IN THIS JOURNAL

Great Britain Journals Press

journalspress.com

London Journal of Research in Management & Business

Volume 25 | Issue 4 | Compilation 1.0

COMPILED IN UNITED KINGDOM

ENGLISH

London Journal of Research in Management and Business

Volume 25 | Issue 4 | Compilation 1.0

PUBLISHER

Great Britain Journals Press
1210th, Waterside Dr, Opposite Arlington Building, Theale, Reading
Phone:+444 0118 965 4033 Pin: RG7-4TY United Kingdom

SUBSCRIPTION

Frequency: Quarterly

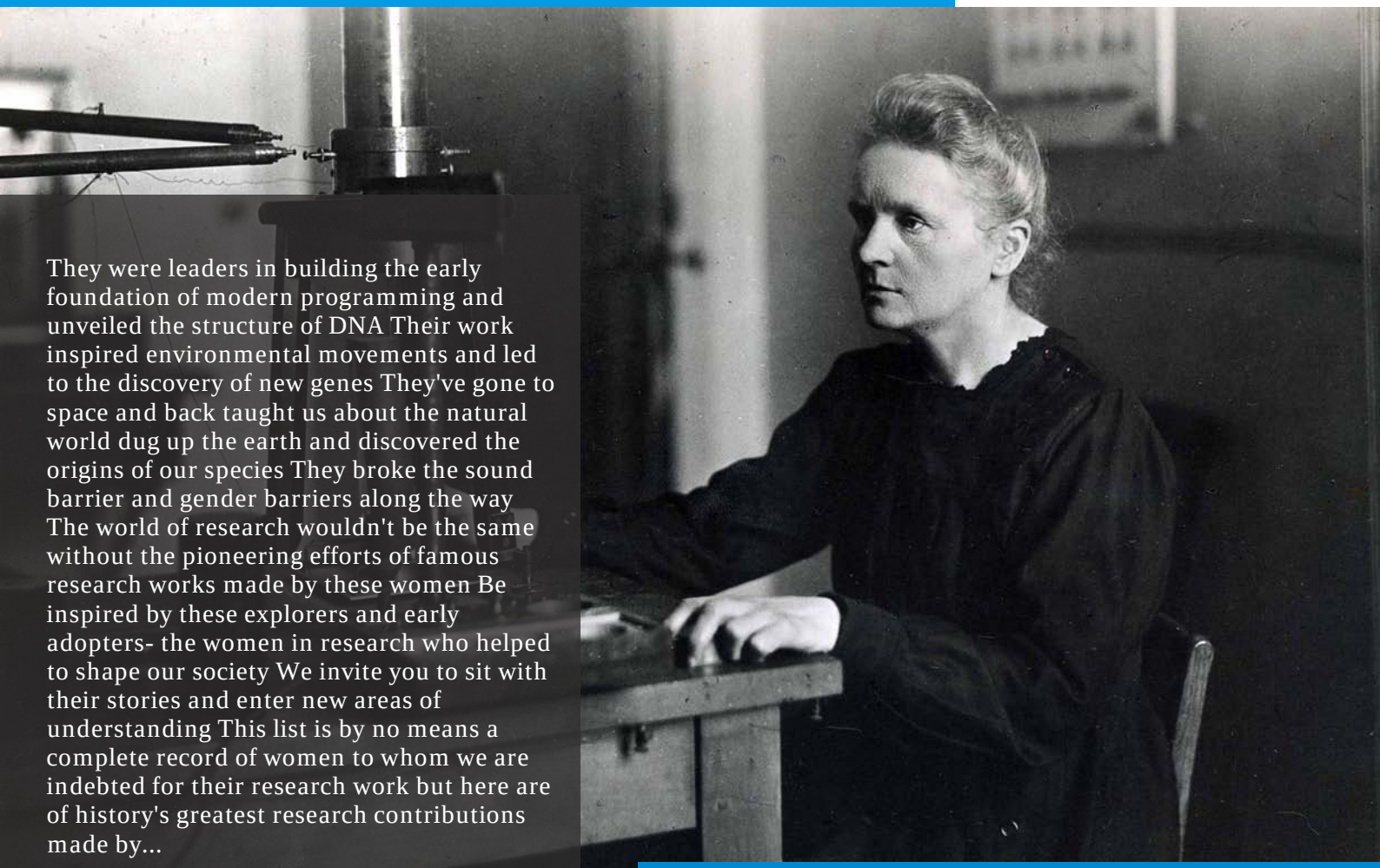
Print subscription
$280USD for 1 year
$500USD for 2 year
(*color copies including taxes and international shipping with TSA approved)*
Find more details at https://journalspress.com/journals/subscription

ENVIRONMENT

Great Britain Journals Press is intended about Protecting the environment. This journal is printed using led free environmental friendly ink and acid–free papers that are 100% recyclable.

Great Britain Journals Press Headquaters

1210th, Waterside Dr,
Opposite Arlington
Building, Theale, Reading
Phone:+444 0118 965 4033
Pin: RG7-4TY
United Kingdom



They were leaders in building the early foundation of modern programming and unveiled the structure of DNA Their work inspired environmental movements and led to the discovery of new genes They've gone to space and back taught us about the natural world dug up the earth and discovered the origins of our species They broke the sound barrier and gender barriers along the way The world of research wouldn't be the same without the pioneering efforts of famous research works made by these women Be inspired by these explorers and early adopters- the women in research who helped to shape our society We invite you to sit with their stories and enter new areas of understanding This list is by no means a complete record of women to whom we are indebted for their research work but here are of history's greatest research contributions made by...

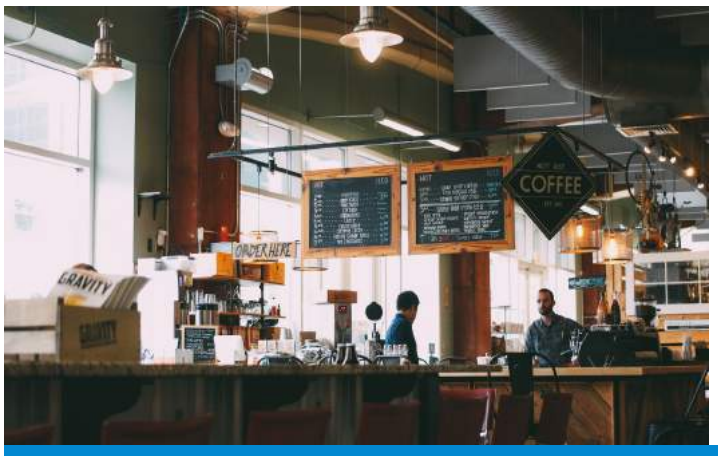
Read complete here:
https://goo.gl/1vQ3lS

Women In Research

Writing great research...

Prepare yourself before you start Before you start writing your paper or you start reading other...

Read complete here:
https://goo.gl/qKfHht



Small Businesses and its Impact

It is no Secret that money has been hard to come by these past few years but now that the economy...

Read complete here:
https://goo.gl/h4x245

Journal Content
In this Issue

Great Britain Journals Press

Editorial Board

Curated board members

Prof. Bartlomiej Kaminski

Information Technology and Management Rzeszow University Poland Ph.D., Department of Economics University of Warsaw, Poland

Dr. John D. Theodore

American Military University
JDT Management Consultants, President.
D.B.A., Business Economy
University of South Africa
Ph.D. Aristotelian University
Business Administration
Ph.D. Administration, University of Kansas, USA

Prof. Moji Moatamedi

Honorary Vice Chair
Ph.D., at The University of Sheffield,
MBA, Manchester Business School
University of Manchester
UK

Dr. Charles A. Rarick

Ph.D.
Professor of International Business
College of Business
Purdue University Northwest
Hammond, Indiana USUS

Dr. Yongbing Jiao

Ph.D. of Marketing
School of Economics & Management
Ningbo University of Technology
Zhejiang Province, P. R. China

Dr. Dodi Irawanto

Ph.D., M.Com, B.Econ Hons.
Department of Management
Faculty of Economics and Business
Brawijaya University
Malang, Indonesia

Dr. Wing-Keung Won

Ph.D., University of Wisconsin-Madison,
Department of Finance and
Big Data Research Center
Asia University,
Taiwan

Dr. Agni Aliu

Ph.D. in Public Administration,
South East European University, Tetovo, RM
Asociater profesor South East European University,
Tetovo, Macedonia

Dr. Tsutomu Harada

Professor of Industrial Economics
Ph.D., Stanford University, Doctor of Business
Administration, Kobe University

Professor Maura Sheehan

Professor, International Management
Director, International Centre
for Management & Governance Research (ICMGR)
Ph.D. in Economics, UK

Research papers and articles

Volume 25 | Issue 4 | Compilation 1.0

Effect of Green Accounting on Market Value of Listed Oil and Gas Companies in Nigeria

Satumari, Samaila Abdulaziz, Dr. Okonkwo, Okechukwu PhD, Uchenna, Clems Ozegbe, Okolie, Franklin Chukwueloke & Tsekpegher, Abraham Ter

Veritas University

ABSTRACT

The oil and gas sector plays a crucial role in global economic development, yet it faces increasing scrutiny due to its environmental impact. In Nigeria, Africa's largest oil producer, the sector significantly contributes to environmental degradation, including oil spills and gas flaring. This study explores the effect of green accounting on the market value of listed oil and gas companies in Nigeria. Specifically, it aims to assess the impact of environmental expenditure disclosure (EEXD) and stakeholder engagement disclosure (SED) on the market value of these companies. The population of the study comprises nine (9) publicly listed oil and gas companies on the Nigerian Exchange Group (NGX) as of December 31, 2023. Using purposive sampling technique, five (5) companies with substantial environmental disclosures in their annual reports were selected. Data were sourced from the NGX Fact Book and the annual reports of the selected companies from 2014–2023. Descriptive statistics were employed to summarise the data characteristics, while correlation analysis examined the relationships between environmental expenditure disclosures and market value. Multivariate regression analysis was conducted to assess how EEXD and SED predict market value, with statistical analysis performed using Jamovi software (Version 2.3.28).

Keywords: environmental expenditure disclosure, stakeholder engagement disclosure, market value, market capitalisation.

Classification: For Code: 120301

Language: English

Great Britain Journals Press

LJP Copyright ID: 146441
Print ISSN: 2633-2299
Online ISSN: 2633-2302

London Journal of Research in Management & Business

Volume 25 | Issue 4 | Compilation 1.0

Effect of Green Accounting on Market Value of Listed Oil and Gas Companies in Nigeria

Satumari, Samaila Abdulaziz[α], Dr. Okonkwo, Okechukwu PhD[σ], Uchenna, Clems Ozegbe[ρ], Okolie, Franklin Chukwueloke[Ↄ] & Tsekpegher, Abraham Ter[§]

ABSTRACT

The oil and gas sector plays a crucial role in global economic development, yet it faces increasing scrutiny due to its environmental impact. In Nigeria, Africa's largest oil producer, the sector significantly contributes to environmental degradation, including oil spills and gas flaring. This study explores the effect of green accounting on the market value of listed oil and gas companies in Nigeria. Specifically, it aims to assess the impact of environmental expenditure disclosure (EEXD) and stakeholder engagement disclosure (SED) on the market value of these companies. The population of the study comprises nine (9) publicly listed oil and gas companies on the Nigerian Exchange Group (NGX) as of December 31, 2023. Using purposive sampling technique, five (5) companies with substantial environmental disclosures in their annual reports were selected. Data were sourced from the NGX Fact Book and the annual reports of the selected companies from 2014–2023. Descriptive statistics were employed to summarise the data characteristics, while correlation analysis examined the relationships between environmental expenditure disclosures and market value. Multivariate regression analysis was conducted to assess how EEXD and SED predict market value, with statistical analysis performed using Jamovi software (Version 2.3.28). The findings reveal that both Environmental Expenditure Disclosure and Stakeholder Engagement Disclosure have positive and statistically significant effects on market value. This study contributes to the growing body of literature on environmental disclosures in Nigeria's oil and gas sector, emphasising the importance of transparent disclosure practices to foster market competitiveness and stakeholder confidence.

Keywords: environmental expenditure disclosure, stakeholder engagement disclosure, market value, market capitalisation.

Author α: Veritas University, Abuja Department of Accounting.
σ: Department of Accounting, Veritas University, Abuja
ρ: Department of Accounting, Veritas University, Abuja Nigeria.
Ↄ: Department of Finance and Account, National Space Research and Development Agency, Abuja, Nigeria.
§: Department of Accounting, Joseph Sarwuan Tarka University, Nigeria.

I. INTRODUCTION

The oil and gas sector plays a pivotal role in global economic growth but remains one of the most scrutinised industries due to its significant environmental impact. Concerns over climate change, pollution, and resource depletion have intensified calls for greater corporate responsibility. In response, Environmental Accounting Disclosure (EAD) has emerged as a critical aspect of corporate reporting, particularly for industries with substantial ecological footprints. With growing global emphasis on sustainability, oil and gas firms face increasing pressure from governments, investors, and civil society to disclose their environmental performance, including expenditures on green initiatives and stakeholder engagement efforts. These disclosures are now recognised as strategic tools for mitigating risks, building stakeholder trust, and enhancing corporate market value (KPMG, 2022).

Environmental expenditure disclosure reflects a company's commitment to addressing environmental challenges by allocating resources

to mitigate its ecological impact. Similarly, stakeholder engagement disclosure demonstrates an organisation's efforts to maintain transparent and collaborative relationships with its stakeholders, including communities, investors, and regulators. Together, these disclosures play a vital role in shaping perceptions of corporate accountability and sustainability (Chopra et al., 2023).

In Nigeria, the largest oil producer in Africa, the oil and gas sector is both the backbone of the economy and a significant contributor to environmental degradation. Challenges such as oil spills, gas flaring, and deforestation are prevalent, particularly in the Niger Delta region (Akeju & Oguntimein, 2023). The weak enforcement of environmental regulations and the lack of comprehensive disclosure frameworks exacerbate these issues. Despite these challenges, environmental accounting disclosure is gradually gaining traction, driven by rising awareness of its potential benefits in enhancing corporate reputation, investor confidence, and financial performance (Igbekoyi et al., 2022).

The relationship between environmental expenditure and stakeholder engagement disclosures and firm value has been extensively debated in the literature. Studies suggest that firms engaging in robust environmental expenditure reporting and stakeholder engagement disclosuesr can improve their market value by reducing information asymmetry and enhancing investor trust (Ejoh, Orok, and Sackey, 2014; Ojiakor and E-Obodoekwe, 2018; Kujala et al., 2022). The legitimacy theory further underscores the importance of aligning corporate activities with societal expectations to maintain a competitive edge (Mousa & Hassan, 2015). However, while some research such as Arena, Bozzolan, and Michelon (2014), and Jamil and Rodiel (2020) highlight the financial benefits of environmental expenditure and stakeholder engagement disclosures, others argue that the associated costs may outweigh immediate gains (Kujala et al., 2022; Ayuba & Yunusa, 2023 and Osayabor and Izedonmi (2023). This underscores the need for further exploration of these dynamics, particularly in the context of Nigeria's oil and gas sector.

Despite the growing interest in environmental accounting disclosure, existing studies in Nigeria have primarily focused on general environmental accounting and financial performance (Adegbie et al., 2020; Gbenga & Josiah, 2020; Osayabor and Izedonmi, 2023). Limited attention has been given to the combined impact of environmental expenditure and stakeholder engagement disclosures on the market value of oil and gas companies. Studies conducted in other regions, such as Arena, Bozzolan, and Michelon (2014), Griffin et al. (2017) and Bogdan et al. (2022), provide valuable insights but lack direct applicability to the Nigerian context. Similarly, research that examined environmental accounting disclosures and market value such as Olagunju & Ajiboye (2022) excluded environmental expenditure and stakeholder engagement, focusing instead on economic value added (EVA) rather than market value. Furthermore, Oshiole, Elamah, and Amahalu (2020) and Osayabor and Izedonmi (2023) examined environmental cost disclosure with a focus on the profitability, but produced a conflicting result.

To address these gaps, this study investigates the effect of environmental expenditure and stakeholder engagement disclosures on the market value of oil and gas firms listed on the Nigerian Exchange Group (NGX). By doing so, it contributes to the understanding of how these disclosures can influence corporate value in a developing economy with unique regulatory and environmental challenges such as the Nigeria's oil and gas industry.

Research Objectives

1. Evaluate the effect of environmental expenditure disclosure on the market value of listed oil and gas companies in Nigeria.
2. Assess the effect of stakeholder engagement disclosure on the market value of listed oil and gas companies in Nigeria.

Research Hypotheses

H_{01}: Environmental expenditure disclosure does not have significant effect on the market value of listed oil and gas companies in Nigeria.
H_{02}: Stakeholder engagement disclosure does not have significant effect on market value of listed oil and gas companies in Nigeria.

The rest of the paper is structured as follows: Section 2 reviews the literature; Section 3 outlines the methodology; Section 4 presents data analysis and discusses the results; Section 5 concludes with key findings and recommendations.

II. LITERATURE REVIEW

2.1.1 Environmental Expenditure Disclosure

Environmental expenditure refers to the financial resources allocated by companies to mitigate the environmental impacts of their operations. Hansen and Mowen (2007) describe these expenditures as investments aimed at protecting the environment from operational activities. These include pollution control, resource conservation, and the adoption of eco-friendly technologies. Environmental expenditure disclosure involves the transparent reporting of such financial commitments in a company's statements, enabling stakeholders to assess its environmental accountability (Ojiakor & E-Obodoekwe, 2018). Wang et al. (2023) described environmental expenditure disclosure as reporting financial investments in initiatives like pollution control, resource conservation, and sustainability programmes. It includes expenses for waste management, renewable energy, compliance with regulations, and eco-friendly research, aiming to demonstrate a company's commitment to mitigating environmental impact and promoting sustainability (Almaqtari et al., 2023).

The practice of environmental expenditure disclosure serves multiple purposes, including enhancing corporate reputation, fostering stakeholder trust, and ensuring regulatory compliance. For instance, Pekovic, Grolleau, and Mzoughi (2018) argue that such disclosures highlight a firm's commitment to sustainability through investments in green infrastructure and environmental management systems. Similarly, Wang et al. (2023) emphasise the role of environmental expenditure disclosure in addressing stakeholder concerns about corporate environmental responsibility.

In the Nigerian context, where environmental degradation due to oil and gas activities is prevalent, environmental expenditure disclosure is crucial for demonstrating corporate accountability. It plays a pivotal role in addressing challenges such as oil spills and gas flaring (Ojiakor & E-Obodoekwe, 2018). Ibrahim, Ibrahim, and Hussain (2023) note that such disclosures can bolster investor confidence by showcasing a company's dedication to mitigating environmental risks. Companies that actively disclose environmental expenditures not only demonstrate their commitment to environmental sustainability but also enhance their corporate reputation, attract socially responsible investments, and comply with regulatory requirements (Almaqtari et al., 2023).

Drawing from these perspectives, this study defines environmental expenditure disclosure as the practice of providing comprehensive information about a company's financial commitments toward mitigating environmental impacts of its activities. This includes investments in waste management, pollution control, renewable energy, and other sustainability initiatives, as adapted from Hansen and Mowen (2007) and Ojiakor et al. (2018).

2.1.2 Stakeholder Engagement Disclosure

Stakeholder engagement is a critical aspect of corporate governance that involves interacting with individuals or groups affected by a company's operations. According to Freeman (1984), stakeholders include employees, customers, investors, and communities, among others. Stakeholder engagement disclosure refers to the transparent reporting of strategies and activities related to stakeholder interactions, particularly concerning environmental matters (Kujala et al., 2022). Stakeholder engagement disclosure involves the practices and policies

companies use to communicate and interact with stakeholders, such as local communities, regulators, investors, employees, and NGOs (Kujala et al., 2022). It entails transparent reporting on strategies, activities, and outcomes to address stakeholder concerns, foster dialogue, and incorporate feedback into decision-making (Olutimehin et al., 2024; Ardiana, 2019). While definitions vary, the consensus highlights activities aimed at understanding stakeholder concerns, exchanging information, and fostering mutually beneficial relationships.

Stakeholder engagement demonstrates a company's efforts to foster dialogue, address stakeholder concerns, and incorporate feedback into decision-making processes. Galeotti et al. (2023) highlight that stakeholder engagement enhances transparency, accountability, and inclusivity by detailing how companies engage stakeholders on sustainability initiatives. Such disclosures often include information on community outreach programmes, environmental education campaigns, and collaborative projects with non-governmental organisations (Olutimehin et al., 2024).

In the oil and gas sector, stakeholder engagement is particularly significant due to the environmental and social challenges associated with resource extraction. Ardiana (2019) argues that effective stakeholder engagement can mitigate conflicts, improve community relations, and enhance corporate reputation. In Nigeria, where oil exploration has led to environmental degradation and social unrest, SED serves as a vital tool for rebuilding trust between companies and affected communities (Dewi et al., 2023).

This study adopts the definition of SED as outlined by Galeotti et al. (2023) and Dewi et al. (2023), which emphasises the level of disclosure regarding a company's interactions with stakeholders concerning environmental issues. This includes engaging investors, regulators, and communities in discussions about environmental policies and mitigation strategies, thereby demonstrating a commitment to sustainability and inclusivity.

2.1.3 Market Value

Market value is a fundamental measure of a company's worth, reflecting investor perceptions of its future prospects. Damodaran (20002) defines market value as the price at which an asset or company can be bought or sold in a competitive marketplace. It is influenced by factors such as financial performance, growth potential, and prevailing economic conditions. Fama and French (1992) describe it as the total value of a firm's equity, calculated by multiplying the current share price by the total number of outstanding shares. According to Brealey, Myers, and Allen (2008), market value represents a company's perceived worth to investors, shaped by factors like its financial performance, growth prospects, and economic environment. Penman (2013) describes it as the price investors are willing to pay for a firm's equity in the market, reflecting their expectations of its future earnings and potential returns. Similarly, Ross et al. (2021) define market value as a firm's economic worth, determined by the balance of supply and demand in financial markets and encompassing both tangible and intangible assets. Collectively, these perspectives emphasise that market value is a dynamic measure influenced by market conditions, investor sentiment, and a firm's performance.

This study proxied market value as market capitalisation, as defined by Pavone (2019). Market capitalisation is calculated by multiplying a company's current stock price by its total number of outstanding shares. Recognised as a reliable indicator of a firm's value and financial health, it reflects investor confidence and the overall performance of the market (Gujarati, 2009). Market capitalisation is widely used in financial analysis as an indicator of a firm's valuation and stability in the marketplace (Brealey, Myers, & Allen, 2008).

2.2 Theoretical Frameworks/Models

2.2.1 Legitimacy Theory

Legitimacy theory, introduced by Dowling and Pfeffer (1975) and refined by Suchman (1995), asserts that organisations seek to align their

operations with societal norms to maintain legitimacy and ensure survival. Suchman describes legitimacy as a critical resource firms strive to acquire and sustain. In the oil and gas industry, environmental disclosures are a means to exhibit corporate social responsibility and counteract negative public perceptions. Deegan (2002) highlights the role of environmental disclosure in upholding legitimacy, arguing that firms in environmentally scrutinised industries use such practices to safeguard their standing.

For Nigerian oil and gas companies, legitimacy theory is particularly relevant due to public and regulatory concerns over environmental damage. Disclosing environmental information enables these firms to align with societal expectations and demonstrate responsibility. Deegan (2002) warns that failure to conform to societal norms can lead to reputational damage and loss of market value.

Studies by Akbaş and Canikli (2018) suggest that larger firms are more inclined to engage in environmental disclosure to preserve legitimacy. Nigerian firms are likely to follow this trend, using disclosures to protect or enhance their market value. However, the theory's applicability in Nigeria is influenced by factors such as weak regulatory enforcement and the socio-political environment, which can shape corporate behaviour and perceptions of legitimacy.

2.2.2 Stakeholder Theory

Stakeholder theory, developed by Freeman (1984), emphasises the need for organisations to address the interests of various stakeholders, including shareholders, employees, and the broader community. Transparent communication, particularly through environmental disclosures, becomes essential for maintaining trust and meeting stakeholder expectations.

In the oil and gas sector, environmental issues significantly concern stakeholders such as local communities and government bodies. Firms use environmental disclosures to build trust, demonstrate accountability, and foster stronger stakeholder relationships. Emeka-Okoli et al. (2024) argue that transparent environmental practices not only strengthen stakeholder ties but also contribute to enhanced market value.

In Nigeria, environmental disclosures are crucial for managing relationships with local communities impacted by issues like oil spills. However, weak regulatory enforcement and limited public awareness of environmental challenges may reduce the effectiveness of stakeholder theory, resulting in less pressure on companies to provide comprehensive disclosures.

2.2.3 Signalling Theory

Signalling theory, proposed by Spence (1973), explains how organisations convey information to reduce information asymmetry between themselves and external parties. Companies use environmental disclosures as signals to highlight their quality, ethical standards, and commitment to environmental stewardship (Connelly et al., 2011).

In Nigeria's oil and gas sector, robust environmental disclosures can differentiate firms from competitors and reassure investors of their efforts to manage environmental risks. Effective disclosures may attract socially responsible investors and bolster global reputations. However, inadequate regulatory enforcement may encourage "greenwashing," where firms present misleading environmental claims, undermining the credibility of such signals and reducing the theory's overall efficacy.

