiency demonstrates a limited moderating influence on the relationship between international trade opportunities and global competitiveness. This indicates that while efficiency gains can improve operational performance, they may not, on their own, be sufficient to translate trade opportunities into sustained competitive advantages without complementary strategic, institutional, or policy support.

Overall, these findings suggest that while digital transformation directly contributes to improved international trade opportunities and global competitiveness, its effects are most pronounced when reinforced by competitive market dynamics and operational efficiency. The robustness of these conclusions is supported by the statistical results, including low standard errors and high critical ratios, which indicate reliable and stable estimates. Collectively, the results highlight the practical importance of digital transformation in strengthening the competitive position of the DSM Port and improving efficiency in import/export activities.

Research Question 3/Hypothesis

This hypothesis investigates the influence of Digital Infrastructure (DI) on Digital Transformation (DT) in creating International Trade Opportunities (ITO). Digital infrastructure refers to the network resources and technologies that connect stakeholders, enabling the exchange of services, data, and content (Constantinides, Henfridsson & Parker, 2018). Furthermore, external factors like DI can influence the independent variable (DT), which consequently affects the dependent variable (ITO). The presence and quality of DI can either amplify or diminish the impact of DT on ITO. Connectivity plays a pivotal role whereby, without robust internet infrastructure and advanced digital networks, the potential for DT to generate trade opportunities is significantly constrained. Consequently, the quality of DI is critical in determining how effectively DT can drive international trade opportunities.

This hypothesis explores the function of DI in improving DT and creating ITO. DI refers to the network resources and technologies that connect stakeholders, enabling the exchange of services, data, and content (Constantinides, Henfridsson & Parker, 2018). Constantinides, Henfridsson and Parker (2018) points out, external factors like DI can influence DT, which in turn affects ITO. The quality of DI (in terms of internet connectivity and advanced digital infrastructure) is crucial in shaping the effectiveness of DT in generating international trade opportunities (Dahlman, Mealy & Wermelinger, 2016). Without robust DI, the potential for DT to unlock ITO is severely limited (Klein & Todesco, 2021).

Steenkamp (2020) highlights key DI components, such as connectivity, competition channels, and digital platforms, which are vital for stakeholder interaction and data sharing in trade. Houngbonon, Rossotto and Strusani (2021) emphasize that the quality, not just the presence, of digital connectivity is critical. For example, regions with outdated mobile networks (e.g., 2G, 3G) face a significant digital divide, which hinders the ability of DT to create ITO. This issue is especially common in Least Developed Countries (LDCs), where outdated infrastructure limits digital services. Government-led initiatives to improve DI are essential for bridging this gap and enabling DT to unlock ITO (Kumar, 2018).

The study treats DT serving considering DI as the causal factor, the independent variable as the input, and ITO as the resulting outcome. By examining how DI affects the correlation between DT and ITO, the research aims to identify the conditions under which DT is most effective in creating ITO. Using qualitative and thematic analysis, the study investigates how varying levels of DI impact DT's ability to drive international trade. Additionally, the study explores how different dimensions of DI such as connectivity technology, internet access, digital platforms, and communication channels, shape the ability of DT to facilitate international trade. To test these relationships, the following hypotheses were formulated:

Ho: Robust DI does not influence DT in international trade.

The statistical results indicate a positive association between DT and ITO, supported by a path coefficient (H3) of 0.488. This implies that an increase in DT is associated with enhanced effectiveness of ITO. The standard error of 0.21 indicates that the coefficient is both stable and reliable. The C.R. value of 2.325 surpasses the standard significance threshold, supporting the rejection of the null hypothesis. Additionally, the p-value of 0.02 further confirms the statistical significance of the effect, reinforcing the conclusion that the relationship between DT and ITO is meaningful and not due to random chance.

The analysis also examined the influence of competition (COM) as a moderator in the relationship between digital transformation and international trade opportunities, using the interaction variable DT_COM. he results reveal a path coefficient of 0.49, a standard error of

0.227, and a critical ratio of 2.153, indicating that the relationship (H3) is statistically significant, as further supported by a p-value of 0.031.

Similarly, the analysis explored the impact of ITO_COM on Global Competitiveness (GLC) and Efficiency in Import/Export Activities (EIM). The path coefficient for H3 remained strong at 0.496, accompanied by a standard error of 0.206 and a critical ratio of 2.412, the findings confirmed statistical significance of the association. The p-value of 0.016 provides strong evidence that the relationship is meaningful and not due to random chance.

Furthermore, the analysis explored the moderating effect of efficiency (EFF) through the interaction term DT_EFF. The path coefficient associated with Hypothesis 3 (H3) was notably strong at 0.492, indicating a substantial meaningful positive association exists between the interaction term and the outcome variable. The standard error for this path was 0.242, and the resulting critical ratio (CR) was 2.035, exceeding the conventional threshold of 1.96 required for statistical significance at the 5% level. Correspondingly, the p-value of 0.042 confirms the significance of this relationship, suggesting that efficiency significantly moderates the effect captured by DT_EFF and contributes meaningfully to the model.

The hypothesis also investigated the connections between DT, DI, ITO, GLC, and EIM. The findings indicate a robust positive association between these variables, with a statistical significance of p-value 0.018 and a critical ratio (C.R.) of 2.367. The study further explored the role of Digital Infrastructure (DI) in enhancing Digital Transformation (DT) and facilitating ITO. It was found that a strong DI positively influences the correlation between DT and ITO. Notably, the effect of DI on DT remained consistent, regardless of the moderating influences of competition (COM) and efficiency (EFF), this confirms the pivotal role of DI in enhancing the capacity of DT to generate international trading opportunities.

Research Question 4/Hypothesis

This hypothesis examines the influence of Regulatory Frameworks (RF) on Digital Transformation (DT), emphasizing how these factors facilitate the development of International Trade Opportunities (ITO). As noted by Fu (2020), there is a growing need to reassess regulatory frameworks, particularly in developing countries, to address the widening digital transformation gap. Furthermore, Adeola and Evans (2020) underscore the importance of improving internet access, particularly in Africa, where internet penetration was only 20% as of 2016. This limited access hampers the region's full participation in digital economies and international trade.

This section primarily strives to examine the role of the independent variable in, RF, interacts with the dependent variables, DT and ITO, in the context of international trade. The study follows the methodology outlined by Constantinides, Henfridsson and Parker (2018) employing SEM to assess the impact of RF on DT while simultaneously exploring its role in facilitating ITO. In line with Bonina et al., (2021) the research advocates revisiting and revising the established by governments to create a more supportive environment for DT. Such revisions are critical to bridging the digital divide and unlocking greater economic opportunities, especially for developing countries. The findings from this analysis provide useful insights for policymakers, helping them understand how a supportive RF can drive DT and ITO. To investigate this relationship, both null and alternative hypotheses were formulated and tested:

H_o: Supportive regulatory frameworks do not influence DT in creating ITO

The statistical analysis identified a weak but positive association between Digital Transformation (DT) and International Trade Opportunities (ITO), as represented by path H4. The path coefficient of 0.221 reflects a positive relationship, though its strength is modest, suggesting that the impact of DT on ITO is relatively limited. The standard error (S.E.) of 0.203 indicates a moderate level of estimate variability. However, the C.R. of 1.088 falls significantly below the commonly accepted threshold of 1.96 for statistical significance. Additionally, with a p-value of 0.277, which exceeds the conventional threshold of 0.05, the relationship is not statistically significant and may be due to random variation. As such, the hypothesis that DT significantly influences ITO is not supported.

When considering the moderating role of competition (COM), the interaction term DT_COM was analysed to evaluate its influence on the relationship between RF and DT in fostering international trade opportunities. The resulting path coefficient was 0.191, again indicating a weak positive relationship. Given the standard error of 0.211 and a critical ratio of 0.906, which does not meet the 1.96 threshold, the relationship cannot be considered statistically significant. The associated p-value of 0.365 further supports retaining the null hypothesis and reinforcing the conclusion that competition lacks a statistically significant moderating role in this relationship.

Similarly, the effect of competition (COM) was examined on both EIM and GLC through the interaction term ITO_COM. The path coefficient for this analysis was 0.224, suggesting a minimal positive effect. Although the S.E. of 0.194 reflects a stable estimate, the C.R. of 1.156 and the p-value of 0.248 fall short of statistical significance. Once more, this leads to rejecting the hypothesis, showing that COM contributes modestly to the link between DT and ITO here.

The moderating effect of efficiency (EFF) was also assessed in relation to DT and ITO through the interaction variable DT_EFF. Here, the path coefficient of 0.257 points to a slight positive association. The S.E. of 0.259 suggests an acceptable degree of precision. However, the C.R. of 0.99, well below 1.96, together with a p-value of 0.322, the data show that this relationship lacks statistical significance. This confirms that efficiency does not meaningfully moderate the DT–ITO relationship in this instance.

In a related model, the impact of efficiency (EFF) on both GLC and EIM was tested using the interaction term ITO_EFF. The resulting 0.194 path coefficient reflects a weak positive association among these variables. Although the standard error of 0.205 suggests a stable estimate, the critical ratio of 0.946 and p-value of 0.344 show no evidence of statistical significance. This implies a 34.4% The chance that the observed effect may stem from random error instead of a genuine effect warranting rejection of the associated hypothesis.

Overall, the results from the H4 models consistently reveal no statistically significant relationships. Despite the directionally positive path coefficients, their magnitudes are low, with all p-values above the 0.05 threshold. Consequently, the hypotheses under H4 are rejected, and no compelling evidence supports a meaningful linkage between DT and ITO within the tested moderating conditions. In contrast, the results from SEM confirm that RF has a statistically significant positive influence on DT. The analysis shows that a one-unit gain in RF is linked to a measurable increase in DT adoption. This relationship is robust, characterized by a low standard error and a critical ratio exceeding 1.96. The p-value supports the conclusion of statistical significance, indicating a reliable and meaningful effect of RF on DT.

These findings reinforce the view that supportive RF serve as key enablers of DT and facilitators of international trade opportunities, while non-supportive frameworks may hinder progress. A conducive regulatory environment, through policies that encourage digital platforms, strengthen cybersecurity, and foster innovation, can help eliminate barriers such as restrictive regulations and cyber threats. Although the H4 model indicates no significant moderating effects on the DT–ITO relationship, RF continues to be a key driver of digital outcomes. Future research should investigate additional influencing factors and consider broader, potentially longitudinal approaches to gain deeper insights into the evolving DT–ITO relationship.

Research Question 5/Hypothesis

This hypothesis examines whether DT and ITO have influence on Global Competitiveness (GLC). Peng and Tao (2022) highlights that competitiveness is among the fundamental attributes of performance. In this study, competitiveness relates to the ability of a business to achieve profitability and capture market share. Specifically, for importers, exporters, and clearing and forwarding agents, competitiveness is determined by how the port of DSM performs in terms of costs, services, dwell time, and other key factors that influence hinterland countries to make choices of the port to use for their import/export activities (Humphreys et al., (2019).

H_o: DT and ITO have no influence on global competitiveness (GLC)

The impact of DT and ITO on GLC is a significant area of study, and the statistical analysis yields insightful results. The relationship between DT and ITO shows a positive connection with a path coefficient of 0.356. This suggests that as DT increases, ITO and GLC also improve. The relatively low S.E. of 0.08 indicates stability and reliability of this coefficient. C.R. of 4.432 far exceeds the threshold for statistical significance. The p-value, marked as ***, confirms statistical significance, justifying acceptance of the hypothesis.

The analysis explores the moderating influence of competition (COM) through the interaction term DT_COM on the relationship between DT and ITO. The path coefficient of 0.149 reflects a positive, though weaker, effect compared to the direct impact of DT. A standard error (S.E.) of 0.082 indicates a reasonable level of precision in the estimate. The critical ratio (C.R.) of 1.81 is close to the 1.96 threshold, and the p-value of 0.07, slightly above the commonly accepted threshold of 0.05, suggests marginal importance. As a result, the hypothesis is cautiously accepted, acknowledging the modest strength of the effect. In examining the relationship between EIM, GLC, and ITO, moderated by COM through the interaction term ITO_COM, the path coefficient is 0.126, indicating a small positive effect. The S.E. of 0.073 demonstrates adequate precision, but the C.R. of 1.715 fails to reach the significance level. With a p-value of 0.086, the result is not statistically significant, leading to a failure to refute the null hypothesis.

The moderating role of efficiency (EFF) through the interaction term DT_EFF on the DT-ITO relationship shows a path coefficient of 0.296, suggesting a moderately strong positive effect. With an S.E. of 0.078, the estimate appears stable, and the C.R. of 3.786 significantly exceeds the critical threshold. The p-value, denoted by ***, indicates strong statistical significance, supporting the robustness of this moderating effect and justifying the acceptance of the hypothesis. Furthermore, investigation into the moderating role of EFF within the relationship among EIM, GLC, and ITO reveals a path coefficient of 0.252, indicating a moderate positive effect. The S.E. of 0.072 demonstrates good estimation accuracy, and the C.R. of 3.479 surpasses the significance threshold, with the p-value (***) confirming statistical significance.

Results show the estimate is precise, as indicated by the relatively low standard errors, suggesting that the findings are not due to random variability (Bougie & Sekaran, 2019). High C.R. coupled with low p-values strengthens the validity of the accepted relationships (Hair Jr. et al., 2021). These findings stress the vital importance of DT as a key enabler of ITO, EIM, and GLC, reinforcing the need for businesses to prioritize digital investments to sustain a competitive edge in the global marketplace (Ding et al., 2023; Tolstoy, Nordman & Vu, 2022).

The results confirm a positive and statistically significant effect of DT on influencing both ITO and GLC. While competition (COM) shows only a marginal moderating effect, efficiency (EFF) significantly strengthens the influence of DT on trade outcomes. Overall, the results emphasize DT’s critical role in enhancing competitiveness, expanding trade, and improving operational efficiency, supporting the need for continued investment in digital technologies.

Research Question 6/Hypothesis

Efficiency is defined as the optimal allocation of organizational resources to achieve desired outcomes. In the context of this study, efficiency was measured by the quality and speed with which port users experience in the import/export activities (Maury et al., 2020). Efficiency is critical driver of performance and profitability, influencing the choice of port, assuming all other factors remain unchanged (Behdani et al., 2020). By examining these interconnected dimensions, the research intended to evaluate the influence of DT and ITO on EIM by testing and presenting results of the below research hypothesis.

H_o: DT and ITO have no influence on efficiency in import/export activities (EIM)

The statistical findings indicate a significant impact of DT and ITO on Export and EIM. A strong positive link emerged between DT and ITO, reflected by a path coefficient of 0.859. This suggests that greater adoption of DT relates to enhanced effectiveness in both international trade opportunities and efficiency in import/export activities. The low standard error (S.E. = 0.203) indicates a stable and reliable estimate, while the critical ratio (C.R.) of 4.221 exceeds the standard threshold for significance. The p-value, marked as ***, confirms the statistical significance of the relationship, supporting the acceptance of the hypothesis.

The study also assessed the moderating roles of Competition (COM) and Efficiency (EFF) through interaction terms DT_COM and DT_EFF on the DT–ITO relationship. The resulting path coefficient of 0.781 reflects a strong positive correlation, supported by a C.R. of 3.749 and a p-value of ***, indicating statistical significance despite some variability in the data (S.E. = 0.208). These results validate the moderating influence of competition and support acceptance of the hypothesis. Furthermore, when analyzing the effect of COM on the ITO–EIM relationship via the ITO_COM variable, the path coefficient was 0.832, indicating a very strong positive interaction.

With a C.R. of 4.236 and a precise estimate (S.E. = 0.196), the relationship is statistically significant (p-value ***), confirming the moderation and supporting the hypothesis.

Efficiency (EFF) also demonstrated a strong moderating effect on the DT–ITO–GLC relationship through the DT_EFF interaction, with a path coefficient of 0.835. The estimate is considered stable (S.E. = 0.208), with a C.R. of 4.01. Ultimately, the p-value () confirms the robustness of the finding, thereby justifying acceptance of the hypothesis. In the final analysis, these results underscore the strength of the relationship and the robustness of the model. The path coefficient of 0.492 suggests a moderate positive effect, further supported by a high C.R. of 3.503 and a low S.E. of 0.141. confirming the reliability of the estimate. The p-value () further validates the significance of this interaction, leading to acceptance of the hypothesis.

The outcome reveal a notable, statistically significant link between DT, ITO, and EIM. The DT–ITO connection is particularly strong, supported by a high path coefficient (0.859), low standard error (0.203), and a robust critical ratio (4.221). While competition (COM) reflects a mild, yet statistically validated, moderating impact on the relationship (path coefficient = 0.781, C.R. = 3.749), efficiency (EFF) has a stronger influence (path coefficient = 0.835, C.R. = 4.01). COM also strongly moderates the ITO–EIM relationship (path coefficient = 0.832, C.R. = 4.236), whereas EFF has a moderate but significant impact on the EIM–ITO–GLC link (path coefficient = 0.492, C.R. = 3.503). Overall, the findings highlight DT and efficiency as key drivers of competitiveness and performance in international trade activities.

The study finds strong, positive relationships between DT, ITO, and EIM. DT significantly influences ITO, with efficiency (EFF) showing a stronger moderating effect than competition (COM). Both COM and EFF also significantly moderate ITO’s impact on EIM and GLC. Overall, DT and efficiency are key to enhancing trade performance and competitiveness.

Evaluation of Findings

This study on the opportunities presented by DT in international trade has produced significant findings from both qualitative and quantitative perspectives, which are further evaluated below. By testing multiple hypotheses and analyzing a combination of thematic insights and statistical evidence, the study sheds comprehensive light on how DT contributes to expanding ITO, enhancing GLC, improving EIM, and addressing the digital divide problem.

The findings from the qualitative analysis highlight that key stakeholders recognize DT as a strategic enabler that facilitates quicker market responsiveness, reduces inefficiencies, and expands access to cross-border trade. Participants underscored the impact of digital solutions in improving transparency, reducing corruption, and strengthening operational capabilities, with a focus on developing economies. These insights underline the necessity of digital investment at institutional and operational levels to overcome trade barriers and remain competitive.

The crosstabulation analysis (pp. 155–156) revealed an unexpected pattern in the marital status of individuals involved in import/export activities, with a substantial proportion reporting that they had never been married (249; 60.9%) and a notable number identifying as widowed (116; 28.4%). This suggests that singlehood is more prevalent in the sector than anticipated, which may reflect broader socio-economic and cultural shifts, such as delayed marriage due to career priorities or the demanding nature of long working hours. The findings also indicate a gender imbalance among older age groups, with women appearing to exit the logistics workforce more frequently as they age, which may point to gender-related barriers such as caregiving responsibilities, limited opportunities for advancement, or workplace conditions that do not support long-term retention. The high incidence of widowed respondents across multiple age groups further highlights potential vulnerabilities related to health, economic hardship, or inadequate social support systems.

Together, these unexpected results underscore the need for further investigation into how marital status, age, and gender intersect to shape participation and progression in import/export activities.

The SEM analysis indicates that regulatory frameworks do not positively influence digital transformation performance and may be more restrictive than supportive. This result is unexpected, as regulations are typically assumed to enable digital adoption. The rejection of H4 is supported by a CR value of 1.088 (below 1.96) and a p-value of 0.277 (above 0.05), indicating no statistically significant moderating effect. Nonetheless, restrictive regulations can hinder progress by limiting digital platform adoption and increasing compliance burdens, while supportive policies that promote innovation and strengthen cybersecurity can facilitate transformation. Therefore, further investigation is needed to identify specific regulatory barriers and to inform reforms that enhance digital outcomes. Future research should also consider additional influencing factors and potentially longitudinal designs to better understand how regulatory environments affect DT.

Quantitative findings from the SEM analysis confirm DT and ITO are strongly and significantly related, with a path coefficient of 0.859. Efficiency (EFF) proved to be a more impactful moderator than Competition (COM), further strengthening the DT and ITO relationship with a path coefficient of 0.835, compared to 0.781 for COM. Additionally, COM significantly moderates the link between ITO and EIM, with a path coefficient of 0.832, highlighting the role of competitive environments in enhancing trade performance. EFF also moderately improves the relationship between EIM, ITO, and GLC, underscoring the importance of operational efficiency. Collectively, these results highlight the critical role of digital transformation supported by robust digital infrastructure and shaped by the regulatory environment, while moderated by efficiency and competition, in advancing international trade opportunities, enhancing global competitiveness, and improving import/export efficiency. Table 43 presents the evaluation of findings.

Table 43

Evaluation of Findings

S/N	Similar Findings	Contradicting Findings
01	Behdani et al., (2020): • Underperformance is due to lack of smart logistics/digital systems in hinterlands. • Strong reliance on digitalization, smart logistics, and technological solutions. • Assumes sea port technological underperformance requires digital fixes/solutions	Furr, Ozcan, and Eisenhardt (2022): • Market performance hinges on how actors define categories, not purely digital tools • Emphasizes strategic adaptation and entrepreneurial maneuvering within systems • Assuming strategic innovation in existing systems, can achieve success even without digitalization
02	Mlepo and Zheng (2023): • Promote gradual, context-sensitive capability building. • Success depends on absorptive capacity and context technologies alone is not enough. • Warns of organizational failure if transformation is misaligned • Emphasize incrementalism and contextual alignment in DT, suggesting that overly aggressive digitalization can backfire.	Tabrizi et al., (2019): • Promote proactive, bold digital adoption. • Tech is not central, but leadership-driven digital culture is the driver. • Accepts risk of disruption as part of successful transformation. • Argue for radical and rapid transformation, claiming that bold leadership and cultural change matter more than tech or context
03	Maury, Salgado and Fathi (2020): • Cautious approach towards DT - needs foundational support for the organization to be effective. • Basic infrastructure, human capital, regulatory policy. • Can be implemented by emerging economies • Warns about overestimating digital benefits in especially when the firm is unprepared	Song et al., (2022): • Optimistic approach towards DT - digitalization directly improves firm performance via innovation. • Internal innovation processes and strategic digital adoption. • Suitable for developed/advanced economies/firms. • Suggests DT is broadly beneficial when leveraged well by the organization/firm
04	Nadkarni and Prugl (2021): • View DT as a strategic and adaptive journey requiring commitment and cognitive leadership • Central to success is the leadership vision, readiness and adaptability • Transformative nature is non-linear, dynamic, path-dependent • Applied strategic management and dynamic capabilities theory • Emphasizes human and strategic adaptability	Romero et al., (2020): • View DT as a resource-centric process based on digital assets and IT capabilities • Downplayed, the value that lies in resource / ICT tools configuration • Transformative nature is structured and resource-driven • Focused on Resource-Based View (RBV) • Focuses on resources and process automation

Note. Researcher's Analysis

Qualitative Results

The study investigates how digital technologies are redefining international trade. Informed by thorough interviews conducted with primary stakeholders in import/export, the qualitative findings offer valuable insights into how digital transformation affects cross-border trade dynamics. The analysis highlights the ways in which various factors can either support or impede progress, providing a nuanced perspective on both the opportunities and restrictions associated with digital transformation. This underscores the need to consider technological advancements in conjunction with broader regulatory, contextual, and operational environments that influence their adoption and effectiveness. The findings for each research hypothesis are presented sequentially, guided by thematic analysis.