2:2:4 Relevance of Theories to the Study

Among these theories, Legitimacy Theory is most applicable to this research. It underscores the importance of aligning corporate practices, including environmental disclosures, with societal expectations to maintain legitimacy. In Nigeria's oil and gas sector, where environmental concerns and public scrutiny are significant, disclosures related to greenhouse gas emissions and waste management play a critical role in sustaining legitimacy. Firms can improve their reputation and market value by demonstrating environmental accountability, hence Legitimacy theory is the best framework for understanding

how environmental accounting disclosures affect market value in this industry.

2.3 Empirical Review

2:3:1 Environmental Expenditure Disclosure

Ejoh, Orok, and Sackey (2014) examined environmental accounting and disclosure practices in Nigeria's manufacturing sector. The study aimed to evaluate the extent of environmental accounting practices and the level of awareness regarding environmental costs among Nigerian manufacturing firms. The sample included three companies: UNICEM Plc, Niger Mills Nigeria Plc, and PAMOL Nigeria Ltd. The period of the study was not defined. Data were gathered using questionnaires and annual reports. Independent t-tests and ANOVA were employed to test the hypotheses. Findings revealed a negative and statistically insignificant difference between environmental cost awareness and environmental expenditures accounted for in the firms' financial reports. The study concluded that environmental expenditures should be tracked and disclosed independently to enhance transparency. However, the sample size limited the generalisability of the findings, and the study did not have a defined period neither did it consider stakeholder engagement in driving environmental disclosure practices, which could influence reporting effectiveness. Furthermore, the focus on manufacturing excluded the oil and gas sector, which is a significant part of Nigeria's economy.

Polycarp (2019) explored the relationship between environmental accounting practices and financial performance in Nigerian oil and gas companies. The study targeted oil and gas firms, using a sample of eleven (11) companies for which financial reports were available from 2015 to 2017. Secondary data were analysed using multiple regression analysis to examine the relationship between environmental expenditures, such as those for pollution control, and financial performance indicators like return on capital employed (ROCE), net profit margin (NPM), and earnings per share (EPS). The results showed a positive and significant relationship between employee health and safety compliance cost, and pollution prevention cost. This study contributes to understanding environmental disclosures' effect in the oil and gas sector. However, while the study's methodological rigor was commendable, it focused on financial performance and not market value. It also did not consider stakeholders' engagement.

Jamil and Rodiel (2020) investigated the effect of environmental accounting disclosures on financial performance in publicly traded mining and oil firms in the Philippines. The study covered the period of 2012 to 2016. The population included publicly traded firms in the mining and oil sectors, with a sample of 24 firms selected for the study. Panel regression analysis was used, incorporating both time-series and cross-sectional data. Findings revealed that environmental accounting disclosures had a negative and statistically insignificant impact on business value. The study suggested that factors such as location and firm characteristics played a crucial role in determining the financial impact of environmental practices. However, the study's focus on return on equity and the Philippine context limited its generalisability to other regions like Nigeria and their market value.

Amahalu (2020) investigated the effect of environmental cost disclosure on profitability in listed oil and gas firms in Nigeria between 2010 and 2019. The study focused on environmental disclosures related to waste management, employee health and safety, and remediation costs, analysing a purposive sample of 11 firms. Data were analysed using content analysis, Pearson correlation, and Panel Least Squares (PLS) regression. The study found that environmental cost disclosures had a significant positive impact on net profit margin. The study concluded that environmental cost disclosure is value-relevant for strategic business decisions. However, the study focused primarily on profitability, neglecting other forms of value variables such as market value, market capitalisation, and stakeholder engagement.

Oshiole, Elamah, and Amahalu (2020) examined the effect of environmental cost disclosure on

profitability in Nigerian oil and gas firms listed on the Nigerian Stock Exchange (NSE) between 2010 and 2019. The study used a purposive sample of 11 firms and analysed data through content analysis, Pearson Correlation Coefficient, and Panel Least Squares (PLS) regression. Findings showed that environmental cost disclosures, including waste management and health and safety costs, had a significant positive effect on market value. These suggests that firms providing more detailed environmental disclosures are likely to see improved financial performance. However, the study did not address other critical factors such as stakeholder engagement and market value, which are particularly relevant in the oil and gas sector.

Olayemi and Ishola (2021) investigated the impact of green accounting on financial performance among natural resource companies in Nigeria. The study used data from two companies listed on the Nigerian Stock Exchange (NSE) from 2015 to 2019 and employed Ordinary Least Squares (OLS) regression. The study found that environmental conservation costs a statistically significant positive effect on the financial performance of natural resource firms. However, the study was limited in sample size by focusing on just two listed companies. Secondly, the period from 2015 to 2019 is small and may not reflect current realities.

Nkwoji (2021) examined the relationship between environmental expenditure and profitability in quoted oil and gas companies in Nigeria, using secondary data from the annual reports of indigenous companies available at the Nigeria stock exchange from 2012 to 2017. The study adopted an explanatory, historical, and correlational design, with data analysed through regression analysis. The findings revealed no statistically significant relationship between environmental expenditure and net profit, suggesting that environmental spending may not have an immediate direct effect on profitability. The study's sample size was not clearly defined and it focused on profitability and not market value. Also, the period ended in 2017 and does not reflect current realities. Thus, the findings underscore the need to further explore environmental cost disclosure and additional variables such as stakeholder engagement to understand their impact on company market value with a more recent data.

Osayabor and Izedonmi (2023) examined the relationship between sustainability disclosure and market value among quoted oil and gas companies in Nigeria. The sample consisted of seven (7) firms selected using purposive sampling based on their full study period from 2012 to 2021. The study employed an ex-post facto research design and used descriptive and inferential statistics, particularly panel data regression analysis. Findings showed that environmental cost disclosure had a negative and significant impact on market value, while community development cost disclosure had an insignificant effect. The study's strength lies in its robust methodology and identification of key variables affecting market value. However, the study did not consider stakeholder perspectives. This study provides a more comprehensive analysis of environmental cost disclosure, including stakeholder engagement, which is critical for assessing the market value of oil and gas firms.

2:3:2 Stakeholder Engagement

Arena, Bozzolan, and Michelon (2014) investigated whether environmental reporting functions as a transparency tool to communicate sound environmental policies or as a manipulation tool to influence stakeholders' perceptions. The study aimed to assess the effectiveness of environmental disclosure in fostering transparency, as well as how the governance structure of firms influenced disclosure practices. The sample consisted of 288 US oil and gas firms, selected through purposive sampling. Data was collected over several years through environmental disclosure reports from 2008-2010. A regression analysis technique was employed to examine the relationship between the tone of environmental disclosures (positive or negative) and future environmental performance. The findings revealed that positive language in environmental disclosures was linked to improved future environmental performance, suggesting that these disclosures served as genuine signals of

transparency. Furthermore, the study found that the stakeholder orientation of the board played a significant role in how effectively environmental efforts were communicated. However, a key limitation of the study is its focus on US firms, which may not fully reflect the context-specific challenges faced by firms in Nigeria's oil and gas sector. The regulatory and market conditions in the US differ significantly from those in other regions, raising questions about the applicability of these findings in Nigeria.

Kujala et al. (2022) conducted a comprehensive literature review on stakeholder engagement, synthesizing 90 articles spanning 15 years (2006 – 2020) across various disciplines such as management and environmental policy. The review aimed to identify key components of stakeholder engagement, such as moral, strategic, and pragmatic elements, and to propose a unified definition. The authors employed descriptive analysis to examine patterns and key themes from the literature. The review also highlighted the potential "dark side" of stakeholder engagement, noting that poorly managed interactions could lead to negative outcomes. The study concluded by outlining future research directions to further explore stakeholder engagement. A limitation of the study is its reliance solely on literature, without empirical data to support the conclusions. As a result, while it provides valuable theoretical insights into stakeholder engagement, further empirical research is needed to validate these findings and understand the practical implications of effective stakeholder engagement in real-world business contexts.

Pwagusadi (2024) examined the effect of environmental disclosure on the market value of listed oil and gas companies in Nigeria, using data from 2009 to 2019. The study focused on 15 oil and gas companies listed on the Nigerian Stock Exchange, selected through purposive sampling. Environmental disclosure was proxied through factors such as environmental management policies, recognition of environmental activities, and stakeholder engagement. Data was collected from secondary sources, and descriptive statistics along with OLS regression analysis were employed to assess the impact of environmental disclosure on market value, measured using Tobin's Q. The study found a significant negative effect of environmental management policies on market value, indicating that investors perceive these policies as costly. However, other environmental activities, including stakeholder engagement, had positive but insignificant effects on market value. The study's reliance on a single financial metric, Tobin's Q, and the focus on voluntary environmental disclosures limit the robustness of the findings. Additionally, the study period may not fully capture current trends in environmental regulations and investor preferences, making the findings less reflective of contemporary conditions.

III. METHODOLOGY

3.1 Research Design

This study employs a quantitative research design to examine the effect of environmental expenditure and stakeholder engagement disclosures on the market value of oil and gas firms in Nigeria. The research used an ex-post facto design , which is appropriate for analysing historical data (Creswell and Creswell, 2018). The analysis focuses on secondary data obtained from the annual reports of oil and gas companies over a ten-year period (2014–2023).

3.2 Population and Sample

The population for this study consists of nine (9) oil and gas companies listed on the Nigerian Exchange Group (NGX) as at December 31, 2023. These companies include Caverton Offshore Support Group, Conoil, Eterna, Japaul Gold and Ventures, MRS Oil Nigeria, Oando, Seplat Energy, TotalEnergies Marketing Nigeria, and Rak Unity Petroleum (Nigerian Exchange Group, 2024). Table 1 contains the population and sample selection.

Table 1: Population and sample selection

S/No	Population	Sample selection
1	Caverton Offshore Support Group	✔ Selected
2	Conoil	✔ Selected
3	Eterna	✔ Selected
4	Japaul Gold and Ventures	
5	MRS Oil Nigeria	
7	Oando	
8	Seplat Energy	✔ Selected
9	TotalEnergies Marketing Nigeria	✔ selected

Source: Research's Compilation, 2024

The study employs a purposive sampling technique to select five (5) companies based on the following criteria: (i) availability and comprehensiveness of environmental disclosures in their annual reports, (ii) consistency in reporting environmental accounting information over the past five years, and (iii) company size and market capitalisation, as larger firms are more likely to engage in and disclose environmental initiatives. These criteria ensure that the selected companies provide sufficient data for meaningful analysis of the effect of green accounting on market value. This technique is recommended by Palinkas et al. (2015) and Campbell et al. (2020) for ensuring the sample is representative of firms with comprehensive environmental information, thus enhancing the validity of the research findings.

3.3 Data Collection and Analysis Techniques

For data collection, the study relies on secondary sources, specifically the Nigeria Exchange Group Fact Book and annual reports and financial statements of publicly listed oil and gas companies. These reports include key disclosures on environmental expenditure, stakeholder engagement, and market capitalisation. To ensure consistency in the data collection process, the study utilises the Environmental Disclosure Index prescribed by the Global Reporting Initiative (GRI) Standards, specifically the GRI 11.1–11.7 indices that focus on environmental impact (Solsbach et al., 2014; Kaoje et al., 2024). The content analysis method was used to systematically extract and quantify the relevant environmental data from the reports, ensuring a rigorous and objective examination of the disclosures related to environmental expenditure and stakeholders engagement. Descriptive statistics was used to summarise the characteristics of the data, offering insights into the central tendencies and variability of environmental disclosures. Correlation analysis was used to explore relationships between environmental disclosures (e.g., environmental expenditure and stakeholder engagement) and market value (Osayabor and Izedonmi, 2023). To determine how these environmental disclosures predict market value, the study used multivariate regression analysis, which assesses the influence of multiple independent variables (disclosure practices) on the dependent variable (market value). This approach helps identify significant predictors of market value, as supported by Okeke, Ifurueze & Nwadiaro, 2021). The statistical analysis is conducted using Jamovi software (Version 2.3.28), selected for its user-friendly interface and robust capabilities in both descriptive and regression analysis (Şahin & Aybek, 2020).

3.4 Model Specification

The functional relationship in equation (i) expresses the idea that the market capitalisation (MCAP) of a firm is a function of environmental

expenditure disclosure (EEXD) and stakeholder engagement disclosure (SED). The multiple regression model is as follows:

$$MCAP = f(EEXD, SED, FSZ) \quad .....(i)$$

Where:

MCAP represents the market capitalisation of the firm, which serves as the dependent variable.

EEXD stands for Environmental Expenditure Disclosure.

SED stands for Stakeholder Engagement Disclosure.

FSZ stands for Firm Size (Control variable)

To further specify the model in a linear form for empirical testing, the following equation is used:

$$MCAP_{it}=\beta 0+\beta 1EEXD_{it}+\beta 2SED_{it}+FSZ_{it}+\epsilon_{it} \quad .....(ii)$$

Where:

$MCAP_{it}$ = Market capitalisation of firm i at time t (the dependent variable)

β_0 = Intercept (constant term)

β_1, β_2, β_3, = Coefficients for the independent variables, measuring their impact on market capitalisation

$EEXD_{it}$ = Environmental Expenditure Disclosure for firm i at time t

SED_{it} = Stakeholder Engagement Disclosure for firm i at time t

FSZ_{it} = Firm Size for firm i at time t

ε_{it} = Error term for firm i at time t, accounting for unexplained variations in market capitalisation

i represents the individual firm (cross-sectional unit) in the sample (different oil and gas companies).

t represents time, indicating the specific time period (year) during which the observations were recorded.

3.5 Description and Measurement of Variables

The following firm-specific dependent and independent variables were included in the model.

Table 1: Variables, definitions and measurements

Variable	Description	Measurement	Source	Validated Literature/Studies
Market Capitalisation (MCAP)	The total market value of the firm's outstanding shares	Log. of Market Capitalisation.	Annual Reports; Nigeria Exchange Group Fact Book.	Omodero (2020)
Environmental Expenditure Disclosure (EEXD)	Financial investments in eco-friendly practices, technologies, or environmental conservation	Log. of environmental Cost	Annual Reports: Sustainability Reports	Ayoola-Akinjobi, & Akintoye (2024), Oshiole, et al. (2020).
Stakeholder Engagement Disclosure (SED)	Disclosure of engagement with stakeholders regarding environmental policies, impacts, and sustainability efforts.	Number of Stakeholders engaged	Annual reports: Sustainability Reports, CSR Reports	Kujala et al. (2022); Pwagusadi (2024)
Firm Size	Control variable	Log. of Total Asset	Annual reports	Okpala and Iredele (2018)

Source: Researcher's Compilation (2024)

IV. DATA ANALYSIS

4.1 Descriptive Statistics

Descriptive statistics were calculated for the dataset based on key parameters to provide valuable insight into the data's distribution and central tendencies. Table 2 contains the results

Table 2: Descriptive Statistics

	EEXD	SED	FSZ	MCAP
N	50	50	50	50
Missing	0	0	0	0
Mean	8.13	23.7	4.23	10.4
Median	8.09	20.0	4.09	10.3
Standard deviation	0.433	11.1	0.724	0.674
Minimum	7.15	12.0	3.11	9.48
Maximum	8.72	57.0	5.57	11.9

Source: Jamovi Output

Environmental Expenditure Disclosure (EEXD): The mean score for Environmental Expenditure Disclosure (EEXD) is 8.13, with a standard deviation of 0.433, indicating generally consistent disclosure practices among the firms, but with a slight variability in environmental expenditure disclosure. The median value of 8.09 is close to the mean, suggesting that the majority of firms are consistent in their environmental expenditure disclosure. The range from 7.15 to 8.72 shows minor variations in environmental expenditure across firms.

Stakeholder Engagement Disclosure (SED): The mean for Stakeholder Engagement Disclosure (SED) is 23.7, with a higher standard deviation of 11.1, indicating a wider variability in the level of stakeholder engagement. The median value of 20.0, which is lower than the mean, suggests that half of the firms report lower levels of stakeholder engagement compared to the average. The range is from 12.0 to 57.0, indicating wide differences in engagement levels.

Firm Size (FSZ): The mean score for Firm Size (FSZ) is 4.23, with a standard deviation of 0.724, suggesting moderate variability in firm size across the firms in the sample. The median of 4.09 is close to the mean, indicating that most firms are similar in size. The range of 3.11 to 5.57 shows that the firms exhibit moderate variation in size, with some being slightly larger or smaller than others.

Market Capitalization (MCAP): The mean value for Market Capitalisation (MCAP) is 10.4, with a standard deviation of 0.674, indicating moderate variability in market capitalisation across firms. The median of 10.3 is very close to the mean, indicating that most firms have similar market capitalisations. The range from 9.48 to 11.9 shows that the firms have similar market capitalizations, with some slightly higher than others.

4.2 Diagnostic Tests/Assumption Checks

Prior to conducting regression analysis, it is essential to ensure that the assumptions underpinning the model are satisfied. Key diagnostic evaluations required for regression include tests for autocorrelation using the Durbin-Watson statistic, multicollinearity and normality. The results of these tests are presented and discussed in the subsequent sections.

4.2.1 Durbin-Watson (DW) statistic

The Durbin-Watson (DW) statistic measures autocorrelation in regression residuals. A DW value of around **2** indicates no autocorrelation. That is, a DW between 1.5 and 2.5 is generally considered acceptable independence of residuals and suggests little to no autocorrelation. Values much below or above this range (especially approaching 0 or 4) signal more severe autocorrelation, which can affect the reliability of the model.

Table 3: Durbin–Watson Test for Autocorrelation

Autocorrelation	DW Statistic	p
0.517	0.915	< .001

Source: Jamovi Output

The Durbin–Watson test indicates moderate positive autocorrelation in the residuals, with a DW statistic of 0.517, which is considerably below the threshold of 2. The p-value of < 0.001 confirms that this positive autocorrelation is statistically significant. Therefore, collinearity statistics and normality tests are necessary to confirm the suitability of parametric test such as regression.

4.2.2 Variance Inflation Factor (VIF)

The Variance Inflation Factor (VIF) measures multicollinearity. A VIF below 5 indicates no issue, 5–10 suggests moderate multicollinearity, and above 10 signals problematic multicollinearity. Tolerance, the reciprocal of VIF (1/VIF), provides an additional measure. A tolerance value below 0.1 indicates high multicollinearity, whereas values closer to 1 reflect greater independence among predictors, which is ideal.

Table 4: Collinearity Statistics

	VIF	Tolerance
EEXD	3.14	0.319
SED	2.33	0.429
FSZ	4.25	0.236

Source: Jamovi Output

The collinearity statistics indicate no significant multicollinearity among predictors. VIF values for EEXD (3.14) and SED (2.33) are well below the critical threshold of 10, while FSZ has a slightly higher VIF of 4.25, still within acceptable limits. Tolerance values—0.319 for EEXD and 0.429 for SED—confirm sufficient independence among variables. Though FSZ shows some correlation (tolerance: 0.236), it remains manageable. Overall, multicollinearity is not a concern for the model.

4.2.3 Normality Test

A normality test assesses whether a dataset follows a normal distribution, crucial for parametric statistical methods. The Shapiro-Wilk test compares the observed data to a normal distribution. A p-value above 0.05 indicates normality, supporting parametric tests, while a p-value below 0.05 suggests significant non-normality, favouring non-parametric methods (Shapiro & Wilk, 1965). Table 5 presents the normality test results.

Table 5: Normality Test (Shapiro-Wilk)

Statistic	p
0.965	0.189

Source: Jamovi Output

The Shapiro-Wilk test for normality confirms that the residuals are approximately normally distributed, with a statistic of 0.965 and a p-value of 0.189. This result supports the assumption of normality, indicating that the model meets this essential criterion for valid regression analysis.

4.3 Correlation Matrix

Correlation analysis is a statistical technique used to evaluate the strength and direction of the relationships among two or more variables (Field, 2013). Table 6 contains the result of correlation between MCAP and the predictor variables

Table 6: Correlation Matrix

		MCAP	EEXD	SED	FSZ
MCAP	Pearson's r	—			
	df	—			
	p-value	—			
EEXD	Pearson's r	0.138	—		
	df	48	—		
	p-value	0.366	—		
SED	Pearson's r	0.210	0.646	—	
	df	48	48	—	
	p-value	0.166	< .001	—	
FSZ	Pearson's r	0.156	0.825	0.754	—
	df	48	48	48	—
	p-value	0.307	< .001	< .001	—

Source: Jamovi Output

MCAP and Environmental Expenditure Disclosure (EEXD): The Pearson's r value is 0.138, showing a weak positive correlation with MCAP. This suggests that firms with higher environmental expenditure disclosure tend to have slightly higher market capitalisation, though the correlation is weak. The p-value of 0.366 indicates that this relationship is not statistically significant, meaning it is not a meaningful or reliable association.

MCAP and Stakeholder Engagement Disclosure (SED): The Pearson's r value is 0.210, indicating a weak positive correlation with MCAP. This implies that firms with higher stakeholder engagement disclosure may have slightly higher market capitalisation. However, the p-value of 0.166 suggests the correlation is not statistically significant, meaning the relationship is not strong enough to be conclusive or reliable.

MCAP and Firm Size (FSZ): The Pearson's r value is 0.156, showing a weak positive correlation with MCAP. This suggests that larger firms may have slightly higher market capitalisation, but the correlation is weak. The p-value of 0.307 indicates that this relationship is not statistically significant.

4.4 Regression analysis

Regression analysis was conducted to determine the influence of Environmental Expenditure Disclosure and Stakeholder Engagement Disclosure on market capitaisation. Results are presented in Tables 7 and 8.

Table 7: Model Fit Measures

				Overall Model Test			
Model	R	R^2	Adjusted R^2	F	df1	df2	p
1	0.683	0.467	0.428	12.0	3	47	< .001

Note. Models estimated using sample size of N=45

Source: Jamovi Output

The model fit measures in Table 7 show that the independent variables explain a moderate amount of the variation in market capitalisation (MCAP). The R^2 value of 0.467 indicates that approximately 46.7% of the variation in MCAP is explained by the model. The adjusted R^2 value of 0.428 accounts for the number of predictors and suggests a relatively strong fit. The F-statistic of 12.0 with a p-value of < 0.001 confirms that the model is statistically significant, indicating a meaningful relationship between the predictors and MCAP.

Table 8: Model Coefficients - MCAP

Predictor	Estimate	SE	t	p
Intercept	4.8078	1.9873	2.42	0.020
EEXD	1.2122	0.3143	3.86	< .001
SED	0.0436	0.0106	4.12	< .001
FSZ	1.2463	0.2187	5.70	< .001

Source: Jamovi Output

Table 8 presents the model coefficients for MCAP. The intercept is 4.8078, with a p-value of 0.020, indicating that it is statistically significant.

Environmental Expenditure Disclosure (EEXD) has a positive effect on MCAP, with an estimate of 1.2122, and a p-value of < 0.001, indicating a strong, statistically significant positive impact on market capitalisation.

Stakeholder Engagement Disclosure (SED) also positively influences MCAP, with an estimate of 0.0436 and a p-value of < 0.001, showing a statistically significant positive association.

Firm Size (FSZ) has a positive effect on MCAP, with an estimate of 1.2463 and a p-value of < 0.001, indicating that larger firms tend to have higher market capitalisation.

4.5 Test of Hypotheses

Ho_1: Environmental Expenditure Disclosure (EEXD) does not have a significant effect on the market value of oil and gas companies in Nigeria.

From Table 8, the coefficient for EEXD is 1.2122 with a p-value of < 0.001, which is highly significant. Since the p-value is less than 0.05, we reject the null hypothesis (H01) and conclude that Environmental Expenditure Disclosure has a significant effect on the market value of oil and gas companies in Nigeria.

Ho_2: Stakeholder Engagement Disclosure (SED) does not have a significant effect on the market value of oil and gas companies in Nigeria.

The coefficient for SED is 0.0436, with a p-value of < 0.001, indicating a significant positive effect. Given the p-value is less than 0.05, we reject the

null hypothesis (H02) and conclude that Stakeholder Engagement Disclosure significantly affects the market value of oil and gas companies in Nigeria.

4.6 Discussion of Findings

This study investigated the impact of Environmental Expenditure Disclosure (EEXD) and Stakeholder Engagement Disclosure (SED) on the market value of oil and gas firms in Nigeria. The findings revealed that Environmental Expenditure Disclosure (EEXD) had a positive and statistically significant effect on market value, indicating that higher environmental expenditure disclosure is associated with increased market value. Stakeholder Engagement Disclosure (SED) also showed a positive and statistically significant effect on market value, suggesting that greater stakeholder engagement tend to have significant positive effect on market value.

The positive relationship between environmental expenditure disclosure and market value in this study is in line with Amahalu (2020), who found a significant positive effect of environmental cost disclosures on strategic business decisions and profitability. Similarly, Oshiole, Elamah, and Amahalu (2020) highlighted the positive influence of environmental disclosures on profitability, indirectly supporting the notion that enhanced transparency in environmental expenditures may drive firm value. This study extends by focusing on market value rather than profitability, thus providing further evidence of the relevance of environmental expenditure disclosures in the oil and gas sector. Contrary to the negative relationship observed by Osayabor and Izedonmi (2023), where environmental cost disclosures negatively impacted market value, this study's findings show that EEXD positively influences market value. This difference could arise from variations in industry-specific factors, corporate governance practices, and investor perceptions of environmental expenditures.