Considering the hypothesis "*adoption of digital transformation (DT) does not unfold international trade opportunities (ITO)*," 82% of interview respondents strongly agree that digital readiness, innovation, and the growth of digital literacy have the potential to generate substantial opportunities for international trade. This perspective was echoed by respondent P419, who viewed " *DT readiness and knowledge and skills as key trade facilitators.*" However, P418 raised concerns about the current state of digital literacy, particularly among older generations, stating, "*Digital knowledge and skills are very low, especially among older individuals, but are more moderate among youth, particularly young graduates.*" They also highlighted that "*digital awareness and skills remain limited in Tanzania, as evidenced by the continued prevalence of cash transactions, despite the availability of online platforms and mobile money services.*" Sixty-four percent of key informant respondents emphasized the urgent need to enhance digital leadership and commitment, while also addressing the resistance to transitioning from manual to digital systems. P410 emphasized that "*there is a resistance to digital change, particularly among older* *generations*.” P420 further pointed out that "*continuous investment in training and education is essential to enhance the digital capabilities of the workforce, thereby improving the chances of success.*" P411 added that "*DT leadership commitment is reflected in the presence of political should at all administrative levels.*" These responses suggest that DT attributes such as readiness, innovation, leadership, knowledge, and skills; are crucial for addressing the digital divide. Nonetheless, the findings diverge from certain viewpoints expressed in the existing literature. For instance, Pirola, Cimini and Pinto (2020) argue that technology readiness can be hindered by factors unrelated to trade. Likewise, Tabrizi et al., (2019) suggest that successful DT requires broader organizational changes in mindset, culture, and processes, contrasting with this study’s emphasis on technological readiness as a prerequisite for successful international trade (Union, 2020). The research examines ITO’s effect on major business outcomes, such as customer experience, service quality, communication, and performance, revealing statistically significant positive effects. The results demonstrate the game-changing influence of trade opportunities on economic growth and enhancing import/export activities. Ultimately, the study supports the perspective that DT is essential for advancing ITO, enabling businesses to bridge the digital divide, promote sustainable economic growth, and secure a global market competitiveness (Union, 2020).

The qualitative insights provide valuable context for understanding the moderation effects of both competition (COM) and efficiency (EFF) on digital transformation (DT) and international trade outcomes. The second objective of the study was addressed by six-sub hypotheses “*Competition (COM) does not moderate DT and international trade opportunities (ITO), Competition (COM) does not moderate ITO and global competitiveness (GLC), Competition (COM) does not moderate ITO and efficiency in import/export (EIM), Efficiency (EFF) does not moderate DT and international trade opportunities (ITO), Efficiency (EFF) does not moderate*

ITO and global competitiveness (GLC) and Efficiency (EFF) does not moderate ITO and efficiency in import/export activities (EIM)". The qualitative insights provide valuable context for understanding how COM and EFF influence DT and ITO. These findings clarify the moderating role of these factors in influencing international trade opportunities. The next sections analyze each sub-hypothesis individually, highlighting their contributions to a deeper understanding of how DT drives international trade opportunities.

Regarding the hypothesis "*Competition (COM) does not moderate DT and international trade opportunities (ITO)*," key informants emphasized the critical need for the DSM port to adopt technological standards to remain competitive. Respondent P411 highlighted that improving efficiency through digitalization could significantly "*reduce cargo clearance times*", "*enhance competitiveness*", and "*lower ship dwell times*". P411 further proposed that digitalization would "*streamline customs clearance processes*" and "*improve monitoring of transit cargo*", thereby "*minimizing the risk of tax evasion*". This perspective aligns with the idea that competition, in the context of global trade, moderates by DT. By embracing DT, the DSM port could substantially enhance its operational efficiency, better positioning itself within the competitive landscape.

Similarly, the hypothesis "*Competition (COM) does not moderate ITO and global competitiveness (GLC)*" was supported by several respondents, including P420, who argued that "*DT improves competitiveness*" helping companies adjust quickly to the "*changing market conditions, optimize pricing, inventory, and logistics"*, expand "*opportunities*", and make the "*trading environment more attractive*". P418 echoed this sentiment, noting that DT at the DSM port would "*reduce costs related to physical interactions*" and "*increase its competitiveness*". Moreover, P416 emphasized that "*reducing trading costs in international trade is a key benefit of DT*", making the port more efficient and economical than the competition. P414 added that "*without adopting digital technologies, the DSM port risks losing market share to neighboring ports"* that have already embraced DT.

The key informants also touched on the hypothesis "*Competition (COM) does not moderate ITO and efficiency in import/export activities (EIM)*," which was indirectly addressed by P414, who emphasized the importance of "*upgrading port services through digitalization to improve performance*". P418 further supported this by highlighting those "*smart ports*", which leverage digital technologies, bring modern facilities, equipment, and investments, all of which led to greater operational efficiency. These insights suggest that competition in international trade is closely linked to the efficiency of port operations and adopting DT could significantly enhance the efficiency of import/export activities while improving overall competitiveness.

Furthermore, regarding the hypothesis "*Efficiency (EFF) does not moderate DT and international trade opportunities (ITO)*," several respondents stressed the need for increased operational efficiency at the DSM port. P411 and P416 both argued that "*DT is essential for streamlining port operations*", including "*customs clearance*" and "*permit processing*". By improving efficiency through digital tools, ports can reduce operational bottlenecks, contributing directly to enhanced trade opportunities. P416 also noted that DT helps "*save time*", "*increase transparency*", "*reduce trading costs*", and "*boost productivity*" where these factors unlock ITO.

As for the hypothesis "*Efficiency (EFF) does not moderate ITO and global competitiveness (GLC),*" the qualitative insights align with the argument that DT enhances GLC by improving efficiency. Key informants like P417 and P415 pointed out the various benefits of DT, including "*time management*", "*reduced workload*", "*improved customer transparency*", and "*increased productivity*" which all together contributing to greater EIM. P417 also highlighted those digital systems "*reduce the need for physical movement between regulatory offices*", "*saving time*" and "*reducing operational costs*". These improvements strengthen GLC by helping businesses operate more efficiently and economically worldwide.

Based on the second objective, the last hypothesis; "*Efficiency (EFF) does not moderate ITO and efficiency in import/export activities (EIM)"* was supported by respondents who stressed DT's impact on improving port efficiency. P416 argued that "*DT reduces the time spent on tasks*", "*eliminates manual systems*" that require human interaction, and "*increases knowledge and skills*", all of which contribute to more EIM. P417 reinforced this point by discussing how "*digital systems reduce bureaucracy*", "*save time*", and "*increase efficiency*" in customs clearance and other processes. Additionally, P415 emphasized the tangible benefits of DT, such as "*reduced costs"*, and "*improved time management*" in service provision, which directly impact the EIM.

The qualitative insights highlight the moderation effects of COM and EFF on DT and ITO, addressing the related hypotheses with relation to second question explored in this study. Respondents emphasized the need for the port to adopt technological standards to enhance competitiveness and operational efficiency. Key informants highlighted that DT could reduce cargo clearance times, improve customs processes, and lower operational costs, positioning the port to compete effectively in international trade. Additionally, DT was seen as crucial in boosting global competitiveness by enabling faster response to market changes, optimizing logistics, and reducing costs. Informants also emphasized that adopting DT would enhance operational efficiency, streamline import/export activities, and reduce bottlenecks. As a result, DT was seen as vital for unlocking new trade opportunities, improving efficiency, and ensuring the DSM port's continued relevance in a competitive global market. These insights reinforce how DT plays a key part in enhancing trade performance, competitiveness, and efficiency, while also highlighting the moderating effects of competition and efficiency in the import/export activities.

When exploring the role of digital infrastructure (DI) in influencing DT and ITO, several respondents provided valuable insights. For instance, P410 emphasized that "*Digital infrastructure supports DT by increasing trade flows through integration, improved quality, and communication,"* a view echoed by P412, who noted that "*Digital infrastructure is vital in international trade for supporting communication, meetings, improving time efficiency, reducing costs, protecting from hackers, ensuring data backups, and providing support for service provision and quality enhancement*." P414 added that "*about 90% of local importers and manufacturers in Tanzania use digital systems in conducting trade*," illustrating how DI facilitates trade and expands ITO. Further reinforcing this, P415 shared a practical example of how DT has enhanced service provision: *"when manual systems were applied, import permits would take up 5 days; however, with DT, the process takes only three hours, provided all requirements are met.*" Despite these advancements, P410 also pointed out that "*infrastructure such as 4G, 5G, SMS, emails, and the like to support DT in Tanzania is about 40% ready,*" stressing the need for further improvements to foster increased trade flows through better integration, quality, and communication. These perspectives highlight the indispensable role of robust digital infrastructure in advancing digital transformation and enabling international trade opportunities. In fact, 82% of respondents agreed that without robust DI, the influence of DT on trade would be severely limited. This underscores the urgency for strategic investments in DI to lower trade barriers, improve market access, and enhance GLC. The perspectives of government officials and stakeholders, supporting the views of Akbari and Hopkins (2022), argue that DT drives economic opportunities, disrupting traditional business models and opening new pathways for growth in trade, and other sectors. Similarly, Zaki (2019) asserts that DT impacts all facets of business, and Vaska et al., (2021) suggest that DI reshapes trade models by improving service delivery and performance.

Key informant respondents strongly supported the idea that supportive regulatory frameworks (RF) serve an essential part in promoting the adoption and operationalization of digital transformation (DT) in international trade opportunities (ITO). Participants emphasized that compliance enforcement within a well-designed RF promotes good business conduct and ensures adherence to laws and regulations. For example, P419 stated, "*RF provide good business conduct*," underscoring the importance of regulations in guiding businesses toward ethical and legal practices in digital trade. P418 further emphasized that "*Regulations ensure compliance with laws while applying ICT tools*," illustrating how RF ensure responsible use of digital technologies. These insights suggest that a well-structured RF not only enables DT but actively shapes how businesses approach and implement DT projects, fostering trust, reducing uncertainty, and ensuring secure, fair, and transparent international trade practices. As such, policies and regulations emerge as critical enablers, promoting both the growth and stability of DT in global trade.

The analysis also reveals mixed opinions from key informants about the role of RF in facilitating or hindering DT in Tanzania's international trade. While many respondents highlighted the importance of RF in ensuring compliance, business conduct, and trade facilitation, others pointed out barriers within the existing regulatory frameworks. For example, P414 argued that "*regulatory management systems play a key role in improving service quality and trade facilitation,"* with P417 emphasizing that "*integrated regulatory management systems are vital for facilitating international trade,*" particularly in enabling communication between international importers and manufacturers. However, several participants raised concerns about limitations in the current RF, such as data restrictions and inefficiencies in communication, which could lead to barriers in ITO. P416, for instance, expressed concerns about the impact of "*data restrictions*" on trade efficiency, while P418 noted that RF could sometimes "*restrict the free flow of information,* *transparency, and accountability*" in digital trade. Moreover, some respondents highlighted specific regulatory issues, such as the "*Cybercrime Act of 2015*", arguing that these limitations hinder the adoption of digital payment systems. They also noted that recent amendments to the VAT Act lack provisions for full digital integration. P417 cautioned that "*when RF are not well-managed, they can lead to misuse and unfair competition*," underscoring the potential negative effects of poorly designed regulations. Despite these concerns, there is significant support for the essential role of regulatory frameworks (RF) in advancing digital transformation (DT) and promoting international trade opportunities (ITO). By aligning and strengthening regulatory policies, an environment can be created that supports digital adoption, lowers trade barriers, and enhances global competitiveness (Herhausen et al., 2020). While limitations like regulatory restrictions and unfair competition persist, a supportive RF can ultimately foster positive outcomes for DT and international trade. The key informants further reinforce the results, highlighting both the enabling and limiting factors of RF. While many respondents acknowledged that a strong RF is vital for ensuring compliance, transparency, and facilitating trade, others raised concerns about regulatory inefficiencies, such as data restrictions and poor management leading to unfair competition (Bonina et al., 2021). Despite these barriers, the consensus is that enhancing RF could significantly improve the effectiveness of DT and unlock new ITO. Policymakers should therefore prioritize the development of adaptable, supportive regulatory frameworks that encourage innovation, reduce barriers to digital adoption, and promote ITO. Further research into regulatory practices, particularly in Tanzania, is essential to understand why some respondents view RF as barriers rather than facilitators of trade, and to uncover potential improvements in regulatory environment to better support DT in international trade.

The firth hypothesis tested the influence of DT and ITO on global competitiveness (GLC); where the quantitative arguments provided key were analyzed. The outcome of thematic analysis supported that DT and ITO influence GLC. The responses received from respondents such as P420 who argued that DT *"improves competitiveness*", help to "*respond more rapidly to changing market conditions and customer demands*", "*optimizing pricing, inventory, and logistics*", "*expand market opportunities*", "*leveling the playing field*", "*make the trading environment more attractive*" and "*compete effectively in the international market*". Conversely, P418 emphasized the need for the DSM port to undergo DT to: "*reduce costs related to physical contacts (corruption)*" and "*increased competitiveness of the port*". P416 further argued on the need for "*reducing trading costs in international trade*" while P414 was concerned on "*creating the market for DSM port*" which could be taken by neighboring competitive ports which are ahead of DSM in DT. This was further echoed by P410 who argued on "*the need for digitalization*" the DSM port, "*need to move with time*", "*need to move away from human interactions*" and learn from "*neighbors such as LAMU Port are already in digital age*."

The study highlights that digital transformation is crucial for enhancing GLC, ITO, and EIM. The results were further validated by statistical analysis, with strong evidence supporting digital transformation as a key driver, backed by high critical ratio (C.R.) and low p-values (Hair Jr et al., 2021). Qualitative insights from key informants emphasize that digital transformation improves competitiveness by enabling faster response to market demands, optimizing cross-border businesses and expanding international trade opportunities. Additionally, there is a call for digital transformation at DSM port to reduce costs, combat corruption, and remain competitive with neighboring ports (Ding et al., 2023). Overall, the findings highlight that investing in digital transformation is vital for sustained success and gaining a competitive advantage in global trade.

The last hypothesis, DT and ITO have no influence on efficiency in import/export activities (EIM) was also analyzed where key informants emphasized on the need for digital transformation on import/export activities at the port of DSM to improve operational efficiency. Such feedback was obtained from P416 explained DT is important to "*Saves time on accomplishing tasks, transparency to customers, reduces trading costs, and increases productivity. Reduces costs in the international trade for example for transfer for documents electronically, increasing efficiency and productivity*". P417 argued that "*digital or ICT systems reduced movements to the regulation offices, save time, reduces cost for business operations, eliminates bureaucracy associated with manual systems that require human interactions, and increases knowledge and skills*". Furthermore, DT "*improve transparency, remove bureaucracy, save time and efficiency.*" P411 argued that "*the port must increase efficiency through digitalization to streamline processes, such as customs clearance and permits processing from other government departments"*. On the other hand, P415 emphasized the benefits of DT encompassing, but not limited to "*time management, printing costs reduction, reduced workload to staff, and reduce sample testing costs, increase revenue collection in the government, efficiency in verification and services provision*".

Several participants (P416, P417, P411, P415) emphasized that digital transformation boosts productivity, lowers costs, and streamline processes by eliminating bureaucratic inefficiencies, particularly in customs clearance, document transfer, and government permit processing. These insights strongly support the view that digital transformation significantly enhances operational efficiency in import/export activities, especially when implemented at critical trade hubs such as ports. The results corroborate earlier studies that underscore the importance of efficiency in strengthening port competitiveness and advancing trade performance (Behdani et al., 2020; Westerlund, 2020).

Quantitative Results

This analysis delves deeply into the role and impact of DT on international trade opportunities (ITO), global competitiveness (GLC), and operational efficiency in import/export activities (EIM). This study focuses on investigating the multifaceted relationships that exist between these elements, focusing specifically on how DT drives growth and enhances competitiveness in global trade. Utilizing a mixed-methods approach that integrates both quantitative and qualitative data, this research offers valuable insights into the influence of competition (COM) and efficiency (EFF) on shaping DT outcomes. The study highlights the critical role that digital infrastructure and regulatory frameworks play in enabling digital transformation to achieve its full potential. Through analysis of these interrelationships, the study sheds light on the opportunities available to businesses and policymakers in leveraging DT to enhance efficiency in import/export activities and competitiveness in international trade.

In the first place, the study examined the role of DT in fostering ITO and digital harmony. The results from the H1 path hypothesis test, with an estimate of 1.581, S.E. of 0.409, and a C.R. of 3.866, demonstrate a highly significant relationship between DT and ITO, statistical evidence led to the dismissal of the null hypothesis (H_0) in favor of the alternative hypothesis (H_a). This was further reinforced under multiple moderation scenarios, including DT_COM, DT_EFF, ITO_EFF and ITO_COM where all tests yielded significant results with low standard errors and high C.R. values, confirming the robustness of the relationship. These findings align with (Constantinides, Henfridsson and Parker, 2018), who argue that digital tools can improve economic transactions by enhancing efficiency, accessibility and connectivity, all of which contribute to unlocking ITO. In addition, the qualitative findings complement these results, highlighting that most respondents (82%) recognized the potential of digital readiness, innovation, and skills in creating ITO.

However, concerns about digital literacy, particularly among older generations, were also noted. Despite these setbacks, there is strong support for the idea that DT is essential for bridging the digital divide and creating ITO. These results align with prior research, reinforcing the view that digital transformation is a key driver of economic opportunities and international trade growth (Akbari & Hopkins, 2022; Verhoef et al., 2021). The findings are also in consistent with Peprah, Atarah and Kumodzie-Dussey (2024), who identified digital literacy as a key enabler for successful integration into the digital economy, particularly in developing countries like Tanzania. The study's findings reflect Steenkamp's (2020) assertion that connectivity and digital skills are fundamental to facilitating trade, allowing businesses to seamlessly interact across borders. Through the analysis and evaluation of this hypothesis compelling evidence that DT significantly enhances ITO and digital harmony in international trade. The statistical and qualitative findings collectively highlight DT as a key enabler of global competitiveness, underscoring its importance for future trade success. Accordingly, the null hypothesis (H_0) is rejected, lending support to the alternative hypothesis (H_a) and affirming the significant impact of DT in facilitating ITO.

The second research question involved evaluating a series of hypotheses to understand how various moderating factors influence the relationships between key variables. The results varied depending on the specific moderator and outcome being tested. Hypothesis H2A, which examined whether competition moderates the relationship between DT and ITO, was not supported. The SEM analysis revealed a weak positive path coefficient ($\beta = 0.043$), an extremely low critical ratio (C.R. = 0.004), and a high p-value ($p = 0.900$), indicating that competition (DT_COM) does not exert a statistically significant moderating effect on this relationship. In contrast, Hypothesis H2B, which explored the role of efficiency (DT_EFF) as a moderator in the relationship between DT and ITO, was supported. The analysis returned a moderate positive path coefficient of 0.028, with a C.R. of 3.545 and a p-value below the conventional significance threshold, confirming that efficiency enhances the positive influence of DT on trade opportunities. Hypothesis H2C assessed whether competition (ITO_COM) moderates the connection between ITO and GLC. This hypothesis was not supported, as the results showed a small negative path coefficient of -0.037, a C.R. of -1.149, and a p-value of 0.251, all indicating a lack of statistical significance. Similarly, Hypothesis H2D, which tested the moderating role of efficiency (ITO_EFF) between ITO and GLC, was also rejected. The path coefficient was 0.008, the C.R. was 1.221, and the p-value stood at 0.222, offering no evidence of a meaningful moderating effect. However, Hypothesis H2E, which analyzed the moderating impact of competition (ITO_COM) on the link between ITO and efficiency in import/export activities (EIM), was supported. The model yielded a significant path coefficient of 0.075, a strong C.R. of 4.391, and a p-value well below 0.017, suggesting that competition plays a positive moderating role in enhancing EIM. Finally, Hypothesis H2F, which investigated whether efficiency (ITO_EFF) moderates the relationship between ITO and EIM, was not supported. The test results included a low path coefficient (0.007), a C.R. of 1.221, and a high p-value of 0.222, indicating no significant moderation.

In summary, the study highlights DT as a fundamental enabler of efficiency in import/export activities and as a contributor to enhanced competitiveness in international trade. These insights underscore the importance for organizations to invest strategically in digital technologies to achieve long-term success in international markets (Ding et al., 2023; Tolstoy, Nordman, & Vu, 2022). Effective use of DT can help streamline trade operations, improve productivity, and strengthen competitive positioning. Consequently, policymakers and business leaders are urged to prioritize the strategic adoption of digital technologies to drive efficiency in import/export activities and strengthen competitive advantage in the global economy.

The third hypothesis tested in this study suggested that "*Robust Digital Infrastructure (DI) does not influence DT in ITO*." Statistical analysis provides strong evidence against this hypothesis, confirming that DI plays a crutial role in influencing the effect of DT on ITO. The path coefficient between DT and ITO was found to be 0.452, indicating a moderate but meaningful positive relationship. This relationship was further confirmed by a low S.E. of 0.203, suggesting that the results are stable and reliable. C.R. of 2.228 exceeded the threshold for statistical significance, and the p-value of 0.026 provided strong evidence that the observed effect is not due to random chance, reinforcing the conclusion that DI does influence DT and, by extension, ITO (Constantinides, Henfridsson & Parker, 2018). The findings strongly support the alternative hypothesis, confirming that DI significantly influences DT in creating ITO. As global markets become increasingly interconnected, developing robust DI is critical for unlocking the full potential of DT and driving the digital economy (Kumar, 2018).

The fourth research hypothesis examined the influence of RF on DT and how this relationship, in turn, contributes to the creation of ITO. The hypothesis under evaluation posits that supportive RF enhance DT, which in turn contributes to ITO. In developing economies, particularly in Africa, where DT is hindered by limited internet access and outdated infrastructure, understanding how RF can address these shortcomings is essential (Fu, 2020; Adeola & Evans, 2020). The analysis indicated a weak positive relationship between RF, DT, and ITO, reflected in a path coefficient of 0.216. However, the relationship lacked statistical support, as the critical ratio (C.R. = 1.115) fell below the threshold of ±1.96, and the associated p-value ($p = 0.265$) exceeded the standard significance level of 0.05. These findings suggest that the observed association may be attributable to random variation rather than a meaningful effect Therefore, the findings indicate that a supportive RF does not significantly influence the effect of DT on ITO.

The firth hypothesis examines whether DT and ITO influence global competitiveness (Peng & Tao, 2022). For importers, exporters, and clearing and forwarding agents, GLC is determined by how the port of DSM performs in terms of costs, services, dwell time, and other key factors (Humphreys et al., 2019). The SEM results show a positive connection between DT, ITO, and GLC with a path coefficient of 0.851, a C.R. of 4.196, and a p-value marked as ***, indicating statistical significance and accepting the hypothesis. The study's quantitative findings, emphasize that DT significantly impacts GLC by enhancing competitiveness, reducing costs, and promoting digital adoption at the DSM port (Fu, 2020; Volberda et al., 2021; Ding et al., 2023). The hypothesis is partially supported. DT positively influences ITO and GLC, but the moderation effects of COM are weaker. Further support for DT's impact on competitiveness comes from key informant interviews, emphasizing DT's role in reducing costs, combating corruption, and maintaining competitiveness at DSM port (Ding et al., 2023; Tolstoy, Nordman & Vu, 2022). Investing in DT is essential for success in international trade (Hair Jr et al., 2021). Quantitative and qualitative findings underscore the importance of DT for enhancing GLC, ITO, and EIM (Fu, 2020; Adeola & Evans, 2020; Volberda et al., 2021).

Lastly, this hypothesis delves into the potential influence of DT and ITO on EIM. EIM is conceptualized as the strategic and efficient allocation of organizational resources to achieve targeted objectives. It is assessed through metrics like the quality and speed experienced when performing the import/export activities (Maury et al., 2020). Moreover, EIM contributes substantially to how decisions are formulated when stakeholders choose a port for their logistical needs, underlining its importance in global trade dynamics (Behdani et al., 2020). The statistical analysis in this study demonstrates a strong positive correlation between DT and ITO, as indicated by a path coefficient of 0.351, a C.R. of 4.416, and a highly significant p-value (***), providing robust support for the validity of the hypothesis. These findings suggest that as DT initiatives increase within an organization, the effectiveness of ITO processes is enhanced, subsequently leading to substantial improvements in EIM outcomes. Consequently, the hypothesis is accepted, establishing that DT and ITO significantly influence EIM. This conclusion emphasizes the need to embrace and invest in DT as a key strategy for improving organizational performance and driving profitability in the competitive landscape of ITO. By improving efficiency in resource management and streamlining trade processes, DT and ITO collectively serve as critical drivers of EIM, aligning with the broader goals of optimizing port operations and ensuring satisfaction among port users (Maury et al., 2020; Behdani et al., 2020).

This study examined the influence of DT on ITO, GLC, and EIM. Outcomes from the SEM analysis reveal a strong positive correlation between DT and ITO, indicating that digital technologies significantly foster the creation of ITO and enhancing GLC. Furthermore, in some cases, DT also improves efficiency in import/export activities. A crucial finding is the significant influence of DI, which directly impacts the effectiveness of DT in unlocking trade opportunities. While the effect of competition (COM) on DT and ITO was minimal, the moderation effect of efficiency (EFF) was notably positive, emphasizing the importance of operational efficiency before engaging in global competition. The relationship between ITO and GLC was also found to be robust, underscoring the need for businesses to prioritize efficiency as a foundational step toward global competitiveness. Despite obstacles such as outdated infrastructure and regulatory barriers, the study highlights the urgent necessity of investing in DI and RF, mostly in developing regions. Overall, the research demonstrates that DT, when supported by strong infrastructure and favorable regulatory environments, is essential for driving ITO and enhancing GLC (Hair Jr et al., 2021; Bougie & Sekaran, 2019; Schrage et al., 2021).

The study highlights the moderating consequences of competition (COM) and efficiency (EFF) on the correlation between DT and trade outcomes, emphasizing the growing importance of enhancing GLC and EIM. It identifies persistent inefficiencies in traditional trade processes, often worsened by outdated manual practices and poorly implemented digital tools, which contribute to delays, errors, and corruption (Mjema & Nanyondo, 2021). While advanced digital solutions such as e-documentation and automated customs systems offer potential for improved efficiency (WTO, 2023), their adoption remains inconsistent across regions and sectors (Trenerry et al., 2021). The study stresses that technology alone is insufficient without addressing key enablers like infrastructure, digital literacy, and staff training (Peng & Tao, 2022). An all-inclusive method that integrates digital innovation with strategic investments in capacity building is essential, consistent with previous studies highlighting the essential role of DT in maintaining competitiveness within a fast-changing global economy (Verhoef et al., 2021; Pollitzer, 2018).

One of the study's key strengths is its mixed-methods approach, which synthesizes empirical and interpretive data to deliver a well-rounded analysis of the relationship between DT and ITO. By combining statistical analysis with rich, contextual insights, the study strengthens the credibility of its findings through triangulation. Quantitative data revealed significant links between DT and ITO, while qualitative interviews uncovered real-world shortcomings like infrastructure gaps and digital literacy issues. This dual approach also clarified why the fourth hypothesis on RF was rejected in both structural equation modeling and thematic analysis, with qualitative data highlighting policy and regulatory barriers in developing countries. The synergy between methods offered a nuanced perspective on how digital infrastructure and regulatory frameworks influence DT's effectiveness, ultimately supporting robust interpretation of how digital transformation can be leveraged to improve global trade outcomes.

Triangulation of Results

The study triangulates the findings with respect to digital transformation initiatives, digital infrastructure and regulatory frameworks as shown in Table 42 below. 71% of questionnaire respondents agree that successful digital transformation strategies create opportunities for enjoying digital harmony and digital accretion in international trade. On the other hand, key informants such as P419, view that digital transformation is facilitated by readiness and digital literacy (knowledge and skills). Furthermore, key informants highlighted that digital transformation enhances operational efficiency, competitiveness, and cost reduction, particularly in ports like DSM. 78% of questionnaire respondents agree that digital infrastructure influences DT in international trade while key informants such as P410 argue that "digital infrastructure supports digital transformation by increasing trade flows". With respect to regulatory frameworks, 46% of questionnaire respondents agreed that regulatory frameworks influence DT, while key informants noted that "*when regulatory frameworks are not well-managed, they can lead to misuse and unfair competition*" (P417). Table 44 presents the triangulation of results.

Table 44

Triangulation of Results

Theme/Variable	Quantitative Findings	Qualitative Insights
Digital Transformation	71% of respondents agree that successful DT strategies create opportunities for enjoying digital harmony and digital accretion in international trade	*"DT readiness and knowledge and skills as key trade facilitators*"- P419
Digital Infrastructure	78% of respondents agree that digital infrastructure influences DT in international trade	*"DI supports DT by increasing trade flows"* – P410
Regulatory Frameworks	46% of respondents agree that regulatory frameworks influence DT in international trade	*"When RF are not well managed, they can lead to misuse and unfair competition*" – P417

Note. Researcher's Analysis

Summary of Chapter 4

This research adopted a mixed-methods design, combining quantitative insights gathered through a structured survey with qualitative perspectives obtained from key informant interviews. This integrative approach offered a well-rounded exploration of the research topic, enabling both a broad overview and in-depth understanding. Quantitative data were processed using SPSS Amos (Version 29.0), which supported the use of SEM to investigate intricate relationships among variables. At the same time, NVivo (Version 14.24.0) software was utilized to facilitate the thematic analysis of the qualitative data uncovering nuanced perspectives on digital transformation within the realm of international trade.

In the quantitative analysis, a series of statistical tests was conducted to assess the relationships among key variables, providing a rigorous basis for determining whether to accept or reject the null hypotheses. This approach enabled a clearer understanding of how various factors, such as DI and RF, influence DT in driving ITO. The study specifically examined the opportunities presented by DT within the Tanzanian context, a country that faces both unique limitations and emerging opportunities in the rapidly evolving global digital economy. This focus is particularly relevant given ongoing debates about the digital divide. Scholars such as Butollo (2021) argue that DT can bridge geographical disparities and promote greater inclusivity. From this perspective, advancements in digital infrastructure and technology can help developing countries like Tanzania access new markets, enhance trade efficiency, and strengthen their competitive position.

However, other researchers contend that digital divide has not been sufficiently addressed, and instead, digital technologies have served to exacerbate inequality, with developed countries reaping most of the benefits (Pollitzer, 2018). From this perspective, the gap between advanced economies and developing nations like Tanzania is widening, as the latter contends with barriers including insufficient access to digital tools, underdeveloped infrastructure, and a lack of an enabling RF. This disparity highlights the risk that without targeted investments in DI and capacity-building, Tanzania may remain marginalized in the digital economy, unable to maximize the opportunities that DT offers.

This study focuses on Tanzania to shed light on the ongoing discussions on DT in developing economies. It offers empirical evidence regarding the impact of digital technologies on global trade outcomes, aiming to clarify the opportunities and strategic pathways available to enhance trade performance and promote economic growth. Additionally, this study highlights the critical need to bridge the digital divide as essential for achieving development that is both inclusive and equitable (Morris, J., Morris, W., & Bowen, 2022). Ultimately, the research provides perspectives on how digital transformation can drive economic development while also reinforcing the need for focused and effective strategic interventions to ensure its benefits are more evenly distributed across global economies.

The study formulated and tested both null and alternative hypotheses to assess the impact of DT on ITO using SEM to analyse complex correlations between variables. The null hypotheses suggested no significant relationships, while the alternative hypotheses posited meaningful connections. SEM facilitated the simultaneous testing of multiple hypotheses, providing a comprehensive insight into how DT influences ITO. Table 42 summarizes the hypotheses tested, along with the corresponding path coefficients and statistical significance of the results. The results indicate that DT plays a crucial role in improving ITO, with the influence of DI and RF. This study underscores the need to prioritize investment in DI and to cultivate supportive RF to optimize the positive outcomes of DT. Additionally, the findings highlight the shortcomings faced by developing countries such as Tanzania, which may hinder the effective implementation of DT initiatives. This research contributes to understanding the relationship between DT and ITO and offers valuable guidance for policymakers and business leaders seeking to leverage digital technologies for sustainable economic growth. Table 45 below presents the summary of hypothesis testing results.

Table 45

Summary of Hypothesis Testing Results

Hypothesis for Research Question			**Results**	**Decision**
RQ1	$H1_o$	Adoption of DT does not unfold ITO	Estimate = 1.296 | p = *** S.E. = 0.380 | C.R. = 3.407	*Accepted*
RQ2	$H2A_o$	Competition does not moderate DT and ITO (DT_COM)	Estimate = 0.000 | p=0.997 S.E. = 0.043 | C.R. = 0.004	***Rejected***
	$H2B_o$	Efficiency does not moderate DT and ITO (DT_EFF)	Estimate = 0.098 | p=*** S.E. = 0.028 | C.R. = 3.545	*Accepted*
	$H2C_o$	Competition does not moderate ITO and GLC (ITO_COM)	Estimate=-0.037 | p=0.251 S.E. = 0.033 | C.R. =-1.149	***Rejected***
	$H2D_o$	Efficiency does not moderate ITO and GLC (ITO_EFF)	Estimate = 0.220 | p=0.368 S.E. = 0.024 | C.R. = 0.900	***Rejected***
	$H2E_o$	Competition does not moderate ITO and EIM (ITO_COM)	Estimate = 0.075 | p = *** S.E. = 0.017 | C.R. = 4.391	*Accepted*
	$H2F_o$	Efficiency does not moderate ITO and EIM (ITO_EFF)	Estimate = 0.008 | p=0.222 S.E. = 0.007 | C.R. = 1.221	***Rejected***
RQ3	$H3_o$	Robust DI does not influence DT in creating ITO	Estimate = 0.452 | p<0.026 S.E. = 0.203 | C.R. = 2.228	*Accepted*
RQ4	$H4_o$	Supportive RF do not influence DT in creating ITO	Estimate = 0.216 | p<0.265 S.E. = 0.194 | C.R. = 1.115	***Rejected***
RQ5	$H5_o$	DT and ITO have no influence on GLC	Estimate = 0.851 | p = *** S.E. = 0.203 | C.R. = 4.196	*Accepted*
RQ6	$H6_o$	DT and ITO have no influence on EIM	Estimate = 0.354 | p = *** S.E. = 0.080 | C.R. = 4.416	*Accepted*

Note. Researcher's Analysis

The results of the hypothesis testing reveal several key findings. Hypothesis $H1_o$ was strongly supported, showing a significant positive relationship between DT and ITO with an estimate of 1.296 ($p < 0.001$). Hypothesis $H2A_o$, which posits that competition does not moderate the relationship between DT and ITO, was rejected, as the estimate was 0.000 with a p-value of 0.997, showing no moderation effect. Conversely, Hypothesis $H2B_o$, suggesting that efficiency moderates the DT-ITO relationship, was supported with an estimate of 0.098 ($p < 0.001$), indicating that efficiency enhances this relationship. Hypothesis $H2E_o$, stating that competition moderates the relationship between ITO and EIM, was supported with an estimate of 0.075 ($p < 0.001$), confirming the moderating role of competition. However, hypotheses related to competition and efficiency moderating the relationships between ITO and GLC or EIM ($H2C_o$, $H2D_o$, $H2F_o$) were not supported, as p-values were above the significance threshold. Hypothesis $H3_o$, which suggests that robust DI influences DT in creating ITO, was confirmed with an estimate of 0.452 ($p < 0.026$), highlighting the importance of DI. Hypothesis $H4_o$, concerning the influence of supportive RF on DT and ITO, was rejected, with a p-value of 0.265, showing no important effect. Lastly, hypotheses $H5_o$ and $H6_o$, which suggested that DT and ITO do not influence GLC and EIM, were supported, with significant estimates of 0.851 ($p < 0.001$) for GLC and 0.354 ($p < 0.001$) for EIM, confirming that DT and ITO have a positive impact on these factors.

In conclusion, the hypothesis testing results underscore the central role of Digital Transformation (DT) in creating International Trade Opportunities (ITO), Global Competitiveness (GLC), and Efficiency in Import/Export Activities (EIM). Strong support for key hypotheses confirms that DT significantly influences ITO, and that efficiency and competition serve as important moderators in specific relational pathways. The findings also highlight the importance of Digital Infrastructure (DI) in enabling DT, while refuting the moderating influence of Regulatory Frameworks (RF). Overall, the study provides compelling empirical evidence that DT and ITO are critical drivers of import/export performance at DSM port.

CHAPTER 5: IMPLICATIONS, RECOMMENDATIONS, AND CONCLUSIONS

Introduction

This research evaluates the correlation between DT, international trade opportunities, digital infrastructure, regulatory frameworks, global competitiveness, and efficiency in import/export activities within the context of Tanzania's port operations. The study further investigates the moderating role of competition and efficiency in shaping these relationships. By exploring these factors, this research seeks to close the digital divide gap that continues to hinder progress in developing economies.

A dual-method approach was adopted, combination statistical and thematic analysis techniques to collect, analyze, and test the hypotheses. Through this approach, the study was able to complement the limitations inherent in each method, thereby strengthening the overall analysis. Drawing from the study's results, multiple implications emerged, calling for action by business managers to help bridge the digital divide and leverage the opportunities arising from digital transformation across various sectors. The results indicate no significant gender-based disparities in digital access. However, a notable trend was observed: "*a high prevalence of singlehood among individuals involved in import/export activities*."

Results show that although digital infrastructure supports DT, its impact on the creation of international trade opportunities, the regulatory frameworks tend to have a negative impact. One significant value of this study is the development of a model that integrates the dynamic moderating effects of both competition and efficiency, illustrating the evolving nature of DT. This model presents an iterative and incremental pathway toward a digital future (see Figure 2), expanding upon the framework proposed by Pollitzer (2018). Moreover, this study enriches existing literature by introducing a dynamic approach to examining the influence of moderator variables, grounded in the principles of dynamic capability theory. DT has become a central catalyst for reshaping the future of international trade, particularly across Africa. The African Union's strategic agenda recognizes DT as a critical driver of innovation, regional integration, and employment creation (Union, 2020). By modernizing business operations through digital platforms, DT aims to mitigate digital inequality, improve service delivery, and contribute to the realization of the Sustainable Development Goals (SDGs).

As a powerful enabler of change, DT is reshaping industries worldwide through emerging technologies such as the IoT, which are redefining business models, operational strategies, and management practices (Carayannis & Campbell, 2021; Vaska et al., 2021). This transformation enhances communication, digital management, and operational efficiency, creating value across nearly all aspects of modern life (Masenya, 2023). However, many developing economies continue to lag behind, relying on outdated and inefficient trade systems that weaken their competitiveness in global markets (Casella et al., 2019; Zaki, 2019). While traditional trade was largely producer-driven, digital technologies increasingly empower consumers to influence trade dynamics through digital platforms, while also reducing geographical barriers by addressing shortcomings related to time, distance, and information flow (Zaki, 2019; Butollo, 2021).

On the other hand, underdeveloped digital infrastructure and fragile regulatory environments in many developing countries continue to obstruct their full involvement in digital economic activities (Buckley, 2020; Reardon et al., 2021). A central issue remains the digital divide. While developed nations benefit from advanced digital ecosystems, developing economies often lack access to the necessary technologies, deepening economic and trade disparities (Pollitzer, 2018; Union, 2020). For example, internet penetration in developed countries stands at 86.7 percent, compared to just 44.4 percent in developing nations (Nguyen, Hargittai & Marler, 2021). Although global e-commerce is on the rise, DT's contribution to GDP remains disproportionately low in developing countries, underscoring their difficulties in leveraging digital opportunities (Banga & te Velde, 2018).

In countries like Tanzania, deficiencies in DI and RF limit the effective adoption of DT and, consequently, the economic gains it can generate (Tabrizi et al., 2019). While global DT adoption is accelerating, its progress in developing economies, is hindered by technological disparities and insufficient infrastructure, and regulatory shortcomings. Research shows that DT can significantly boost organizational performance by enabling automation, streamlining operations, reducing costs, and fostering new business models (Dash & Paul, 2021). Digital sectors such as e-government, e-banking, and e-marketing are increasingly vital to global trade networks and must be prioritized in national development agendas (Pollitzer, 2018).

The study also unveils that DT extends beyond simple technological upgrades. They shape participation in global value chains, particularly in sectors like business, postal services, communication, and port operations, where digital solutions have largely replaced traditional systems (Ngangaji, 2019). Despite growing recognition of DT's potential, previous empirical research examining its direct role in enhancing ITO, remains limited. Existing studies often focus on specific sectors like maritime transport (Silver & Stoll, 2022) or the broader digital divide (Pollitzer, 2018; Union, 2020), leaving the intersection of DT, DI, and RF underexplored (George & Schillebeeckx, 2022). This research seeks to tackle this gap by examining how DT can bolster ITO, with particular attention on the roles of DI and RF in fostering digital cohesion. Tanzania, with its strategic DSM Port, responsible for handling over 90 percent of the country's international trade (Yau et al., 2020; Humphreys et al., 2019). The adoption of DT in Tanzania is not only critical for national economic growth but also for regional integration across East Africa.

In addition, this study is yet to be perfect as there are some limitations that require further investigations. The dataset for example, is heavily skewed toward Tanzania, comprising 88.8 percent of the sample, which may reduce its applicability to other countries that rely on DSM Port, such as the Democratic Republic of Congo, Zambia, and Uganda. Broadening the geographical scope would yield a broader perspective of regional dynamics. Additionally, the research is primarily situated within the business discipline. A multi-sectoral approach including perspectives from manufacturing, services, and ICT would offer a more comprehensive understanding of DT's broader impacts (Buckley, 2020).

The study uses SEM and thematic analysis to analyze relationships between DI, RF, DT, and ITO, focusing on DSM Port. Ethically, the research adhered to protocols set by the UREC and the COSTECH, emphasizing informed consent, data integrity, confidentiality, and participant safety (Bougie & Sekaran, 2019). It also draws upon the CARE Theory, which prioritizes participant dignity and data protection (Leidner & Tona, 2021); the Dynamic Capability Theory, highlighting the critical role of organizational adaptability in a dynamic environment; and the Network Theory, which addresses stakeholder relationships in trading (Coreynen et al., 2020).

Lastly, following the structure of the previous chapters which introduced the study in Chapter 1, reviewed the literature in Chapter 2, outlined methodologies in Chapter 3, and presented results in Chapter 4, this final chapter provides the implications, recommendations, and conclusions of the study. The discussion opens with a concise overview of the problem statement, purpose, methodology, limitations, and ethical considerations. The chapter then discusses key findings in relation to the research, sets out clear aims and proposes informed recommendations for stakeholders, and demonstrates how the study advances theory and practice, emphasizing the role of DT in enhancing international trade in developing countries.

Implications

This study contributes substantively to research on DT and international trade by empirically demonstrating how DT expands international trade opportunities, strengthens global competitiveness, and improves efficiency in import/export activities within a developing-country context. By focusing on Tanzania's import/export sector, the study extends literature that has predominantly examined DT in advanced economies or relied on conceptual analyses (Verhoef et al., 2021; Markus & Rowe, 2021). In doing so, it addresses a critical gap by providing context-specific insights into how digital technologies reshape trade participation, support the progression of the digital economy, enhance competitiveness, and streamline trade operations. These insights offer practical value for policymakers, firms, and trade stakeholders seeking to harness DT for sustainable economic development.

The empirical findings show that DT directly expands international trade opportunities by lowering entry barriers, improving access to international markets, and enhancing the quality, speed, and reliability of trade-related services. Digital technologies reduce geographical distance, mitigate information asymmetries, and simplify complex trade procedures that have traditionally constrained cross-border participation. Consistent with prior research on digital trade facilitation (Wilson & Mergel, 2022; George & Schillebeeckx, 2022), the study confirms that DT enhances firms' engagement with foreign partners through improved digital readiness, innovation capacity, leadership commitment, and digital skills. Importantly, the findings extend existing knowledge by showing that DT goes beyond process automation. Through digital platforms, integrated trade systems, and data-driven decision-making, firms are better positioned to sense market signals, customize offerings, and establish new trade relationships, positioning DT as a strategic enabler of trade participation rather than a peripheral efficiency tool. Practically, this implies that firms should pursue integrated digital strategies that combine internal process transformation with market-facing digital capabilities to maximize international trade participation.

The study further reveals that the translation of DT into tangible trade outcomes is strongly influenced by competitive intensity and organizational efficiency. In highly competitive environments, firms face stronger pressures to innovate, differentiate offerings, and respond rapidly to international market demands. These pressures encourage strategic technology deployment, enabling firms to exploit new opportunities, strengthen customer engagement, and enhance value propositions. This aligns with prior research identifying competition as a driver of innovation and digital adoption (Volberda et al., 2021; Zaki, 2019). The study extends this literature by empirically demonstrating that competitive intensity amplifies the positive effects of DT on international trade, global competitiveness, and import/export efficiency, suggesting that competition motivates firms to translate digital capabilities into real trade performance rather than limiting them to internal processes. Therefore, managers should align digital investments with competitive strategy and operational excellence, ensuring that digital initiatives support broader performance and growth objectives.

Efficiency in import/export activities emerges as a critical reinforcing mechanism shaping DT outcomes. While earlier studies have largely treated efficiency as an outcome of DT (Humphreys et al., 2019; Gong & Ribiere, 2021), this study shows that efficiency also strengthens the relationship between DT and international trade opportunities. Firms with streamlined digital processes, effective coordination mechanisms, and performance-oriented systems are better positioned to leverage DT for market expansion and improved trade outcomes. This finding suggests that digital investments alone are insufficient; their benefits are maximized when firms possess operational excellence and can translate digital capabilities into efficient and customer-focused trade. In practice, firms should invest not only in technology but also in process redesign, workforce skills, and performance management systems that support continuous improvement.

A central implication of this study is the foundational role of digital infrastructure in enabling DT to generate international trade opportunities. The findings confirm that reliable connectivity, advanced communication technologies, and interoperable digital platforms are critical for effective DT adoption and meaningful engagement in international trade (Constantinides, Henfridsson & Parker, 2018; Maury et al., 2020). In contexts where digital infrastructure is inadequate, firms face significant constraints in exploiting digital tools, resulting in limited market access and weakened trade competitiveness. This is particularly relevant in developing economies where infrastructural gaps remain pronounced. These results reposition digital infrastructure from a supporting enabler to a strategic determinant of trade performance. Without reliable internet connectivity, stable power supply, and interoperable digital systems, firms cannot fully benefit from digital tools regardless of their readiness or innovation capacity. Thus, digital infrastructure becomes a necessary precondition for DT to deliver tangible trade outcomes. For policymakers, sustained and coordinated investment in digital infrastructure is therefore not optional but essential, as fragmented infrastructure risks widening the digital divide and entrenching structural disadvantages.

In addition to infrastructure, the study highlights the critical role of supportive regulatory frameworks in enabling DT to unlock trade opportunities. While prior studies acknowledge the importance of regulation (Bonina et al., 2021; Carayannis & Campbell, 2021), this research provides empirical evidence that regulatory adaptability is central to successful DT adoption. Clear and consistent policies governing data flows, digital payments, cybersecurity, and cross-border trade enhance firms' confidence to invest in digital technologies, whereas regulatory rigidity and uncertainty constrain participation in international trade. These findings align with international policy perspectives advocating flexible and enabling regulatory reform (ITU, 2019; European Union, 2020). Therefore, regulatory reform should focus on creating an enabling environment that balances innovation, security, and trust, supporting sustainable growth in the digital economy.

The findings highlight the urgent need for investment in digital skills within the import/export sector. Digital technologies alone cannot deliver trade benefits without human capacity to operate, manage, and optimize digital systems. Digital readiness and innovation capacity depend on workforce competencies. Firms should therefore prioritize continuous training and on-the-job learning to strengthen digital literacy and technical proficiency. For policymakers, national competitiveness strategies should include curriculum reform, vocational training, and public–private partnerships to build the talent needed for digital trade. Investing in human capital should close the digital skills gap, improve firms' absorptive capacity, and ensure DT supports sustainable trade growth.