The positive impact of stakeholder engagement disclosure found in this study aligns with research by Kujala et al. (2022), which emphasized the importance of stakeholder engagement in promoting transparency and enhancing corporate reputation. It also resonates with the conclusions of Arena, Bozzolan, and Michelon (2014), who suggested that transparency in stakeholder engagement contributes to improved corporate governance and market performance. Similarly, Pwagusadi (2024) suggested that stakeholder engagement could improve market value, although this effect was deemed insignificant in their study. This study's findings, however, highlight its positive and statistically significant impact on market value.

In conclusion, this study aligns with several previous studies, particularly those that underscore the importance of transparency in environmental expenditures and stakeholder engagement for enhancing corporate market value. However, it diverges from studies such as Osayabor and Izedonmi (2023) and Polycarp (2019), where environmental disclosures were found to have either negative or insignificant effects. These discrepancies highlight the evolving understanding of how environmental expenditure and stakeholder engagement practices influence market value, especially in the oil and gas sector. The findings suggest that investors in Nigerian oil and gas firms may increasingly value environmental conservation expenditure and stakeholder engagement transparency, offering new insights for both academic researchers and practitioners in the field of corporate governance.

The significant positive effect of Environmental Expenditure Disclosure (EEXD) on the market value of oil and gas companies in Nigeria supports legitimacy theory (Suchman, 1995). By disclosing environmental expenditures, firms demonstrate their commitment to sustainable practices, which enhances their legitimacy in the eyes of the public and investors. This transparency is particularly important in the Nigerian context, where environmental concerns are increasingly scrutinised, and firms need to align with societal norms to safeguard their market position (Okeke et al., 2021). The significant positive effect of stakeholder engagement disclosure on market value also aligns with legitimacy theory. By

engaging stakeholders and providing information on their environmental efforts, firms build trust and demonstrate accountability, which further strengthens their legitimacy (Kornom-Gbaraba and Chukwuemeka, 2022). This disclosure serves to assure stakeholders that the company is committed to addressing environmental issues, which in turn enhances its market value.

The significant positive effect of both environmental expenditure and stakeholder engagement disclosures on the market value of Nigerian oil and gas companies reflects firms' responsiveness to stakeholder concerns, aligning with Stakeholder theory (Freeman, 1984). In particular, environmental expenditure disclosure shows how companies are addressing the increasing pressure from stakeholders, including investors and regulatory bodies, to be more transparent about their environmental expenditures. Similarly, stakeholder engagement disclosure highlights how firms are engaging directly with stakeholders to demonstrate their commitment to addressing environmental and social concerns. These disclosures help build trust and strengthen relationships with key stakeholders, contributing to improved market value (Okeke et al., 2021; Kornom-Gbaraba and Chukwuemeka, 2022).

V. CONCLUSION

The study concludes that Environmental Expenditure Disclosure and Stakeholder Engagement Disclosure have a significant positive effect on the market value of oil and gas companies in Nigeria. The empirical results indicate that Environmental Expenditure Disclosure has a highly significant and positive impact on market capitalisation, suggesting that as companies increase their environmental expenditure transparency, their market value improves. Similarly, Stakeholder Engagement Disclosure demonstrates a positive and statistically significant effect, highlighting that firms engaging in transparent stakeholder communication related to environmental issues are likely to experience an increase in their market value.

In light of these findings, the study recommends the following:

1. Management and Board of Oil and Gas Firms should prioritise comprehensive and transparent environmental expenditure disclosures. Enhancing the quality and detail of these disclosures will help build investor trust and positively influence market perceptions.
2. Oil and Gas Companies should continue to foster strong stakeholder engagement, ensuring that their environmental and social governance (ESG) practices are clearly communicated. This will contribute to stronger relationships with key stakeholders and improve their overall market value.

REFERENCES

1. Adegbie, F. F., Ogidan, A. A., Siyanbola, T. T., & Adebayo, A. S. (2020). Environmental accounting practices and share value of food and beverages manufacturing companies quoted in Nigeria. *Journal of critical reviews, 7* (13), 2256-2264.
2. Akbaş, H. E., & Canikli, S. (2018). Determinants of voluntary greenhouse gas emission disclosure: an empirical investigation on Turkish firms. *Sustainability*, *11*(1), 107. https://doi.org/10.3390/su11010107.
3. Akeju, F.B. & Oguntimein, G. (2023). Environmental impact of oil exploration in nigeria: a case study of Nembe Local Government. *International journal of research and innovation in applied science.* VIII(IX). 75-89. https://doi.org/10.51584/IJRIAS.2023.8910.
4. Almaqtari, F. A., Elsheikh, T., Abdelkhair, F., & Mazrou, Y. S. (2023). The impact of corporate environmental disclosure practices and board attributes on sustainability: Empirical evidence from Asia and Europe. *Heliyon*, *9*(8), e18453. https://doi.org/10.1016/j.heliyon.2023.e18453.
5. Amahalu, N. (2020). Effect of environmental cost disclosure on profitability of listed oil and gas firms in Nigeria. International journal of academic research in accounting, finance and

management sciences, 10(2), 157–170. https://ssrn.com/abstract=3704487
6. Ardiana, P. A. (2019). Stakeholder engagement in sustainability reporting: evidence of reputation risk management in large Australian companies. *Australian accounting review*, *29*(4), 726-747. https://doi.org/ 10.1111/auar.12293
7. Arena, C., Bozzolan, S. & Michelon, G. (2014). Environmental reporting: transparency to stakeholders or stakeholder manipulation? an analysis of disclosure tone and the role of the board of directors. *Corporate social responsibility and environmental management*.22(6),1-56. https://doi.org/10.1002/csr.1350
8. Ayoola-Akinjobi, O.O. & Akintoye, R.I. (2024), Environmental Accounting Practices and Value of Accounting Numbers in Corporate Reporting, International Journal of Innovative Research in Accounting and Sustainability, 9(1), 58-67.
9. Ayuba, T. & Yunusa, G. (2023). Impact of environmental and social disclosure on return on asset of listed oil and gas companies in nigeria. *International Journal of Finance and Accounting*, *8*(1), 23–35. https://doi.org/10.47604/ijfa.1778.
10. Bogdan, V., Sabău-Popa, C. D., Boloş, M. I., Popa, D. N., & Beleneşi, M. (2022). Tracking waste management information disclosure behavior connected to financial performance through moderating variables. *International journal of environ- mental research and public health*, *19*(20), 13068. https://doi.org/10.3390/ijerph192013068.
11. Brealey, R., Myers, S. & Allen, F. (2008). Brealey, Myers, and Allen on valuation, capital structure, and agency issues. *Journal of applied corporate finance*. 20.(4), 49-57. https://doi.org/10.1111/j.1745-6622.2008.00203.x.
12. Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D., & Walker, K. (2020). Purposive sampling: complex or simple? research case examples. *Journal of research in nursing*, *25*(8), 652-661. https://doi.org/10.1177/1744987120927206
13. Chopra, S. S., Senadheera, S. S., Dissanayake, P. D., Withana, P. A., Chib, R., Rhee, J. H., & Ok, Y. S. (2023). Navigating the challenges of environmental, social, and governance (esg) reporting: the path to broader sustainable development. *Sustainability*, *16*(2), 606. https://doi.org/10.3390/su16020606.
14. Connelly, B., Certo, T., Ireland, R. & Reutzel, C. (2011). Signaling theory: a review and assessment. *Journal of Management*. 37(1). 39-67. https://doi.org/10.1177/0149206310388419.
15. Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research (3rd ed.)*. Thousand Oaks, CA: SAGE
16. Damodaran, A. (2002). Investment valuation: tools and techniques for determining the value of any asset. New York, NY: John Wiley & Sons
17. Deegan, C. (2002). The legitimising effect of social and environmental disclosures – a theoretical foundation. *Accounting, auditing & accountability journal*. 15(3), 282-311. https://doi.org/10.1108/09513570210435852.
18. Dewi, A. A., Saraswati, E., Rahman, A. F., & Atmini, S. (2023). Materiality, stakeholder engagement disclosure, and corporate governance: Critical elements for the quality of sustainability reporting. *Cogent business & management*, *10*(1), 1-22 https://doi.org/10.1080/23311975.2023.2175437.147-160. https://doi.org/10.2307/2095101
19. Dowling, J. and Pfeffer, J. (1975) Organizational legitimacy: social values and organizational behaviour. *Pacific sociological review*, 18(1), 122-136. https:// doi.org/ 10.2307/1388226.
20. Emeka-Okoli, S., Nwankwo, T., Otonnah, C. & Nwankwo, E. (2024). Effective stakeholder relationship management in the oil & gas sector: a conceptual and review perspective. *Finance & Accounting Research Journal*. 6(3), pp. 372-383. https://doi.org 10.51594/farj.v6i3.898.
21. Ejoh, N.O., Orok, E.O. & Sackey, J.A. (2014). The development of environmental accounting and disclosure practice of manufacturing companies in Nigeria. *journal of economics and Sustainable Development,* 5(12), 70-79.

22. Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. *The Journal of Finance*, *47*(2), 427-465. https://doi.org/10.1111/j.1540-6261.1992.tb04398.x
23. Field, A. (2013). Discovering statistics using ibm spss statistics: and sex and drugs and rock "n" roll, 4th Edition, Sage, Los Angeles, London, New Delhi.
24. Freeman, R. E. (1984). Strategic management: A stakeholder approach. Pitman.
25. Galeotti, R. M., Camilleri, M. A., Roberto, F., & Sepe, F. (2024). Stakeholder engagement disclosures in sustainability reports: Evidence from Italian food companies. *Business Ethics, the Environment & Responsibility*, *34*(1), 260-279. https://doi.org/ 10.1111/beer.12642.
26. Gbenga, E. & Josiah, M. (2020). Environmental accounting disclosure: a critical examination of literature. I*nternational journal of economics finance and management sciences*. 17(2). 34-45.
27. Goodman, M. S., Ackermann, N., Bowen, D. J., & Thompson, V. (2019). Content validation of a quantitative stakeholder engagement measure. *Journal of Community Psychology*, *47*(8), 1937- 1951. https://doi.org/10.1002/jcop.22239
28. Griffin, P. A., Lont, D. H., & Sun, E. Y. (2017). The relevance to investors of greenhouse gas emission disclosures. *Contemporary accounting research*, *34* (2), 1265-1297. https://doi.org/10.1111/1911-3846.12298.
29. Gujarati, D.N. (2009) *Basic econometrics*. Tata McGraw-Hill Education, New Delhi.
30. Hansen, D.R. & Mowen, M.M. (2207). *Managerial accounting*. *8th ed*. Thomson South Western.
31. Ibrahim, R., Ibrahim, Y.K. & Hussain, S.M. (2023). Environmental Reporting and Financial Performance of Listed Industrial and Consumer Goods Firms in Nigeria. Fudma Journal of accounting and Finance research, 1(2), 123-140. https://doi.org/10.33003/fujafr-2023.v1i2.41.123-140
32. Igbekoyi, O., Solanke, F., Adeusi, S., Alade, M. & Agbaje, W. (2022). Environmental accounting disclosure and financial performance of listed multinational firms in nigeria. *Global journal of management and business research*. 21(2), pp. 17-28. https://doi.org/10.34257/GJMBRDVOL21IS2PG17.
33. Jamil C. C. & Rodiel C. F. (2020) Effect of environmental accounting on financial performance and firm value of listed mining and oil companies in the Philippines Asia. *Pacific social science review,* 20(1), 117–134.
34. Kaoje, N.A., Olanrewaju, O.J., Mohammed, N.M. & 1 Ruggah, H.H. (2024). Firm characteristics and environmental disclosure of listed oil and gas marketing companies in Nigeria. *Lapai international journal of management and social sciences,* 16(1), 278-292.
35. KPMG (2022). Survey of sustainability reporting 2022. Retrieved from: https://assets.kpmg.com/content/dam/kpmg/se/pdf/komm/2022/Global-Survey-of- Sustainability-Reporting-2022.pdf
36. Kujala, J., Sachs, S., Leinonen, H., Heikkinen, A. & Laude, D. (2022). Stakeholder Engagement: Past, Present, and Future. Business & Society. 61(5),1-61 . https://doi.org/10.1177/00076503211066595.
37. Mousa, G. & Hassan, N. (2015). Legitimacy theory and environmental practices: short notes. *International journal of business and statistical analysis*. 2(1), pp.41-53. https://doi.org/10.12785/ijbsa/020104.
38. Nkwoji, N. (2021). Environmental accounting and profitability of selected quoted oil and gas companies in Nigeria (2012-2017). Journal of accounting and financial management, 7(3), 22-39.
39. Omodero, C.O. (2020), Capital Market Determinants and Market Capitalization in Nigeria, International Journal of Financial Research, 11(1), 462-473. https://doi.org/10.5430/ijfr.v11n1p462.
40. Ojiakor, I., Ezuwore C. N.O. & Ozioko, B. (2018). Environmental cost disclosure in the financial statements of motor vehicle manufacturing firms in south east nigeria. International Journal of Management and Social Sciences. 5(3), 286-299.

41. Okeke, E.E., Ifurueze, M.S. & Nwadiaro, E.O. (2021). Effect of effluent and waste treatment cost disclosure on economic value added of quoted oil and gas firms in nigeria. *International journal of sustainable development*, 6(4)78-97.
42. Okpala, O. & Iredele, O.I. (2019). Corporate social and environmental disclosures and market value of listed firms in Nigeria. *Copernican Journal of Finance & Accounting*. 7(3), 9- 28. https://doi.org/10.12775/CJFA.2018.013.
43. Olagunju, A., & Ajiboye, O. O. (2022). Environmental accounting disclosure and market value of listed non-financial firms in nigeria. *International journal of management, accounting and economics*, 9(7), 413-430.
44. Olayemi, O. A. & Ishola, R. A. (2021). Green accounting and business health in Sub-Saharan Africa. 3rd ICAN-Malaysia international conference on accounting and finance (ICAF- IMDS 2021).
45. Olutimehin, D., Ofodile, O., Ugochukwu, C. & Nwankwo, E. (2024). Corporate governance and stakeholder engagement in Nigerian enterprises: a review of current practices and future directions. *World journal of advanced research and reviews*. 21(3), pp. 736-742.https://doi.org/10.30574/wjarr.2024.21.3.0737
46. Osayabor, E.F. & Izedonmi, F.P. (2023). Sustainability disclosure and market value of quoted oil and gas companies in Nigeria". *ABUAD Journal of social and management sciences,* 4 (2), 208-27. https://doi.org/10.53982/ajsms.2023.0402.03-j.
47. Oshiole, S., Elamah, A.F., & Amahalu, N.N. (2020). Effect of environmental cost disclosure on profitability of listed oil and gas firms in Nigeria. *International Journal of Academic Research in Accounting, Finance and Management Sciences 10*(2), 157-170.
48. Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and policy in mental health*, 42(5), 533–544. https://doi.org/10.1007/s10488-013-0528-y.
49. Pavone, Pietro. (2019). Market capitalization and financial variables: evidence from italian listed companies. *International Journal of Academic Research in Business and Social Sciences*. 9(3), 1356–1371. https://doi.org/10.6007/IJARBSS/v9-i3/5802.
50. Penman, S. (2013). *Financial statement analysis and security valuation. 5th Edition*, McGraw Hill, New York.
51. Permata, I. & Alkaf, F. (2020). Analysis of market capitalization and fundamental factors on firm value. Journal of Accounting and Finance Management. 1(1), 59-71. https://doi.org/10.38035/jafm.v1i1.12.
52. Polycarp, S. U. (2019). Environmental accounting and financial performance of oil and gas companies in nigeria. *Research journal of finance and accounting,* 10(10), 192-200.
53. Pwagusadi, J.S. (2024) Effect of Environmental disclosure on market value of listed oil and gas companies in Nigeria. *International journal of humanities social science and management (IJHSSM),* 4(4), 683-700.
54. Ross, S.A., Westerfield, R.W.; Jaffe, J. & Jordan, B.D. (2021). *Corporate Finance (thirteenth edition.)*. McGraw-Hill.
55. Şahin, M. & Aybek, E. (2019). Jamovi: an easy to use statistical software for the social scientists. *International journal of assessment tools in education,* 6(4), 670 - 692, https://doi.org/10.21449/ijate.661803
56. Shapiro, S.S. and Wilk, M.B. (1965) An Analysis of Variance Test for Normality (Complete Samples). Biometrika, 52, 591-611. https://doi.org/10.1093/biomet/52.3-4.591
57. Solsbach, A., Isenmann, R., Gómez, M.J. & Teuteberg, F. (2014). Inter-organizational Sustainability Reporting – a harmonized XRBL approach based on GRI G4 XBRL and further Guidelines. Proceedings of the 28th EnviroInfo 2014 Conference, Oldenburg, Germany.
58. Spence, M. (1973). Job market signaling. *Quarterly journal of economics*, 87, 355- 374. https://doi.org/10.2307/1882010

59. Suchman, M. (1995). Managing legitimacy: strategic and institutional approaches. *Academy of management review*, 20(3), pp.571-611. https://doi.org/10.2307/ 258788
60. Wang, L., Shang, Y., Li, S. & Li, C. (2023). environmental information disclosure-environmental costs nexus: evidence from heavy pollution industry in China. *Sustainability,* MDPI, 15(3), 1-21.

Evaluating the Liberia Revenue Code: A Strategic Framework for Combating Illicit Financial Flows and the Informal Sector

Dr. Bonokai & G. B. Gould, Sr

University of Liberia

ABSTRACT

This paper critically examines the Liberia Revenue Code (LRC) for its efficiency in revenue collection and its capacity to address illicit financial flows (IFFs) and the informal sector. It explores how weaknesses in policy design, enforcement mechanisms, and institutional capacity have limited the Code's effectiveness in reversing revenue losses and expanding the formal tax base. Drawing on relevant fiscal, legal, and economic literature as well as practical developments within the Liberian context, the analysis demonstrates that while the LRC provides a foundational tax framework, it lacks the structural provisions to effectively combat the twin challenges of IFFs and informality. The proliferation of unregulated financial activities and informal enterprises continues to erode Liberia's tax base, undermining efforts to achieve economic stability, equity, and development. The paper calls for the development and implementation of a national strategy anchored on empirical research, institutional strengthening, legal reforms, and digital innovations to ensure greater fiscal sustainability, improved compliance, and a formalized economic environment conducive to national development. It argues that without strategic intervention, the fiscal cost of these phenomena will continue to widen, and the state will remain handicapped in delivering on its developmental mandate.

Keywords: NA

Classification: JEL Code: H26, H20, O17

Language: English

Great Britain Journals Press

LJP Copyright ID: 146442
Print ISSN: 2633-2299
Online ISSN: 2633-2302

London Journal of Research in Management & Business

Volume 25 | Issue 4 | Compilation 1.0

Evaluating the Liberia Revenue Code: A Strategic Framework for Combating Illicit Financial Flows and the Informal Sector

Dr. Bonokai[α] & G. B. Gould, Sr.[σ]

ABSTRACT

This paper critically examines the Liberia Revenue Code (LRC) for its efficiency in revenue collection and its capacity to address illicit financial flows (IFFs) and the informal sector. It explores how weaknesses in policy design, enforcement mechanisms, and institutional capacity have limited the Code's effectiveness in reversing revenue losses and expanding the formal tax base. Drawing on relevant fiscal, legal, and economic literature as well as practical developments within the Liberian context, the analysis demonstrates that while the LRC provides a foundational tax framework, it lacks the structural provisions to effectively combat the twin challenges of IFFs and informality. The proliferation of unregulated financial activities and informal enterprises continues to erode Liberia's tax base, undermining efforts to achieve economic stability, equity, and development. The paper calls for the development and implementation of a national strategy anchored on empirical research, institutional strengthening, legal reforms, and digital innovations to ensure greater fiscal sustainability, improved compliance, and a formalized economic environment conducive to national development. It argues that without strategic intervention, the fiscal cost of these phenomena will continue to widen, and the state will remain handicapped in delivering on its developmental mandate.

Author α σ: Senior Lecturer Department of Economics Business College University of Liberia.

I. INTRODUCTION

Liberia, like many developing countries, grapples with systemic barriers to effective domestic revenue mobilization. Despite the establishment of a comprehensive tax framework in the Liberia Revenue Code (LRC) of 2000 and its subsequent amendments in 2011 and 2020, the country's fiscal space remains constrained. These amendments have sought to rationalize tax rates, encourage investment, and simplify compliance procedures. However, Liberia continues to experience high levels of illicit financial flows (IFFs) and a dominant informal sector. There are two major factors that undermine the LRC's operational efficiency and the broader objective of fiscal sustainability.

Illicit financial flows: typically involving tax evasion, trade mis-invoicing, corruption, and unregulated capital flight, are estimated to cost Liberia hundreds of millions of dollars annually. Simultaneously, the informal sector, which encompasses a wide range of unregistered and untaxed businesses, remains largely outside the LRC's reach. Together, these phenomena account for significant revenue leakages, weakening the government's capacity to invest in public services and social infrastructure.

The current LRC, while comprehensive in some respects, lacks targeted provisions to directly confront these structural deficiencies. Weak enforcement mechanisms, outdated compliance systems, and limited institutional capacity further exacerbate the situation. This paper argues that addressing these gaps requires more than periodic legislative amendments. It calls for the formulation and implementation of a holistic national strategy that incorporates in-depth

research, robust enforcement frameworks, legal reforms, and technological innovation. Such a strategy should be supported by legislative action, cross-sectoral partnerships, and international collaboration to ensure that the revenue potential of the Liberian economy is fully realized. The paper aims to contribute to the discourse on fiscal reform in Liberia by highlighting the urgent need for systemic change and sustainable solutions to the challenges of IFFs and informality.

II. THE LIBERIA REVENUE CODE: STRENGTHS AND STRUCTURAL LIMITATIONS

2.1 Strengths of the LRC

- The Liberia Revenue Code, particularly following the 2020 amendment, demonstrates commendable features including:
- Comprehensive coverage of income, corporate, excise, and customs taxation. - Anti-avoidance provisions under Sections 203 and 1103 to combat base erosion and profit shifting.
- Incentive structures for investment, including special investment incentives under Chapter 21.
- Integration of international tax standards, including transfer pricing rules. - Inflation adjustments and investor protection mechanisms for stability.

These features provide a stable legal framework. However, their implementation is impeded by practical weaknesses within tax administration and enforcement.

2.2 Structural Limitations

Despite its strengths, the LRC exhibits critical gaps:

- Complex compliance procedures discourage voluntary compliance among micro, small, and medium enterprises (MSMEs).
- Overdependence on resource-based taxation, particularly from rubber, iron ore, and timber sectors, exposes the revenue base to external shocks.
- Inadequate integration with anti-money laundering laws, leading to loopholes for IFFs.

- Limited alignment with financial transparency norms, such as beneficial ownership disclosure and automatic exchange of information.

These gaps limit the capacity of the LRC to serve as a robust instrument against revenue leakage, especially from informal and illicit activities.

III. THE SHADOW ECONOMY AND ILLICIT FINANCIAL FLOWS IN LIBERIA

3.1 Situation and Extent

The shadow economy in Liberia is estimated to constitute approximately 61% of GDP (IMF, 2020), indicating a substantial proportion of economic activities outside the formal tax net. Illicit financial flows, largely facilitated through trade misinvoicing, unrecorded capital flight, and tax evasion, account for over USD 200 million in annual losses (Global Financial Integrity, 2021).

3.2 Linkages to the LRC

The LRC currently lacks explicit provisions to address IFFs comprehensively. While Chapter 18 on Customs and Chapter 9 on Income Tax offer sanctions for non-compliance, they fall short of tackling systemic issues such as offshore tax evasion and shell companies. Furthermore, the Code does not mandate cross-border financial data reporting, which is crucial in identifying and reversing IFFs.

3.3 Impact on Revenue

Illicit financial flows (IFFs) and informal economic activities collectively represent one of the most significant drains on Liberia's domestic revenue potential. According to estimates by the Global Financial Integrity (GFI) and regional studies on sub-Saharan Africa, developing countries lose approximately 3–6% of their GDP annually to IFFs. Applying this conservative benchmark to Liberia, whose GDP was approximately USD 3.9 billion in 2023, suggests that the country may be losing between USD 117 million and USD 234 million each year through illicit channels alone.

The informal sector, which constitutes over 80% of Liberia's labor force, further exacerbates revenue losses. The Liberia Institute of Statistics and Geo-Information Services (LISGIS) reports that most micro, small, and medium-sized enterprises (MSMEs) operate outside the purview of formal tax regulation. This severely limits the tax base. With unregistered businesses, underreported income, and widespread non-compliance, tax revenue leakage from the informal economy is conservatively estimated at an additional USD 50–75 million annually.

Cumulatively, these losses account for 30–35% of Liberia's potential tax revenue each fiscal year. Given that the country's domestic revenue is estimated at USD 500 million, this implies an annual loss of USD 150–175 million, a staggering figure that equates to nearly half of Liberia's education and health sector budgets combined.

Curbing these losses through the development of a national strategy targeting IFFs and informal sector integration could result in a 20–25% increase in Liberia's fiscal capacity. That would equate to an additional USD 100–125 million annually, funds that could be reinvested in critical infrastructure, healthcare, education, and social protection programs. Moreover, enhanced transparency and formalization would improve Liberia's creditworthiness, reduce donor dependency, and promote private sector confidence.

It is important to underscore that these estimates may understate the problem, given the challenges in data collection and reporting in fragile contexts like Liberia. Nonetheless, they present a compelling case for urgent reforms. Quantifying and addressing these losses is not merely a matter of fiscal accounting, it is a prerequisite for sustainable national development. Without systemic interventions to stem IFFs and formalize the shadow economy, Liberia will continue to forgo substantial financial resources needed to meet its development goals and lift millions of its citizens out of poverty.

IV. BENEFITS OF CURBING IFFS AND FORMALIZING THE INFORMAL SECTOR

4.1 Revenue Expansion

Tackling IFFs and formalizing the informal sector could lead to substantial revenue gains:

- Enhanced compliance and base broadening (+15–20% revenue increase).
- Improved customs enforcement (+5–10%)
- Reduced tax evasion via beneficial ownership and digital reporting requirements.

4.2 Economic Formalization

- Formalization creates opportunities for:
- Access to credit and financial services
- Legal protections for MSMEs
- Enhanced productivity through digitalization and skills upgrading

4.3 Institutional Strengthening

Capacity building within the Liberia Revenue Authority (LRA) and collaboration with the Financial Intelligence Unit (FIU) will enhance monitoring and enforcement, especially in high-risk sectors such as mining, telecommunications, and cross-border trade.

V. DEVELOPING A NATIONAL STRATEGY TO ADDRESS IFFS AND THE SHADOW ECONOMY

5.1 Rationale

A national strategy is essential to coordinate regulatory reforms, institutional strengthening, and digital transformation. This strategy should align with international best practices (e.g., OECD's BEPS framework, FATF recommendations, and the African Union High-Level Panel on IFFs).

5.2 Core Pillars of the Strategy

1. Research and Data Systems Development: Establishing a centralized IFF monitoring system and baseline studies.
2. Legal and Regulatory Reforms: Integrating transparency standards and mandatory disclosure laws.

3. Digital Financial Infrastructure: Expanding e-taxation and trade data digitalization.
4. Institutional Capacity Building: Enhancing LRA, Ministry of Finance, and FIU capabilities.
5. Public Engagement and Formalization Incentives: Encouraging voluntary compliance and registration.
6. Implementation Pathway and Projected Gains

6.1 Short-term (1–2 years)

- Baseline research and mapping of IFF-prone sectors.
- Amendments to the LRC and relevant AML laws
- Training programs for tax inspectors, FIU staff, and border officials.

6.2 Medium-term (3–5 years)

- National implementation of a digitized taxpayer database
- Establishment of automatic exchange of information systems
- Collaboration with ECOWAS and OECD tax transparency initiatives

6.3 Projected Gains

- Recovery of USD 50–100 million annually within five years
- Reduction of shadow economy to under 40% of GDP
- Establishment of Liberia as a compliant, transparent tax jurisdiction

VI. ZPOLICY RECOMMENDATIONS

6.1 Legislative Reform

- Amend the LRC to include clear provisions on beneficial ownership (Chapter 2 or 9)
- Enforce automatic exchange of information and data sharing with regional and global partners

6.2 Institutional Action

- Create an inter-agency task force on IFFs led by the Ministry of Finance, LRA, FIU, and the Central Bank
- Introduce a whistleblower policy and protection framework to uncover hidden assets

6.3 International Cooperation

- Join the OECD Global Forum on Transparency and Exchange of Information
- Enhance partnerships with UNCTAD, IMF, and AU institutions focused on curbing IFFs

VII. CONCLUSION

The Liberia Revenue Code (LRC) is foundational to the country's fiscal framework but remains structurally inadequate in curbing illicit financial flows (IFFs) and formalizing the shadow economy. While the LRC has undergone amendments, notably in 2020, to address some systemic gaps, these revisions have yet to sufficiently tackle the persistent and complex challenges posed by informality, tax evasion, and cross-border financial leakages.

The absence of specific provisions targeting the identification, measurement, and curtailment of IFFs, as well as a comprehensive approach to bringing informal enterprises into the tax net, severely undermines Liberia's capacity to mobilize domestic revenue effectively. Furthermore, enforcement weaknesses, data fragmentation, and low digitalization of tax processes further exacerbate vulnerabilities in the system.

To address these challenges, a well-coordinated national strategy is essential. This strategy must be anchored in three key pillars: legal reform, institutional capacity building, and technological transformation. Legal reform should include explicit clauses in the LRC to criminalize and penalize IFFs, expand the tax base through targeted formalization measures, and harmonize the Code with international tax and transparency standards. Capacity building must prioritize equipping revenue authorities, customs officials, and financial intelligence units with the tools and training necessary to detect, investigate, and prevent financial crimes. Investment in digital infrastructure, such as integrated taxpayer databases, e-filing systems, and real-time transaction monitoring, will be critical in minimizing leakages and boosting compliance.

In addition, legislative support is indispensable for approving necessary amendments and securing budget allocations for implementation. International cooperation, especially with regional and global bodies combating IFFs, will bolster cross-border enforcement, while civil society engagement will ensure transparency and foster public trust in the tax system.

With committed implementation and oversight, Liberia could realistically recapture up to 25% of its currently lost revenue due to IFFs and informality. Such gains would not only close fiscal gaps but could also finance critical development priorities in health, education, and infrastructure. Ultimately, transforming Liberia's fiscal trajectory depends on bold reforms and an unwavering commitment to revenue integrity and national accountability.

REFERENCES

1. Liberia Revenue Code (LRC), 2011 and 2020 amendments
2. Global Financial Integrity (2021). Illicit Financial Flows to and from Developing Countries.
3. International Monetary Fund (2020). Liberia: Selected Issues. IMF Country Report. - OECD (2015). Base Erosion and Profit Shifting Action Plan.
4. African Union/ECA (2015). Report of the High-Level Panel on Illicit Financial Flows from Africa.

This page is intentionally left blank

Cybersecurity Threats and Their Impact on Financial Inclusion Drivers in Nigeria

Ajibare, Adedayo Oluyemi & Oguntuase, Oluwaseun James

ABSTRACT

This research examined the intricate relationship between cybersecurity threats and financial inclusion in Nigeria, providing novel insights into their dynamic interplay. Considering the staggering growth of cyber frauds targeting financial inclusion drivers in Nigeria, it has become critical to understand the impact of cybersecurity threats on financial inclusion, as inclusive finance is paramount for fostering comprehensive economic development. This study examined the relationship between cybersecurity threats and the demand/supply sides of financial inclusion. The data used were sourced from reputable institutions like the Nigeria Electronic Fraud Forum (NeFF) and the World Bank Development Indicator. The hypotheses of the study were robustly tested using three estimation techniques, which include Ordinary Least Squares (OLS), Two-Stage Least Squares (2SLS), and Generalized Method of Moments (GMM). Key findings challenged conventional wisdom, revealing unexpected relationships between cybersecurity threats and financial inclusion. Contrary to prior assumptions, a positive long-run relationship is revealed between cybersecurity threats and the demand side of financial inclusion. Additionally, the cybersecurity threat has a significant influence on the supply side of financial inclusion. The study thus recommended a revised, robust, and innovative cybersecurity framework for the Nigerian financial sector.

Keywords: cybersecurity threats, demand/supply side of financial inclusion, nigeria, and OLS/2SLS/GMM.

Classification: JEL Code: 21, O16, C36

Language: English

Great Britain Journals Press

LJP Copyright ID: 146443
Print ISSN: 2633-2299
Online ISSN: 2633-2302

London Journal of Research in Management & Business

Volume 25 | Issue 4 | Compilation 1.0

Cybersecurity Threats and Their Impact on Financial Inclusion Drivers in Nigeria

AJIBARE, Adedayo Oluyemi[α] & OGUNTUASE, Oluwaseun James[σ]

ABSTRACT

This research examined the intricate relationship between cybersecurity threats and financial inclusion in Nigeria, providing novel insights into their dynamic interplay. Considering the staggering growth of cyber frauds targeting financial inclusion drivers in Nigeria, it has become critical to understand the impact of cybersecurity threats on financial inclusion, as inclusive finance is paramount for fostering comprehensive economic development. This study examined the relationship between cybersecurity threats and the demand/supply sides of financial inclusion. The data used were sourced from reputable institutions like the Nigeria Electronic Fraud Forum (NeFF) and the World Bank Development Indicator. The hypotheses of the study were robustly tested using three estimation techniques, which include Ordinary Least Squares (OLS), Two-Stage Least Squares (2SLS), and Generalized Method of Moments (GMM). Key findings challenged conventional wisdom, revealing unexpected relationships between cybersecurity threats and financial inclusion. Contrary to prior assumptions, a positive long-run relationship is revealed between cybersecurity threats and the demand side of financial inclusion. Additionally, the cybersecurity threat has a significant influence on the supply side of financial inclusion. The study thus recommended a revised, robust, and innovative cybersecurity framework for the Nigerian financial sector. It also suggested a review of the theory of production to validly include digital/financial technology as the latest (fifth) factor of production to enable academia, practitioners, and indeed all other stakeholders to understand its features, merits, and demerits, and therefore be able to combat its inherent risks safely.

Keywords: cybersecurity threats, demand/supply side of financial inclusion, nigeria, and OLS/2SLS/GMM

I. INTRODUCTION

The pervasiveness of cybersecurity crime has been well documented in the literature. This crime is seen as a threat, unwaveringly reducing the rate of participation in the digital financial market. In recent years, the financial service sector has undergone significant changes due to the widespread integration of digital technologies. This has created fresh opportunities for global financial access and participation. Innovations like online payment systems and mobile banking apps have enabled millions, particularly those in remote or underserved areas, to access basic financial services. However, alongside these developments comes an escalating risk of cybersecurity breaches and digital scams, posing significant challenges to achieving widespread financial inclusion.

According to Cook (2023), if cybercrime were a country, it would have been the third largest economy in the world behind the US and China, with a currently staggering value of $8 trillion, which is expected to climb to $10.5 trillion by 2025. This is an indication that cyber-fraudsters are winning the war despite the array of risk management measures being periodically deployed by experts and professional bodies. If this trend continues without the right orientation and actions, over one-tenth of the global GDP, which is currently estimated at $99trillion (Rao, 2023) may soon be under the control of criminals and fraudsters; and if technologically advanced economies suffer cyberfraud in large magnitude, then critical attention must be paid to the developing economies to avoid a skewed tech progress or overdependence in the nearest future.

As the rate of cybercrime increases, the unbanked may assume that the risk involved in using electronic financial services and products is higher than the benefits and may deliberately choose to be excluded. Africa has had one of the fastest growth rates in cybercrime activities among emerging nations; in fact, the World Economic Forum has identified cybercrime as one of Africa's top challenges for 2019. An estimated value of $650 million and $210 million in losses came from Nigeria and Kenya, respectively, and $3.5 billion in losses were incurred throughout Africa in 2019 (World Bank, 2020).

Unequivocally, the issue of cybersecurity threats and financial inclusion calls for an urgent examination. This is why Ozili (2018) and, more recently, Sambuli and Grossman (2022) examined this relationship and explained that the lack of consumer trust in digital finance services leads to the readoption of informal mechanisms. A similar study was also conducted by David, Nicholas, and Emma (2021); they revealed that to reduce cyberattacks and their effects, firms are required to build in-house cybersecurity (human) measures and give proper training to their employees instead of using only basic software protection and strong passwords. They, however, did not consider the impact of cybercrime on the firms' customers; rather, they focused on the protection of the firms. Gustavo (2023) also stated that the adoption of Digital Financial Services (DFS), which are made possible by digital technologies, is a crucial factor in financial inclusion and has been significantly hampered by security and privacy concerns.

Fadairo-Cokers and Ibrahim (2021) reported that cybercrime and the usage of some financial institutions' services and products are negatively related. Similarly, Durai and Stella (2019) explained that security has a negative influence on digital financial inclusion, meaning the measured variables are inversely related. There are a series of studies relating to cybercrime with some other variables. For instance, Aribake (2015) analyzed the impact of Information and Communication Technology (ICT) tools for fighting cybercrime on online banking activities in Nigeria, and the findings revealed that cybercrime and ICT tools are inversely related since the improvement in ICT can be used to forestall internet crime. Attamah (2019) also examined the effect of cybercrime on the online banking system, and he discovered that there is widespread cybercrime in Nigeria, and this has an inverse impact on online banking activities.

So far, however, there is no concrete study that relates cybersecurity threats to financial inclusion, simultaneously emphasizing the safety of both the users (clients) and the suppliers (financial institutions). Another uniqueness of this study is to examine the role of cybersecurity threats on financial inclusion to establish findings on the long and short-run relationships between the variables, using a more robust technique such as a dynamic multivariate framework with the capability to explain temporal breaks or shocks. Also, this study is rooted in the Theory of Technology-Enabled Crime and one of the Theories of Financial Inclusion, known as the Technology Acceptance Model (TAM). In light of this, the study has thus significantly extended the existing literature. This study will consider how cybersecurity threats influence financial inclusion in the context of Nigeria. Unlike the study of Aribake (2015) which analyzed the impact of ICT tools for fighting cybercrime on online banking in Nigeria.

II. LITERATURE REVIEW

The impact of cybercrimes on online banking transactions and Automated Teller Machine (ATM) usage among bank customers in the Federal Capital Territory (FCT) has been documented by Fadairo-Cokers and Ibrahim (2021). The authors used primary data that was collected from nine (9) different banks in the Federal Capital Territory (FCT) region of the country and descriptive statistics for analyzing their hypotheses. The study highlights a notable prevalence of banking cybercrime activities in the FCT. While the online protocols implemented by banks to counteract such activities are deemed adequate, the effectiveness of efforts by related agencies in combating banking cybercrimes in the FCT falls short of expectations. Poor financial literacy and limited knowledge of internet

operations are identified as major contributors to banking cybercrimes in the FCT. Despite this, the study acknowledges that awareness initiatives on banking cybercrimes by related agencies are adequate (Fadairo Cokers and Ibrahim 2021). Considering these findings, they recommended intensified awareness campaigns by related agencies to mitigate the occurrence of online banking and ATM cybercrimes in the FCT. Furthermore, it suggests that various banks reassess their online protocols aimed at curbing banking cybercrime activities in the Federal Capital Territory to minimize instances of such crimes.

Before the work of Fadairo-Cokers and Ibrahim (2021), Durai and Stella (2019) analysed how digital finance impacts financial inclusion. The authors underscored that the proliferation of digital technologies has facilitated an expanded array of financial services, encompassing online banking, mobile banking, and various e-payment methods such as e-wallets, mobile wallets, and credit and debit cards. These technological advancements offer numerous advantages to consumers, including enhanced convenience and streamlined financial transactions. However, the looming threat of cyberattacks presents a critical concern, particularly in tandem with the ongoing evolution of the economy towards cashless transactions. Despite the growing acceptance of cashless payment methods, there persists a range of apprehensions, including concerns regarding security vulnerabilities, inadequate network coverage, merchant reluctance, elevated transactional costs, and limited user proficiency with technology (Durai and Stella 2019). These factors collectively impede the widespread adoption of the new payment ecosystem. The result of the One-way ANOVA shows that digital finance has a significant and positive influence on inclusive finance, however, digital finance has several negative influences on matters bordering on security, affordability, and adaptability, which collectively impair the safety, acceptance, and growth of financial inclusion (Durai and Stella 2019).

Iwedi, Owakah, and Wofuru-Nyenke (2023) investigated the impact of financial technology on financial inclusion within Nigeria. Utilizing quarterly secondary data sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin (2021) spanning from 2009 to 2019, the study assessed various indicators of financial technology, including point of sale, automated teller machine (ATM), web banking technology, and mobile banking technology. Financial inclusion in Nigeria was assessed using the deposit ratio as a proxy. Employing the vector autoregression (VAR) estimation technique, the study analyzed the time series data. The findings indicate that web banking technology exhibits a positive and statistically significant effect on financial inclusion in Nigeria. However, point of sale, automated teller machines, and mobile banking technology demonstrate positive effects on financial inclusion, albeit not statistically significant. In the same vein, Attamah (2019) examines the effect of cybercrime on the online banking system in Nigeria. The author discovered that there is widespread cybercrime in Nigeria, and this negatively impacts online banking activities.

Several empirical studies (Bouveret, 2018; Faccia and Petratos, 2021; Johri and Kumar, 2023; Ohiani, 2020; and Onunka et al., 2023) have shed light on the devastating repercussions of cybercrime on banking institutions, prompting increased efforts to implement cybersecurity measures aimed at mitigating its impact and fortifying existing defenses. Banks have emerged as direct targets of cybercrime, particularly evident in India, where numerous financial institutions have succumbed to large-scale malware attacks (Acharya and Joshi 2020). These attacks not only result in the compromise of valuable and sensitive data but also inflict substantial financial losses on the affected banks. Acharya and Joshi (2020) studied how cyberattacks affect banking institutions in India. This study aims to delineate the business domains most vulnerable to cyberattacks and to devise tailored strategies for the enhancement and refinement of cybersecurity protocols. The study used secondary data that were sourced from various online platforms, which include government websites, scholarly articles, and

research papers. The secondary data analysis was supported using a case study relating to notable cyber threats and criminal incidents, resulting in significant financial consequences in the past.

The study underscores the exponential proliferation of cybercrime and its profound ramifications as a formidable menace to the integrity of banking and financial institutions. It advocates for a comprehensive approach to combating cyber insecurities, asserting that Indian banks must not only confront external threats but also address internal attitudinal barriers and cultivate a mindset conducive to proactive engagement with cyber threats and criminals. Furthermore, the authors advocate for the abandonment of traditional methodologies in favour of adopting cutting-edge technologies and agile, proactive approaches to cybersecurity. They emphasized the imperative of continually assessing the cybersecurity landscape and anticipating emerging threats to effectively safeguard against cyber vulnerabilities.

The inability to curb the increasing cybercrime will result in a decrease in the use of financial products and services. The rising prominence of risk control issues, including data security, privacy protection, and information disclosure, presents a significant challenge to the global expansion of digitally inclusive finance. While developing digitally inclusive banking services, numerous commercial banks and financial service providers have introduced new systems, established online platforms, and engaged in partnerships with numerous third-party entities simultaneously. Any disruptions in the transaction process can severely impact the operations of these businesses or platforms. Such disruptions not only tarnish the reputation of banks and financial service providers but also raise concerns about the potential unauthorized access to and disclosure of user data by third-party entities (Zuo, 2020).

Nevertheless, some studies are focused on how the digitalization of banking services influences the economy. The study on the intricacy of the Fintech era's digital service transformation was carried out by Truong (2022). The study's findings unmistakably supported FinTech's rapidly expanding responsibilities in contemporary economics and offered benchmarks for digitizing the current corporate culture. Wonglimpiyarat and Khaemasunun (2017) analyzed FinTech and its dynamic shifts within the banking sector. The findings' analyses demonstrate the systemic traits of FinTech-based innovations in the banking sector, both globally and in the context of Thailand. Similarly, Iwedi, Kocha, and Wike (2022) studied how the Nigerian economy was affected by the digitalization of financial services. This study made use of 12-year aggregate yearly digital banking service data from the Central Bank of Nigeria (CBN) Statistical Bulletin. The significance of the link between Nigeria's economic performance and digital banking service channels was ascertained through the application of Ordinary Least Squares (OLS). The outcome demonstrates that there is a high correlation between Nigeria's economic growth and both WEB Pay and Mobile Pay. They also found that Nigeria's economic growth is positively and significantly correlated with the digitalization of banking service channels.

From the various scanned literature, there appears to be little empirical research that directly relates cybersecurity threats to either the demand (users') side or supply (financial institutions') side of financial inclusion. One of these studies was conducted by Khan, Mubarik, and Naghavi (2021), who examined how cybersecurity helps limit the negative effects of cybercrimes on financial inclusion. They used a closed-ended questionnaire to gather data from Pakistan's banking industry, and they analyzed the collected data using partial least squares structural equation modeling. They provided evidence that robust cybersecurity lessens the effects of online risks on financial inclusion.

Adeyemi and Festus (2022) evaluated how technology adoption influences financial inclusion in Nigeria and China. The authors used internet usage, Automated Teller Machines, and mobile cellular subscriptions to proxy the adoption of technology, and financial inclusion was proxied by the number of depositors with commercial banks per 1,000 adult population. They adopted

the Pooled OLS and Generalized Least Squares estimators. Their study revealed that all the independent variables (internet usage, Automated Teller Machines, and mobile cellular subscriptions) have an insignificant but positive influence on financial inclusion in the two countries (China and Nigeria).

III. METHODS

3.1 Data Collection

The design/plan of this study is in different stages, starting from the secondary data collection, intuitive specification of underlying relationships, hypothesis testing/verification, methods of estimation, and robustness checks. Financial inclusion is classified into two, namely the demand side and the supply side. Specifically, the demand (clients) side's proxy is the deposit rate to the cost of intermediation ratio, which is considered because customers' main obligation to the banks is deposit, and can therefore be used as a measurement of financial inclusion. The supply (banks) side is represented by ATM per 100,000 and bank branches per 100,000 persons; these are considered because they constitute how banks financially include customers.

In the notion of Nwobia, Adigwe, Ezu, and Okoye (2020), cybersecurity threats emanate from the amount of losses associated with the use of financial technology such as ATM, POS, e banking, etc. Therefore, this study proxies cybersecurity threats by the amount of losses resulting from ATM and POS. The raw data on these variables were collected from the Nigeria Electronic Fraud Forum (NeFF), and the World Bank Development Indicator through https://databank.worldbank.org/, over a sample period from 2013 to 2023 on an annual scale. The choice of this period is influenced by the scarcity of data. However, the data are decomposed into monthly figures to increase the quality of the regression outputs.

3.2 Estimation Techniques

A linear dynamic multivariate time-series relationship is introduced to show a causal influence from cybersecurity threats to inclusive finance. This provides an avenue to test the hypotheses that cybersecurity threats negatively impact the supply side and demand side of financial inclusion.

Additionally, a unit root test is conducted to establish the order of integration and purported co-integration to confirm whether a long relationship exists between financial inclusion and cybersecurity threats. Again, the estimation of the long-run and short-run dynamic relationships between the variables of interest using the OLS method is conducted. Robustness checks are conducted by further using the 2SLS and GMM methods to facilitate results comparability and subsequently establish their integrity.

Finally, to account for confounding effects or Simpson's paradox, the study controls for secure internet servers and individuals using the internet. Controlling for these two variables can enhance the quality of regression outputs.

3.3 Model Specification

Thus, econometrically and in the spirit of Nwobia, Adigwe, Ezu, and Okoye (2020), the underlying methodological relationship is defined in two blocks.

Block One- This refers to the supply side of financial inclusion. It comprises ATM per 100,000 persons and bank branches per 100,000 persons. Thus:

$$atmp_t = \alpha_0 + \alpha_1 lossatm_t + \alpha_2 losspos_t + \alpha_3 sis_t + \alpha_4 iui_t + u_t; \quad 3.1$$

$$bbp_t = \phi_0 + \phi_1 lossatm_t + \phi_2 losspos_t + \phi_3 sis_t + \phi_4 iui_t + w_t; \quad 3.2$$

Block Two- This concerns the demand side of financial inclusion. It is restricted to only one variable deposit rate to the cost of intermediation ratio. Thus:

$$dcir_t = \theta_0 + \theta_1 lossatm_t + \theta_2 losspos_t + \theta_3 sis_t + \theta_4 iui_t + v_t; \quad 3.3$$

Where: $atmp_t$ ATM per Persons 100000 bbp_t -bank branch per 100,000 persons, $dcir_t$ *-ratio of* deposit rate to cost of intermediation, $lossatm_t$ -loss associated with ATMs as a source of threat to customers, $losspos_t$ loss associated with POS as a source of threat to customers, sis_t -secur internet server and $iuis_t$ -individual using the internet.

In general form, the model can be restated using the VAR specification of lag 1:

$$y_t = \lambda + \rho y_{t-1} + \varepsilon_t; \varepsilon_t \sim IID(0, \delta_\varepsilon^2) \quad 3.4$$

Where: y_t is the vector of all the variables of interest in each equation specified above, ε_t is t the contemporary disturbances that is normally distributed with zero mean and constant variance.

Scaling equation 3.4 gives rise to VECM, as shown below.

$$\Delta y_t = \eta + \psi \Delta y_{t-1} + \varphi y_{t-1} + \mu_t; \quad 3.5$$

Where: The vector Ψ are the coefficients of the short-run dynamics and the vector ϕ are the long-run elaasticity coefficients.

The study proposes to estimate the weights or coefficients of equation 3.5 using the OLS, 2SLS, and GMM estimation procedures.

IV. RESULTS

The variables employed for this study are described using descriptive statistics. These variables are ATM per 100,000 persons (ATM), bank branch per 100,000 persons (BBP), ratio of deposit rate to cost of intermediation (DCIR), loss associated with ATM as a source of threat to customers (LOSSATM), loss associated to POS as a source of threat to customers (LOSSPOS), secure internet server (SIS), and individual using the internet (% of population) (IUI). Table 1 reports the outputs of the results obtained.