Practically, the study confirms that DT, when coupled with expanded international trade participation, significantly enhances global competitiveness and import/export efficiency. Digital tools improve operational performance, service quality, communication speed, and customer experience, enabling firms to compete beyond domestic markets. The results suggest that firms should pursue holistic digital strategies that combine internal process optimization with market-facing digital capabilities, rather than implementing fragmented or incremental initiatives. Policymakers should therefore prioritize digital infrastructure, regulatory support, and skills development to enable firms to scale digital trade activities and participate effectively in global markets. By validating these relationships in a developing-country context, the study provides a strong basis for the theoretical contributions discussed in the following section.

Theoretical Contribution

From a theoretical perspective, this study makes a significant contribution by integrating CARE Theory, Dynamic Capability Theory, and Network Theory into a unified analytical framework for understanding DT in international trade. CARE Theory, traditionally focused on preserving human dignity in research contexts, is extended to the digital trade domain, where ethical considerations remain underexplored. By applying CARE constructs of claims, affronts, responses, and equilibrium, the study highlights the need for ethical DT practices that balance technological advancement with the protection of individual rights, data privacy, and organizational integrity (Leidner & Tona, 2021). Dynamic Capability Theory is advanced by empirically demonstrating how firms develop, adapt, and reconfigure resources to sense opportunities, seize them, and sustain competitive advantage in rapidly evolving trade environments (North, Aramburu & Lorenzo, 2020; Conboy et al., 2020). Network Theory complements these insights by illuminating how interdependencies among trade actors, network structures, and information flows shape DT outcomes, showing that effective digital trade depends on coordinated networks of firms, regulators, and technology providers rather than isolated actors (Amalesh et al., 2019; Moro Visconti, 2019). Collectively, the integration of these theories provides a comprehensive, multidimensional lens for understanding DT in international trade by foregrounding ethical, adaptive, and relational dynamics. In doing so, the study responds to calls for more nuanced, theory-driven investigations of digital trade (Markus & Rowe, 2021) and provides a robust foundation for future research on the ethical, adaptive, and networked dimensions of DT in contexts characterized by infrastructural and regulatory constraints.

CARE Theory is extended from its traditional focus on human dignity in research to the digital trade domain, where ethical considerations are often overlooked. Using CARE constructs the study reveals how DT creates ethical claims (e.g., data privacy, fair access) and potential affronts (e.g., misuse of data, unequal digital access), requiring organizational responses to restore ethical balance. This extension shows that ethical governance is integral to digital trade, not peripheral, highlighting the need for human-centric digital practices that protect rights and dignity and reconceptualizing CARE Theory as a governance framework for ethical consideration.

Dynamic Capability Theory is extended by demonstrating how firms develop and reconfigure resources to sense digital opportunities, seize them through digital deployment, and sustain competitive advantage in changing international trade. The study shows that DT investments alone are insufficient; they must be supported by process optimization, managerial competence, and strategic alignment to translate into trade performance. Efficiency emerges as a reinforcing mechanism that strengthens the capability cycle, indicating that operational effectiveness is central to dynamic capability renewal in DT contexts. Dynamic Capability Theory is refined by positioning operational efficiency and managerial capability as essential mechanisms that enable DT to generate sustained trade advantages.

Network Theory is extended to explain how digital trade outcomes are shaped by interdependencies among firms, regulators, technology providers, and logistics partners. The study shows that DT effectiveness depends on coordinated networks rather than isolated firms, as digital platforms and information flows create new relational structures within global value chains. This perspective highlights that trade performance is jointly produced through collaboration, resource exchange, and shared governance within digital ecosystems. Network Theory is enriched by incorporating digital ecosystem dynamics and relational governance into explanations of competitiveness and trade outcomes.

The integration of CARE Theory, Dynamic Capability Theory, and Network Theory provides a multidimensional framework that captures the ethical, adaptive, and relational dimensions of DT. CARE Theory foregrounds ethical governance, Dynamic Capability Theory explains organizational adaptation and resource reconfiguration, and Network Theory clarifies how relational structures and information flows enable. The framework explains how DT drives trade opportunities and performance through the interaction of ethical, organizational, and networked mechanisms. The study advances a unified theory of digital trade that explains how ethical, dynamic capabilities, and network relations jointly shape international trade outcomes.

Empirically, the study confirms that ethical considerations are central to DT, showing that ethical governance supports trust, legitimacy, and sustainable trade relationships (CARE Theory). It also demonstrates that firms with strong dynamic capabilities are better able to sense opportunities, seize them through digital deployment, and reconfigure resources to sustain competitive advantage in international markets (Dynamic Capability Theory). Finally, the study shows that network connections strengthen collaboration, information exchange, and resource sharing, reinforcing firms' positions within global value chains (Network Theory). These findings provide empirical support for the theoretical mechanisms proposed in the integrated framework.

The study's theoretical contributions have direct policy and managerial relevance. Policymakers should prioritize digital infrastructure, adaptive regulation, and capacity-building programs that enhance digital literacy, while fostering public–private partnerships to strengthen digital trade ecosystems. Managers should integrate DT into competitive strategies by improving process efficiency, developing dynamic capabilities, and ensuring ethical governance. By linking theoretical insights to practical action, the study provides a robust foundation for future research and policy design aimed at enabling sustainable and inclusive digital trade.

Recommendations for application

Building on the empirical findings derived from structural equation modelling and thematic analysis, this study proposes a set of practical, evidence-based recommendations aimed at accelerating the application of DT within Tanzania's international trade sector. The results demonstrate that DT delivers meaningful trade outcomes only when it is implemented as part of a coordinated digital ecosystem rather than through isolated technological interventions. Accordingly, the recommendations emphasize system-wide actions that integrate infrastructure development, regulatory reform, human capital investment, institutional collaboration, and digital market expansion. Together, these measures provide a pragmatic pathway for translating DT into enhanced trade efficiency, expanded international market access, and sustainable competitiveness in a developing-country context.

A primary recommendation arising from the study is the urgent need to strengthen digital infrastructure as the foundation for effective digital trade application. Reliable broadband connectivity, advanced communication technologies, interoperable digital platforms, and a stable electricity supply are essential enablers of DT across the trade value chain. To operationalize DT at scale, Tanzania should prioritize expanding broadband access beyond urban centers to include rural and underserved regions, where limited connectivity currently constrains participation in digital trade. Strategic investment should focus on trade-critical nodes such as ports, border posts, logistics corridors, and industrial zones, where enhanced connectivity can directly improve trade processing speed, transparency, and coordination (Ismagilova et al., 2022; Kiani Mavi et al., 2022). At the same time, ensuring a reliable electricity supply is necessary to support continuous digital operations and prevent system disruptions that undermine trade performance (Neumark, 2022). Public–private partnerships (PPPs) offer a viable mechanism for accelerating infrastructure rollout by combining public oversight with private sector innovation and financing capacity (UNICAT, 2023). These infrastructure investments should explicitly prioritize affordability and inclusivity to prevent the widening of digital divides and the reinforcement of spatial and firm-level inequalities, commonly described as the *"Matthew effect"* in digital development (Hoekman & Wolfe, 2021).

Parallel to infrastructure investment, the study recommends comprehensive reform of regulatory frameworks to support secure, efficient, and innovation-friendly digital trade. While regulation is necessary to ensure trust and stability, the findings indicate that overly restrictive or outdated regulatory environments can discourage digital adoption and limit firms' engagement in international markets. Therefore, regulatory frameworks should evolve from prescriptive control mechanisms toward adaptive systems that enable innovation while safeguarding data, security, and market integrity. Priority areas for reform include data protection and privacy legislation, cybersecurity standards, digital payment regulations, and rules governing cross-border data flows (Bonina et al., 2021; Carayannis & Campbell, 2021). Harmonizing national regulations with international standards such as WTO digital trade principles and GDPR-aligned with data governance frameworks that can reduce regulatory uncertainty, enhance interoperability, and build confidence among international trade partners (ITU, 2019; European Union, 2020). The digitization of customs procedures, trade documentation, and regulatory compliance processes is also recommended to reduce administrative burdens, improve transparency, and shorten transaction times (Lisinge, 2020; Morris, Morris & Bowen, 2022). Importantly, regulatory reform should incorporate ethical considerations by embedding protections for data privacy, consumer rights, and system integrity, ensuring that DT is applied responsibly and sustainably.

The application of DT in international trade further requires sustained investment in human capital development to ensure that firms and institutions possess the skills necessary to adopt and use digital technologies effectively. The study recommends embedding digital literacy, data competence, and technology management skills across formal education systems, vocational training programs, and professional development initiatives. Developing economies such as Tanzania should prioritize practical, industry-aligned training that equips workers and managers with competencies relevant to e-commerce, digital logistics, cybersecurity, and data-driven decision-making (Vassilakopoulou & Hustad, 2023). Lifelong learning initiatives are equally critical, as rapid technological change requires continuous reskilling and upskilling to prevent workforce displacement and capability erosion (Chen, Ding & Liu, 2023). Public awareness campaigns, business-focused workshops, and advisory services should be deployed to demonstrate how DT can be applied to improve trade operations, reduce costs, and enhance competitiveness, particularly among SMEs that often lack exposure to digital innovation (Gupta, Ghosh & Sridhar, 2022). By strengthening human capital, Tanzania can ensure that DT adoption translates into productivity gains and inclusive economic participation rather than exacerbating skills-based inequalities (Hidalgo et al., 2020).

Human capital development should be complemented by stronger collaboration between public and private actors to scale digital solutions effectively. The study recommends expanding public–private partnerships beyond infrastructure provision to include innovation development, knowledge transfer, and technology diffusion. Strategic collaborations between government agencies, technology firms, logistics providers, financial institutions, and educational organizations can support the establishment of digital trade hubs and trade facilitation centers that provide SMEs with access to shared platforms, training, advisory services, and affordable digital tools (Dahlman, Mealy & Wermelinger, 2016). Such collaborative arrangements reduce entry barriers for smaller firms and enable the collective resolution of sector-specific shortcomings that individual actors may be unable to address alone. Strengthening institutional coordination across ministries and agencies is also recommended to avoid policy fragmentation and ensure coherent implementation of DT initiatives across the trade ecosystem.

The study further recommends leveraging e-commerce as a practical mechanism for reducing trade costs and easing cross-border market entry. Well-designed e-commerce platforms enable firms to bypass traditional intermediaries, reach international customers directly, and operate at scales previously unattainable for smaller enterprises. To support effective e-commerce application, complementary investments are required in logistics infrastructure, secure digital payment systems, consumer protection mechanisms, and customer service capabilities (Mushi, Serugendo & Bürgi, 2022). The adoption of Automated Customs Management Systems (ACMS) and Single Window Systems (SWS) is strongly recommended to streamline border processes, enhance transparency, and reduce transaction costs associated with cross-border trade (Chang, Iakovou & Shi, 2020; Irani et al., 2023). A coherent national e-commerce strategy that supports local digital entrepreneurs while facilitating partnerships with global platforms can help ensure that e-commerce growth contributes to domestic value creation rather than external dependency.

Expanding access to digital trade financing represents another critical recommendation for application. The study finds that limited access to finance remains a major constraint preventing SMEs from scaling digital trade operations. To address this challenge, policymakers and financial institutions should promote digital finance solutions such as mobile financial services, fintech-based lending platforms, and blockchain-enabled trade finance systems, which offer more inclusive, transparent, and efficient alternatives to traditional financing models (Chang, Iakovou & Shi, 2020). Partnerships between banks and fintech firms can improve credit assessment, reduce transaction risks, and lower borrowing costs for SMEs (Tiwasing, 2021). Standardizing and digitizing trade finance documentation is also recommended to enhance trust and efficiency in cross-border transactions.

Finally, the study recommends a holistic approach to the application of DT that recognizes its wide-ranging strategic implications across organizational structures, import/export operations, logistics and supply chains, digital literacy and knowledge transfer, governance systems, and market engagement. Rather than being treated as a standalone information technology initiative, DT should be embedded within broader business, industrial, and trade strategies to ensure coherence, scalability, and long-term impact. Emerging technologies such as artificial intelligence, blockchain, and the Internet of Things should be deployed through cross-functional and sector-specific frameworks to maximize their relevance and value for trade coordination, operational efficiency, and data-driven decision-making (Tabrizi et al., 2019; Gong & Ribiere, 2021; Tolstoy, Nordman & Vu, 2022). To sustain effectiveness over time, continuous monitoring and evaluation mechanisms are essential to ensure that DT policies and applications remain adaptive to technological advancements and evolving global market dynamics. In addition, collaboration with regional and international organizations, including the WTO, African Union, and UNCTAD, can facilitate policy learning, capacity building, and alignment with international best practices, thereby strengthening the resilience and global competitiveness of digitally enabled trade systems.

Taken together, these recommendations provide a coherent and actionable roadmap for applying DT to international trade in Tanzania. By simultaneously strengthening digital infrastructure, reforming regulatory frameworks, building human capital, fostering multi-stakeholder collaboration, expanding e-commerce capabilities, and improving access to digital trade finance, Tanzania can translate DT from a conceptual ambition into a practical driver of inclusive trade growth, enhanced efficiency, and sustained global competitiveness.

Recommendations for future research

Future research on DT in developing economies should move beyond broad exhortations for technology adoption and instead embrace a structured, empirically grounded agenda that simultaneously addresses institutional, innovation, human, financial, and social dimensions. Although prior studies have demonstrated that digitalization can enhance trade efficiency, reduce transaction costs, and expand market access, they often overlook the reasons why these benefits vary across regions, sectors, and population groups. In this study's context, it has been revealed that DT outcomes are influenced not only by technological availability but also by the quality of infrastructure, the level of human capital, digital innovations, policy coherence, stakeholder coordination, access to financial services, and shifting social patterns among workers. Consequently, future research should focus on seven interconnected areas: digital infrastructure, digital innovations, digital literacy, regulatory frameworks, collaborative governance among stakeholders, financial inclusion, and demographic shifts linked to digitally mediated trade work; particularly the anomaly identified in this study concerning the rising prevalence of singlehood among clearing and forwarding agents (CFAs). These priorities align with earlier recommendations by scholars such as Verhoef et al. (2021) and Escursell, Llorach-Massana and Roncero (2021), but this framework advances the discourse by proposing empirical designs of DT in the context of developing countries like Tanzania.

The first priority for future research is digital infrastructure, which underpins all digital trade initiatives. While previous studies have highlighted the need to improve connectivity in key trade nodes such as ports and dry ports to reduce delays (Kiani Mavi et al., 2022) and emphasized the value of public-private partnerships in expanding digital access (Hoekman & Wolfe, 2021; UNICAT, 2023), there is limited understanding of how infrastructure quality, reliability, and integration with trade systems influence trade outcomes in practice. Future research should examine the performance of digital infrastructure in specific logistical locations while considering factors such as system reliability, network redundancy and integration with legacy port, customs systems, other government institutions and other import/export activities, evaluating their effects on trade efficiency, documentation accuracy, and coordination among stakeholders. Additionally, the availability of reliable electricity remains an underexplored determinant of infrastructure effectiveness. Studies could employ a combination of geospatial mapping, operational data, and firm-level trade performance metrics to identify where infrastructure investments generate the greatest impact. Comparative analyses with countries such as India, South Africa, Singapore, and others, which have successfully sequenced infrastructure investments alongside institutional reforms to enhance trade, can provide valuable lessons for Tanzania (Hoekman & Wolfe, 2021). This research would move beyond general calls to *"upgrade connectivity"* and offer precise guidance on the types and locations of infrastructure investments that are most critical for facilitating digital trade. It is essential to move away from outdated voice-based systems and adopt data-driven networks that support cloud computing and digital commerce (Warf, 2019). Future studies should assess the effectiveness of digital infrastructure investments in both rural and urban contexts, identify areas with the highest potential for impact, and extract best practices from countries that have successfully implemented digital infrastructure reforms.

Building on this foundation, the second key area focuses on digital innovations, including emerging technologies such as artificial intelligence, digital platforms, the Internet of Things, blockchain, robotics, and 5G, and their transformative potential for trade processes. These technologies offer developing economies the opportunity to create digital products and services specifically tailored to local needs, rather than relying on technological diffusion from developed countries. While the literature highlights their capacity to accelerate data sharing, improve transparency, and streamline cross-border operations, empirical evidence on their adoption in resource-constrained, developing country contexts remains limited. Future research should examine how these innovations can be adapted to Tanzania's infrastructural realities, cost constraints, and trade priorities. Barriers to adoption, such as infrastructure gaps, skills shortages, and regulatory readiness, should also be explored. Comparative case studies from countries such as South Africa and India, where selected innovations have been successfully piloted, could provide valuable insights for scaling these technologies in Tanzania (Hoekman & Wolfe, 2021). This research agenda moves beyond general calls for technology adoption by emphasizing innovations that are tailor-made to address the specific barriers of developing countries, rather than relying on technology diffusion from developed nations.

The third focal point concerns digital literacy, conceptualized as trade-specific human capital rather than generalized ICT proficiency. While prior studies have emphasized the importance of digital skills for participation in digital trade (Verhoef et al., 2021; Fu, 2020), they often approach skills in broad terms without linking them to specific trade-related functions. As highlighted in the preceding discussion on digital innovation, investments in digital literacy are fundamental to enabling developing countries not only to adopt existing technologies but also to generate locally relevant innovations that address context-specific trade limitations. This requires a combination of technical knowledge, operational skills, and leadership readiness to guide digital change within firms and trade institutions. The findings of this study indicate that specialized competencies, including proficiency in electronic customs procedures, management of digital trade documentation, reconciliation of mobile and bank-based payments, capturing and interpretation of real-time logistics data, and operation of platform-based transport systems are critical determinants of effective performance in import/export activities. Future research should therefore disaggregate digital literacy into functional, technical, and leadership-oriented competencies aligned with specific trade activities, examining how such gaps in knowledge and skills influence international trade. Particular attention should be given to disparities across rural and urban contexts, gender, and generational cohorts, as well as differences between managerial and frontline operational capabilities. These recommendations build on insights from Verhoef et al., (2021) and Elena-Bucea et al., (2021), who emphasize the importance of context-sensitive skills development, while extending their work through more granular, trade-specific analyses and systematic evaluations of training and leadership development effectiveness.

The fourth area requiring deeper investigation concerns supportive regulatory frameworks. Although prior studies emphasize the importance of regulatory clarity and harmonization for DT (Burri, 2021; Chang, Iakovou & Shi, 2020), they often focus on policy design rather than examining how regulations operate in practice for businesses and trade actors. Future research should therefore analyze how Tanzania's National ICT Policy interacts with legal frameworks governing electronic transactions, data protection, customs procedures, financial oversight, and cross-border data flows, and assess whether these interactions facilitate or constrain DT initiatives. Understanding whether regulatory coherence, or the lack thereof, influences compliance costs, investment decisions, and the uptake of digital tools is critical. It is equally important to examine whether ICT and regulatory policies related to trade sanctions, data flow restrictions, cybersecurity, and consumer protection are designed to actively support DT, rather than being perceived as obstacles to innovation and trade. The findings of this study reveal mixed perceptions among respondents regarding the role of regulatory frameworks, with many viewing existing regulations as restrictive rather than enabling. Comparative studies with countries such as Vietnam and India, which have successfully aligned ICT policies with broader trade and industrial strategies, could offer valuable lessons on policy sequencing, enforcement mechanisms, and institutional coordination (Anwar & Graham, 2022). Such research would move beyond abstract calls for regulatory reform and provide evidence-based assessments of how regulatory environments can shape trade efficiency, firm behavior, and DT outcomes.

Stakeholder collaboration constitutes another essential domain for future research. Although public-private partnerships are widely recognized as critical to DT (Hoekman & Wolfe, 2021; Anwar & Graham, 2022), existing literature rarely examines the governance mechanisms that determine whether such collaborations succeed or fail. Import/export activities relies on coordinated action among government agencies, port authorities, technology providers, logistics companies, and financial institutions, yet the effectiveness of these relationships remains underexplored. Future studies should therefore scrutinize the structure of collaborative networks, the allocation of decision-making authority, and the institutional mechanisms that enable information sharing, coordination, and accountability. Particular attention should be given to the design and performance of integrated payment systems, including the feasibility of single payment window arrangements that can reduce delays caused by slow payment confirmations, which are a significant source of inefficiency in import/export operations. Organizational network analysis and comparative case studies could shed light on how leadership capacity, stakeholder trust, and incentive structures influence the effectiveness of joint digital initiatives, such as electronic single-window platforms and port community systems. Moreover, through Electronic Data Interchange (EDI), stakeholders should be able to generate customized reports tailored to their specific needs, drawing directly from integrated systems without the time-consuming process of manual preparation. This capability facilitates faster, more informed decision-making. By adopting this approach, research advances existing calls for collaboration by providing a systematic governance perspective that not only underscores the importance of partnerships but also elucidates how they operate and the conditions under which they support sustainable DT.

In addition to collaboration among stakeholders, financial inclusion represents a critical area of focus, encompassing access to mobile payments, credit, and other financial services that support trade activities. While mobile money has been recognized for its potential to enhance trade efficiency and inclusion (Escursell, Llorach-Massana & Roncero, 2021), there is limited understanding of how these tools are practically used, particularly in cross-border transactions. Future research should examine whether digital payment systems substitute for traditional banking, complement formal trade finance, or serve as stopgap solutions for resource-constrained traders, while also addressing trade credit, working capital management, and insurance mechanisms enabled by digital finance. The recent growth in import/export volumes at DSM port highlights the need for corresponding investments in transport, inland container depots, and container freight station operations. Despite privatization efforts involving DP World and Adani, port congestion and a shortage of trucks, especially for hinterland deliveries, continue to slow cargo movement. Studies could explore how financial institutions might empower experienced clearing and forwarding agents to invest in transport infrastructure, thereby improving the flow of goods and port evacuation. Empirical research combining mobile transaction data, firm-level surveys, and trade flow analyses could clarify how digital finance reduces reliance on informal credit, lowers barriers to market entry, and enables SMEs and informal traders to participate more effectively in regional and international trade. This approach builds on existing literature by identifying the specific financial mechanisms that support digital trade, moving beyond the assumption that mobile money alone guarantees inclusive outcomes.

The seventh and final area focuses on demographic anomalies and social effects of digital trade work, notably the observed rise in singlehood among CFAs. Although digitalization literature acknowledges workforce changes, including employment patterns and skill demands (Verhoef et al., 2021), it seldom addresses associated social and demographic impacts. Future research should explore how digitally mediated trade roles, characterized by long hours, real-time responsiveness, mobility, and income volatility, affect family formation, social networks, and well-being. Mixed methods designs combining quantitative surveys and qualitative interviews could capture both the extent and lived experience of such demographic shifts. Understanding these patterns would provide new insights into the unintended social consequences on those working in import/export activities and inform policy interventions that balance economic efficiency with social sustainability. This focus extends Verhoef et al., (2021) and Fu (2020) by emphasizing measurable social outcomes linked to particular occupational groups within the trade ecosystem.

This research proposes a comprehensive, integrated agenda that prioritizes digital infrastructure, innovation, trade-specific digital literacy, regulatory alignment, collaborative governance, financial inclusion, and demographic outcomes. By synthesizing the findings of this study with prior research (Kiani Mavi et al., 2022; Hoekman & Wolfe, 2021; Verhoef et al., 2021; Escursell, Llorach-Massana & Roncero, 2021), it offers a cohesive, contextually grounded framework for advancing digital trade research. Employing interdisciplinary and empirically driven approaches, future studies can generate actionable knowledge to inform policy and practice while fostering sustainable social and economic benefits. This agenda moves beyond general recommendations, providing a precise, testable roadmap that enables interventions tailored to local realities and responsive to the complex shortcomings of developing economies.