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Skewness	Kurtosis
ATM	16.30480	0.678575	-2.395444	9.871839
BBP	4.727456	0.453806	1.320423	3.511589
DCIR	1.000244	0.264830	-0.273598	1.845968
LOSSATM	4.31E+08	1.11E+08	-1.832106	5.332971
LOSSPOS	2.19E+08	92580777	-0.450461	1.998983
SIS	16717.33	12303.95	0.334944	2.346912
IUI	38.39442	12.44011	-0.126493	1.475448

Source: E-View 12 Output

In the table above, the descriptive statistics of the variables used in this study are explained. The average value, standard deviation, skewness value, and kurtosis value are presented.

Table 2: Normality Test Result

Variable	Jarque Bera	Lilliefors (D)	Cramer-von Mises (W2)	Watson (U2)	Anderson Darling (A2)
ATM	35.80(0.00)	0.31(0.00)	1.77(0.00)	1.56(0.00)	9.82(0.00)
BBP	36.48(0.00)	0.18(0.00)	1.60(0.00)	1.37(0.00)	9.26(0.00)
DCIR	8.22(0.02)	0.12(0.00)	0.29(0.00)	0.28(0.00)	2.09(0.00)
LOSSATM	95.13(0.00)	0.33(0.00)	3.68(0.00)	3.36(0.00)	18.67(0.00)
LOSSPOS	9.14(0.01)	0.20(0.00)	0.89(0.00)	0.85(0.00)	4.67(0.00)
SIS	4.41(0.11)	0.12(0.00)	0.47(0.00)	0.46(0.00)	3.31(0.00)
IUI	12.04(0.002)	0.15(0.00)	0.66(0.00)	0.65(0.00)	4.43(0.00

Source: E-View 12 Output.

Table 2 shows the normality results of all the variables using the Jarque-Bera, Lilliefors, Cramer- Mises (W2), von, Watson (U2), and Anderson Darling (A2). The tests were conducted under the null hypothesis that the series follows a normal distribution. From these results, only the secure internet server (sis) series is normally distributed when considering the output of the Jarque-Bera statistics. All the other variables series do not follow a normal distribution. Nevertheless, according to the Central Limit Theorem (CLT), rejection of normality does not matter in this study since the sample size is asymptotically large.

4.2 Unit Root Test

The test for unit root is conducted using the Augmented Dickey-Fuller (ADF), Philip-Peron (PP), and Kwiatkowski-Phillips-Schmidt-Shin test statistic (KPSS) method on the variables of interest. The summary of the results is presented in Table 3 below:

Table 3: Unit Root Test Result

Variable	ADF	PP	KPSS
ATM	2.99(1.94)	2.99(1.94)	0.14(0.15)
BBP	2.05(1.94)	2.12(1.94)	0.09(0.15)
DCIR	2.44(1.94)	2.56(1.94)	0.13(0.46)
LOSSATM	2.83(1.94)	2.83(1.94)	0.37(0.46)
LOSSPOS	3.14(1.94)	3.24(1.94)	0.24(0.46)
SIS	2.16(1.94)	2.16(1.94)	0.16(0.46)
IUI	1.05(1.94)	1.05(1.94)	0.30(0.46)

Source: E-View 12 Output.

Note: The critical values are enclosed in parentheses to indicate their significance levels.

The stationarity test results for all the variables of the study are presented in Table 3 above. The Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) test, and Kwiatkowski Phillips-Schmidt-Shin (KPSS) tests were employed to assess stationarity. The test statistics are provided together with their respective critical values in parentheses. The values of the ADF statistics and PP statistics for all the variables are greater than their critical statistics at a 5% alpha value. Thus, the null hypothesis is rejected, meaning the series are all stationary. This is supported by the result of the KPSS. Therefore, there is a strong indication that all the variables of interest in this study are I(1) variables. In this regard, we proceed to conduct a multivariate co-integration test by Johansen.

4.3 Co-integration Test

The three models of this study are tested thus; 1, whether there is a long-run relationship between the number of ATM per 100,000 persons and cyber security threat (loss associated to ATM as a source of threat to customers, and loss associated with POS as a source of threat to customers). 2, whether there is a long-run relationship between bank branches per 100,000 persons and cyber security threat (loss associated with ATM as a source of threat to customers, and loss associated with POS as a source of threat to customers). 3, if there is a long-run relationship between the ratio of deposit rate to cost of intermediation and cybersecurity threats (loss associated with ATM as a source of threat to customers, and loss associated with POS as a source of threat to customers). The following are the test results, which are based on trace statistics and maximum Eigen statistics.

Table 4: Test Results of no Cointegrating Relationship between the number of ATMs per 100,000 people and cyber security threat

Hypothesized no CE's	Eigenvalue	Trace-Stat	5% Critical	Max-Eigen	5% Critical
		Stat	Value	Stat	Value
None *	0.147106	42.08415	35.19275	18.77612	22.29962
At most 1 *	0.113991	23.30803	20.26184	14.28133	15.8921
At most 2	0.073645	9.026701	9.164546	9.026701	9.164546

Source: E-View 12 Output. Note: To each statistic, there is a correspondent critical value at 5%, and start rejecting until you do not reject. Also, the Trace test indicates 1 cointegrating eqn(s) at the 0.05 level and the Max eigenvalue test indicates no cointegrating eqn(s) at the 0.05 level.

In Table 4 above, the variables tested for their cointegrating relationship are the supply side of financial inclusion (the number of ATMs per 100,000 persons) and cybersecurity threat (loss associated with ATM as a source of threat to customers, and loss associated with POS as a source of threat to customers). As reported above, the Eigenvalue is respectively less than one, meaning that the system containing these three variables is stable. The eigenvalues indicate system stability, this supports a cointegrating relationship. Further tests by trace statistic also confirm that the null hypothesis of no cointegration is rejected at a 5% level of significance because the trace statistic is larger than the corresponding 5% critical value. There is also evidence of one cointegrating equation and one cointegrating rank. This means that cybersecurity threat maintains a long-run relationship with the supply side of financial inclusion.

Table 5: Test Results of No Cointegrating Relationship between the Bank Branches per 100,000 Persons and Cyber Security Threat

Hypothesized no CE's	Eigenvalue	Trace-Stat	5% Critical	Max-Eigen	5% Critical
		Stat	Value	Stat	Value
None *	0.133886	29.31556	24.27596	16.96119	17.7973
At most 1 *	0.099318	12.35437	12.3209	12.34313	11.2248
At most 2	9.53E-05	0.011244	4.129906	0.011244	4.129906

Source: E-View 12 Output. Note: To each statistic, there is a correspondent critical value at 5%, and start rejecting until you do not reject. Also, the Trace test indicates 1 cointegrating eqn(s) at the 0.05 level and the Max eigenvalue test indicates no cointegrating eqn(s) at the 0.05 level.

Table 5 shows that the trace statistic under the assumption of at most 1 cointegrating equation is approximately 12.35 and the associated critical value of 12.32. This implies that the null hypothesis of no cointegration is rejected. However, under the Maximum Eigen statistics, we do not reject the null hypothesis of no cointegration, thus, we go with the result of the trace statistics. There is therefore a long-run relationship between the supply side of financial inclusion (bank branches per 100,000 persons) and cybersecurity threats (loss associated to ATM as a source of threat to customers, and loss associated with POS as a source of threat to customers).

Table 6: Test Results of no Cointegrating Relationship between the Ratio of Deposit Rate to Cost of Intermediation and Cyber Security Threat

Hypothesized no CE's	Eigenvalue	Trace-Stat	5% Critical	Max-Eigen	5% Critical
		Stat	Value	Stat	Value
None *	0.271784	56.18261	35.01090	35.20456	24.25202
At most 1 *	0.172132	20.97806	18.39771	20.96806	17.14769
At most 2	9.01E-05	0.009997	3.841465	0.009997	3.841465

Source: E-View 12 Output. Note: To each statistic, there is a correspondent critical value at 5%, and start rejecting until you do not reject. Also, the Trace test indicates 1 cointegrating eqn(s) at the 0.05 level and the Max eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level.

The variables of cybersecurity threat and the demand side of financial inclusion, cointegrating relationship loss associated to ATM as a source of threat to customers, and loss associated to POS as a source of threat to customers, and ratio of deposit rate to cost of intermediation. As seen above the Eigenvalue is respectively less than one, this implies that the system containing these three variables is stable. Additionally, the test of no cointegration is rejected because the trace statistic (56.18) is larger than the 5% critical value (35.01). At the same time, the maximum Eigen statistic (35.21) is larger than the 5% critical value (24.25). However, we cannot reject the hypothesis that there is only one cointegrating vector because the trace statistic and the maximum Eigen statistic are respectively smaller than their associated critical values. This indicates that the null hypothesis of no cointegration is refuted. Based on the result of the trace statistic and the maximum Eigen statistic, we can equally state that for the null hypothesis, there is only one cointegrating vector that cannot be rejected. Therefore, there is a presence of a long-term

relationship between the demand side of financial inclusion (ratio of deposit rate to cost of intermediation) and loss associated with ATM as a source of threat to customers, and loss associated with POS as a source of threat to customers proxies for cybersecurity threat.

4.4 Testing the Nature of the Long-Run Relationship

The co-integration test conducted earlier has shown that financial inclusion and cybersecurity threats have a long-term relationship. Therefore, there is a need to investigate the nature of this long-run relationship. When referring to the nature of a relationship, we mean that a rise in any one of the losses associated with ATM or POS causes the supply side/demand side of financial inclusion to change in one or the other direction by a specific percentage. Therefore, three methods were employed in this study, these methods are OLS, 2SLS, and GMM. The essence of employing these three methods is to establish a robustness check or to confirm the certainty of the nature of the long-run relationship. The results are presented in Tables 7, 8, and 9 for the three equations/models.

Table 7: The Nature of the Long Run Relationship between the Number of ATMs per 100,000 Persons and Cyber Security Threat

	OLS		2SLS		GMM	
Variable	Coeff	PV	Coeff	PV	Coeff	PV
LOSSATM	0.110421	0.000	0.110421	0.000	0.110421	0.000
LOSSPOS	0.017795	0.0001	0.017795	0.0001	0.017795	0.0175
IUI	-0.054328	0.000	-0.054328	0.000	-0.054328	0.000
SIS	-0.001252	0.4738	-0.001252	0.4738	-0.001252	0.5817
C	0.203716	0.000	0.203716	0.000	0.203716	0.0085
Adjusted R-squared	0.894331		0.894331		0.894331	

Source: E-View 12 Output. Note: PV is the probability value. Also, because this is a time series analysis, the instruments used for 2SLS and GMM estimator are predetermined variables (lag/previous value of the dependent variable)

Table 7 displays the results of the long-run relationship between the number of ATMs per 100,000 persons and cyber security threats (loss associated with ATM (LOSSATM) and loss associated with POS (LOSSPOS). The coefficient of LOSSATM is approximately 0.11 or 11% with a corresponding probability value of 0%. This implies that there is a positive and significant relationship between these variables, this relationship is significant at a 1% alpha value. This result shows that despite the loss recorded from using ATMs, the number of ATMs per 100,000 persons is still increasing. Banks' customers are still using the ATM (an instrument of financial inclusion). The coefficient of LOSSPOS is also positive, which suggests that this threat factor moves in the same direction as the supply side of financial inclusion (the number of ATMs per 100,000 persons). It is noted that the three estimators yielded the same outcome, thus, the cybersecurity threat has a direct relationship with the supply side of financial inclusion.

Table 8: The Nature of the Long-Run Relationship between the Bank Branches per 100,000 Persons and Cyber Security Threat OLS 2SLS GMM

	OLS		2SLS		GMM	
Variable	Coeff	PV	Coeff	PV	Coeff	PV
LOSSATM	-0.08646	0.000	-0.08646	0.000	0.08646	0.0001
LOSSPOS	0.023349	0.0002	0.023349	0.0002	0.023349	0.0795
IUI	-0.078466	0.000	-0.078466	0.000	-0.078466	0.0002
SIS	-0.029107	0.000	-0.029107	0.000	-0.029107	0.000
C	1.460583	0.000	1.460583	0.000	1.460583	0.000
Adjusted R-squared	0.951233		0.951233		0.951233	

Source: E-View 12 Output. Note: In the study, the results yielded by the OLS were confirmed using the 2SLS and the GMM. The reason for this confirmation is to see if the parameter for these methods changes or remains the same. Since the parameter remained the same, there is strong evidence that the relationship exists. If the parameter had changed, the inconsistency would have been reported.

One output of the test on the nature of the long-run relationship between the supply side of financial inclusion (bank branches per 100,000 persons) and cyber security threats is reported in the above table. The results of the three estimators reveal that LOSSATM has a negative and significant influence on bank branches per 100,000 persons, this implies that loss associated with the use of ATM moves in the opposite direction with bank branches per 100,000 persons; meaning a 1% decrease in ATM losses will lead to about 0.1 or 10% increase in bank branches per 100,000 persons. The three-estimation techniques produced the same output, for variable LOSSPOS has a positive coefficient of approximately 0.02 or 2% and this shows that this variable has a weak but positive impact on the supply side of financial inclusion. As the loss from POS increases, bank branches per 100,000 persons also increase in the long run. The results from OLS and 2SLS methods show that LOSSPOS has a significant influence on bank branches per 100,000 persons at a 1% alpha value while the GMM method shows that these variables are significantly related at a 10% alpha value.

Therefore, these results reveal that as the threat of using POS increases, people prefer to use the bank, so branches' transactions increase. Furthermore, as loss in ATM usage increases, banks' customers withdraw from the bank which in the long run will lead to a decrease in the number of bank branches.

Table 9: The Nature of the Long Run Relationship between the Ratio of Deposit Rate to Cost of Intermediation and Cyber Security Threat

	OLS		2SLS		GMM	
Variable	Coeff	PV	Coeff	PV	Coeff	PV
LOSSATM	0.064104	0.5719	0.064104	0.5719	0.064104	0.6251
LOSSPOS	0.097933	0.1471	0.097933	0.1471	0.097933	0.2971
IUI	-0.928349	0.000	-0.928349	0.000	-0.928349	0.0003
SIS	0.079538	0.0039	0.079538	0.0039	0.079538	0.0661

C	-0.245075	0.7191	-0.245075	0.7191	-0.245075	0.6843
Adjusted R-squared	0.420563		0.420563		0.420563	

Source: E-View 12 Output

The coefficients for loss associated to ATM as a source of threat to customers (LOSSATM), and loss associated to POS as a source of threat to customers (LOSSPOS) are approximately 0.06, and 0.10 respectively. ATM and POS losses are positively impacting the ratio of deposit rate to cost of intermediation, this is contrary to a-priori expectation, nevertheless, this positive impact is very weak and insignificant in the long run.

4.5 Testing the Short-Run Dynamic Relationship between the supply and demand sides of Financial Inclusion and Cybersecurity threat

Examining the short-run dynamic influence from loss associated with ATM as a source of threat to customers (LOSSATM), and loss associated with POS as a source of threat to customers (LOSSPOS) to supply and demand sides of financial inclusion is another crucial aspect of this study. The findings summary is reported in Tables 10, 11, and 12 respectively.

Table 10: Short Run Dynamic on the Relationship between the Number of ATMs per 100,000 Persons and Cyber Security Threat

	OLS		2SLS		GMM	
Variable	Coeff	PV	Coeff	PV	Coeff	PV
DATM(-1)	0.73542	0.000	0.73542	0.000	0.73542	0.000
DLOSSATM	0.255674	0.000	0.255674	0.000	0.255674	0.0001
DLOSSATM(-1)	-0.200008	0.000	-0.200008	0.000	-0.200008	0.0006
DLOSSPOS	0.007944	0.000	0.007944	0.000	0.007944	0.0469
DLOSSPOS(-1)	0.00011	0.9233	0.00011	0.9233	0.00011	0.9674
DIUI	-0.042583	0.0129	-0.042583	0.0129	-0.042583	0.012
DSIS	-0.002022	0.0242	-0.002022	0.0242	-0.002022	0.067
C	0.000101	0.5651	0.000101	0.5651	0.000101	0.4607
Adjusted R-squared	0.955815		0.955815		0.955815	

Source: E-View 12 Output

The changes in the number of ATMs per 100,000 persons (DATM(-1)), DLOSSATM, DLOSSATM (-1), DLOSSPOS, DLOSSPOS(-1) are approximately 0.74, 0.26, -0.20, 0.01, and 0.00011 respectively. This means that ATM at lag one has a positive short-run effect on the current ATM. Similarly, loss associated with POS as a source of threat to customers (LOSSPOS) at lag one, current LOSSPOS, and current LOSSPOS have a positive short-run effect. That is, there is a dynamic short-run positive influence from LOSSPOS at lag one, current LOSSPOS, and current LOSSATM to the supply side of financial inclusion. Nevertheless, LOSSATM at lag one has a negative coefficient. This indicates that there is a short-run dynamic from previous LOSSATM to the supply side of financial inclusion. Furthermore, only the short-run dynamic effect from LOSSPOS at lag one to the supply side of financial inclusion is not significant across the three techniques.

Table 11: Short Run Dynamic on the Relationship between Bank Branches per 100,000 Persons and Cyber Security Threat

	OLS		2SLS		GMM	
Variable	Coeff	PV	Coeff	PV	Coeff	PV
DBBP(-1)	0.898039	0.000	0.898039	0.000	0.898039	0.000
DLOSSATM	0.040837	0.4213	0.040837	0.4213	0.040837	0.5254
DLOSSATM(-1)	-0.043026	0.3275	-0.043026	0.3275	-0.043026	0.4481
DLOSSPOS	0.002706	0.3988	0.002706	0.3988	0.002706	0.3888
DLOSSPOS(-1)	0.000663	0.7428	0.000663	0.7428	0.000663	0.7689
DIUI	-0.051404	0.1173	-0.051404	0.1173	-0.051404	0.2928
DSIS	0.001405	0.4112	0.001405	0.4112	0.001405	0.4586
C	0.000201	0.5381	0.000201	0.5381	0.000201	0.4889
Adjusted R-squared	0.836663		0.836663		0.836663	

Source: E-View 12 Output

As shown in the table above, the value of bank branches per 100,000 persons (DBBP (-1)), loss associated to ATM as a source of threat to customers, (DLOSSATM), loss associated with ATM as a source of threat to customers (DLOSSATM(-1)) at lag one, loss associated to POS as a source of threat to customers (DLOSSPOS), and loss associated to POS as a source of threat to customers at lag one (DLOSSPOS(-1)) are approximately 0.90, 0.04, -0.04, 0.003 and 0.001 respectively. All these variables except LOSSATM at lag one have a positive short-run effect on bank branches per 100,000 persons (supply side of financial inclusion). Thus, in the short run, these variables play a positive role on the supply side of inclusive finance.

Table 12: Short Run Dynamic on the Relationship between Ratio of Deposit Rate to Cost of Intermediation and Cyber Security Threat

	OLS		2SLS		GMM	
Variable	Coeff	PV	Coeff	PV	Coeff	PV
DDCIR(-1)	0.847403	0.000	0.847403	0.000	0.847403	0.000
DLOSSATM	0.066841	0.8679	0.066841	0.8679	0.066841	0.9313
DLOSSATM(-1)	-0.016604	0.9622	-0.016604	0.9622	-0.016604	0.9806
DLOSSPOS	-0.053316	0.037	-0.053316	0.037	-0.053316	0.0646
DLOSSPOS(-1)	0.019199	0.2366	0.019199	0.2366	0.019199	0.2223
DIUI	-0.471442	0.073	-0.471442	0.073	-0.471442	0.1492
DSIS	0.013654	0.2893	0.013654	0.2893	0.013654	0.5044
C	0.002498	0.3424	0.002498	0.3424	0.002498	0.4454
Adjusted R-squared	0.783919		0.783919		0.783919	

Source: E-View 12 Output

The changes in cybersecurity threats to the demand side of financial inclusion are observed at lag one only. In the above table, the coefficient of the ratio of deposit rate to cost of intermediation at lag one DDCIR(-1) is approximately 0.85 with a probability value of zero. This implies that within the short-run dynamic, changes in the ratio of deposit rate to cost of intermediation respond positively to the previous ratio of deposit rate to cost of intermediation. Loss associated with ATM as a source of threat to customers (LOSSATM) at lag one and loss associated with POS as a source of threat to customers (LOSSPOS) have negative coefficients, while the coefficients of loss associated with POS as a source of threat to customers (LOSSPOS) at lag one and loss associated to ATM as a source of threat to customers (LOSSATM) are positive, indicating a system that is not stable. In the same view, LOSSPOS at lag one and LOSSATM have a positive short-run effect on the demand side of financial inclusion. However, LOSSATM at lag one and LOSSPOS have negative short-run influence on the demand side of financial inclusion. The value of the Adjusted R-square is approximately 0.78. This suggests that the regressors have a joint effect of about 78% on the regressands.

V. CONCLUSION

There exists a long-run relationship between cybersecurity threats and both the supply and demand sides of financial inclusion. The research sheds light on the nuanced dynamics between cybersecurity threats and financial inclusion, revealing both expected and unexpected relationships. Contrary to prior assumptions, for example, the studies of Demirgüç-Kunt et al., 2018, Bouveret, 2018; Faccia and Petratos, 2021; Johri and Kumar, 2023; Ohiani, 2020 and Onunka, et al. 2023) claimed that cybercrime has a negative impact on users of financial products. Also, the study of Malladi et al., (2021) showed that inclusive finance can be hindered because of unguarded digital platforms. This study however finds a positive long-run relationship between cybersecurity threats and the demand side of financial inclusion, challenging conventional wisdom that human beings naturally tend to avoid whatever exposes them to financial or economic losses, thus prompting a re-evaluation of existing frameworks. This unexpected finding underscores the complexity of the relationship between cybersecurity and financial inclusion, highlighting the need for a more nuanced understanding of the underlying mechanisms at play.

The nature of the long-run relationship between cybersecurity threats and the supply side of financial inclusion is significant, this practically implies that the more the banks roll out financial inclusion tools, the higher the spate of fraud. This indicates that financial institutions need to allocate resources to enhance cybersecurity infrastructure**.** Moreover, the importance of considering cybersecurity threats in the context of financial inclusion, particularly in emerging economies like Nigeria is demonstrated in this study. With the rapid digitization of financial services and the increasing prevalence of cyberattacks, understanding the implications of cybersecurity threats on financial inclusion is paramount for ensuring the resilience and stability of the financial system.

Also, the nature of the short-run relationship between cybersecurity threats and both the supply and demand sides of financial inclusion varies, with a positive relationship observed for the supply side and an insignificant relationship for the demand side.

Therefore, based on the reality of modern business processes, especially with digital technology warehousing vast data for the provision of products and services to customers, it is indeed crucial to reassess the continuous relevance of the Theory of production. The traditional goal of the firm is to efficiently combine the factors of production to create products and services that will continually meet the ever-changing needs of customers; a role digital technology has now unconsciously sneaked into. Digital and/or financial technology has obviously dwarfed the essence of land and labour as factors of production, clearly revealing the outdatedness of the Theory of production.

This study recommends a review that will recognize digital technology as the fifth and indeed, a very critical factor of production to identify its characteristics and dynamics, understand its merits and demerits, and ultimately be able to devise measures that will safely alleviate its ravaging intrinsic threats on people's welfare, financial sector's survival and economic development generally.

REFERENCES

1. Acharya, S. and Joshi, S. (2020) "Impact of cyber-attacks on banking institutions in India: A study of safety mechanisms and preventive measures", *Palarch's Journal of Archaeology of Egypt/Egyptology 17(6)*, pp. 4656-4670, ISSN 1567-214x
2. Adeyemi, W. A. and Festus, O. O. (2022) "The effect of technology adoption on financial inclusion: a cross-country panel analysis between China and Nigeria", *European Journal of Business and Management Research*, 7(2), 1-11 DOI: http://dx.doi.org/10.24018/ejbmr.2022.7.2.1314
3. Aribake, F O. (2015) "Impact of ICT tools for combating cybercrime in Nigeria online banking: A conceptual review", *International Journal Trade, Economics and Finance* 6, pp. 272-277.
4. Attamah, N. (2019) "Effect of cybercrime on Nigeria's online banking system", *Journal of Applied Sciences* 5(1), pp. 72-79, www.iaajournals.org IAA
5. Bouveret, A. (2018) "Cyber risk for the financial sector: a framework for quantitative assessment", IMF Working Papers, 18 (143), Pp.1. https://doi.org/10.5089/9781484360750.001
6. Cook, J. (2023) *'If cybercrime was a country, it would be the world's third-largest economy after the U.S. and China' - Business Leader News, Business Leader*. Available at: https://www.businessleader.co.uk/interview-raluca-saceanu-ceo-smarttech247/.
7. David B.-G, Nicholas, L, and Emma, B. (2021) "The dynamics of business, cybersecurity, and cyber-victimization: foregrounding the internal guardian in prevention, victims & offenders", 16(3), 286-315, DOI: 10.1080/15564886.2020.1814468
8. Davis, F. D. (1989) "Perceived usefulness, perceived ease of use, and user acceptance of information technology", MIS Quarterly, 13(3), pp. 319-340.
9. Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., and Hess, J. (2018) "The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution", The World Bank.
10. Durai, T, and Stella, G. (2019) "Digital finance and its impact on financial inclusion", *Journal of Emerging Technologies and Innovative Research* (JETIR), 6(1), pp. 122-127.
11. Faccia, A., and Petratos, P. (2021) "Blockchain, Enterprise Resource Planning (ERP) and Accounting Information Systems (AIS): Research on e-Procurement and System Integration", https://scite.ai/reports/10.3390/app11156792
12. Fadairo-Cokers, O A and Ibrahim, G U. (2021) "Impact of Cybercrime on Selected Deposit Money Banks (DMBs) in the Federal Capital Territory (FCT)", *International Journal of Advanced Research in Statistics, Management, and Finance*. 8(1), pp. 176-188, 10.48028/iiprds/ijarsmf.v8.i1.12
13. Gustavo M V B A. (2023) "The effect of national cybersecurity commitment on financial inclusion", MSc Thesis, Georgetown University.
14. International Telecommunication Union (ITU). (2019), Global Cybersecurity Index (GCI) 2018. Retrieved from https://www.itu.int/en/ITU-D/Cybersecurity/Pages/GlobalCybersecurityIndex.aspx
15. Iwedi, M., Kocha, C., and Wike, C. (2022) "Effect of digitalization of banking services on the Nigerian economy", *Contemporary Journal of Banking and Finance*, 2(1), pp. 1-9.
16. Iwedi M., Owakah N. F., and Wofuru-Nyenke O. K. (2023) "Effect of financial technology on financial inclusion in Nigeria", *African Journal of Accounting and Financial Research* 3(1), pp.21-36. DOI: 10.52589/AJAFR-A7LQZBE9
17. Johri, A., and Kumar, S. (2023) "Exploring Customer Awareness towards Their Cyber

Security in the Kingdom of Saudi Arabia: A Study in the Era of Banking Digital Transformation", https://scite.ai/reports/10.1155/2023/2103442
18. Khan, A., Mubarik, M. S., and Naghavi, N. (2021) "What matters for financial inclusions? Evidence from emerging economy", *International Journal of Finance and Economics*, Pp. 821838 https://doi.or HYPERLINKn"https://doi.org/10.1002/ijfe.2451"g HYPERLINK "https://doi.org/ 10.1002 ijfe.2451"/10.1002/HYPERLINK "https://doi.org/10.1002/ijfe.2451"ij HYPERLINK "https://doi. org/10.1002/ijfe. 2451"fe.2451
19. Malladi, C. M., Soni, R. K., and Srinivasan, S. (2021) "Digital financial inclusion: Next frontiers —Challenges and opportunities". CSI Transactions on ICT, 9(2), pp. 127-134.
20. Nwobia, C.E., Adigwe, P. A., Ezu, G. K. and Okoye, J. N. (2020) "Electronic fraud and performance of deposit money banks in Nigeria: 2008-2018", *International Journal of Business and Management*, 15(6), pp. 126-136, doi:10.5539/ijbm.v15n6p126
21. Ohiani, A.S. (2020) "Technology innovation in the Nigerian banking system: prospects and challenges", *Rajagiri Management Journal*, 15 (1), Pp. 2-15. https://doi.org/10.1108/ramj-05- 2020-0018
22. Onunka, O., Alabi, A. M., Okafor, C. M., Obiki-Osafiele, A. N., Onunka, T. and Daraojimba, C. (2023) "Cybersecurity in U.S. and Nigeria Banking and Financial Institutions: Review and Assessing Risks and Economic Impacts". *Acta Informatica Malaysia*, 7(1), pp. 54-62
23. Ozili, P K. (2018) "Impact of digital finance on financial inclusion and stability", *Borsa Istanbul Review*, 18(4), 329–340, https://doi.org/ 10.1016/j.bir.2017.12.003
24. Rao, P. (2023) *Visualizing the $105 Trillion World Economy in One Chart, Visual Capitalist*. Available at: https://www.Visual capitalist.com/visualizing-the-105-trillion-world-economy in-one-chart/.
25. Sambuli, N, and Grossman, T. (2022) "Introducing CyberFI: Perspectives on cybersecurity, capacity development, and financial inclusion in Africa. Carnegie Endowment for International Peace", https://carnegieendowment.org/2022/05/02/introducing-cyberfi-perspectives-on cybersecurity-capacity-development-and-financial-inclusion-in-africa-pub-87001
26. Truong, Q. N. (2022) "Management strategies for digital transformation thrive in constant change", Master of Business Administration Thesis for a Master of Digital Business Management (UAS) - Degree Vaasa 2022.
27. Wonglimpiyarat, J and Khaemasunun, P. (2017) "Strategies of remodelling China towards an innovation-driven economy", *International Journal of Business Innovation and Research*, 12(2), pp. 175-188
28. World Bank Group. (2020) Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution. Retrieved from htt HYPERLINK "https://globalfindex.worldbank.org/"pHYPERLINK https://globalfindex.worldbank.org/"s://HYPERLINK"https://globalfindex.worldbank.org/"gHYPERLINK "https://globalfindex.worldbank.org/"lobalfindex.worldbank.orHYPERLINK "https://globalfindex.worldbank.org/"g HYPERLINK "https://globalfindex.worldbank.org/"/
29. Zuo, W. (2020) "The analysis of digital finance and digital inclusive finance discussion on impact, problems and suggestions", *Advances in Economics, Business and Management Research*, vol. 203, pp. 2151-2154.

Blockchain and AI in Reverse Logistics: A Qualitative Synthesis of Strategic Applications and Challenges

Meriem Bouzedif

ABSTRACT

Since the rapid growth of e-commerce, product returns volume has soared, creating pressure on reverse logistics systems to be more efficient, transparent and cost-effective. Nonetheless, the traditional reverse logistics processes are encountered with operational challenges such as high costs, return fraud, ineffective tracking systems, and environmental concerns. Mature AI and Blockchain Technologies allow businesses to automate various processes, make more informed decisions, and ensure that supply chain operations are transparent.

Based on case studies from leading global companies including Amazon, Walmart, and Alibaba, this study sheds light on the integration of AI and Blockchain in reverse logistics as an avenue for reverse logistics integration in overall supply chain strategy. Employing a qualitative methodology and secondary data sources, including industry reports, academic literature, and company publications, this study explores how these modern technologies are positively impacting return management processing, fraud detection, operational efficiency, and sustainability.

Keywords: reverse logistics, blockchain, artificial intelligence, e-commerce, supply chain optimization, returns management, fraud prevention, sustainability.

Classification: DDC Code: 658.7, 658.05

Language: English

Great Britain Journals Press

LJP Copyright ID: 146444
Print ISSN: 2633-2299
Online ISSN: 2633-2302

London Journal of Research in Management & Business

Volume 25 | Issue 4 | Compilation 1.0

Blockchain and AI in Reverse Logistics: A Qualitative Synthesis of Strategic Applications and Challenges

Meriem Bouzedif

ABSTRACT

Since the rapid growth of e-commerce, product returns volume has soared, creating pressure on reverse logistics systems to be more efficient, transparent and cost-effective. Nonetheless, the traditional reverse logistics processes are encountered with operational challenges such as high costs, return fraud, ineffective tracking systems, and environmental concerns. Mature AI and Blockchain Technologies allow businesses to automate various processes, make more informed decisions, and ensure that supply chain operations are transparent.

Based on case studies from leading global companies including Amazon, Walmart, and Alibaba, this study sheds light on the integration of AI and Blockchain in reverse logistics as an avenue for reverse logistics integration in overall supply chain strategy. Employing a qualitative methodology and secondary data sources, including industry reports, academic literature, and company publications, this study explores how these modern technologies are positively impacting return management processing, fraud detection, operational efficiency, and sustainability.

AI-powered automation greatly helps the companies in returns forecasting, inventory optimization, and customer service, unveiling the time and costs relating to reverse logistics operations as per the findings. Simultaneously, the implementation of blockchain technology allows for real-time tracking, fraud mitigation, and generation of trusted data for sharing, thereby enhancing return transactional transparency. Specifically, companies which combine both AI and blockchain, directly creates use cases leading to superior decision-making capabilities, more efficient logistics and support processes, as well as superior management of product returns.

While these technologies offer potential advantages, the study reveals critical hurdles in implementing these technologies, such as high deployment costs, regulatory obstacles, data privacy issues, and interoperability challenges among various blockchain systems. Moreover, it can also be quite challenging for companies to find the technical expertise needed to implement AI or blockchain in their logistics infrastructure. To the best of our knowledge, this research effort contributes to the literature on supply chain management and technology adoption by providing tested instruments and best practice options for businesses that seek to enhance their reverse logistics operations through the application of technologies. The study also aids theory and practice by illustrating some policies for adoption challenges and offering managerial recommendations for firms. These insights need to be validated and refined through empirical research and industry application of AI and blockchain in the context of reverse logistics (Wang et al., 2018; Kafeel et al., 2023).

Keywords: reverse logistics, blockchain, artificial intelligence, e-commerce, supply chain optimization, returns management, fraud prevention, sustainability.

Author: Master Student in MBA, Barcelona, Spain.

London Journal of Research in Management & Business

I. INTRODUCTION

1.1 Background: The Growth of Reverse Logistics in E-Commerce

The surge in e-commerce has significantly altered the dynamics of global supply chains, introducing more complexity and an escalating volume of reverse logistics activities. Reverse logistics is a supply chain process, which deals with the return of goods, repairs, recycling, remanufacturing, and disposal of packaging, helping to ensure returned goods are effectively reintegrated into the supply chain. Whereas forward logistics deals with the flow of product from manufacturers to consumers, reverse logistics pertains to the retrieval, inspection, reprocessing and redistribution of products in a more cost-effective and sustainable way (Rogers & Tibben-Lembke, 2001).

Over the past few years, consumer behaviors have vastly changed, with increased expectations for easy return processes in-place. This increased return rates in multiple industries, most commonly in fashion (30–40%), electronics (20–30%), and home goods (15–25%) (Deloitte, 2023). While in the same year, return merchandise cost businesses nearly $816 billion in lost sales in the United States alone (National Retail Federation, 2023) highlighting the need for businesses to improve their reverse logistics process.

However, the plan of producing a new mattress from your old one also falls under the umbrella of reverse logistics, and as e-commerce continues to grow, and more people are aware of sustainability issues and pertinently the circular economy (Statista, 2024), as well as tighter policy framework adopted by governments, it is evidence that the global reverse logistics market is expected to reach meeting 1.6 trillion dollars by the year 2030. Efficient reverse logistics can improve customer satisfaction, lower operating costs, and further sustainability initiatives, but many companies face challenges in processing returns efficiently.

1.2 Readjusting Reverse Logistic Challenges: Conflict, Elongated Timelines, and Escalated Expenditures

Although its importance is increasing, reverse logistics still has various operational, financial, and technological problems and it is the most resource-consuming part of supply chain management (Govindan et al., 2015). Some of the biggest issues are:

1.2.1 High Costs and Profitability Constraints

- The returns management process entails multiple steps including transportation, inspection, restocking, refurbishing and reselling all of which incur costs in terms of labor, warehousing and administration.
- According to several studies, return processing costs can amount to 20–30% of a product's original price, and reverse logistics is considered a significant expense for retailers (Gao et al., 2024).
- Recapturing value from returned goods is extremely challenging for many businesses, especially when the product is damaged, counterfeit, or unsellable.

1.2.2 Return Fraud and Abuse

- The cost of return fraud for businesses runs into the billions of dollars each year, with some common schemes including:
  - Wardrobing: Customers buy, use and return products.
  - Receipt Fraud: Customers submit counterfeit or copied receipts for refunds.
  - Fake Returns: Crooked customers send back cheap knockoff versions of their product.
- According to research, about 10% of all returns have some sort of fraudulent element, which can be a significant cost area for retailers (PwC, 2023).

1.2.3 Inefficient and Fragmented Processes

Conventional manual return management systems complicate lead times, errors, and diversity in supply chain networks (Guide & Van

Wassenhove, 2009). • More specifically, poor visibility in the reverse logistics process results in misplaced items, incorrect inventory reporting, and missed resale opportunities. • Processing returns is complicated because many companies do not have standard policies for returns across multiple sales channels.

1.2.4 Environmental and Sustainability Issues

- The Return of Products adds substantially to carbon footprints because each year landfills receive 5 billion pounds of returned merchandise (Optoro, 2022).
- The inefficient process of handling returns leads to increased waste output as well as unsustainable packaging usage thus contravening sustainability targets.
- The Circular Economy Action Plan of the European Union (European Commission, 2023) forces businesses to adopt environmentally sustainable reverse logistics practices.

1.3 Emerging Technological Solutions: Automation and Transparency Using AI and Blockchain

Blockchain and AI together have evolved as an effective solution to overcome reverse logistics inefficiencies. They have benefits in automating processes, preventing fraud, tracking in real time and making decisions (Tsolakis et al., 2023).

1.3.1 Artificial Intelligence (AI) Applications in Reverse Logistics

Predictive Analytics: AI systems use machine learning algorithms to predict returns patterns, optimize inventory levels, and prevent overstocking. • Intelligent Return Management: AI-enabled chatbots and RPA streamline the return approval process and communication with clients while keeping human input to a minimum.

AI for Fraud Detection: By analyzing patterns of returns, exceptions, behavior, and more, AI systems can detect fraudulent transactions in real-time.

AI Image Quality Check | Computer Vision Automated image quality inspections for returned items | Measuring the level of damage | Automation of the restocking decisions

1.3.2 Blockchain Applications in Reverse Logistics

- Blockchains provide a decentralized ledger for all the return transactions and make it tamper-proof and visible.
- Smart Contracts: Automated self-executing agreements that process refunds by e.g. validating whether returns meet conditions (Saberi et al., 2019).
- Supply Chain Collaboration: Blockchain allows retailers, manufacturers, and logistics providers to share information in real-time, enhancing operational efficiency.

1.3.3 The AI-Blockchain Synergy

- When used together, AI and blockchain forms an intelligent and fraud-proof reverse logistics system that allows businesses to:
  - Lower operational costs via automation.
  - Blockchain-based tracking to increase security and transparency o Increased customer satisfaction for a better and smoother return experience.

1.4 Aim and Objectives of the Research

The objective of this study is to explore how global firms are integrating the use of AI and blockchain into their reverse logistics strategies with the potential of enhancing efficiency, eliminating fraud and improving decision-making. The research objectives are:

- To explore the effect of AI and blockchain on reverse logistics efficiency.
- To explore the advantages and disadvantages of implementing these technologies.
- To capture best practices from global firms applying AI and blockchain in return management.

1.5 Research Questions

In realizing these aims, the study seeks to answer the following key research questions:

1. In what ways do AI and blockchain promote efficiency in reverse logistics?
2. What are the advantages and disadvantages when these technologies are used in return management?
3. What lessons can be learned from global firms that overturned the use of AI and blockchain in reverse logistics?

1.6 Structure of the Paper

The paper is structured as follows:

Section 2 (Literature Review) investigates fundamental theories, models, and previous studies related to AI, blockchain, and reverse logistics.

Section 3 (Methodology) provides details regarding the research design, case study selection, data sources, and analytical approach.

Section 4 (Case Study) analyze various global firms using AI and blockchain in reverse logistics.

Section 5 (Findings and Discussion) draws on insights from the case studies to explore the benefits, challenges, and best practices identified.

Section 6 (Conclusion and Recommendations) which contains the summary of key findings, managerial implications and future research directions.

II. LITERATURE REVIEW

2.1 Reverse Logistics in E-Commerce: Definition, Importance, and Challenges

Reverse logistics is the activities that deal with the return of goods including the disposal, recycling, repair, and remanufacturing of products, reintegrating into the supply chain (Rogers & Tibben-Lembke, 2001). In the field of e-commerce, reverse logistics is a key element in the operations of a company based on the rapidly growing number of returns with considerable effects on profitability, efficiency of operations, and environmental sustainability (Govindan et al., 2015).

2.2 The Rising Significance of Reverse Logistics

The explosion of e-commerce has driven a skyrocketing rate of product returns in some high-returns industries, including fashion, electronics, and consumer goods (Gao et al., 2024). NRF (2023) states that return rates in e-commerce can even reach as high as 30%, being one of the most significant pain points for retailers. Some of the major reasons to implement effective reverse logistics strategies are:

- Customer satisfaction & competitive advantage: An easy return process can drive brand allegiance and further purchases (Sharma et al., 2024).
- Financial & Operational Efficiency: Companies that maximize returns will decrease processing costs, restocking inefficiencies, and scrap (Deloitte, 2023)
- Sustainability & Circular Economy Practices: In the effort to develop models that minimize exclusion and maximize the well-being of all, various governments and organizations are highlighting waste reduction, resource recovery, and green supply chain initiatives as priorities, establishing reverse logistics as an integral component of sustainable operations (European Commission, 2023).

2.3 Blockchain and IoT Integration in Reverse Logistics

Reverse logistics with leveraging blockchain and IoT can solve some issues of the current process. For example, Hrouga et al., (2022) illustrate based on a detailed case study how the complementary relationship of these technologies can improve traditional reverse supply chains. As positive characteristics, blockchain can provide an unchangeable and decentralized ledger system that can lead to better data integrity and more secure interactions between stakeholders. Additionally, Internet of Everything (IoT) devices make tracking returned goods in real-time easy, lending visibility to the condition and location of items throughout the reverse logistics cycle. Collectively, these technologies address widespread challenges ranging from information

asymmetry, to counterfeit returns and manual data entry, all of which negatively impact operational performance. Hrouga et al. (2022) point out that the environmental impact of digitalizing reverse logistics can be significant because better-quality data enables companies to pursue eco-friendly and circular economy goals.

2.4 Current Status and Challenges of Blockchain in Reverse Logistics

Though there is considerable opportunity for the augmentation of reverse logistics with blockchain technology, the implementation is not free from practical and strategic challenges. Kumar et al. (2021) describe the current state of blockchain adoption in reverse logistics and outline where its adoption to solve common reverse logistics problems such as traceability problems, distrust between parties involved, inefficiencies of the system, and management inside a company could benefit from it. The study also reflects into block chain's trust-building potential in product authentication and across the-board return processing. It also highlights significant downsides such as high implementation costs, scalability concerns and regulatory ambiguity. Concordantly, Naseem et al. (2023) focuses on fuzzy Analytic Hierarchy Process (AHP) to prioritize the significant obstacles of blockchain adoption. Evidence demonstrates that technological complexity, organizational unpreparedness, and low awareness among supply chain actors are significant barriers. Again, developments in the areas mentioned here prove the need for strategic alignment, governmental patronage and engagement across the sectors in order to lay the groundwork to enable the successful perspective of application of Blockchain towards reverse logistics.

2.5 The Role of Artificial Intelligence in Reverse Logistics Optimization

AI offers unique capabilities to process significant volumes of data to predict trends and automate decision-making, which is becoming more evident to its role to revolutionize reverse logistics. Sharma et al. (2024) explore AI-enabled reverse logistics focusing on the context of developing economies where logistical inefficiencies are likely to be more pronounced. According to them 'this allows for accurate return forecasting as well as intelligent sorting and efficient route planning of recovered products which improves the economy by some multiple in circular. These should support waste reduction and reuse activities, especially in settings with limited infrastructure. These claims show that AI is not just an operational tool; it is also a strategic asset toward facilitating sustainable solutions in resource-constrained settings.

2.6 AI and Big Data for Waste and Resource Management

This also means that AI can link up with big data analysis to form an effective solution for reverse logistic operations optimization. As per Al Doghan and Sundram (2023), "Data-driven decision-making has emerged as the door key for successful management of returns, waste and resource recovery." Their research demonstrates how AI algorithms can examine patterns in products being returned and recommend ideal reuse, recycling or disposal options. This smart automation allows for split-second decision making which makes reverse logistics networks more responsive. Big data can yield to organizations not only essential insights on customer return behavior, environmental footprints and inventory management, such insights also enable organizations to make data driven decisions on designing efficient and sustainable reverse supply chains.

2.7 AI as a Pathway to Sustainable Supply Chains

This positions AI as an important enabler of sustainable supply chain management, particularly in the reverse logistics field. Alzoubi & Ahmed (2024) regards AI-leveraged reverse logistics as an integrated solution of the long-term sustainability mission. Companies can also reduce turnaround times; optimize their processes to minimize environmental harm and reduce resource consumption; and better align their operations with the principles of circular economy principles through the use of machine learning, predictive modeling, and cognitive automation. AI, on the other hand, improves the

reverse logistics systems' agility and resilience to adapt to changing return volumes and consumer expectations, argue Alzoubi & Ahmed (2024). This not only causes better environmental outcomes but increases competitiveness of the organization in a time where pressure to comply with sustainability increases.

2.8 AI-Driven Reverse Logistics for Circular Economy in Developing Countries

Sharma et al. (2024) examine the potential of artificial intelligence (AI) to facilitate reverse logistics and, consequently, to enhance circular economy performance within the context of developing nations. In their research article, they mention systematic limitations in traditional reverse logistics models, particularly in developing countries where less sophisticated infrastructure systems exist, and the predominant practice is manual processes. AI is hailed as a transformative technology capable of automating decision making, optimizing the return time of a product and predicting demand for reused or remanufactured products. The authors focus on AI's ability to identify patterns in consumer behavior, conserve resources and decrease environmental harm with intelligent waste sorting and material recycling. The paper also points out the implicit need of developing context-specific AI-driven solutions that incorporate socio-economic and infrastructural constraints of developing regions and as such context-sensitive AI systems can provide a facilitative layer in transforming sustainable objectives into real world implementations.

2.9 Blockchain-Enabled Reverse Logistics in the Automotive Industry

Bajar et al. (2024) explore potential applications of blockchain to enhance reverse logistics in the automotive sector, as it consists of complex supply chains and huge sustainability challenges. Their results have indicated that blockchain has the potential to address inefficiencies related to mismanagement of spare part returns, vehicle recalls and component recyclability by establishing a transparent, decentralized network for information exchange. Blockchain provides a verifiable audit trail of each component, addressing the automotive industry's issues with counterfeit parts, warranty fraud and limited traceability. Indeed, the research notes that traceability of end-of-life vehicle (ELV) recovery, which requires very fine-grain accounting of all parts of a product throughout its lifecycle, may be blockchain's blockchain potential. By improving visibility among all stakeholders—from manufacturers to dismantlers—the technology will help deliver operational efficiencies but also enable regulatory compliance and support of a circular economy. The paper provides insights on how blockchain can serve as a digital ledger to transform and streamline industrial reverse logistics.

2.10 Foundational Applications of Blockchain in Reverse Logistics

Subramanian et al. (2020) provide an exhaustive summary of the applications of blockchain technology in reverse logistics. The authors share several examples in the paper showing how block chain can reinvent reverse flows through increased data accuracy, fraud prevention, and end-to-end visibility. In contrast to traditional centralized systems, blockchain establishes an ecosystem of trust in which each participant can see the same version of truth, minimizing disputes and delays. This study bifurcates the benefits of reverse logistics from blockchain into operational (e.g., lower processing time), strategic (e.g., higher brand image), and environmental (e.g., increased compliance and reduced carbon footprint) benefits. More importantly, the authors address that the adoption of blockchain can only take place when additional elements of the ecosystem are ready as well — that is, stakeholder alignment, legal frameworks, digital infrastructure, etc.

2.11 Artificial Intelligence (AI) in Reverse Logistics

AI is redefining reverse logistics through automated fraud detection, predictive and prescriptive analytics and operating efficiency (Sharma et al., 2024) The adoption of AI powered technologies in logistics operations has shown substantial improvements in processing times,

error reduction, and sustainability performance (Al Doghan & Sundram, 2023).

Key AI Applications in Reverse Logistics

Automation of Return Processing

AI-enabled chatbots and Robotic Process Automation (RPA) manage return requests, automatically assessing product eligibility, issuing refunds, and updating inventory records (Sharma et al., 2024).

2. Predictive Analytics for Demand and Returns Forecasting

Machine learning (ML) models use data from historical return patterns, consumer behavior, and seasonality to optimize the return handling process (Govindan et al., 2015).

3. AI-Based Fraud Detection

High-volume data processing using image recognition, pattern analysis, and behavioral tracking (Kumar et al., 2021) makes AI algorithms capable of detecting anomalous return behavior and minimizes fraud risk.

4. Computer Vision for Product Inspection

Returned products are analyzed and sorted by AI image recognition and quality control systems to determine whether they will be restocked, refurbished or recycled (Sharma et. al., 2024).

Challenges of AI Implementation in Reverse Logistics

While potentially powerful, there are multiple hindrances to the adoption of AI in reverse logistics:

- Implementation Cost Impediments: Implementing AI solutions requires huge investments in infrastructure, training, and algorithm development (Al Doghan & Sundram, 2023).
- Data Privacy & Cybersecurity Concerns: AI systems require vast amounts of data, and this raises concerns regarding data security and their compliance with privacy regulations (PwC, 2023).
- Integration Difficulty: Utilizing AI is an integrated process, meaning it must be woven into existing logistics management systems, which can be an intermediate challenge for companies relying on old-world tech (Tsolakis et al., 2023).

AI can profoundly improve decision-making processes, automation, and fraud detection, while blockchain technology provides benefits of security, transparency, and trust that complement AI systems.