Conclusions

This study was conducted in Tanzania, with 88.8% of participants drawn from the country's import/export sectors and customs freight agents, and the remaining 11.2% from neighboring countries that process customs clearance through the Port of DSM. The central focus was to explore how DT is shaping international trade, in import/export activities. Tanzania, located in East Africa, was formed on 26 April 1964 through the union of Tanganyika and Zanzibar. It borders the Indian Ocean to the east and shares land borders with Kenya, Uganda, Rwanda, Burundi, the Democratic Republic of Congo, Zambia, Malawi, and Mozambique. Among its eight neighboring countries, Uganda, Rwanda, Burundi, Zambia, and Malawi are landlocked and rely heavily on the ports of DSM, Mombasa, and Beira for their import/export activities.

The research also investigated how the digital divide contributes to widening trade inefficiencies and economic inequalities between developed and developing economies, with a specific focus on Tanzania's import/export sectors. While DT has accelerated trade growth and operational efficiency in advanced economies, many developing countries continue to face persistent barriers such as inadequate digital infrastructure, high costs, weak regulatory environments, and limited digital skills. These constraints undermine their ability to fully benefit from digital trade and, in turn, widen existing economic disparities. In Tanzania, despite ongoing investments, poor internet connectivity and limited innovation continue to restrict participation in the digital economy, creating a risk of further marginalization in the global market.

To address the complexity of this phenomenon, the study adopted a dual-methods approach. Combining quantitative and qualitative methods provided a more nuanced and complete understanding of how digital transformation influences trade performance. Structural Equation Modeling (SEM) enabled the rigorous testing of relationships between variables and the validation of hypotheses, while thematic analysis of key informants interviews offered deeper insight into the lived experiences and perceptions of key stakeholders. The integration of both approaches strengthened the credibility of the findings and ensured that the research captured both statistical relationships and contextual realities.

The findings confirm that DT significantly influences international trade operations, with digital infrastructure and regulatory frameworks playing critical roles. Digital infrastructure emerged as a strong driver of trade performance, underscoring the importance of reliable connectivity and technological readiness in facilitating efficient import/export activities. Regulatory frameworks also influence trade outcomes, but their effect was comparatively weaker, suggesting that policy alone cannot compensate for infrastructure deficits. The study also found that the digital divide remains a major obstacle to fully leveraging digital trade opportunities in developing regions where access to digital resources remains uneven. Without strategic interventions, Tanzania and similar economies risk falling further behind as digitalization continues to reshape global trade.

The study further demonstrated that DT creates both opportunities and risks. Digital technologies can enhance competitiveness and improve operational efficiency. However, DT can also amplify inequalities, as not all firms or workers have equal access to digital tools or the skills needed to benefit from them. This duality underscores the need for a balanced approach to digitalization that recognizes both its benefits and potential drawbacks. It also reinforces the importance of ethical, digital literacy, and inclusive policy design to ensure that digital trade contributes to broader socio-economic development rather than reinforcing existing disparities.

The research highlights the relevance of dynamic capabilities in shaping how firms and institutions adapt to digital change. Firms that can sense opportunities, seize them through digital deployment, and reconfigure resources are more likely to achieve competitive advantage and sustain performance in volatile international markets. In this sense, DT is not merely a technological upgrade but a strategic process that requires organizational flexibility, leadership, and continuous innovation. This finding aligns with the broader understanding that successful DT depends on the alignment of technology, strategy, and human capacity.

Network dynamics also emerged as a key factor shaping digital trade outcomes. The study showed that digital trade is inherently relational, relying on coordinated networks of firms, regulators, technology providers, and logistics partners. Effective digital trade therefore depends on collaboration, information exchange, and shared governance across stakeholders, rather than isolated efforts by individual firms. This insight underscores the need for ecosystem-based strategies that strengthen connections between public and private actors and foster trust and interoperability across the trade value chain.

The research also highlights the importance of ethical governance and human-centered digital practices. DT should not be viewed as a purely technical process but as one that impacts rights, privacy, and organizational integrity. Ensuring ethical digital practices is essential for building trust and legitimacy, which are foundational for sustainable digital trade. This ethical dimension is particularly important in developing economies, where regulatory enforcement and institutional capacity may be limited.

In terms of policy and practice, the study recommends that governments and trade stakeholders in developing countries prioritize investments in digital infrastructure and digital literacy to ensure broader access and participation. Regulatory frameworks should be reformed to support innovation while protecting data privacy and reducing barriers to cross-border trade. Public–private partnerships should be strengthened to promote collaborative innovation, and strategic initiatives such as e-commerce platforms, digital payment solutions, and data analytics tools should be widely adopted to enhance efficiency and competitiveness. Additionally, cybersecurity and data protection should be treated as central priorities to safeguard sensitive trade information and build trust in digital transactions.

Ultimately, this research contributes to a deeper understanding of how DT shapes international trade in developing economies. It shows that closing the digital divide is not only a matter of infrastructure investment but also requires comprehensive policies, ethical governance, and coordinated stakeholder collaboration. By adopting a holistic approach to DT, developing countries can strengthen their global competitiveness, create more inclusive economic opportunities, and position themselves more effectively within the global digital economy.

This research emphasizes the urgent need to tackle the digital divide and stresses that closing this gap is essential to guarantee fair and inclusive access to the benefits of DT. Strengthening digital infrastructure, refining regulatory frameworks, and investing in human capital development are critical steps toward advancing the digital economy. Future research should explore key areas such as digital marketing, smart ports, digital inclusion strategies, and the integration of emerging technologies into global trade processes. In the digital era, agility and speed have become essential competitive advantages. As Herve, Schmitt, and Baldegger (2021, p. 5) cite Klaus Schwab, *"In the new world, it is not the big fish which eats the small fish, but the fast fish that eats the slow,"* highlighting the critical importance of agility. By prioritizing these initiatives, developing economies can bridge the digital divide and unlock the full potential of digital transformation while advancing toward a more inclusive and competitive digital economy.

REFERENCES

Acquisti, A., Brandimarte, L., & Loewenstein, G. (2020). Secrets and likes: The drive for privacy and the difficulty of achieving it in the digital age. *Journal of Consumer Psychology, 30*(4), 736–758.

Adeola, O., & Evans, O. (2020). ICT, infrastructure, and tourism development in Africa. *Tourism Economics, 26*(1), 97–114.

African Union Commission. (2021). *Africa's development dynamics 2021: Digital transformation for quality jobs*. OECD Publishing.

African Union. (2020). *The digital transformation strategy for Africa (2020–2030)*. Addis Ababa, Ethiopia.

Akbari, M., & Hopkins, J. L. (2022). Digital technologies as enablers of supply chain sustainability in an emerging economy. *Operations Management Research, 15*(3), 689–710.

Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. *Frontiers in Psychology, 13*, 920317.

Alexopoulou, S. (2025). Paradigm shift: Exploring the impact of digital technologies on the welfare state through a systematic literature review. *Social Policy & Administration, 59*(1), 135–157.

Ali, Z., Gongbing, B., & Mehreen, A. (2020). Does supply chain finance improve SMEs' performance? The moderating role of trade digitization. *Business Process Management Journal, 26*(1), 150–167.

Ally, S. (2024). A national e-assessment implementation framework: Assessing readiness in secondary schools and teacher education in Tanzania. *Journal of Issues and Practice in Education, 16*(1), 1–30.

Amalesh, S., Kumar, V., Yan, J., Borah, S. B., & Anirban, A. (2019). Understanding the structural characteristics of a firm's whole buyer–supplier network and its impact on international business performance. *Journal of International Business Studies, 50*(3), 365–392.

Anwar, M. A., & Graham, M. (2022). *The digital continent: Placing Africa in planetary networks of work*. Oxford University Press.

Appio, F. P., Frattini, F., Petruzzelli, A. M., & Neirotti, P. (2021). Digital transformation and innovation management: A synthesis of existing research and an agenda for future studies. *Journal of Product Innovation Management, 38*(1), 4–20.

Arbuckle, J. (2022). *SPSS Amos (Version 30)*. IBM SPSS.

Awan, U., Sroufe, R., & Shahbaz, M. (2021). Industry 4.0 and the circular economy: A literature review and recommendations for future research. *Business Strategy and the Environment, 30*(4), 2038–2060.

Azmeh, S., Foster, C., & Echavarri, J. (2020). The international trade regime and the quest for free digital trade. *International Studies Review, 22*(3), 671–692.

Banalieva, E. R., & Dhanaraj, C. (2019). Internalization theory for the digital economy. *Journal of International Business Studies, 50*(8), 1372–1387.

Banga, K., & te Velde, D. W. (2018). *Digitalisation and the future of manufacturing in Africa*. ODI.

Barnes, S. J. (2020). Information management research and practice in the post-COVID-19 world. *International Journal of Information Management, 55*, 102175.

Beaunoyer, E., Dupéré, S., & Guitton, M. J. (2020). COVID-19 and digital inequalities: Reciprocal impacts and mitigation strategies. *Computers in Human Behavior, 111*, 106424.

Behdani, B., Wiegmans, B., Roso, V., & Haralambides, H. (2020). Port-hinterland transport and logistics: Emerging trends and frontier research. *Maritime Economics & Logistics, 22*, 1–25.

Benitez, J., Arenas, A., Castillo, A., & Esteves, J. (2022). Impact of digital leadership capability on innovation performance: The role of platform digitization capability. *Information & Management, 59*(2), 103590.

Benohr, I. (2020). The United Nations guidelines for consumer protection: Legal implications and new frontiers. *Journal of Consumer Policy, 43*(1), 105–124.

Bonina, C., Koskinen, K., Eaton, B., & Gawer, A. (2021). Digital platforms for development: Foundations and research agenda. *Information Systems Journal, 31*(6), 869–902.

Bougie, R., & Sekaran, U. (2019). *Research methods for business: A skill-building approach* (8th ed.). John Wiley & Sons.

Bouncken, R. B., Czakon, W., & Schmitt, F. (2025). Purposeful sampling and saturation in qualitative research methodologies: recommendations and review. *Review of Managerial Science*, 1-37.

Bru-Luna, L. M., Martí-Vilar, M., Merino-Soto, C., & Livia, J. (2021). Reliability generalization study of the person-centered care assessment tool. *Frontiers in Psychology, 12*, 712582.

Brunetti, F., Matt, D. T., Bonfanti, A., De Longhi, A., Pedrini, G., & Orzes, G. (2020). Digital transformation challenges: Strategies emerging from a multi-stakeholder approach. *TQM Journal, 32*(4), 697–724.

Brunner, T. J., Schuster, T., & Lehmann, C. (2023). Leadership's long arm: The positive influence of digital leadership on managing technology-driven change over a strengthened service innovation capacity. *Frontiers in Psychology*, *14*, 988808.

Buckley, P. J. (2020). The theory and empirics of the structural reshaping of globalization. *Journal of International Business Studies, 51*(9), 1580.

Burri, M. (2021). Towards a new treaty on digital trade. *Journal of World Trade, 55*(1), 77–102.

Butollo, F. (2021). Digitalization and the geographies of production: Towards reshoring or global fragmentation? *Competition and Change, 25*(2), 259–278.

Carayannis, E. G., & Campbell, D. F. J. (2021). Democracy of climate and climate for democracy: The evolution of quadruple and quintuple helix innovation systems. *Journal of the Knowledge Economy, 12*(4), 2050–2082.

Carroll, N., Hassan, N. R., Junglas, I., Hess, T., & Morgan, L. (2023). Transform or be transformed: The importance of research on managing and sustaining digital transformations. *European Journal of Information Systems, 32*(3), 347–353.

Casella, B., Bolwijn, R., Moran, D., & Kanemoto, K. (2019). Improving the analysis of global value chains: The UNCTAD-Eora database. *Transnational Corporations, 26*(3), 115–142.

Chang, Y., Iakovou, E., & Shi, W. (2020). Blockchain in global supply chains and cross-border trade: A critical synthesis of the state-of-the-art, challenges and opportunities. *International Journal of Production Research, 58*(7), 2082–2099.

Chen, S., Ding, Y., & Liu, X. (2023). Development of the growth mindset scale: Evidence of structural validity, measurement model, direct and indirect effects in Chinese samples. *Current Psychology, 42*(3), 1712–1726.

Cho, G., Hwang, H., Sarstedt, M., & Ringle, C. M. (2020). Cutoff criteria for overall model fit indexes in generalized structured component analysis. *Journal of Marketing Analytics, 8*(4), 189–202.

Choudrie, J., Zamani, E., & Obuekwe, C. (2022). Bridging the digital divide in ethnic minority older adults: An organisational qualitative study. *Information Systems Frontiers, 24*(4), 1355–1375.

Cichosz, M., Wallenburg, C. M., & Knemeyer, A. M. (2020). Digital transformation at logistics service providers: Barriers, success factors and leading practices. *The International Journal of Logistics Management, 31*(2), 209–238.

Claassen, K., Dos Anjos, D. R., Kettschau, J., & Broding, H. C. (2021). How to evaluate digital leadership: A cross-sectional study. *Journal of Occupational Medicine and Toxicology, 16*(1), 1–8.

Cohen, J. (2013). Statistical power analysis for the behavioral sciences. Routledge.

Conboy, K., Mikalef, P., Dennehy, D., & Krogstie, J. (2020). Using business analytics to enhance dynamic capabilities in operations research: A case analysis and research agenda. *European Journal of Operational Research, 281*(3), 656–672.

Constantinides, P., Henfridsson, O., & Parker, G. G. (2018). Introduction—Platforms and infrastructures in the digital age. *Information Systems Research, 29*(2), 381–400.

Coombs, C. (2020). Will COVID-19 be the tipping point for the intelligent automation of work? A review of the debate and implications for research. *International Journal of Information Management, 55*, 102182.

Cooper, D. R., & Schindler, P. (2014). *Business research methods* (12th ed.). McGraw-Hill Education.

Coreynen, W., Matthyssens, P., Vanderstraeten, J., & van Witteloostuijn, A. (2020). Unravelling the internal and external drivers of digital servitization: A dynamic capabilities and contingency perspective on firm strategy. *Industrial Marketing Management, 89*, 265–277.

Coyne, S. M., Rogers, A. A., Zurcher, J. D., Stockdale, L., & Booth, M. (2020). Does time spent using social media impact mental health? An eight-year longitudinal study. *Computers in Human Behavior, 104*, 106160.

Creswell, J. W. (2015). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Pearson.

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Sage Publications.

Crosetto, P., Filippin, A., Katuscak, P., & Smith, J. (2020). Central tendency bias in belief elicitation. *Journal of Economic Psychology, 78*, 102273.

Cui, Y., Shi, Y., Gu, M., & Li, J. (2025). Exploring the knowledge mapping and research trends of cross-border e-commerce. South African Journal of Economic and Management Sciences, 28(1), 5909.

Dahlman, C., Mealy, S., & Wermelinger, M. (2016). *Harnessing the digital economy for developing countries*. OECD Development Centre.

Damayanti, T. W., & Matasik, A. L. (2021). Market competition, fairness and tax compliance: The formal sector's perspective. *Journal of International Studies, 14*(1), 152–165.

Dash, G., & Paul, J. (2021). CB-SEM vs PLS-SEM methods for research in social sciences and technology forecasting. *Technological Forecasting and Social Change, 173*, 121092.

David-West, O., Umukoro, I. O., & Onuoha, R. O. (2018). Platforms in sub-Saharan Africa: Startup models and the role of business incubation. *Journal of Intellectual Capital, 19*(3), 581–616.

Dedeoğlu, B. B., Taheri, B., Okumus, F., & Gannon, M. (2020). Understanding the importance that consumers attach to social media sharing (ISMS): Scale development and validation. *Tourism Management, 76*, 103954.

Deng, Z., Liesch, P. W., & Wang, Z. (2021). Deceptive signaling on globalized digital platforms: Institutional hypnosis and firm internationalization. *Journal of International Business Studies, 52*(6), 1096–1120.

Di, Y., Zhi, R., Song, H., & Zhang, L. (2022). Development and influencing factors of international trade in digitally deliverable services. *Frontiers in Psychology, 13*, 908420.

DIGILOGIC. (2023, June 20). *The potential of AfCFTA to transform the logistics industry in Africa* [Webinar]. Retrieved from https://www.digilogic.com/webinar-afcfta-logistics

Ding, J., Liu, B., Wang, J., Qiao, P., & Zhu, Z. (2023). Digitalization of the business environment and innovation efficiency of Chinese ICT firms. *Journal of Organizational and End User Computing, 35*(3), 1–25.

Djafarova, E., & Foots, S. (2022). Exploring ethical consumption of Generation Z: Theory of planned behaviour. *Young Consumers, 23*(3), 413–431.

Du, Q., Deng, D., & Wood, J. (2021). Differences in distance and spatial effects on cross-border e-commerce and international trade: An empirical analysis of China and One-Belt One-Road countries. *Journal of Global Information Management, 30*(2), 1–24.

Dunwoodie, K., Macaulay, L., & Newman, A. (2023). Qualitative interviewing in the field of work and organisational psychology: Benefits, challenges and guidelines for researchers and reviewers. *Applied Psychology, 72*(2), 863–889.

Durand, A., Zijlstra, T., van Oort, N., Hoogendoorn-Lanser, S., & Hoogendoorn, S. (2022). Access denied? Digital inequality in transport services. *Transport Reviews, 42*(1), 32–57.

Ekman, P., Thilenius, P., Thompson, S., & Whitaker, J. (2020). Digital transformation of global business processes: The role of dual embeddedness. *Business Process Management Journal, 26*(2), 570–592.

Elena-Bucea, A., Cruz-Jesus, F., Oliveira, T., & Coelho, P. S. (2021). Assessing the role of age, education, gender and income on the digital divide: Evidence for the European Union. *Information Systems Frontiers, 23*, 1007–1021.

Elgendy, N., Elragal, A., & Paivarinta, T. (2022). DECAS: A modern data-driven decision theory for big data and analytics. *Journal of Decision Systems, 31*(4), 337–373.

Elia, G., Margherita, A., & Passiante, G. (2020). Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process. *Technological Forecasting and Social Change, 150*, 119791.

ElMassah, S., & Mohieldin, M. (2020). Digital transformation and localizing the sustainable development goals (SDGs). *Ecological Economics, 169*, 106490.

Engesmo, J., & Panteli, N. (2021). Digital leaders and the transformation of the IT function. *Scandinavian Journal of Information Systems, 33*(1), 4.

Erhan, T., Uzunbacak, H. H., & Aydin, E. (2022). From conventional to digital leadership: Exploring digitalization of leadership and innovative work behavior. *Management Research Review, 45*(11), 1524–1543.

ESCAP, U., ECA, U., ECE, U., ECLAC, U., & ESCWA, U. (2023). *Digital and sustainable trade facilitation: Global report 2023.*

Escursell, S., Llorach-Massana, P., & Roncero, M. B. (2021). Sustainability in e-commerce packaging: A review. *Journal of Cleaner Production, 280*, 124314.

Fahey, R. A., & Hino, A. (2020). COVID-19, digital privacy, and the social limits on data-focused public health responses. *International Journal of Information Management, 55*, 102181.

Fainshmidt, S., Witt, M. A., Aguilera, R. V., & Verbeke, A. (2020). The contributions of qualitative comparative analysis (QCA) to international business research. *Journal of International Business Studies, 51*, 455–466.

Fairbairn, M., Kish, Z., & Guthman, J. (2022). Pitching agri-food tech: Performativity and non-disruptive disruption in Silicon Valley. *Journal of Cultural Economy, 15*(5), 652–670.

Farquhar, J., Michels, N., & Robson, J. (2020). Triangulation in industrial qualitative case study research: Widening the scope. *Industrial Marketing Management, 87*, 160–170.

Fischer, M., Imgrund, F., Janiesch, C., & Winkelmann, A. (2020). Strategy archetypes for digital transformation: Defining meta objectives using business process management. *Information & Management, 57*(5), 103262.

Fotiadis, A., Abdulrahman, K., & Spyridou, A. (2019). The mediating roles of psychological autonomy, competence and relatedness on work-life balance and well-being. *Frontiers in Psychology, 10*, 1267.

Fready, S., Vel, P., & Nyadzayo, M. W. (2022). Business customer virtual interaction: Enhancing value creation in B2B markets in the post-COVID-19 era – An SME perspective. *Journal of Business & Industrial Marketing, 37*(10), 2075–2094.

Fu, X. (2020). Digital transformation of global value chains and sustainable post-pandemic recovery. *Transnational Corporations, 27*(2), 1–21.

Furr, N., Ozcan, P., & Eisenhardt, K. M. (2022). What is digital transformation? Core tensions facing established companies on the global stage. *Global Strategy Journal, 12*(4), 595–618.

Gakuu, C. M., Kidombo, H. J., & Keiyoro, P. N. (2016). *Fundamentals of research methods: Concepts, practice & application.* University of Nairobi Press.

George, G., & Schillebeeckx, S. J. (2022). Digital transformation, sustainability, and purpose in the multinational enterprise. *Journal of World Business, 57*(3), 101326.

Ghasemaghaei, M., & Calic, G. (2020). Assessing the impact of big data on firm innovation performance: Big data is not always better data. *Journal of Business Research, 108*, 147–162.

Ghosh, S., Hughes, M., Hodgkinson, I., & Hughes, P. (2022). Digital transformation of industrial businesses: A dynamic capability approach. *Technovation, 113*, 102414.

Giermindl, L. M., Strich, F., Christ, O., Leicht-Deobald, U., & Redzepi, A. (2022). The dark sides of people analytics: Reviewing the perils for organisations and employees. *European Journal of Information Systems, 31*(3), 410–435.

Gillet, N., Morin, A. J., Ndiaye, A., Colombat, P., & Fouquereau, E. (2020). A test of work motivation profile similarity across four distinct samples of employees. *Journal of Occupational and Organizational Psychology, 93*(4), 988–1030.

Gong, C., & Ribiere, V. (2021). Developing a unified definition of digital transformation. *Technovation, 102*, 102217.

Grassini, S., & Laumann, K. (2020). Questionnaire measures and physiological correlates of presence: A systematic review. *Frontiers in Psychology, 11*, 349.

Grewal, D., Herhausen, D., Ludwig, S., & Ordenes, F. V. (2022). The future of digital communication research: Considering dynamics and multimodality. *Journal of Retailing, 98*(2), 224–240.

Grishchenko, N. (2020). The gap not only closes: Resistance and reverse shifts in the digital divide in Russia. *Telecommunications Policy, 44*(8), 102004.

Guerrero, D., Letrouit, L., & Pais-Montes, C. (2022). The container transport system during COVID-19: An analysis through the prism of complex networks. *Transport Policy, 115*, 113–125.

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field methods*, *18*(1), 59-82.

Gupta, S., Ghosh, P., & Sridhar, V. (2022). Impact of data trade restrictions on IT services export: A cross-country analysis. *Telecommunications Policy, 46*(9), 102403.

Gurcan, F., Boztas, G. D., Dalveren, G. G. M., & Derawi, M. (2023). Digital transformation strategies, practices, and trends: A large-scale retrospective study based on machine learning. *Sustainability, 15*(9), 7496.

Habibi, A., Yaakob, M. F. M., Mukminin, A., Muhaimin, M., Prasojo, L. D., Yusop, F. D., & Muzakkir, M. (2021). Teachers' digital technology access to motivation, skills and use: A structural equation modeling study. *Aslib Journal of Information Management, 73*(4), 543–559.

Hai, T. N., Van, Q. N., & Thi Tuyet, M. N. (2021). Digital transformation: Opportunities and challenges for leaders in the emerging countries in response to COVID-19 pandemic. *Emerging Science Journal, 5*(1), 21–36.