III. METHODOLOGY

3.1. Research Design

The study adopts a qualitative research design within a descriptive and exploratory framework. The main aim is to discuss the usage of Artificial Intelligence (AI) and Blockchain technologies in reverse logistics processes, mainly by identifying key insights from the prevalent academic and industrial studies. As digital technologies are evolving constantly and they are dynamic topologies affecting supply chain operations, the qualitative study is the best method to explore the complexity, context and nuance of these innovations.

Unlike empirical case studies or quantitative modelling, this work is not the collection of primary data through fieldwork or experiment. Rather, it takes a desk-based research approach, which is a systematic process in collecting, reviewing, and synthesizing secondary data sources. It encompasses peer-reviewed journalism articles, professional whitepapers, commercial brochures, and technical deployment reports. This approach has the potential for in depth thematic synthesis and comparative analysis of practices in countries around the world.

This design was chosen for several reasons:

Field Relevancy: AI and blockchain are both relatively newfound fields in the realm of logistics. Thus, recent literature and pilot studies or corporate reports furnish the most useful insights, rather than long-established databases or static datasets.

Breadth of Inquiry: With secondary data, the researcher can develop many experiences across

a variety of industries/geographies. This allows scholars and practitioners to gain a wide-ranging insight into these areas contributing to the state of-the-art developments and multi-sectoral implementations of the smart technologies in reverse logistics.

Research Design: The qualitative exploratory research design is appropriate for such a nascent area with few empirical studies to jointly explore AI and blockchain in reverse logistics context since it allows to advance the foundational understanding of the topic, identify novel themes, and indicates potential research gaps.

Overall, the research design chosen will enable the research to generate theoretically rich narratives while at the same time also maintaining methodological robustness, enabling it to write nuanced insights while supporting a conceptual contribution to the digital transformation literature in supply chain management.

3.2. Research Purpose and Questions

This research intends to evaluate the impact of AI and blockchain technology integration on the global retail and e-commerce reverse logistics capabilities. With product returns and circular economy strategies fast becoming the dominant issue in supply chain management, there has been a widening need for new digital solutions. This paper explores how these technologies, both separately and jointly, improve transparency, efficiency, sustainability, and decision-making in reverse logistics systems.

This study fills an important gap in the existing literature; although the individual applications of AI and blockchain in logistics have become hot topics for researchers in recent years, little information exists in the academic literature regarding these technologies applied together, especially in relation to reverse logistics. Additionally, even less perform an aggregation through secondary analysis of practices across several global firms which is what this study intends to do. This research aims to develop generalizable insights and identify best practices for implementation in similar organizational contexts by synthesizing insights across published research, corporate documentation, and industry reports.

Research Aim

To assess the good and bad roles, and synergies of Artificial Intelligence and blockchain technologies in improving reverse logistics operations through secondary data obtained from global firms.

Research Objectives

- To assess the impact of AI on reverse logistics related to operational efficiency, automation and decision making.
- To study the blockchain role in meaningfully enhancing transparency, traceability, and fraud mitigation in returns management.
- To uncover potential advantages, challenges, and limitations related to the adoption of these technologies.
- Synthesize recommendations based on documented organizational strategies and case-based literature.

Research Questions

- How do AI (Artificial Intelligence) and blockchain technologies help to gain efficiency, transparency & sustainability in reverse logistics systems? This question examines the technological enablers and operational implications AI and blockchain can unlock in returns processes.
- Which benefits and challenges are identified in the literature and industry reports about implementing such technologies within reverse logistics? This centers on the identification of common benefits — e.g., improved accuracy, more timely fraud detection, real-time data visibility — as well as obstacles like cost, complexity or reluctance to adopt.
- What guidelines and principles can we discover through the documented experiences of global conglomerates who have implemented AI and blockchain technology in their reverse logistics processes? This question provides an opportunity to extend lessons from secondary data, offering actionable insights for organizations pondering such integrations.

The research is theoretically significant as it fleshes out a not-uncommon observational lens within the field of logistics which here were blended with three disciplines, while practically it yields synthesized discussion points for practitioners, policymakers, and technology developers in logistics and supply chain decision-making.

3.3. Data Collection Method

This research between data were collected through secondary sources (publicly available materials) which explain implementing Artificial Intelligence (AI) and blockchain in reverse logistics from October 2023 to September 2023. In this regard, secondary data has some advantages, meaning it provides access to vast amounts of information, time and cost savings, and the potential to generalize results across various industries and geographies.

Types of Secondary Data Collected

- Peer-Reviewed Academic Journal Articles: The peer-reviewed literature offers a theoretical foundation, empirical research, and conceptual overviews about the use of artificial intelligence and blockchain in logistics and supply chain operations. We reviewed high-impact journals in the areas of logistics and supply chains, such as Journal of Cleaner Production, International Journal of Logistics Management, Supply Chain Forum: An International Journal, along with other academic articles from strong journals in the domains of operations management and digital transformation.
- And Industry Reports and White Papers: Established consulting firms (like Deloitte, PwC, Accenture, and McKinsey) and organizations such as NRF and WEF have put together reports with numbers on the real-world impact of AI and blockchain in reverse logistics. Such documents usually analyze market dynamics, trends in technology adoption and use cases at the forefront of technology integration in logistics operations across establishment players like Amazon, Walmart and Alibaba.
- Company Publications and Press Releases — Corporate publications such as annual reports, sustainability reports, case studies, and press releases were reviewed to identify practical examples of how some companies are applying AI and blockchain to their reverse logistics operations. Such publications typically describe technology deployments, operational efficiencies and other challenges, and strategic goals around sustainability and customer satisfaction.
- Processing from Conference Proceedings and Industry Events: Data were extracted from the proceedings and presentations at international conferences on logistics, AI, and blockchain. These publications present revolutionary findings, as well as sector-specific talks about contemporary trends and what's ahead. Any relevant and novel insights found in supply chain management and logistics students' dissertations and doctoral theses were also considered.
- Regulatory literature- Documents and standards published by the regulatory bodies including the European Union, ISO (International Organization for Standards), OECD (Organization for Economic Co-operation and Development), etc. These will shed light on compliance and governance implications tied to technology adoption.

Criteria for data source selection

To be eligible for inclusion, reports had to meet the following selection criteria:

- Reverse Logistics: A filtered approach was used and only the articles that mention reverse logistics or returns management or circular economy related perspectives were included in the table scope. That ensures it is focused on the technologies applicable to reverse logistics (both in the broad sense and in specific to that of generation of product returns) discussion and does not bleed into the supply chain or forward logistics space.
- AI & Blockchain: Sources required to respond the blend of AI and blockchain technologies pointed towards Logistics and supply chain division. We removed any papers that discussed digital transformation but did not reference AI or blockchain specifically.

- Credibility of sources: Peer-reviewed journals, respected industry reports and official publications were weighted more heavily. These include — but are certainly not limited to — archival participants, procedural artifacts, legal
- documents and controvertible opinions of experts who are well-understood for their verifiable reliability, as well as established rule of thumb to prepare degree textbooks in a manner that ensures the academic rigor and reliability of the research is of absolute integrity.
- Publication Year: To incorporate the most timely and relevant findings, documents dated between 2015 and 2024 were included. Insights At Published Date Up to Date: The information provided is derived from data as of October 2023, which accurately reflects recently developed breakthroughs in AI, blockchain, and reverse logistics.

Data Access and Retrieval Process

Data collection was conducted through three distinct phases:

- Database Search: Academic papers were filtered from research databases (Scopus, Google Scholar, and ScienceDirect) using search terms related to the topic such as (but not limited to) "AI in reverse logistics", "blockchain in supply chains", "smart logistics" and "returns management technology". These databases are related to a significant number of peer-reviewed articles, conference proceedings, and dissertations.
- Industry Reports available on websites of leading consulting firms (such as Deloitte, McKinsey) and supply chain-oriented organizations (such as NRF, WEF) Many these reports can be obtained free or can be downloaded after registering.
- Company reports and white papers The official websites of companies such as Amazon, Alibaba and Walmart. Such companies often publish tangible information on their technology and reverse logistics systems.
- Conference & Event Publications: Typically, the big conferences available in these sites are the major logistics and technology conferences combinations those of IEEE Xplore and SpringerLink papers and proceedings of the major logistics and technology conferences.
- Standards documents: Regulatory documents were also pulled from the official websites of standards organizations including ISO and OECD.

Limitations of Secondary Data

While it is possible to obtain useful insights from secondary data sources, this data collection method has several limitations as well:

- Available secondary data related to blockchain and AI applications in the context of reverse logistics are still developing as not all companies freely share historical
- case studies of their operation. And some of the reports may be cherry-picked, leaving out less successful implementations.
- Data Quality and Bias: The quality of secondary data sources, especially those from companies, may be biased in how they report the applications of AI and blockchain, often emphasizing success stories while glossing over challenges or failures. Several sources were referred to in order to prevent bias from affecting the results.
- No Primary Data: This paper does not feature interviews or survey data and thus does not bring any insights directly from companies and people who are working with the technology in question. And those outside beacons might not fully capture the nuance needed to come away with a deep understanding of the company's culture, decision-making processes and internal challenges.
- This data collection method confirms that the research works on reliable and high-quality secondary data, needed for qualitative investigation into AI and blockchain use in reverse logistics. MSD complements its presentation of respondent and organization-level data with respondent comments from multiple source types, which enrich the descriptive findings.

3.4 Case Selection Criteria

Although this study does not conduct interviews or on-ground visits to collect primary data, it follows a thematic multiple-case review research strategy by reviewing secondary data from global-level organizations that leveraged Artificial Intelligence (AI) and blockchain in the process of reverse logistics implementation. It is this kind of approach that enables perceiving comparisons in data up to October 2023 and one that can yield actionable insights and best practices based on the literature.

As a methodological approach to ensuring academic integrity and a consistent collection of data, we followed specific guidelines to shape these guidelines and delineate what companies or documents were of relevance for inclusion in this review. This criterion is derived from the research goal of assessing the role that AI and blockchain play in organizations leading the implementation of reverse logistics systems while focusing on the retail and e-commerce landscapes.

3.4.1 Inclusion Criteria for Organizations

The organizations examined in this study were chosen based on the following key factors:

- Global Reach and Industry Leadership: The firms being considered must have a regional or global perspective in either operations or focus, with a presence across
- multiple markets and a strong implementation in the e-commerce, retail, or supply chain space. A multi-city approach guarantees the results to be scalable and representative of more advanced logistics ecosystems.
- Technology Adoption for Reverse Logistics: Selected firms should have adopted or piloted both blockchain and AI technologies in some aspect of their returns management or reverse logistics operations. Organizations that were only applying one of the technologies or had no reference to documented applications in reverse logistics were immediately ruled out.
- Access to Robust Secondary Source Data: A critical factor for selecting partners was not only the depth of secondary source data available (academic research, whitepapers, industry reports, public disclosures, etc.) but also the verifiability of these data sources. It is through this criterion that transparency, replicability and depth of analysis are assured.
- Among these firms, there are examples (Amazon, Walmart, Alibaba, IKEA, and Zara (Inditex)) that have already been widely profiled in academic and industry literature for taking actions towards digitalizing logistics and address sustainability through returns optimization.

3.4.2 Inclusion Criteria for Documents

Selection of documents based on the following guidelines in addition to firm-level criteria:

- Recency and Relevancy: Only articles published from 2015 to 2024 were utilized to guarantee contemporary relevance and prospective inclusion for the zooming technology evolution of AI and blockchain systems.
- With an aim to preserve academic validity, peer-reviewed articles, reports published by respected consultancy firms (such as McKinsey and PwC) and authentic corporate communi-cations were prioritized.
- Avoidance of Content Not Relevant to Reverse Logistics or Circular Economy: We wanted to ensure that the documents discussed the use of smart technologies applied specifically around product returns, waste reduction, or remanu facturing/reverse flows in the supply chain.

3.4.3 Justification for Thematic Case Analysis Approach

Instead of classical case studies that rely on interviews or ethnographic methods, this study is based on a thematic multiple case synthesis from literature. This is ideal for subjects/topics that can be:

- Technology driven and rapidly changing, where primary data may not always be readily available.
- Interdisciplinary, across logistics, operations management, AI, and information systems
- Widespread application across domains,

allowing cross-organizational comparisons and generalizable learnings.

This approach guarantees a broad comprehension of blockchain and AI collective impact factors that contribute to reverse logistics performance, while paving the path towards the clarification of emerging trends, implementation obstacles, and strategic outcomes.

3.5. Data Analysis Technique

We then use content analysis, supplemented by thematic synthesis, cross-comparison, mapping of concepts using conceptual mapping and SWOC analysis, to ensure a strong interpretation of the results and an extraction of actionable insights from the existing data. The use of these complementary analytical techniques provides both a detailed and wider view of how AI and blockchain technologies are being adopted in reverse logistics systems around the world.

3.5.1. Thematic Coding

In the first step of analysis, we conducted manual, inductive coding of the academic literature, industry reports and white papers. Using the technique of textual analysis, each document was then examined line by line to derive recurring keywords, phrases, and concepts that could be explicitly or implicitly linked to the use of AI and blockchain in reverse logistics. Data were coded using Braun and Clarke (2006) thematic analysis (by looking at the data in relation to each other instead of looking for codes within the data) to permit a reflexive, bottom-up construction of meaning.

From the data, a few themes stood out:

- Automation and Operational Efficiency: Exploring how AI enables faster decision making in fields such as predictive analytics and process automation during the returns process, inventory management and what this means for warehouse operations.
- Transparency and Fraud Mitigation: | Discuss about role of blockchain in traceability, counterfeit prevention and immutability of transaction records.
- Improving Customer Experience — A case on how the front-end of reverse logistics - real-time tracking, automated return approval, and personalization - is more customer-facing.
- Sustainability and Circularity — demonstrate how these technologies enable to the drive toward circular economy models as they optimize the recovery, recycling and remanufacturing of products.
- Technical Integration Difficulties: Concerns about synergy among systems, standardization of data, and the workforce readiness.

3.5.2. Cross-Study Comparison

A comparative analysis was conducted of the coded themes across industries, geographical regions, and company sizes to compare convergence and divergence. In doing so, this comparative lens allowed the study to highlight generalizable trends, context-specific challenges and unique factors for success. As an example, companies in North America showed a stronger focus on blockchain-based traceability, while Asian companies revealed a priority on AI-powered optimization of operations.

3.5.3. Conceptual Synthesis and Mapping

Several themes emerged from the thematic analysis and a conceptual framework was developed to illustrate how these themes connected to one another in multiple dimensions:

- Technological Drivers: Enabler Tools of AI + blockchain.
- Functions in Logistics: Returns management, remanufacturing, refurbishment, and redistribution
- Outcomes: Cost reduction, transparency, customer satisfaction, and sustainability performance.

In this regard, this model makes a theoretical contribution by shedding light on how the integration of these digital technologies enable the key aims of reverse logistics in a circular economy context.

3.5.4. SWOT Analysis

To validate and further strengthen the findings, a SWOT (strengths, weaknesses, opportunities, and threats) analysis was conducted. The strategic implications of adopting. AI and blockchain technologies in reverse logistics are summarized as follows in the following matrix:

- Strengths: Instantaneous data-driven decisions, corruption-free data, automated processes.
- Weaknesses: Implementation cost, lack of interoperability, & technology complexity.
- Opportunities: stronger customer loyalty, circular economy alignment, scalable digital infrastructures.
- Threats: Data privacy, regulatory uncertainty, technological inertia.

The SWOT analysis scheme offers strategic assessment beyond the problem description that can guide and inform policy makers, logistics managers, and digital transformation leaders to make well-informed decisions on future investments in AI and blockchain enabled systems.

3.6. Trustworthiness and Validity

A systematic and transparent approach is necessary when conducting qualitative research based on secondary data to ensure trustworthiness and validity. Several strategies were employed to ensure the credibility, dependability and transferability of the findings produced in this study.

3.6.1 Source Triangulation

Data were collected from many secondary sources in order to reduce bias and increase the robustness of findings. Such as peer-reviewed academic journals, corporate reports, policy publications, technology whitepapers, and global consultancy studies. The study achieves this by triangulating data from these three types of publications, which prevents a single story from monopolizing the analysis. It also adds rich, dimensionality to the insights garnered.

3.6.2 Contextualization of Findings

Data were not interpreted as standalone. Each piece of evidence was analyzed with reference to the broader context of the digital transformation of global supply chains. Such considerations include: the evolution of the economy and the projection of technological and regulatory changes that will influence the intersection of AI and blockchain. The study deepens the contextual significance and theoretical coherence of its findings by anchoring them in global supply chain megatrends (e.g., sustainability, automation, traceability).

3.6.3 Peer Debriefing

Research process included peer debriefing with co-researchers and academic supervisors to strengthen interpretive validity. Such interactions helped to verify the logic of the thematic interpretations, refine key assumptions, and confirm the coherence of our conceptual framework. Peer feedback also helped to unearth areas for researcher bias that we may not have thought of, again ensuring transparency and intellectual accountability.

3.6.4 Transparency and Auditability

In this document, the coding process is reported, the themes generated, and the analytical thinking are made open, enabling auditability and future replication. And even more importantly, this transparency allows other scholars to follow researchers through their analytical decision-making process to ensure rigor in scholarship.

While secondary data cannot directly penetrate organizational realities, the process of triangulation, contextualization and peer review go some way to mitigating this limitation and allow the findings of the study to be trustworthy.

3.7. Limitations of the Methodology

Although this research provides valuable insights into the utilization of blockchain and AI in reverse logistics, some methodological limitations

need to be addressed due to the exclusive use of secondary data.

3.7.1 Lack of Primary Empirical Data

It does not include interviews, focus groups, or surveys with practitioners, experts, or stakeholders. Thus, it doesn't have direct access to experiential perceptions and tacit knowledge that typically accompany technological transitions within firms. This limits the ability to capture nuanced implementation challenges that can vary by firm or sector.

3.7.2 Access Barriers and Data Representation Bias

This research only made use of publicly available data. This naturally restricts both what information is available and what is made available by companies and researchers. Thus, critical information about timelines for implementation, cost implications, technical setbacks, or return on investment (ROI) is often missing or downplayed. This is most relevant regarding proprietary or competitive technologies that firms would be loath to make fully available.

3.7.3 Publication Bias and Reporting Bias

Like corporate reports and whitepapers, successful pilots and case studies are overrepresented, while failures or difficulties in implementation go underreported. This creates a tendency to make it seem like those optimistically framed narratives (i.e., that AI and blockchain simply work well in reverse logistics) strongly correlates with the maturity or effectiveness of such technologies (AI and blockchain) in reverse logistics, especially in emerging economies or logistics systems that are under-resourced.

3.7.4 Generalizability Limitations

The focus on global firms and the reliance on secondary data also means that the findings may be more representative of industry leaders in technologically advanced markets. As a result, the findings may not fully generalize to smaller firms, local logistics providers or economies with less digital infrastructure. The findings of this study highlight common trends and themes but do not profess universal applicability across all organizational contexts.

Although limited, the research presents a valuable addition by providing a thick, thematic overview of existing literature. It paves the way for future empirical research to build on these insights through fieldwork, quantitative modelling or across different industries.

3.8. Ethical Considerations

This study does not involve human participants nor sensitive personal data collection but still maintains strong ethical standards in accordance with academic research.

3.8.1 The Use of Publicly Accessed Data

Data sources used in this analysis are publicly disclosed and were gathered via academic databases, journal websites, institutional repositories, and corporate official portals. Hence there are no privacy concerns, nor any endangers to the privacy of people or organizations.

3.8.2 Scholarly Integrity and Transparency

All citations used in this document have been referenced appropriately (according to Harvard referencing convention) for the reader to source additional material or more information to support the research. Paraphrasing or interpreting secondary material is done responsibly and without distortion or overstatement of the original authors' work.

3.8.3 Avoidance of Plagiarism

It is fully set in accordance with anti-plagiarism regulations. All quotations, paraphrases, and conceptual borrowings are duly cited. New insights have been generated rather than rehashing previous findings through original analysis and synthesis.

3.8.4 Proceeding with Safe Routes to Academic Publishing

The study follows the ethical publication and research guidelines from the institutions. As the research involved using secondary data, this study was not subject to any formal ethical

approval, but the research process has been conducted according to the principles of transparency, objectivity, and academic integrity, as required in peer-reviewed articles.

To conclude, the study adheres to the ethical best practice standards in data usage, interpretation and presentation, which adds the credibility and professionalism to the research process.

IV. FINDINGS AND DISCUSSION

This chapter introduces and discusses the major findings obtained from the qualitative analysis of the secondary data regarding the adoption of AI and blockchain technologies in reverse logistics systems. It will aim to collate evidence from existing academic literature, industry reports and organizational documentation to identify recurring themes, applications and strategic implications related to the adoption of these emerging technologies.

The chapter is organized thematically, capturing the major areas of impact and concern, as identified during the process of data analysis. It uses coded data to describe how reverse logistics in global e-commerce and retail firms is being impacted by operational, environmental, and customer levels of AI and blockchain technologies.

The questions that framed this research were:

- RQ1: How do AI and blockchain increase reverse logistics efficiency?
- RQ2: What benefits and challenges come with using these technologies?
- RQ3: What lessons can we learn from the approaches of multinational firms?

It warrants a reminder of the methodology that frames these findings. A qualitative, interpretive research design was selected, with secondary data collected from peer reviewed journal articles, industry whitepapers, company case studies, and relevant policy documents. We used a thematic content analysis approach, which enabled the inductive identification of key themes, as well as the synthesis of diverse insights into a cohesive conceptual framework.

The implications of the findings are described in the following sections, with each dedicated to a key emergent theme. Analyzing literature references and practical examples this discussion embedded the analysis in existing literature and practice to provide analytical depth and academic rigor.

4.1 Overview of Emergent Themes

Our study employs a qualitative content analysis approach that highlights key interrelated themes characterizing the impacts of AI and blockchain technologies on reverse logistics systems across the global landscape of e-commerce and retail industries. These emergent themes display not only tactical and operational aspects of technology adoption, but also efficiency improvements, customer-centricity, transparency, and systematization.

The analysis resulted in five overarching thematic categories that are briefly outlined below and explored in greater depth in each of the following sections:

- *Automation and Operational Efficiency:* This theme encapsulates how AI powered tools—like machine learning algorithms, robotics, and predictive analytics—are optimizing reverse logistics processes, specifically return authorizations, sorting, and restocking.
- *Transparency, Traceability, and Fraud Mitigation:* A wide-ranging theme seemed to emerge around creating immutable records on a blockchain, the inherent integrity of data, traceability of returned goods, and prevention of fraud — with smart contracts being key to building trust among different parts a supply chain.
- *Customer Experience and Service Optimization:* Using intelligent chatbots, dynamic return policies and real-time tracking improves customer satisfaction and retention by making returns easier and increasing service responsiveness.
- *Sustainability and Circular Economy Alignment:* AI and blockchain were also found to enable a greener reverse logistics process by improving waste reductions, remanufacturing

and product life-cycle management, which are important engines for companies that are targeting goals for environmental or regulatory stakeholders.

- *Technological and Organizational Challenges:* However, despite the potential that these technologies hold, they suffer from issues surrounding complexity of implementation, data standardization, interoperability and organizational readiness, especially in organizations who have legacy systems or fragmented solutions across interdependent members of their supply chains.

These concepts together give a broad base of knowledge to leverage when determining the complex report that AI and blockchain play in reverse logistics. The subsequent sections elaborate yet further on each theme you alighted upon, weaving in evidence from the secondary data while applying critical insights relevant to the research questions.

Table 1: Summary of Emergent Themes in AI and Blockchain Integration in Reverse Logistics

Theme	Associated Technologies	Key Insights
1. Automation and Operational Efficiency	AI (Machine Learning, Robotics, Predictive Analytics)	Enhances speed, accuracy, and scalability in returns handling, sorting, and inventory decisions.
2. Transparency, Traceability, and Fraud Mitigation	Blockchain (Distributed Ledger, Smart Contracts)	Ensures secure, tamper-proof records of return transactions and combats fraud in return claims.
3. Customer Experience and Service Optimization	AI (Chatbots, Recommendation Systems)	Facilitates real-time support, personalized return options, and streamlined interactions.
4. Sustainability and Circular Economy Alignment	AI + Blockchain	Improves material recovery, remanufacturing tracking, and eco-friendly return strategies.
5. Technological and Organizational Challenges	Both AI and Blockchain	Highlights barriers such as system integration, high costs, data fragmentation, and resistance to change.

4.2 Theme 1: Automation and Operational Efficiency

One of the most notable observations that emerged from this analysis is the transformative association of artificial intelligence (AI) with operational efficiency in reverse logistics. By leveraging AI-based solutions like machine learning algorithms, robotics, and prompter analytics, e-commerce companies were able to automate and upgrade return-related processes, thereby greatly enhancing the aspects of cost control, speed, and accuracy.

4.2.1 Role of AI in Automating Return Flows

AI Technologies have well advanced and are being used to automate even the most tedious tasks of reverse logistics lifecycle. They often use machine learning algorithms to estimate the volume of returns, taking into account historical trends and customer behaviour. This prediction capability allows companies to predict logistical requirements better, allocate resources to optimize them, and reduce unnecessary bottlenecks in returning merchandise.