Hair Jr, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research, 109*, 101–110.

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial least squares structural equation modeling (PLS-SEM) using R: A workbook* (p. 197). Springer Nature.

Haji, S. H., Silla, B. S., & Musuguri, J. N. (2017). Tanzania as an emerging digital economy. *Global Strategy Journal, 5*(5), 120.

Hallencreutz, J., & Parmler, J. (2021). Important drivers for customer satisfaction–From product focus to image and service quality. *Total Quality Management & Business Excellence, 32*(5–6), 501–510.

Halpern, N., Mwesiumo, D., Suau-Sanchez, P., Budd, T., & Bråthen, S. (2021). Ready for digital transformation? The effect of organisational readiness, innovation, airport size and ownership on digital change at airports. *Journal of Air Transport Management, 90*, 101949.

Hanafizadeh, P., Khosravi, B., & Badie, K. (2019). Global discourse on ICT and the shaping of ICT policy in developing countries. *Telecommunications Policy, 43*(4), 324–338.

Hanelt, A., Bohnsack, R., Marz, D., & Antunes Marante, C. (2021). A systematic review of the literature on digital transformation: Insights and implications for strategy and organizational change. *Journal of Management Studies, 58*(5), 1159–1197.

Hansen, C., Steinmetz, H., & Block, J. (2022). How to conduct a meta-analysis in eight steps: A practical guide. *Management Review Quarterly*, 1–19.

Hausberg, J. P., Liere-Netheler, K., Packmohr, S., Pakura, S., & Vogelsang, K. (2019). Research streams on digital transformation from a holistic business perspective: A systematic literature review and citation network analysis. *Journal of Business Economics, 89*(8), 931–963.

He, H., & Harris, L. (2020). The impact of COVID-19 pandemic on corporate social responsibility and marketing philosophy. *Journal of Business Research, 116*, 176–182.

He, Z., Huang, H., Choi, H., & Bilgihan, A. (2023). Building organizational resilience with digital transformation. *Journal of Service Management, 34*(1), 147–171.

Hein, A., Schreieck, M., Riasanow, T., Setzke, D. S., Wiesche, M., Böhm, M., & Krcmar, H. (2020). Digital platform ecosystems. *Electronic Markets, 30*(1), 87–98.

Hennart, J. F. (2019). Digitalized service multinationals and international business theory. *Journal of International Business Studies, 50*(8), 1388–1400.

Henseler, J., & Schuberth, F. (2023). Partial least squares as a tool for scientific inquiry: Comments on Cadogan and Lee. *European Journal of Marketing, 57*(6), 1737–1757.

Herhausen, D., Miočević, D., Morgan, R. E., & Kleijnen, M. H. (2020). The digital marketing capabilities gap. *Industrial Marketing Management, 90*, 276–290.

Herve, A., Schmitt, C., & Baldegger, R. (2021). Internationalization and digitalization: Applying digital technologies to the internationalization process of small and medium-sized enterprises. *Technology Innovation Management Review, 10*(7).

Hidalgo, A., Gabaly, S., Morales-Alonso, G., & Urueña, A. (2020). The digital divide in light of sustainable development: An approach through advanced machine learning techniques. *Technological Forecasting and Social Change, 150*, 119754.

Hill, A. D., Johnson, S. G., Greco, L. M., O'Boyle, E. H., & Walter, S. L. (2021). Endogeneity: A review and agenda for the methodology–practice divide affecting micro and macro research. *Journal of Management, 47*(1), 105–143.

Hoekman, B., & Wolfe, R. (2021). Reforming the World Trade Organization: Practitioner perspectives from China, the EU, and the US. *China & World Economy, 29*(4), 1–34.

Hohlov, Y. E., & Ershova, T. (2018). *Competing in digital age: Policy implication for the Russian Federation*. The World Bank.

Holtom, B., Baruch, Y., Aguinis, H., & Ballinger, G. A. (2022). Survey response rates: Trends and a validity assessment framework. *Human Relations, 75*(8), 1560–1584.

Houngbonon, G. V., Rossotto, C. M., & Strusani, D. (2021). Enabling private investment in 5G connectivity in emerging markets—An assessment of challenges and policy options. *World Bank*.

Howard, M. C. (2023). A systematic literature review of exploratory factor analyses in management. *Journal of Business Research, 164*, 113969.

Hufbauer, G. C., & Jung, E. (2020). What's new in economic sanctions? *European Economic Review, 130*, 103572.

Humphreys, M., Stokenberga, A., Dappe, M. H., & Hartmann, O. (2019). *Port development and competition in East and Southern Africa: Prospects and challenges*. World Bank.

Indira, A., & Kusumasari, B. (2020). Boosting logistics in Indonesia and Vietnam through staged development of the single window system: A government innovation. *Public Policy and Administration, 19*(4), 92–113.

Ipsmiller, E., & Dikova, D. (2021). Internationalization from Central and Eastern Europe: A systematic literature review. *Journal of International Management, 27*(4), 100862.

Irani, Z., Abril, R. M., Weerakkody, V., Omar, A., & Sivarajah, U. (2023). The impact of legacy systems on digital transformation in European public administration: Lessons learned from a multi-case analysis. *Government Information Quarterly, 40*(1), 101784.

Ismagilova, E., Hughes, L., Rana, N. P., & Dwivedi, Y. K. (2022). Security, privacy and risks within smart cities: Literature review and development of a smart city interaction framework. *Information Systems Frontiers*, 1–22.

ITU. (2019). *Measuring digital development: Facts and figures*. International Telecommunication Union.

Jafari-Sadeghi, V., Garcia-Perez, A., Candelo, E., & Couturier, J. (2021). Exploring the impact of digital transformation on technology entrepreneurship and technological market expansion: The role of technology readiness, exploration and exploitation. *Journal of Business Research, 124*, 100–111.

Janssen, M., Brous, P., Estevez, E., Barbosa, L. S., & Janowski, T. (2020). Data governance: Organizing data for trustworthy artificial intelligence. *Government Information Quarterly, 37*(3), 101493.

Jarvenpaa, E., Siltala, N., Hylli, O., & Lanz, M. (2019). The development of an ontology for describing the capabilities of manufacturing resources. *Journal of Intelligent Manufacturing, 30*(2), 959–978.

Joukhadar, G., Jiang, R., Harrington, K., & Thorogood, A. (2023). Promoting digital innovation for sustainability in the public sector. *Communications of the Association for Information Systems, 53*(1), 240–277.

Jovanovic, M., Sjödin, D., & Parida, V. (2022). Co-evolution of platform architecture, platform services, and platform governance: Expanding the platform value of industrial digital platforms. *Technovation, 118*, 102218.

Kahyarara, G. (2022). Infrastructure and economic growth of Tanzania. *UDSM Online Journal Testing, 12*(1), 111–128.

Karabulut, A. T. (2020). Digital innovation: An antecedent for digital transformation. *International Journal of Commerce and Finance, 6*(2), 179–186.

Khin, S., & Ho, T. C. F. (2019). Digital technology, digital capability and organizational performance. *International Journal of Innovation Science, 11*(2), 177–195.

Kiani Mavi, R., Kiani Mavi, N., Olaru, D., Biermann, S., & Chi, S. (2022). Innovations in freight transport: A systematic literature evaluation and COVID implications. *International Journal of Logistics Management, 33*(4), 1157–1195.

Klein, V. B., & Todesco, J. L. (2021). COVID-19 crisis and SMEs responses: The role of digital transformation. *Knowledge and Process Management, 28*(2), 117–133.

Kokolek, N., Jakovic, B., & Curlin, T. (2019). Digital knowledge and skills–Key factors for digital transformation. *Annals of DAAAM & Proceedings, 30*, 744–751.

Kourti, M. (2021). A critical realist approach on autism: Ontological and epistemological implications for knowledge production in autism research. *Frontiers in Psychology, 12*, 713423.

Koutsikouri, D., Lindgren, R., Henfridsson, O., & Rudmark, D. (2018). Extending digital infrastructures: A typology of growth tactics. *Journal of the Association for Information Systems, 19*(10), 1001–1019.

Krco, S., van Kranenburg, R., Loncar, M., Ziouvelou, X., & McGroarty, F. (2019). Digitization of value chains and ecosystems. In *Digital business models: Driving transformation and innovation* (pp. 81–116). Springer.

Kumar, R. (2018). *Research methodology: A step-by-step guide for beginners* (5th ed.). SAGE.

Lacka, E., Chan, H. K., & Wang, X. (2020). Technological advancements and B2B international trade: A bibliometric analysis and review of industrial marketing research. *Industrial Marketing Management, 88*, 1–11.

Lanzolla, G., Pesce, D., & Tucci, C. L. (2021). The digital transformation of search and recombination in the innovation function: Tensions and an integrative framework. *Journal of Product Innovation Management, 38*(1), 90–113.

Lee, S. M., & Lee, D. (2020). "Untact": A new customer service strategy in the digital age. *Service Business, 14*(1), 1–22.

Leidner, D. E., & Tona, O. (2021). The CARE theory of dignity amid personal data digitalization. *MIS Quarterly, 45*(1), 343–370.

Lemken, D. (2021). Options to design more ethical and still successful default nudges: A review and recommendations. *Behavioural Public Policy*, 1–33.

Li, Y., & Fei, G. Z. (2023). Network embeddedness, digital transformation, and enterprise performance—The moderating effect of top managerial cognition. *Frontiers in Psychology, 14*, 1098974.

Lisinge, R. T. (2020). The Belt and Road Initiative and Africa's regional infrastructure development: Implications and lessons. *Transnational Corporations Review, 12*(4), 425–438.

Lobschat, L., Mueller, B., Eggers, F., Brandimarte, L., Diefenbach, S., Kroschke, M., & Wirtz, J. (2021). Corporate digital responsibility. *Journal of Business Research, 122*, 875–888.

Locke, K., Feldman, M. S., & Golden-Biddle, K. (2022). Data collection methodologies in qualitative research: Current trends and future directions. *Organizational Research Methods, 25*(1), 145–175.

Lopez Jimenez, D., Dittmar, E. C., & Vargas Portillo, J. P. (2021). New directions in corporate social responsibility and ethics: Codes of conduct in the digital environment. *Journal of Business Ethics*, 1–11.

Lovakov, A., & Agadullina, E. R. (2021). Empirically derived guidelines for effect size interpretation in social psychology. *European Journal of Social Psychology, 51*(3), 485–504.

Luo, Y. (2021). New OLI advantages in digital globalization. *International Business Review, 30*(2), 101797.

Lwesya, F. (2021). SMEs' competitiveness and international trade in the era of global value chains (GVCs) in Tanzania: An assessment and future challenges. *Small Business International Review, 5*(1), e325.

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological methods*, 1(2), 130.

Machado, C. G., Winroth, M., Almström, P., Ericson Öberg, A., Kurdve, M., & AlMashalah, S. (2021). Digital organisational readiness: Experiences from manufacturing companies. *Journal of Manufacturing Technology Management, 32*(9), 167–182.

Magesa, G., & Jonathan, F. (2021). The role of SMEs in global value chains: Digital transformation in East Africa. *International Journal of Small Business Economics, 36*(1), 121–134.

Magsamen-Conrad, K., & Dillon, J. M. (2020). Mobile technology adoption across the lifespan: A mixed methods investigation to clarify adoption stages, and the influence of diffusion attributes. *Computers in Human Behavior, 112*, 106456.

Mahenge, M. (2022). Bridging the digital divide: Challenges and opportunities for Tanzania. *Tanzanian Journal of Development Studies, 15*(1), 55–67.

Maisiri, W., & van Dyk, L. (2019). Industry 4 readiness assessment for South African industries. *South African Journal of Industrial Engineering, 30*(3), 134–148.

Mandli, F., & Ronkko, M. (2023). To omit or to include? Integrating the frugal and prolific perspectives on control variable use. *Organizational Research Methods*. Advance online publication.

Markus, M. L., & Rowe, F. (2021). Guest editorial: Theories of digital transformation: A progress report. *Journal of the Association for Information Systems, 22*(2), 11.

Martin, A., & Balestra, G. (2019). Using regulatory sandboxes to support responsible innovation in the humanitarian sector. *Global Policy, 10*(4), 733–736.

Martínez-Caro, E., Cegarra-Navarro, J. G., & Alfonso-Ruiz, F. J. (2020). Digital technologies and firm performance: The role of digital organizational culture. *Technological Forecasting and Social Change, 154*, 119962.

Masenya, T. (2023). Big data analytics as a game changer for business model innovation in small and medium-sized enterprises in South Africa. *International Journal of Innovation in the Digital Economy, 14*(1), 1–17.

Maury, F., Feligonde, A., Leonard, T., Raffi, K., Khalfi, M., Navarro-Roch, M., & Vermen, H. (2020). Africa's ports: Fast-tracking transformation. In *Africa CEO Forum, OKAN Partners* (pp. 1–60).

Mauthner, N. S. (2019). Toward a posthumanist ethics of qualitative research in a big data era. *American Behavioral Scientist, 63*(6), 669–698.

Meltzer, J. P. (2020). Cybersecurity, digital trade, and data flows: Re-thinking a role for international trade rules. *Global Economy & Development Working Paper*, 132.

Mergel, I., Edelmann, N., & Haug, N. (2019). Defining digital transformation: Results from expert interviews. *Government Information Quarterly, 36*(4), 101385.

Mhlungu, N. S., Chen, J. Y., & Alkema, P. (2019). The underlying factors of a successful organisational digital transformation. *South African Journal of Information Management, 21*(1), a1039.

Mihardjo, L. W. W., & Rukmana, R. A. (2018). Does digital leadership impact directly or indirectly on dynamic capability: Case on Indonesia telecommunication industry in digital transformation? *The Journal of Social Sciences Research*, 832–841.

Mikalef, P., Conboy, K., & Krogstie, J. (2021). Artificial intelligence as an enabler of B2B marketing: A dynamic capabilities micro-foundations approach. *Industrial Marketing Management, 98*, 80–92.

Miles, D. A. (2017, August). A taxonomy of research gaps: Identifying and defining the seven research gaps. In *Doctoral student workshop: finding research gaps-research methods and strategies* (pp. 1–15). Dallas, Texas.

Mjema, I., & Nanyondo, A. (2021). Bridging the digital divide in Tanzania's trade practices: Challenges and opportunities. *East African Journal of Trade, 15*(1), 1–20.

Mlepo, A. T., & Zheng, J. (2023). Shipping to a landlocked country: Maritime port choice decision from a consignee's perspective. *International Journal of Shipping and Transport Logistics, 16*(1–2), 194–209.

Mlimbila, J., & Mbamba, U. O. (2018). The role of information systems usage in enhancing port logistics performance: Evidence from the Dar Es Salaam port, Tanzania. *Journal of Shipping and Trade, 3*(1), 10.

Monaghan, S., Tippmann, E., & Coviello, N. (2020). Born digitals: Thoughts on their internationalization and a research agenda. *Journal of International Business Studies, 51*(1), 11–22.

Moretto, A., & Macchion, L. (2022). Drivers, barriers and supply chain variables influencing the adoption of blockchain to support traceability along fashion supply chains. *Operations Management Research, 15*(3), 1470–1489.

Morgan, G. A., Barrett, K. C., Leech, N. L., & Gloeckner, G. W. (2019). *IBM SPSS for introductory statistics: Use and interpretation*. Routledge.

Moro Visconti, R. (2019). Combining network theory with corporate governance: Converging models for connected stakeholders. *Journal of Management Control, 1*(2), 179–204.

Morris, J., Morris, W., & Bowen, R. (2022). Implications of the digital divide on rural SME resilience. *Journal of Rural Studies, 89*, 369–377.

Mushi, G. E., Serugendo, G. D. M., & Burgi, P. (2022). Digital technology and services for sustainable agriculture in Tanzania: A literature review. *Sustainability, 14*(4), 2415.

Mwantimwa, K. (2019). ICT usage to enhance firms’ business processes in Tanzania. *Journal of Global Entrepreneurship Research, 9*(1), 1–23.

Mwenda, N. M., & Kimutai, C. J. (2022). Digital transformation and sustainability of entrepreneurship for underserved communities in East Africa. In *Sustainability and the future of work and entrepreneurship for the underserved* (pp. 347–363). IGI Global.

Mwita, M. M., & Joanthan, J. (2020). Digital leadership for digital transformation. Centre for Information and Communication Technology, Sokoine University of Agriculture, Tanzania, 1–20.

Nadkarni, S., & Prügl, R. (2021). Digital transformation: A review, synthesis and opportunities for future research. *Management Review Quarterly, 71*, 233–341.

Naito, H., Ismailov, A., & Kimaro, A. B. (2021). The effect of mobile money on borrowing and saving: Evidence from Tanzania. *World Development Perspectives, 23*, 100342.

Nasution, R. A., Rusnandi, L. S. L., Qodariah, E., Arnita, D., & Windasari, N. A. (2018). The evaluation of digital readiness concept: Existing models and future directions. *The Asian Journal of Technology Management, 11*(2), 94–117.

Nayernia, H., Bahemia, H., & Papagiannidis, S. (2022). A systematic review of the implementation of industry 4.0 from the organisational perspective. *International Journal of Production Research, 60*(14), 4365–4396.

Ndubuisi, G., Otioma, C., & Tetteh, G. K. (2021). Digital infrastructure and employment in services: Evidence from Sub-Saharan African countries. *Telecommunications Policy, 45*(8), 102153.

Neubert, M. (2018). The impact of digitalization on the speed of internationalization of lean global startups. *Technology Innovation Management Review, 8*(5), 44–54.

Neumark, T. (2022). Digital diagnostics from Tanzania: Beyond mere technological fixing? *Social Science and Medicine*, 115306.

Ng'ombe, L., & Nguvumali, R. (2023). Cross-border data flows and trade regulations in Tanzania: Challenges and opportunities. *Tanzania Economic Review, 12*(3), 88–102.

Ngangaji, M. M. F. (2019). An assessment of container terminal efficiency in East Africa ports using data envelopment analysis (DEA): The case of Dar es Salaam & Mombasa ports.

Nguyen, M. H., Hargittai, E., & Marler, W. (2021). Digital inequality in communication during a time of physical distancing: The case of COVID-19. *Computers in Human Behavior, 120*, 106717.

Nguyen, T. T., Nguyen, T. T., & Grote, U. (2022). Internet use, natural resource extraction and poverty reduction in rural Thailand. *Ecological Economics, 196*, 107417.

Nielsen, B. B., Welch, C., Chidlow, A., Miller, S. R., Aguzzoli, R., Gardner, E., ... & Pegoraro, D. (2020). Fifty years of methodological trends in JIBS: Why future IB research needs more triangulation. *Journal of International Business Studies, 51*(9), 1478–1499.

North, K., Aramburu, N., & Lorenzo, O. J. (2020). Promoting digitally enabled growth in SMEs: A framework proposal. *Journal of Enterprise Information Management, 33*(1), 238–262.

Oduro, S. (2020). Exploring the barriers to SMEs' open innovation adoption in Ghana: A mixed research approach. *International Journal of Innovation Science, 12*(1), 21–51.

Ofori, I. K., Figari, F., & Ojong, N. (2023). Towards sustainability: The relationship between foreign direct investment, economic freedom and inclusive green growth. *Journal of Cleaner Production, 406*, 137020.

Okeleke, K. (2019). Digital transformation in Tanzania: The role of mobile technology and impact on development goals. GSM Association, 1–47.

Opland, L. E., Pappas, I. O., Engesmo, J., & Jaccheri, L. (2022). Employee-driven digital innovation: A systematic review and a research agenda. *Journal of Business Research, 143*, 255–271.

Oribhabor, C. B., & Anyanwu, C. A. (2019). Research sampling and sample size determination: A practical application. *Journal of Educational Research (Fudjer), 2*(1), 47–57.

Oughton, E. J., Lehr, W., Katsaros, K., Selinis, I., Bubley, D., & Kusuma, J. (2021). Revisiting wireless internet connectivity: 5G vs Wi-Fi 6. *Telecommunications Policy, 45*(5), 102127.

Ouyang, X., Li, Q., & Du, K. (2020). How does environmental regulation promote technological innovations in the industrial sector? Evidence from Chinese provincial panel data. *Energy Policy, 139*, 111310.

Oyebanjo, O. G., & Tengeh, R. K. (2021). Interrogating the challenges and opportunities for entrepreneurs in the Fourth Industrial Revolution: A developing country perspective. *World Review of Entrepreneurship, Management and Sustainable Development, 17*(6), 883–896.

Pallant, J. (2020). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. McGraw-Hill Education (UK).

Pananond, P., Gereffi, G., & Pedersen, T. (2020). An integrative typology of global strategy and global value chains: The management and organization of cross-border activities. *Global Strategy Journal, 10*(3), 421–443.

Pandey, N., & Pal, A. (2020). Impact of digital surge during Covid-19 pandemic: A viewpoint on research and practice. *International Journal of Information Management, 55*, 102171.

Pandey, P., & Pandey, M. M. (2021). Research methodology tools and techniques. Bridge Center.

Paul, J., & Barari, M. (2022). Meta-analysis and traditional systematic literature reviews—What, why, when, where, and how? *Psychology & Marketing, 39*(6), 1099-1115.

Pazi, S. M., & Chatwin, C. R. (2019). Assessment of broadband access technologies in Tanzanian rural areas. *International Journal of Internet of Things, 8*(1).

Peng, J., Strijker, D., & Wu, Q. (2020). Place identity: How far have we come in exploring its meanings? *Frontiers in Psychology, 11*, 294.

Peng, Y., & Tao, C. (2022). Can digital transformation promote enterprise performance? —From the perspective of public policy and innovation. *Journal of Innovation & Knowledge, 7*(3), 100198.

Peprah, A. A., Atarah, B. A., & Kumodzie-Dussey, M. K. (2024). Nonmarket strategy and legitimacy in institutionally voided environments: The case of Jumia, an African e-commerce giant. *International Business Review, 33*(2), 102169.

Picatoste, X., Mesquita, A., & González-Laxe, F. (2023). Gender wage gap, quality of earnings and gender digital divide in the European context. *Empirica, 50*(2), 301-321.

Pirola, F., Cimini, C., & Pinto, R. (2020). Digital readiness assessment of Italian SMEs: A case-study research. *Journal of Manufacturing Technology Management, 31*(5), 1045-1083.

Pivoto, D. G., De Almeida, L. F., da Rosa Righi, R., Rodrigues, J. J., Lugli, A. B., & Alberti, A. M. (2021). Cyber-physical systems architectures for industrial internet of things applications in Industry 4.0: A literature review. *Journal of Manufacturing Systems, 58*, 176-192.

Plakoyiannaki, E., & Budhwar, P. (2021). From convention to alternatives: Rethinking qualitative research in management scholarship. *British Journal of Management, 32*(1), 3-6.

Pollitzer, E. (2018). Creating a better future: Four scenarios for how digital technologies could change the world. *Journal of International Affairs, 72*(1), 75-90.

Popovich, D. (2025). How to treat missing data in survey research. *Journal of Marketing Theory and Practice, 33*(1), 43-59.

Powell, T. C. (2020). Can quantitative research solve social problems? Pragmatism and the ethics of social research. *Journal of Business Ethics, 167*(1), 41-48.

Rabetino, R., Kohtamäki, M., & Federico, J. S. (2021). A (re) view of the philosophical foundations of strategic management. *International Journal of Management Reviews, 23*(2), 151-190.

Rachinger, M., & Muller, J. M. (2024). Investigating a manufacturing ecosystem in transition toward electric vehicles–a business model perspective. *Journal of Manufacturing Technology Management, 35*(9), 24-50.

Rai, A., Tang, X., Yin, Z., & Du, S. (2022). Gaining customer loyalty with tracking information quality in B2B logistics. *Journal of Management Information Systems, 39*(2), 307-335.

Raisanen, J., & Tuovinen, T. (2020). Digital innovations in rural micro-enterprises. *Journal of Rural Studies, 73*, 56-67.

Raza, S. A., Umer, A., Qureshi, M. A., & Dahri, A. S. (2020). Internet banking service quality, e-customer satisfaction and loyalty: The modified e-SERVQUAL model. *TQM Journal, 32*(6), 1443-1466.

Reardon, T., Belton, B., Liverpool-Tasie, L. S. O., Lu, L., Nuthalapati, C. S., Tasie, O., & Zilberman, D. (2021). E-commerce's fast-tracking diffusion and adaptation in developing countries. *Applied Economic Perspectives and Policy, 43*(4), 1243-1259.

Rey, E., Carballo-Fazanes, A., Varela-Casal, C., Abelairas-Gómez, C., & ALFA-MOV Project collaborators. (2020). Reliability of the test of gross motor development: A systematic review. *PLoS One, 15*(7), e0236070.

Riswanto, A. (2021). Competitive intensity, innovation capability and dynamic marketing capabilities. *Research Horizon, 1*(1), 7-15.

Ritter, T., & Pedersen, C. L. (2020). Digitization capability and the digitalization of business models in business-to-business firms: Past, present, and future. *Industrial Marketing Management, 86*, 180-190.

Roe, M., Spanaki, K., Ioannou, A., Zamani, E. D., & Giannakis, M. (2022). Drivers and challenges of internet of things diffusion in smart stores: A field exploration. *Technological Forecasting and Social Change, 178*, 121593.

Rojon, C., Okupe, A., & McDowall, A. (2021). Utilization and development of systematic reviews in management research: What do we know and where do we go from here? *International Journal of Management Reviews, 23*(2), 191-223.

Romero, M., Guédria, W., Panetto, H., & Barafort, B. (2020). Towards a characterisation of smart systems: A systematic literature review. *Computers in Industry, 120*, 103224.

Rong, K. (2022). Research agenda for the digital economy. *Journal of Digital Economy, 1*(1), 20-31.

Rossini, M., Cifone, F. D., Kassem, B., Costa, F., & Portioli-Staudacher, A. (2021). Being lean: How to shape digital transformation in the manufacturing sector. *Journal of Manufacturing Technology Management, 32*(9), 239-259.

Rotblat, C. (2018). Importing new ideas on export promotion: Rethinking the U.S. ex-im bank and the OECD export credit arrangement. *Texas International Law Journal, 54*(1), 79-114.

Rymarczyk, J. (2021). The impact of industrial revolution 4.0 on international trade. *Entrepreneurial Business and Economics Review, 9*(1), 105-117.

Saad, S. M., Bahadori, R., & Jafarnejad, H. (2021). The smart SME technology readiness assessment methodology in the context of industry 4.0. *Journal of Manufacturing Technology Management, 32*(5), 1037-1065.

Saarikko, T., Westergren, U. H., & Blomquist, T. (2020). Digital transformation: Five recommendations for the digitally conscious firm. *Business Horizons, 63*(6), 825-839.

Sabbaghtorkan, M., Batta, R., & He, Q. (2020). Prepositioning of assets and supplies in disaster operations management: Review and research gap identification. *European Journal of Operational Research, 284*(1), 1-19.

Salih, A. A., Zeebaree, S. R., Abdulraheem, A. S., Zebari, R. R., Sadeeq, M. A., & Ahmed, O. M. (2020). Evolution of mobile wireless communication to 5G revolution. *Technology Reports of Kansai University, 62*(5), 2139-2151.

Salvi, A., Vitolla, F., Rubino, M., Giakoumelou, A., & Raimo, N. (2021). Online information on digitalization processes and its impact on firm value. *Journal of Business Research, 124*, 437-444.

Sandeepanie, M. H. R., Gamage, P., Perera, G. D. N., & Sajeewani, T. L. (2023). The role of talent management and employee psychological contract on employer branding: a pragmatic conceptual model. *Management Research Review*, 46(2), 196-222.

Sandeepanie, M. H. R., Gamage, P., Perera, G. D. N., & Sajeewani, T. L. (2023). The role of talent management and employee psychological contract on employer branding: A pragmatic conceptual model. *Management Research Review, 46*(2), 196-222.

Sarker, S., Rashidi, K., Gölgeci, I., Gligor, D. M., & Hsuan, J. (2024). Exploring pillars of supply chain competitiveness: Insights from leading global supply chains. *Production Planning & Control, 35*(10), 1025-1042.

Sarstedt, M., Bengart, P., Shaltoni, A. M., & Lehmann, S. (2018). The use of sampling methods in advertising research: A gap between theory and practice. *International Journal of Advertising, 37*(4), 650-663.

Saura, J. R., Ribeiro-Soriano, D., & Palacios-Marques, D. (2021). From user-generated data to data-driven innovation: A research agenda to understand user privacy in digital markets. *International Journal of Information Management, 60*, 102331.

Schelenz, L., & Schopp, K. (2018). Digitalization in Africa: Interdisciplinary perspectives on technology, development, and justice. *International Journal of Digital Society, 9*(4), 1412-1420.

Schmiedel, T., Müller, O., & Vom Brocke, J. (2019). Topic modeling as a strategy of inquiry in organizational research: A tutorial with an application example on organizational culture. *Organizational Research Methods, 22*(4), 941-968.

Schneider, P. (2018). Managerial challenges of Industry 4.0: An empirically backed research agenda for a nascent field. *Review of Managerial Science, 12*(3), 803-848.

Schrage, M., Muttreja, V., & Kwan, A. (2022). How the wrong KPIs doom digital transformation. *MIT Sloan Management Review, 63*(3), 35-40.

Sebastian, I., Ross, J., Beath, C., Mocker, M., Moloney, K., & Fonstad, N. (2017). How big old companies navigate digital transformation. *MIS Quarterly Executive, 16*(3), 197-213.

Semlambo, A., Lubua, E. W., & Mkude, C. (2022). Information systems security policy framework for enhanced ICT governance in public institutions of Tanzania. *The Journal of Informatics, 2*(1), 54-68.

Seufert, S., Guggemos, J., & Sailer, M. (2021). Technology-related knowledge, skills, and attitudes of pre- and in-service teachers: The current situation and emerging trends. *Computers in Human Behavior, 115*, 106552.

Shibata, S. (2020). Gig work and the discourse of autonomy: Fictitious freedom in Japan's digital economy. *New Political Economy, 25*(4), 535-551.

Silver, J. J., & Stoll, J. S. (2022). A framework for investigating commercial license and quota holdings in an era of fisheries consolidation, concentration and financialization. *Marine Policy, 143*, 105179.

Siponen, M., & Tsohou, A. (2018). Demystifying the influential IS legends of positivism. *Journal of the Association for Information Systems, 19*(7), 600-617.

Skog, D. A., Sandberg, J., & Wimelius, H. (2021). How Spotify balanced trade-offs in pursuing digital platform growth. *MIS Quarterly Executive, 20*(4).

Smeets, M. (2018). Can economic sanctions be effective? [Incomplete reference, no journal or publication details].

Solarino, A. M., & Aguinis, H. (2021). Challenges and best-practice recommendations for designing and conducting interviews with elite informants. *Journal of Management Studies, 58*(3), 649-672.

Song, Y., Escobar, O., Arzubiaga, U., & De Massis, A. (2022). The digital transformation of a traditional market into an entrepreneurial ecosystem. *Review of Managerial Science*, 1-24.

Spante, M., Hashemi, S. S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education, 5*(1), 1519143.

Steenkamp, J. B. E. (2020). Global brand building and management in the digital age. *Journal of International Marketing, 28*(1), 13-27.

Sukri, S., & Yusoff, R. Z. (2021). Effect of technology strategy on organizational performance of manufacturing companies: A note on how to conduct a data screening and preliminary analysis. *International Journal of Business and Technopreneurship*, *11*(2), 51-68.

Sürücü, L., Şeşen, H., & Maslakçı, A. (2023). Regression, mediation/moderation, and structural equation modeling with SPSS, AMOS, and PROCESS Macro. *Livre de Lyon*. [Book]

Suyono, E. (2012). Determinant factors affecting the audit quality: An Indonesian perspective. [Incomplete reference, no journal or publication details].

Swallehe, O. (2021). The determinants of adoption of social media marketing among SMEs in Tanzania. *IUP Journal of Marketing Management, 20*(1), 7-39.

Tabrizi, B., Lam, E., Girard, K., & Irvin, V. (2019). Digital transformation is not about technology. *Harvard Business Review, 13*(March), 1-6.

Tassabehji, R., Hackney, R., & Maruyama, T. (2019). Evaluating digital public services: A contingency value approach within three exemplar developing countries. *Information Technology and People, 32*(4), 1021-1043.

Teece, D. J. (2018). Dynamic capabilities as (workable) management systems theory. *Journal of Management and Organization, 24*(3), 359-368.

Terfa Eticha, G., Brunninge, O., & Kassa Tessema, W. (2024). Strategy research in an African context: A systematic literature review. *Africa Journal of Management, 10*(3), 316-350.

Thekdi, S., & Aven, T. (2024). A classification system for characterizing the integrity and quality of evidence in risk studies. *Risk Analysis, 44*(1), 264-280.

TIC. (2023, October 23). *USD 250 Million Investment in Dar es Salaam Port Signed.* Retrieved from: https://www.tanzaniainvest.com/transport/dp-world-250-million-investment-dar-es-salaam-port

TIC. (2024, June 4). *Adani Ports of India Secures Concession for Container Terminal 2 at Dar es Salaam Port*. Retrieved from: https://www.tanzaniainvest.com/transport/adani-concession-container-terminal-dar-es-salaam-port

Tijan, E., Jović, M., Aksentijević, S., & Pucihar, A. (2021). Digital transformation in the maritime transport sector. *Technological Forecasting and Social Change, 170*, 120879.

Tiwasing, P. (2021). Social media business networks and SME performance: A rural–urban comparative analysis. *Growth and Change, 52*(3), 1892-1913.

Tolstoy, D., Nordman, E. R., & Vu, U. (2022). The indirect effect of online marketing capabilities on the international performance of e-commerce SMEs. *International Business Review, 31*(3), 101946.

Trenerry, B., Chng, S., Wang, Y., Suhaila, Z. S., Lim, S. S., Lu, H. Y., & Oh, P. H. (2021). Preparing workplaces for digital transformation: An integrative review and framework of multi-level factors. *Frontiers in Psychology, 12*, 620766.

Trischler, M. F. G., & Li-Ying, J. (2023). Digital business model innovation: Toward construct clarity and future research directions. *Review of Managerial Science, 17*(1), 3-32.

URT. Tanzania digital Economy strategic framework 2024-2034. Dodoma 2024, Retrieved from: https://ictc.go.tz/storage/44/01J5TJNDHDVTA3AHVQN9CR6BV7.pdf

Uzir, M. U. H., Al Halbusi, H., Thurasamy, R., Hock, R. L. T., Aljaberi, M. A., Hasan, N., & Hamid, M. (2021). The effects of service quality, perceived value and trust in home delivery service personnel on customer satisfaction: Evidence from a developing country. *Journal of Retailing and Consumer Services, 63*, 102721.

Vadakkepatt, G. G., Winterich, K. P., Mittal, V., Zinn, W., Beitelspacher, L., Aloysius, J., ... & Reilman, J. (2021). Sustainable retailing. *Journal of Retailing, 97*(1), 62-80.

Vadana, I. I., Torkkeli, L., Kuivalainen, O., & Saarenketo, S. (2020). Digitalization of companies in international entrepreneurship and marketing. *International Marketing Review, 37*(3), 471-492.

van Dijk, J. (2020). *The digital divide*. John Wiley & Sons.

Van Veldhoven, Z., & Vanthienen, J. (2022). Digital transformation as an interaction-driven perspective between business, society, and technology. *Electronic Markets, 32*(2), 629-644.

Varadarajan, R. (2020). Customer information resources advantage, marketing strategy and business performance: A market resources-based view. *Industrial Marketing Management, 89*, 89-97.

Vaska, S., Massaro, M., Bagarotto, E. M., & Dal Mas, F. (2021). The digital transformation of business model innovation: A structured literature review. *Frontiers in Psychology, 11*, 539363.

Vassilakopoulou, P., & Hustad, E. (2023). Bridging digital divides: A literature review and research agenda for information systems research. *Information Systems Frontiers, 25*(3), 955-969.

Venkatesh, V. (2020). Impacts of COVID-19: A research agenda to support people in their fight. *International Journal of Information Management, 55*, 102197.

Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research, 122*, 889-901.

Verina, N., & Titko, J. (2019, May). Digital transformation: Conceptual framework. In *Proceedings of the International Scientific Conference "Contemporary Issues in Business, Management and Economics Engineering* (pp. 9-10).

Viglia, G., Zaefarian, G., & Ulqinaku, A. (2021). How to design good experiments in marketing: Types, examples, and methods. *Industrial Marketing Management, 98*, 193-206.

Vimalkumar, M., Singh, J. B., & Sharma, S. K. (2021). Exploring the multi-level digital divide in mobile phone adoption: A comparison of developing nations. *Information Systems Frontiers, 23*, 1057-1076.

Voipio, V., Vilko, J., Elfvengren, K., & Korpela, J. (2023). The future of work: Skills and knowledge perspective on service automation in the foodservice industry. *Technology Analysis & Strategic Management*, 1-15. https://doi.org/10.1080/09537325.2023.xxxxxx [Add DOI if available]

Volberda, H. W., Khanagha, S., Baden-Fuller, C., Mihalache, O. R., & Birkinshaw, J. (2021). Strategizing in a digital world: Overcoming cognitive barriers, reconfiguring routines and introducing new organizational forms. *Long Range Planning, 54*(5), 102110.

Walsh, P. P., Murphy, E., & Horan, D. (2020). The role of science, technology and innovation in the UN 2030 agenda. *Technological Forecasting and Social Change, 154*, 119957.

Wang, B., Liu, Y., Qian, J., & Parker, S. K. (2021). Achieving effective remote working during the COVID-19 pandemic: A work design perspective. *Applied Psychology, 70*(1), 16-59.

Wang, S., & Zhang, H. (2025). Digital transformation and innovation performance in small-and medium-sized enterprises: A systems perspective on the interplay of digital adoption, digital drive, and digital Culture. *Systems*, *13*(1), 43.

Warf, B. (2019). Teaching digital divides. *Journal of Geography, 118*(2), 77-87.

Webler, T., & Tuler, S. (2020). Unpacking the idea of democratic community consent-based siting for energy infrastructure. *Journal of Risk Research, 24*(1), 94-109.

Westerlund, M. (2020). Digitalization, internationalization and scaling of online SMEs. *Technology Innovation Management Review, 10*(4), 48-57.

Weyant, E. (2022). *Research design: Qualitative, quantitative, and mixed methods approaches* (J. W. Creswell & J. D. Creswell, Eds.). SAGE.

Wilson, C., & Mergel, I. (2022). Overcoming barriers to digital government: Mapping the strategies of digital champions. *Government Information Quarterly, 39*(2), 101681.

Wolf, E. J., Harrington, K. M., Clark, S. L., & Miller, M. W. (2013). Sample size requirements for structural equation models: An evaluation of power, bias, and solution propriety. *Educational and psychological measurement*, *73*(6), 913-934.

World Trade Organization (WTO). (2023). Global trade growth and the role of digital solutions. *WTO Trade Policy Review, 29*(1), 1-16.

Wulf, J., Mettler, T., & Brenner, W. (2017). Using a digital services capability model to assess readiness for the digital consumer. *MIS Quarterly Executive, 16*(3), 171-195.

Yaslioglu, M., & Yaslioglu, D. T. (2020). How and when to use which fit indices? A practical and critical review of the methodology. *Istanbul Management Journal*, (88), 1-20.

Yau, K. L. A., Peng, S., Qadir, J., Low, Y. C., & Ling, M. H. (2020). Towards smart port infrastructures: Enhancing port activities using information and communications technology. *IEEE Access, 8*, 83387-83404.

Ye, K., & Ramadhani, S. T. (2020). A prioritization model of strategies for small and medium firms in less-developed countries: A Tanzania case. *Advances in Civil Engineering, 2020*, Article ID 123456. [Add article ID or DOI if available]

Yi, J., Yuan, Q., Sun, R., & Bai, H. (2022). Path planning of a manipulator based on an improved P_RRT* algorithm. *Complex & Intelligent Systems, 8*(3), 2227-2245.

Yue, H. (2022). Research on e-commerce data standard system in the era of digital economy from the perspective of organizational psychology. *Frontiers in Psychology, 13*, 900698.

Zaki, M. (2019). Digital transformation: Harnessing digital technologies for the next generation of services. *The Journal of Services Marketing, 33*(4), 429-435.

Zeng, T., Deschenes, J., & Durif, F. (2020). Eco-design packaging: An epistemological analysis and transformative research agenda. *Journal of Cleaner Production, 276*, 123361.

Zhang, X., Xu, Y., & Ma, L. (2022). Research on successful factors and influencing mechanism of the digital transformation in SMEs. *Sustainability, 14*(5), 2549.

Zhao, L., Cao, C., Li, Y., & Li, Y. (2021). Determinants of the digital outcome divide in e-learning between rural and urban students: Empirical evidence from the COVID-19 pandemic based on capital theory. *Computers in Human Behavior, 130*, 107177.

Zoppelletto, A., Orlandi, L. B., Zardini, A., Rossignoli, C., & Kraus, S. (2023). Organizational roles in the context of digital transformation: A micro-level perspective. *Journal of Business Research, 157*, 113563.

APPENDICES

Appendix A: UREC APPROVAL

UREC Decision, Version 2.0

Unicaf University Research Ethics Committee Decision

Student's Name: Bosco Haule

Student's ID #: R1901D7408673

Supervisor's Name: Dr Pantea Foroudi

Program of Study: UU-DBA-900-3-ZM

Offer ID /Group ID: O45415G46909

Dissertation Stage: DS3

Research Project Title:

Opportunities of Digital Transformation in International Trade: A study of Import and Export Activities in Tanzania

Comments: No comments.

Decision*: A. Approved without revision or comments

Date: 25 Mar 2023

*Provisional approval provided at the Dissertation Stage 1, whereas the final approval is provided at the Dissertation stage 3. The student is allowed to proceed to data collection following the final approval.

Appendix B: COSTECH PERMIT

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

TANZANIA COMMISSION FOR SCIENCE AND TECHNOLOGY

RESEARCH PERMIT

Permit Number:	**CST00000055-2023-2024-00048**
Date issued:	**04/01/2024**
Researcher Name:	**BOSCO JOSEPH NYAMPANGULA HAULE**
Nationality:	**TANZANIA, UNITED REPUBLIC OF**
Research Title:	**OPPORTUNITIES OF DIGITAL TRANSFORMATION IN INTERNATIONAL TRADE: A STUDY OF IMPORT AND EXPORT ACTIVITIES IN TANZANIA**
Research Areas:	**Dar es Salaam,Dodoma,Tanga**
Validity:	**From 04/01/2024 to 03/01/2025**

Director Research Coordination and Promotion

Director General

DOI: 945C D2BD

Appendix B (i): COSTECH PERMIT – RESEARCH CLEARANCE

TANZANIA COMMISSION FOR SCIENCE AND TECHNOLOGY

RESEARCH CLEARANCE RECEIPT

Receipt Number:	
Received from:	**BOSCO HAULE**
SPCode:	**SP178**
Paid Amount:	**50.00**
Paid Amount in words:	**Fifty USD Only.**
OutStanding Balance:	**0.0**

In respect of the following bill items (1):

1. Research Clearance Application Fee	50.00
Total Billed Amount	**50.00**

Bill Reference:	**RIMS20230811-1691767101**
Payment Control Number:	991780021788
Payment Date:	01-01-0001
Issued By:	Costech
Date Issued:	11-08-2023

Appendix C: INFORMED CONSENT

UNICAF UNIVERSITY

UU_IC - Version 2.1

Informed Consent Form

Part 2: Certificate of Consent

This section is mandatory and should to be signed by the participant(s)

Student's Name: Bosco Joseph Haule

Student's E-mail Address: bjhaule@gmail.com

Student ID #: A1901D7408673

Supervisor's Name: Dt. Pantea Faroudi

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: DBA Doctorate of Business Administration

Research Project Title: Opportunities of Digital Transformation in International Trade: A study of Import and Export Activities in Tanzania

I have read the foregoing information about this study, or it has been read to me. I have had the opportunity to ask questions and discuss about it. I have received satisfactory answers to all my questions and I have received enough information about this study. I understand that I am free to withdraw from this study at any time without giving a reason for withdrawing and without negative consequences. I consent to the use of multimedia (e.g. audio recordings, video recordings) for the purposes of my participation to this study. I understand that my data will remain anonymous and confidential, unless stated otherwise. I consent voluntarily to be a participant in this study.

Participant's Print name:

Participant's Signature: ______________________

Date:

If the Participant is illiterate:

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had an opportunity to ask questions. I confirm that the aforementioned individual has given consent freely.

Witness's Print name:

Witness's Signature: ______________________

Date:

Appendix D: GATEKEEPER LETTER

UNICAF UNIVERSITY

UU_GL - Version 2.0

Gatekeeper letter

Address: Tanzania Ports Authority, P.O.Box 9184

Date: 03.03.2023

Subject: Permission to Conduct Research

Dear Sir / Madam,

I am a doctoral student at Unicaf University Zambia.

As part of my degree I am carrying out a study on Opportunities of Digital Transformation in International Trade: A Study of Import and Export Activities in Tanzania.

I am writing to enquire whether you would be interested support in this research by providing me with the required permission to recruit participants (randomly selected staffs and port stakeholders).

Subject to approval by Unicaf Research Ethics Committee (UREC) this study will be using online questionnares and interviews as data collection tools

This research combines the concept of 'digitalization' and 'international trade' within ICT and the business disciplines respectively. The research is expected to:
a) Provide insights of digital transformation readiness;
b) Enlighten the need for digital innovations;
c) Reveal the importance of leadership commitment;
d) Advocate digital skills and knowledge;
e) Show the value of digital infrastructure;
f) Awaken decision makers to consider enabling regulatory environment.
Therefore, the study is important to transform port operations, improve economy as well as increasing the level of competitiveness and efficiency in the import/export activities.

Your support is required to provide me port entry access, permission to meet yourstaff who will be anonymously selected and allow them to take few minutes to provide honest information as they will be guided by the data collection tools.

Thank you in advance for your time and for your consideration on this project. Please let me know if you require any further information or clarification.

Yours Sincerely,

Bosco Haule

Student's Name: Bosco Joseph Haule
Student's E-mail: bjhaule@gmail.com
Student's Address and Telephone: +255 784 997722
Supervisor's Title and Name: Dr. Pantea Foroudi
Supervisor's Position: Senior Lecturer
Supervisor's E-mail: p.foroudi@unicaf.org

Appendix E: RESEARCH ETHICS APPLICATION FORM (REAF)

REAF_DS - Version 3.1

UNICAF UNIVERSITY RESEARCH ETHICS APPLICATION FORM DOCTORAL STUDIES	UREC USE ONLY: Application No: Date Received:

Student's Name: Bosco Joseph Haule

Student's E-mail Address: bjhaule@gmail.com

Student's ID #: A1901D7408673

Supervisor's Name: Dr Pantea Faroudi

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: DBA Doctorate of Business Administration

Research Project Title: Opportunities of Digital Transformation in International Trade: A Study of Import and Export Activities at Dar es Salaam port in Tanzania

1. **Please state the timelines involved in the proposed research project:**

Estimated Start Date: 01.06.2023 Estimated End Date: 31.12.2025

2. **External Research Funding (if applicable):**

2.a. Do you have any external funding for your research?

☐ YES ☑ NO

If YES, please answer questions **2b** and **2c**.

2.b. List any external (third party) sources of funding you plan to utilise for your project. You need to include full details on the source of funds (e.g. state, private or individual sponsor), any prior / existing or future relationships between the funding body / sponsor and any of the principal investigator(s) or co-investigator(s) or student researcher(s), status and timeline of the application and any conditions attached.

2.c. If there are any perceived ethical issues or potential conflicts of interest arising from applying or and receiving external funding for the proposed research then these need to be fully disclosed below and also further elaborated on, in the relevant sections on ethical considerations later on in this form.

3. **The research project**

3.a. Project Summary:

In this section fully describe the purpose and underlying rationale for the proposed research project. Ensure that you pose the research questions to be examined, state the hypotheses, and discuss the expected results of your research and their potential.

It is important in your description to use plain language so it can be understood by all members of the UREC, especially those who are not necessarily experts in the particular discipline. To that effect ensure that you fully explain / define any technical terms or discipline-specific terminology (use the space provided in the box).

The rationale of this research is to:

a) Acknowledge the benefits brought by digitalization to international trade (bridges the digital divide gaps)

b) Seize opportunities of digital transformation in international trade

c) Check the extend of applicability of digital transformation in Tanzania's context to capitalize on opportunities of achieving competitiveness in import/export activities.

With development in digital technology; developed countries are enjoying digital harmony and digital accretion while developing countries (like Tanzania) are suffering from digital inequality and digital divide. To address the problem, this research on opportunities of digital transformation in international trade intends to explore details using below reserach questions:

1.To what extent digital transformation (DT) create international trade opportunities (ITO) at Dar es Salaam port in Tanzania?

2. To what extent does the moderation role of competition (COM) and efficiency (EFF) in digital transformation (DT) create international trade opportunities (ITO) to facilitate global competitiveness (GLC) and efficiency in the import/export activities (EIM)?

3. To what extent does the transformative (DT) influence of digital infrastructure (DI) have on creating international trade opportunities (ITO)?

4. To what extent does regulatory frameworks (RF) influence digital transformation (DT) in creating international trade opportunities (ITO)?

5. To what extent do digitally enabled port activities (DT/ITO) influence global competitiveness (GLC)?

6. To what extent digitalization (DT/ITO) of Dar es Salaam port operations influences efficiency in import/export activities (EIM)?

Through digital transformation in international trade; this research is expected to improve the level of competitiveness and efficiency in the import/export activities at Dar es Salaam port in Tanzania

UNICAF UNIVERSITY

REAF_DS - Version 3.1

3.b. Significance of the Proposed Research Study and Potential Benefits:

Outline the potential significance and/or benefits of the research (use the space provided in the box).

With globalization, the world's marketing and sales of products/services are increasingly being digitalized. More studies are required to continuously improve existing practices and/or policies.

The findings of this study will be useful for:
a) Policy makers: to review existing policies and adopt supportive regulations
b) Government: create and managed improved digital infrastructures
c) The business community: exploit opportunities of digital transformation
d) Tax authorities: Increase tax base and revenue generation
e) Education: Add new knowledge of digital transformation.

Furthermore, with Covid-19 pandemic where movements of people were restricted or limited; countries applied lock-down strategies and movements were restricted even within the same country/city. For business survival, digital transformation has become a requirement where the adverse effects of the pandemic has been reduced. In addition, digital transformation has brought more potential for businesses to generate more revenue and increase customer base with minimum additional costs. This research is important for Tanzania, where digital technology is still at infancy stage and the contribution to the country's digital economy is limited to telecoms.

4. **<u>Project execution:</u>**

4.a. The following study is an:

- [x] experimental study (primary research)
- [ ] desktop study (secondary research)
- [ ] desktop study using existing databases involving information of human/animal subjects
- [ ] Other

If you have chosen 'Other' please Explain:

4.b. Methods. The following study will involve the use of:

Method	**Materials / Tools**
Qualitative:	☑ Face to Face Interviews ☐ Phone Interviews ☐ Face to Face Focus Groups ☐ Online Focus Groups ☐ Other *
Quantitative:	☐ Face to Face Questionnaires ☑ Online Questionnaires ☐ Experiments ☐ Tests ☐ Other *

*If you have chosen 'Other' please Explain:

The research will adopt the Mixed Method approach. Interviews will be used to collect qualitative data while quantitative data will be collected using online questionnaires.

5. **Participants:**

5 a. Does the Project involve the recruitment and participation of additional persons other than the researcher(s) themselves?

☑ YES **If YES, please complete all following sections.**

☐ NO **If NO, please directly proceed to Question 7.**

5 b. Relevant Details of the Participants of the Proposed Research

State the number of participants you plan to recruit, and explain in the box below how the total number was calculated.

Number of participants: 318

Using Slovin Formulae where N=1,540; e=5%, $n_0 = N/(1+Ne^2)$

$n = N/(1+Ne^2) = 1{,}540 / (1+1{,}540 \times 0.052)$

$n = 318$

Describe important characteristics such as: demographics (e.g. age, gender, location, affiliation, level of fitness, intellectual ability etc). It is also important that you specify any inclusion and exclusion criteria that will be applied (e.g. eligibility criteria for participants).

Age range From 18 To 80

Gender

- [x] Female
- [x] Male

Eligibility Criteria:

- Inclusion criteria

  Participants are from Tanzania with age below 80 years and with 2 or more years of experience
  - Importers / Exporters
  - Customs Agents
  - Other Stakeholders

- Exclusion criteria
  - Minors
  - Individuals with more than 80 years
  - Individuals with less than 2 years of experience

Disabilities: Individuals who have a mental disability and are not in a position to provide their own consent will not participate in the study

Other relevant information (use the space provided in the box):

REAF_DS - Version 3.1

5 c. Participation & Research setting:

Clearly describe which group of participants is completing/participating in the material(s)/ tool(s) described in 5b above (use the space provided in the box).

- Questionnaires will be disseminated online to Customs Agents, Importers and Exporters.
- Interviews were conducted to Other Stakeholders.

5 d. Recruitment Process for Human Research Participants:

Clearly describe how the potential participants will be identified, approached and recruited (use the space provided in the box).

Gatekeeper forms will be used to obtain approval for the study from government authorities as well as getting the approval to interview government officials. Gatekeeper's will also be used to acquire the email addresses of customs agents, importers/exporters to whom the research questionnaires will be distributed.

Participants will be contacted via e-mail (questionnaire respondents) and by approaching them physically (interview respondents)

5 e. Research Participants Informed Consent.

Select below which categories of participants will participate in the study. Complete the relevant Informed Consent form and submit it along with the REAF form.

Yes	No	Categories of participants	Form to be completed
☑	☐	Typically Developing population(s) above the maturity age *	Informed Consent Form
☐	☑	Typically Developing population(s) under the maturity age *	Guardian Informed Consent Form

* Maturity age is defined by national regulations in laws of the country in which the research is being conducted.

5 f. Relationship between the principal investigator and participants.

Is there any relationship between the principal investigator (student), co-investigators(s), (supervisor) and participant(s)? For example, if you are conducting research in a school environment on students in your classroom (e.g. instructor-student).

☐ YES ☑ NO

If YES, specify (use the space provided in the box).

6. <u>Potential Risks of the Proposed Research Study.</u>

6 a. i. Are there any potential risks, psychological harm and/or ethical issues associated with the proposed research study, other than risks pertaining to everyday life events (such as the risk of an accident when travelling to a remote location for data collection)?

☐ YES ☑ NO

If YES, specify below and answer the question 6 a.ii.

6 a.ii Provide information on what measures will be taken in order to exclude or minimise risks described in 6.a.i.

6 b. Choose the appropriate option

		Yes	No
i.	Will you obtain written informed consent form from all participants?	☑	☐
ii.	Does the research involve as participants, people whose ability to give free and informed consent is in question?	☐	☑
iii.	Does this research involve participants who are children under maturity age? **If you answered YES to question iii, complete all following questions. If you answered NO to question iii, do not answer Questions iv, v, vi and proceed to Questions vii, viii, ix and x.**	☐	☑
iv.	Will the research tools be implemented in a professional educational setting in the presence of other adults (i.e. classroom in the presence of a teacher)?	☐	☑
v.	Will informed consent be obtained from the legal guardians (i.e. parents) of children?	☐	☑
vi.	Will verbal assent be obtained from children?	☐	☑
vii.	Will all data be treated as confidential? If NO, explain why confidentiality of the collected data is not appropriate for this proposed research project, providing details of how all participants will be informed of the fact that any data which they will provide will not be confidential.	☑	☐
viii.	Will all participants /data collected be anonymous? If NO, explain why and describe the procedures to be used to ensure the anonymity of participants and/or confidentiality of the collected data both during the conduct of the research and in the subsequent release of its findings.	☑	☐

UNICAF UNIVERSITY

REAF_DS - Version 3.1

		Yes	No
ix.	Have you ensured that personal data and research data collected from participants will be securely stored for five years?	✔	☐
x.	Does this research involve the deception of participants? If YES, describe the nature and extent of the deception involved. Explain how and when the deception will be revealed, and who will administer this debrief to the participants:	☐	✔

6 c. i. Are there any other ethical issues associated with the proposed research study that are not already adequately covered in the preceding sections?

☐ Yes ☑ No

If YES, specify (maximum 150 words).

6.c.ii Provide information on what measures will be taken in order to exclude or minimise ethical issues described in 6.c.i.

6 d. Indicate the Risk Rating.

☐ High ☑ Low

7. **Further Approvals**

Are there any other approvals required (in addition to ethics clearance from UREC) in order to carry out the proposed research study?

☑ YES ☐ NO

If YES, specify (maximum 100 words).

8. **Application Checklist**

Mark √ if the study involves any of the following:

☐ Children and young people under 18 years of age, vulnerable population such as children with special educational needs (SEN), racial or ethnic minorities, socioeconomically disadvantaged, pregnant women, elderly, malnourished people, and ill people.

☐ Research that foresees risks and disadvantages that would affect any participant of the study such as anxiety, stress, pain or physical discomfort, harm risk (which is more than is expected from everyday life) or any other act that participants might believe is detrimental to their wellbeing and / or has the potential to / will infringe on their human rights / fundamental rights.

☐ Risk to the well-being and personal safety of the researcher.

☐ Administration of any substance (food / drink / chemicals / pharmaceuticals / supplements / chemical agent or vaccines or other substances (including vitamins or food substances) to human participants.

☐ Results that may have an adverse impact on the natural or built environment.

9. **Further documents**

Check that the following documents are attached to your application:

		ATTACHED	NOT APPLICABLE
1	Recruitment advertisement (if any)	☐	☑
2	Informed Consent Form / Guardian Informed Consent Form	☑	☐
3	Research Tool(s)	☑	☐
4	Gatekeeper Letter	☑	☐
5	Any other approvals required in order to carry out the proposed research study, e.g., institutional permission (e.g. school principal or company director) or approval from a local ethics or professional regulatory body.	☐	☑

REAF_DS - Version 3.1

UNICAF UNIVERSITY

10. Final Declaration by Applicants:

(a) I declare that this application is submitted on the basis that the information it contains is confidential and will only be used by Unicaf University for the explicit purpose of ethical review and monitoring of the conduct of the research proposed project as described in the preceding pages.

(b) I understand that this information will not be used for any other purpose without my prior consent, excluding use intended to satisfy reporting requirements to relevant regulatory bodies.

(c) The information in this form, together with any accompanying information, is complete and correct to the best of my knowledge and belief and I take full responsibility for it.

(d) I undertake to abide by the highest possible international ethical standards governing the Code of Practice for Research Involving Human Participants, as published by the UN WHO Research Ethics Review Committee (ERC) on http://www.who.int/ethics/research/en/ and to which Unicaf University aspires to.

(e) In addition to respect any and all relevant professional bodies' codes of conduct and/or ethical guidelines, where applicable, while in pursuit of this research project.

☑ **I agree with all points listed under Question 10**

Student's Name: Bosco Joseph Haule

Supervisor's Name: Dr. Pantea Foroudi

Date of Application: 03.03.2023

Important Note:
Save your completed form (we suggest you also print a copy for your records) and then submit it to your UU Dissertation/project supervisor (tutor). **In the case of student projects, the responsibility lies with the Faculty Dissertation/Project Supervisor.** If this is a student application, then it should be submitted via the relevant link in the VLE. Please submit only electronically filled in copies; **do not** hand fill and submit scanned paper copies of this application.

Appendix F: QUESTIONNAIRE

The survey will take approximately 15 minutes to complete.

Dear Respondent,

I **Bosco J. Haule**, a PhD candidate at the **UNICAF** currently conducting research TITLED **"Opportunities of Digital Transformation in International Trade: A Study of Import and Export Activities at Dar es Salaam Port in Tanzania".** Globally, over 80% of the cargo is transported by sea, and the focal point of the study 'Dar es Salaam port', accounts for over 90% of Tanzania's international trade, thus acting as the main gateway for six hinterland countries for import and export activities. With due respect, I would like to thank you in advance for being selected anonymously to participate in this study. I request your time to read, sign and send back the concert form shared together with this questionnaire. This research is for academic purpose; your response will be treated with anonymity and confidentiality.

1. E-mail: ____

Research Project Title: Opportunities of Digital Transformation in International Trade: A study of Import and Export Activities at Dar es Salaam Port in Tanzania

Informed Consent Form

I have read the foregoing information about this study, or it has been read to me. I have had the opportunity to ask questions and discuss about it. I have received satisfactory answers to all my questions, and I have received enough information about this study. I understand that I am free to withdraw from this study at any time without giving a reason for withdrawing and without negative consequences. I consent to the use of multimedia (e.g. audio recordings, video recordings) for the purposes of my participation to this study. I understand that my data will remain anonymous and confidential, unless stated otherwise.

2. Consent Approval (Name): ____________________________

SECTION A: Background Information

10. Sex: ☐ Female ☐ Male ☐ Not willing to disclose

11. Age (in years): ___________

12. Please select your ethnic group:

☐ Black ☐ Indian ☐ Arabic ☐ Chinese ☐ European

☐ Other: ______________________

13. Please select your country of business

☐ Tanzania ☐ Uganda ☐ Rwanda ☐ Burundi ☐ Malawi

☐ Zambia ☐ South Sudan ☐ Kenya ☐ Other: _____________

14. Please select your country of business

☐ Arusha ☐ Dar es Salaam ☐ Dodoma ☐ Geita ☐ Kagera

☐ Katavi ☐ Kigoma ☐ Kilimanjaro ☐ Lindi ☐ Manyara

☐ Mara ☐ Mbeya ☐ Morogoro ☐ Morogoro ☐ Mtwara

☐ Mwanza ☐ Njombe ☐ Pemba North ☐ Pemba South ☐ Pwani

☐ Rukwa ☐ Ruvuma ☐ Shinyanga ☐ Simiyu ☐ Singida

☐ Songwe ☐ Tabora ☐ Tanga ☐ Unguja North ☐ Unguja South

☐ Other (please specify): _____________________

15. Marital Status: ☐ Never Married ☐ Married ☐ Divorced ☐ Widowed

16. Indicate your role with regard to import and export activities:

☐ Importer ☐ Exporter ☐ Importer/Exporter (ImpEx)

☐ Clearing and Forwarding Agent (CFA)

17. For how long have you been working in the activity? ______________________________

18. In performing your daily activities, you apply [Multiple answers]:

☐ Excel Documents ☐ Manual Files ☐ Standalone Application ☐ Integrated Application

SECTION B: Digital Transformation in International Trade

10. Successful digital transformation strategies create opportunities for enjoying digital harmony and digital accretion in international trade.

Select One Option	Agree [3]	Disagree [1]	Neutral [2]
	☐	☐	☐

11. Indicate the likelihood of each of the following strategies in seizing opportunities while improving competitiveness and efficiency in import/export activities in Tanzania.

Strategy	Probably [3]	Not Likely [1]	Neutral [2]
Digital Transformation readiness	☐	☐	☐
Digital Transformation innovations	☐	☐	☐
Digital Transformation leadership	☐	☐	☐
Digital Transformation knowledge and skills	☐	☐	☐

12. Indicate your level of agreement with the following statements:

Statement	Disagree [1]	Agree [3]	Neutral [1]
DT is inevitable for enjoying digital harmony and digital accretion	☐	☐	☐
International trade competitiveness and efficiency are driven by DT in import/export activities	☐	☐	☐
Digital Transformation improves performance in International Trade	☐	☐	☐
Digital Transformation improves service quality in International Trade	☐	☐	☐
Digital Transformation improves communication in International Trade	☐	☐	☐
Digital Transformation enhances customer experience in International Trade	☐	☐	☐
Privatization of DSM port operations can improve DT and generate more ITO	☐	☐	☐

SECTION C: Digital infrastructure

13. Does digital infrastructure influence digital transformation in international trade?

☐ Yes ☐ No

14. In a scale of 1 to 3 where 3 is Highest Extent and 1 is Least Extent; rank the extent to which DI are likely to improve performance in international trade.

Select One Option	1 (Least Extent)	2 (Moderate Extent)	3 (Highest Extent)
	☐	☐	☐

15. To what extent are the below statements expected to influence DT in international trade?

Statement	Least Extent [1]	Moderate Extent [2]	Highest Extent [3]
Internet connectivity (e.g., hotspots, broadband, cloud, etc.)	☐	☐	☐
Connectivity technology (e.g., 4G, 5G, etc.)	☐	☐	☐
Communication channels (e.g., sms, e-mails, voice calls, etc.)	☐	☐	☐
Digital platforms (e.g., social media, Uber, You Tube, etc.)	☐	☐	☐

16. Choose your agreement / disagreement to the below statements, in relation to opportunities of DT in international trade:

Statement	Disagree [1]	Agree [3]	Neutral [2]
Internet connectivity is required to enable DT in international trade	☐	☐	☐
Connectivity technology increases/decreases the speed of DT	☐	☐	☐
DT in international trade is facilitated by communication channels	☐	☐	☐
Digital platforms increase competitiveness and efficiency in international trade	☐	☐	☐
Weak DI results in suffering from digital inequality and digital divide	☐	☐	☐
Privatization of DSM port operations can result into improved DI	☐	☐	☐

SECTION D: Regulatory Framework

17. Does the regulatory framework influence digital transformation? ☐ Yes ☐ No

18. In a scale of 1 to 3 where 3 is Highest Extent and 1 is Least Extent; rank the extent to which RF is likely to affect efficiency and competitiveness in international trade.

Select One Option	1 (Least Extent)	2 (Moderate Extent)	3 (Highest Extent)
	☐	☐	☐

19. To what extent are the below statements expected to accelerate DT in international trade?

Statement	Least Extent [1]	Moderate Extent [2]	Highest Extent [3]
ICT and Regulatory Policy (e.g., National ICT Policy)	☐	☐	☐
Trade Sanctions (e.g., Restriction to import/export)	☐	☐	☐
Data Flow Restrictions	☐	☐	☐
Security and Protection	☐	☐	☐

20. Choose your agreement / disagreement to the below statements, in relation to opportunities of DT in international trade:

Statement	Disagree [1]	Agree [3]	Neutral [2]
RF influence DT in international trade	☐	☐	☐
Sanctions restrict performance in international trade	☐	☐	☐
Data flow restrictions are bottlenecks to DT in international trade	☐	☐	☐
Security and protection are required to mitigate risks associated with DT	☐	☐	☐
RF provides competitiveness and efficiency in international trade	☐	☐	☐
Privatization of DSM port operations can improve RF, efficiency and competitiveness.	☐	☐	☐

21. What suggestion do you offer for improving DT in facilitating international trade (Import and Export) activities in Tanzania? ____

Thank you for your time.

Appendix G: KEY INFOMANTS' INTERVIEW GUIDE

The survey will take approximately 15 minutes to complete.

Dear Respondent,

I **Bosco J. Haule**, a PhD candidate at the **UNICAF** currently conducting research TITLED **"Opportunities of Digital Transformation in International Trade: A Study of Import and Export Activities at Dar es Salaam Port in Tanzania".** Globally, over 80% of the cargo is transported by sea, and the focal point of the study 'Dar es Salaam port', accounts for over 90% of Tanzania's international trade, thus acting as the main gateway for six hinterland countries for import and export activities. With due respect, I would like to thank you in advance for being selected to participate in this study. I request your time to read, sign and send back the concert form shared together before commencing the interview. This research is for academic purposes; your response will be treated with anonymity and confidentiality.

SECTION A: Background Information

1. Explain your role, with regard to import and export activities? (Probe on import, export, customs agent and other activities): ____
2. For how many years have you been working in the role above? ________________
3. In your daily operations do you use any ICT tools such as a computer and any software to accomplish your practical tasks? Give examples of such tools: _________________________

   ____
4. What are the performance benefits of using such ICT tools compared to manual systems?

   ____

   ____

SECTION B: Digital Transformation in International Trade

5. How does the successful digital transformation strategies create opportunities for enjoying digital harmony in international trade? Probe on: *Online trading, improve efficiency and competitiveness, improve communications, cost reduction, improve quality of service, achieve excellence in execution, trade facilitation:* ____

   ____

6. What is the likelihood of the following strategies in seizing opportunities while improving competitiveness and efficiency in import/export activities in Tanzania?
   i. Digital Transformation readiness: ____
   ii. Digital Transformation innovations: ____
   iii. Digital Transformation leadership: ____
   iv. Digital Transformation knowledge and skills: __________________________________

SECTION C: Digital infrastructure

7. Explain the role of digital infrastructure in driving digital transformation in international trade? (*Probe for*: *Internet connectivity (e.g., hotspots, broadband, cloud, etc.), Connectivity technology (e.g., 4G, 5G, etc.), Communication channels (e.g., sms, e-mails, voice calls, etc.), Digital platforms (e.g., social media, Uber, You Tube, etc.)):*

   ____

   ____

   ____

   ____

8. In your view how does digital transformation improve performance in International Trade? *(Probe for*: *increased trade flows, cost reduction, quality improvement, improved Security and protection, risks reductions, increased competitiveness and efficiency):*

   ____

   ____

   ____

SECTION D: Regulatory Framework

9. How does regulatory framework influence digital transformation in international trade? *Probe: ICT and Regulatory Policy (e.g., National ICT Policy), Trade Sanctions (e.g., Restriction to import/export), Data Flow Restrictions, Security and Protection)*

   ____

   ____

   ____

10. How is regulatory framework likely to affect efficiency and competitiveness in international trade? Please explain.

____

____

____

____

____

11. Do you agree that privatization of Dar es Salaam port operations can improve digital transformation, efficiency and competitiveness? ☐ Yes | ☐ No

    If "Yes", explain why? ____

    ____

    ____

    ____

    If "No", explain why? ____

    ____

    ____

    ____

12. What suggestion(s) do you offer for improving Digital Transformation in performing the import and export activities in Tanzania?

____

____

____

____

____

____

____

____

____

Thank you for your time

Key Informants Guide

S/N	Institution / Organization	No of KI
1	Ministry of Finance	1
2	Ministry of Transport	1
3	Ministry of Industry and Trade	1
4	Tanzania Shipping Agencies Corporation (TASAC)	1
5	Tanzania Revenue Authority (TRA)	1
6	Tanzania Ports Authority (TPA)	1
7	Tanzania Bureau of Standards (TBS)	1
8	Government Chemist Laboratory Authority (GCLA)	1
9	Tanzania Atomic Energy Commission (TAEC)	1
10	Tanzania Medicines and Medical Devices Authority (TMDA)	1
11	e-Government Authority (e-GA)	1
12	Confederation of Tanzania Industries (CTI)	1
13	Tanzania Chamber of Commerce, Industry and Agriculture (TCCIA)	1
14	Tanzania Private Sector Foundation (TPSF)	1
15	Tanzania Freight Forwarders Association (TAFFA)	1