Automated return authorizations, for instance, use AI to quickly determine the validity of return requests by capturing customer behavior, product details, and warranty conditions. This reduces human error, and operational bottlenecks while speeding up the decision making process.

Within warehouse operations, systems that can help AI-enabled robotics rapidly identify returned items and determine whether they are resaleable or best suited for refurbishment or disposal. This reduces handling time and allows for more exact inventory management.

4.2.2 Predictive Analytics and Decision Support

Predictive analytics makes reverse logistics decision-making smart because it analyzes patterns in the return data like high-return products, peak return periods, or any anomaly in customers' behavior. These insights allow you to proactively make product design changes, policy adjustments, inventory control strategies, etc.

These tools are used by companies like Amazon and Alibaba to pre-position return processing capacity and optimize routing decisions for returned units. AI can also advise on the most cost-effective or sustainable resolution — restock, recycling or refurbishment based on the condition of the product and market demand.

4.2.3 Efficiency Outcomes and Strategic Impact

New AI-powered automation takes many shapes—and can generate measurable efficiency gains: shorter return cycle times, reduced labor costs, and more accurate inventory. It also enables companies to expand its reverse logistics processes without a corresponding linear increase in workforce or infrastructure.

More strategically, this theme shows how AI is not just a technical enabler but a competitive differentiator. Companies that can successfully apply AIf in reverse logistics will have better responsiveness, leading to greater customer satisfaction with lower return overheads.

But the survey results also suggest that operational gains depend on data quality and the degree to which AI systems are integrated with existing IT infrastructure. Often, companies that don't leverage real-time data visibility or maintain siloed operations fail to achieve full automation potential.

4.3 Theme 2: Transparency, Traceability, and Fraud Mitigation

The second prominent category identified through thematic analysis of the open-ended responses was the substantial contribution of blockchain technology towards improving transparency, traceability, and reducing fraud in reverse logistics systems. While e-commerce is growing explosively, product returns remain increasingly complex, especially regarding authenticity, warranty validation, and accountability between supply chain stakeholders. With immutable and decentralization ledger capabilities you already know, provides a strong solution for these challenges, the blockchain comes to the hereof.

4.3.1 Blockchain-Enabled Transparency in Returns

Often, reverse logistics runs on fragmented supply chain data, and due to a lack of trust among the stakeholders, transparency is compromised. This is where the technology behind blockchain comes in, as it offers a settlement system that is validated when a transaction is complete, creating a shared, tamper-proof history of transactions that is accessible to all authorized parties. From a return's perspective, this transparency means firms, customers and logistics companies have shared visibility to real-time data about the creation, ownership, movement and handling of returned products.

For instance, blockchain allows companies like Walmart to keep a digital twin on every product and track its life cycle, from when it's sold to when it's returned. This vision gives it the ability to toss its fraud net over return requests and ensures they're checked against the reality of all past orders and handling, reducing the risk of bogus returns. Access to verifiable data reassures customers, which leads to greater trust and brand loyalty.

4.3.2 Traceability and Chain-of-Custody Integrity

Tracking the movement of products at all stages of the reverse logistics cycle is essential for sustainability, compliance, and customer satisfaction. Blockchain, therefore offering immutable chain-of-custody real-time product traceability for returned products across facilities (stocking, shipping), ownership transfers, and disposition (e.g., resale, refurbish, recycle) decisions.

And on the back end, that level of traceability facilitates regulatory compliance, particularly within industries like electronics and pharmaceuticals, where the proper handling of returns is required. It enhances inventory visibility, enabling companies to flexibly manage inventory and eliminate duplicate ordering.

Additionally, by combining blockchain with IoT sensors (e.g., Citing Hrouga et al., 2022), companies can gather supplementary environmental data (e.g., temperature, humidity, damage detection) along the return, providing granular context for return decisions and increasing accountability.

4.3.3 Fraud Prevention Mechanisms

This growing issue is plaguing global e-commerce, costing billions each year. The most common variants are returning counterfeit products, using stolen receipts or just taking advantage of lax return policies. Blockchain eliminates these risks through the authentication of transactions and the implementation of smart contracts that automatically check return requirements according to the entered rules.

For instance, if a return is requested out of warranty terms, or any sign of tampering with identifiers embedded in the product (FFT PRID, RFID, etc.) is detected, a smart contract can reject the request (i.e., it is produced only at the back end). Furthermore, the decentralized nature of the blockchain ledger means that no individual party can change transaction histories, and manipulation without being detected is virtually impossible.

4.3.4 Strategic and Operational Implications

Blockchain adoption in reverse logistics systems creates several strategic advantages. Through its benefits such as better data integrity, operational trust between partners, and improved customer experience due to greater visibility and faster return validation.

However, challenges persist. Costs of implementing (technological complexity and the requirement for ecosystem-wide adoption). However, as a lot of the benefits of blockchain technology are driven significantly by network effects, isolated deployment of technology by one business will likely be limited, unless supported through suppliers, logistics partners and regulatory organizations.

As a whole, this theme highlights the fundamental importance of using blockchain as a means of improving governance, trust, accountability, and risk mitigation in reverse logistics, especially in collaborative inter- company settings where operational transparency and traceability are essential for resilient operations.

4.4 Theme 3: Customer Experience and Service Personalization

One of the key findings from the study is how AI and blockchain technologies can be used to improve customer experience (CX) and personalized services in the reverse logistics context. With the rise of online shopping, customer expectations have correspondingly risen in terms of return convenience, responsiveness and satisfaction. Integrating such intelligent systems and transparent tracking mechanism will have a significant role in tackling with such demanding changes.

4.4.1 Enhancing Return Convenience through AI-Driven Interfaces

With such growing trends, AI technologies are progressively utilized in streamlining and simplifying the returns process, removing friction and improving general satisfaction. Companies can now offer 24/7, real-time support, customized to individual user needs, through chatbots, virtual assistants, and even AI-powered return portals.

For instance, AI systems can identify patterns in customer behaviors to forecast return requests and offer appropriate options such as exchange, credit, or refund—this helps align with personal preferences. This proactive personalization means more convenience for consumers, and builds loyalty, particularly among digital-native consumers.

Furthermore, AI is used to calculate return paths and plan pickups to avoid having to wait a long time and to ensure that any item on the delivery route arrives as quickly as possible, thereby having a positive impact on the customers' experience.

4.4.2 Personalization Through Data-Driven Insights

The machine learning algorithms skim through large volumes of data your customers leave behind, from the purchase history to feedback and return behavior to generate hyper-personalized recommendations. In reverse logistics, this could translate to customized return windows, tailored refund conditions, or customized repair and recycling options depending on the customer profiles.

Frequent, reliable customers might also get automatic refunds upon starting a return, while riskier transactions can be subjected to additional verification. Such segmentation allows firms to offer policies with relevant features and actively manage risk whilst treating the customer fairly, avoiding inefficiencies inherent in blanket policies.

Personalization enhances more methods of communication – And automation systems can interact with clients in more languages, on tentative channels (email, SMS, applications), at right moments by making a user-centered experience.

4.4.3 Trust and Engagement via Blockchain Transparency

When combined with Blockchain, AI can alleviate customer fears around returns. By enabling customers to track their returned items in a live mode with irrefutable evidence of transaction and processing stages, companies foster accountability and transparency.

This is charged in industries such as product authenticity, condition assessment, or ethical sourcing. So, a customer returning a luxury item or eco-friendly product can follow its reverse path via blockchain to verify that it was resold in an environmentally responsible way or recycled properly.

Furthermore, customer engagement is bolstered when firms communicate sustainability outcomes resulting from returns — such as CO_2 savings, reuse stats, or charitable giving — that are only possible thanks to traceable records on the blockchain.

4.4.4 Challenges and Considerations

AI and blockchain coming together adds considerably to the customer experience, but there do exist some concerns that must be addressed. The AI-powered personalization is largely reliant on data quality and privacy, making its use and consent vulnerable to ethical issues. Cart-fulfilling customers could also be weary of AI or distrust machines without good design.

From a blockchain perspective, interacting with decentralized platforms can be technically complex and might limit customer adoption, particularly among users who are not particularly tech-savvy. While transparency is important, it must not to be so overwhelming and confusing, requiring careful user interface design as well as effective communication strategies.

Third and finally, personalization also needs to be inclusive and respectful of the diverse cultural and behavioral norms at play across global markets. While the technology is promising, over-automation threatens to alienate specific demographics, underscoring the importance of hybridization and humanization in operations.

4.5 Theme 4: Sustainability and Circular Economy Enablement

The most influential and strategic implication of the connection between Artificial Intelligence (AI) and Blockchain in reverse logistics is related to sustainability and circular economy (CE) development. With growing regulatory pressure and proliferation of consumers interested in environmentally responsible practices, optimizing reverse flows is crucial for waste minimization, product lifecycle extension, and value retrieval. In this section we will see in practice how these goals are supported with AI and blockchain technologies.

4.5.1 AI for Predictive Sustainability in Reverse Logistics

AI applications in reverse logistics extend beyond pure operational efficiency and are now linked to sustainable resource management. Predictive analytic is used to forecast product return rates, product return and product recovery potential lifespan and recovery potential using machine learning models. Such insights allow firms to:

- Reduce fuel consumption and CO_2 emissions by planning reverse logistics routes more efficiently
- Reduce excess inventory waste by forecasting spare part needs for refurbishment
- Maximize environmental benefits and minimize landfill use, optimizing the decisions on product recovery (repair, reuse, recycle, or disposal)

For example, AI can determine the probable usability of returned products, based on condition reports, uses history, or return rationale—auto-classifying items with suitable CE paths. Such data-driven decision-making catalytic the flow of goods back into the value chain, closing material loops and promoting a lesser reliance on virgin resources."

4.5.2 Blockchain for Ethical and Transparent Supply Chains

Solution for Improved Reverse Logistics: Blockchain. Such transparency is essential to foster the trust that must exist with respect to recycled, refurbished or reused products and for verifying environmental claims made by companies.

Key applications include:

- Data tracing source provenance of materials and reverse journey for compliance under environmental green standards
- Ensuring ethically disposed of, or donated goods are in good condition (e.g., apparel or electronics)
- Upon linking returns transactions to sustainability metrics, the ability to run carbon credit documentation

Smart Contracts enabled by Blockchain can automatically make the donation or recycle an item once it has come back and hit a condition or reached a location, they have defined in which they wish sustainable actions to take place. This removes the heavy lifting whilst ensuring compliance with circular economy policies and CSR (corporate social responsibility) targets.

4.5.3 Enabling Circularity Through Integrated Systems

Jointly, AI and blockchain are as powerful catalysts of circular economy paradigms. Along with Ali, Zawilinski plans to work on closed-loop systems that:

- Monitor product lifecycles from sale to return, remanufacture, and resale
- Seek out value-leakage points and opportunities for reuse or refurbishment
- Automate the CE feedback loops (customer returns resulting in credits of recycled material, etc.

Such systems are particularly useful in sectors with elevated return rates and fast-moving inventory cycles, like fashion, consumer electronics and furniture. Companies deploying these technologies can create new revenue streams by reselling returned items or providing subscription-based take-back services, thus reconciling profitability with sustainability.

4.5.4 Challenges in Achieving Sustainable Outcomes

Yet as promising as the use of AI and blockchain for sustainability may be, there are significant limitations:

- Energy consumption of blockchain networks may undermine environmental benefits, especially if based on proof-of-work protocols
- Data silos and interoperability concerns of AI systems and legacy infrastructure can limit complete circular integration
- There is a risk of greenwashing when firms leverage technology to present themselves as sustainable, without transparent metrics or a long-term commitment.

In addition, access to such technologies is unequal, leading to a divide between large multinational companies and smaller companies that do not have the infrastructure or the expertise for advanced digital transformation.

4.6 Theme 5: Technical Integration and Operational Challenges

To address these challenges, this paper reviews the role of Artificial Intelligence (AI) and Blockchain technologies in reverse logistics, illustrating how both diverse and newly emerging technologies could be integrated together, in order to provide solutions to support reverse logistics. However, the combination of AI and blockchain technologies in the context of reverse logistics provides a multitude of advantages in terms of cognitive capabilities, transparency, security and trustworthiness. This section will look at some of the challenges that firms face as they try to embed these sophisticated technologies into their return operations including interoperability, data quality, legacy infrastructure and human capital.

4.6.1 System Complexity and Integration Barriers

Some of the major challenges will be integrating AI and blockchain into traditional logistics management systems that are fragmented, outdated, and incompatible with decentralized technologies. Most technology firms still operate on legacy enterprise resource planning (ERP) systems, which are not flexible enough to support the real time data requirement for AI algorithms, nor immutable ledgers for blockchain. There are key technical barriers, such as:

- Also known as: Multiple supply chain systems leading to data silos between your departments or partners, limiting access to holistic supply chain information
- Fragmentation of blockchain protocols, complicating collaboration across firms
- Incompatibility of AI platforms and legacy systems, necessitating expensive middleware or rebuilding systems

Such issues can not only slow down digital transformation but also limit the scalability of existing reverse logistics innovations, especially in the case of multinational supply chains having diversified partners and processes.

4.6.2 Data Quality and Availability

For AI and blockchain to work, real-time data plays a critical role, ideally in large volumes and high quality. In contrast, returned products usually have incomplete, incorrect, or inconsistent data in reverse logistics. For example:

- Enter vague (or manually used phrases) results for less accurate AI prediction
- In the boundless cosmos of item exploration potential, Grace Hill's dataset is but a dim star.
- Incomplete lifecycle tracking can lead to break of chain of custody in the blockchain system
- Such data silos can hamper the efforts of automation, traceability and decision-support tools, requiring considerable human intervention to onboard or extend information.

4.6.3 Skills Gaps and Organizational Readiness

A third major challenge is the lack of skilled people to design, implement and operate systems powered by AI and blockchain. Traditionally, reverse logistics is an operational focus, not a digital. As a result, it can be challenging to find staff with cross-functional expertise in:

- Supply chain management
- AI and machine learning
- DLTs (Distributed ledger technologies)

Culture in an organization can also oppose modification, especially in sectors that look at reverse logistics as a cost center as opposed to a value-creator. To avoid project failure or underutilization, training, digital literacy, and change management needs to be invested in.

4.6.4 Regulatory and Security Concerns

The decentralized nature of blockchain is deliberate and its transparency promotes traceability which may set the stage for data privacy, compliance and jurisdictional challenges. Companies that function across different jurisdictions face complex regulatory frameworks, including:

- Data-sharing barriers due to GDPR and data sovereignty legislation
- Vulnerabilities in smart contracts or consensus mechanisms
- Unclear if blockchain records could hold up in case of disputes

Just as companies must now comply with new and evolving ethical — and legal — frameworks, such as the EU AI Act, maintaining ethical consistency in AI systems will be a priority when autonomous systems make ethical decisions on its behalf, such as, product recovery, customer compensation, or environmental reporting.

4.6.5 Strategic Misalignment and High Costs

Most importantly, firms face a strategic misalignment between the advance of highly sophisticated technology and the requirements of their reverse logistics operations. Key issues include:

- High Fixed Initial Investment Cost with Unpredictable ROI
- Limited understanding of reverse logistics resulting in lack of top-management buy-in
- IT and logistics teams not being perfectly in sync; implementation taking too long

Lacking a clearly defined, long-term digital transformation strategy, organizations run the risk of delivering one-off pilot projects that fail to scale or deliver meaningful value.

4.7 Cross-Sector Comparison

In this section, the integration of AI is brought together with blockchain in reverse logistics among various industries and regions and illustrate how there are differences in terms of application, maturity and strategic value.

4.7.1 Retail and E-Commerce Sector

Companies like Amazon, Alibaba and Walmart lead the way with AI and blockchain in reverse logistics. Key observations include:

- Personalization and return forecasting with AI reduce return rates and streamlines inventory restock
- The use of blockchain for product authenticity/ tracking and streamlining refund validation.
- However, large-scale platforms do have the advantage of a high data volume environment as well as an in-house tech capability, which results in end-to-end visibility and control over the user journey.

In multi-category operations, consumer volume and product diversity pose scaling and integration challenges.

4.7.2 Electronics and High-Tech

It covers companies for recovery, refurbishment, and warranty in electronics. Key trends:

- It also deploys AI for fault detection, lifecycle estimation, and return prioritization.
- Blockchain can facilitate component-level traceability and counterfeiting prevention
- Reverse logistics is related to circular economy goals, and sustainability becomes a strategic driver.

This sector shows relatively more rigid reverse flows than others but high-tech complexity and high regulation than retail.

4.7.3 Automotive and Spare Parts

In automotive, reverse logistics enables remanufacturing of used parts, recycling, and spare parts recovery:

- Blockchain allows parts to be authenticated and maintenance history logs to be accessible in real time.
- AI enables envisaging return flows, route optimization, and recovery asset value estimates.
- Regulatory and warranty imperatives encourage tech adoption.
- Tied in with established supply networks, reliance on OEMs adds to the challenge.

4.7.4 Apparel and Fashion

Reverse logistics is here to be driven by the high return rates and the risk of customer dissatisfaction:

- ML model is benefiting in prediction of size and damage categorization.
- From product origin management to ethical sourcing traceability, this is where blockchain comes in.
- Sustainability and brand trust strategies integrate such ethical aspects.

The use of reverse logistics within this industry tends to range in maturity, often correlated with company size and amount of digital infrastructure in place.

4.8 Conceptual Framework and Synthesis

Based on the findings, we propose a conceptual framework illustrating the interrelationship across technology enablers (AI and blockchain), logistics processes, and performance outcomes in reverse logistics systems.

4.8.1 Technology Enablers

- Data Mining: Artificial Intelligence: Automation, prediction, classification, personalization
- Blockchain: Transparency, data integrity, traceability, smart contracts

4.8.2 Core Reverse Logistics Functions

- Returns Management: Labeling, routing, inspection, refund.
- Diagnosis, repair, repurposing: Recovery and Remanufacturing.
- Second Use or Disposal: Resell, recycle, or dispose of in an environmentally responsible manner.

4.8.3 Outcome Dimensions

Operational Efficiency:

- Lower cycle times, fewer interventions
- Improved customer satisfaction: Quicker refunds, better personalization
- Fraud Prevention: Robust verification and authentication
- Sustainability: Reduced waste, enhanced material circularity

4.8.4 Moderating Factors

- Interoperability and data quality
- Organizational readiness
- Regulatory frameworks
- Industry-specific dynamics

This model can help understand how firms can capitalize on AI and blockchain to create value in reverse logistics and the contingencies that need to be managed for successful implementation.

Table 2: Conceptual Framework: Integration of Blockchain and AI in Reverse Logistics

Driver	Function		Outcome
Artificial Intelligence (AI)	- Automated return classification - Predictive analytics for returns - Route optimization	- Reduced - processing time - Improved accuracy - Efficient - transportation	- Cost savings - Enhanced - customer - satisfaction
Blockchain Technology	- Real-time tracking - Smart contracts for returns validation - Immutable audit trails	- Enhanced - transparency - Reduced fraud and disputes implified - verification	- Increased trust - Improved - regulatory - compliance
Combined AI + Blockchain	- Integrated data - systems - Smart, predictive traceability - Automated, - verifiable returns process	- Synergistic - automation and - security - End-to-end - visibility - Data-driven - decision-making	- Circular - economy - enablement - Competitive - advantage

4.9 Conclusion to the Chapter

In this chapter, the main findings of the study – which were discovered through an extensive qualitative content analysis of secondary sources – have been outlined and discussed. Based on a firm understanding of relevant academic literature, the synthesis did, via a thematic analysis, unearth key themes characterizing the responses of global e commerce firms with the potential to embed AI and Blockchain in the functioning of their reverse logistics systems.

Four main themes emerged from the analysis: (1) Automation and Operational Efficiency, highlighting how AI support real-time decision-making and returns processes; (2) Transparency and Traceability, and Fraud Mitigation, enabled largely through Blockchain's immutable ledger and smart contract capabilities; (3) Customer Experience and Service Personalization, which demonstrated that integration of technology yields value-added, customized services for consumers; and (4) Sustainability and Circular Economy Performance, which illustrated how the synergistic technologies facilitate environmentally-conscious reverse logistics activities.
Moreover, a conceptual framework was established to depict the association of technological enablers, logistics functions, and strategic outcomes. Alongside was a comparative analysis on aspects across sectors, demonstrating siloed situational distinctions whilst strengthening the universality of the benefits from engaging AI and Blockchain-driven reverse logistics systems.

This chapter directly addressed the core research questions posed in the introduction:

RQ1: How can AI and blockchain address efficiency in reverse logistics?

→ Responded via themes reflecting automation + smart tracking + predictive capabilities

RQ2: What are the advantages and disadvantages to deploying these technologies?

→ Analyzed through thematic findings and SWOT analysis that highlighted the strengths and weaknesses to operate and implement them.

RQ3: What effective measures are derived from the global firms?

→ Compiled through illustrative case studies and comparison, providing lessons for practical strategic incorporation.

The answers on the above questions will thereby provide a basis for the final chapter, where the study's overall conclusions, its theoretical and practical contributions, its limitations, and its recommendations for future research will be discussed.

V. CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This last chapter gives the general conclusions drawn out of the research, summarises the contributions of the thesis for theory and practice, presents its limitations, and provides recommendations for practitioners, policymakers and future researchers. This chapter consolidates the study by reflecting critically on the conclusions from the thematic findings and then synthesis of concepts from the previous chapter, bringing to context discussing integration of Artificial Intelligence (AI) and Blockchain technologies into reverse logistics systems.

5.2 Summary of the Study

The purpose of this study is to understand how global companies use AI and Blockchain technology in their reverse operations to solve major issues like industrial inefficiency, opacity, and unsustainability. Using an extensive qualitative content analysis of secondary data sources, the study investigated existing use cases, advantages, challenges, and emerging best practices related to the digital transformation of reverse logistics.

To explore these issues, three research questions guided the study:

The role of AI and Blockchain in making reverse logistics more efficient
→ AI on the other hand helps in Sortation, Route optimization, and Demand forecasting whereas Blockchain ensures Traceability, Tamper-proof records, and Automated transactions through smart contracts.

- What are the various advantages and challenges of taking these technologies forward?

→ Key operators: cost-saving, customer experience, fraud prevention, circular economy models support. It is facing challenges such as technical integration challenges, high upfront investment, and regulatory uncertainty.

- What are global firms doing that provides best practice in this space?

→ Phased technology adoption, Investing in Staff Training, Align Digital Solutions with sustainability goals, Leveraging real-time data for Predictive insights.

5.3 Theoretical Contributions

This paper adds to the supply chain innovation literature by:

- Revisiting the reverse logistics conversation through the lens of digital transformation.
- Bringing together literature from AI, Blockchain and circular economy toward a new analytical framework.
- Symbolizing synergies between AI and Blockchain for building more agile, secure, and sustainable reverse supply chains

In addition, the frameworks developed here, the blueprint for further empirical testing and model designing on logistics innovation research.

5.4 Practical Implications

For managers and logistics practitioners, the study provides a number of actionable insights:

- Invest in interoperability — Integration of AI and Blockchain entities requires compatible systems and data protocols, but you also need coordination across departments.
- Go with modular solutions: If possible, start with pilot programs targeting a single reverse logistics function (such as fraud prevention through Blockchain or returns forecasting through AI) can help deliver faster ROI and reduce implementation risk.
- Training is key: The only way to truly adopt AI is if your staff is aware and is digital literate.
- Support ESG objectives: Companies that adopt reverse logistics technologies as part of their environmental, social, and governance (ESG) plans report better performance and stake-holder buy-in.

5.5 Limitations of the Study

Although it has much to teach us, the study has limitations:

- Horizontally, it conceives of the organization as a singular entity governed by analytics, failing to recognize the challenges of conflicting logics within the operational processes that a more detailed multi-entity, multi-level, multi-stage tracking process might uncover.
- As these are secondary data sources with no interviews or surveys data directly from stakeholders, this cannot claim to accurately reflect the perspectives of the relevant stakeholders.
- The results are mostly positioned within global firm contexts and may not be applicable for SMEs or firms in less digitally mature settings.

5.6 Future Research Recommendations

Based on the current findings, future research should:

1. Empirical case studies (logistics and IT managers interviews) to confirm and extend the findings of the AI, Blockchain integration.
2. Consider sector-specific impacts—what are the variances in the way that something is implemented across fashion compared to electronics compared to pharmaceuticals?
3. Quantitatively model the ROI of AI & Blockchain in reverse logistics 4. Examine ethical and regulatory challenges, especially regarding data privacy, algorithmic bias, and cross-border Blockchain deployment.
4. Research on SMEs that implement but face a different set of constraints than large multinationals but still capture a large share of the global e-commerce.

5.7 Final Reflection

Reverse Logistics in a Mature Digital Economy The synergy of AI and Blockchain technologies can transform the future of return management, waste reduction, and customer relationship retention. There is more work to do, but this study shows that strategic technology adoption around data to support higher level business goals is required to maximize the potential of these technologies to have an impact on reverse logistics.

REFERENCES

1. Guide Jr, V. D. R., & Van Wassenhove, L. N. (2009). OR FORUM—The evolution of closed-loop supply chain research. Operations research, 57(1), 10-18.
2. Al Doghan, Mohammed A., and Veera Pandiyan Kaliani Sundram. "AI-enabled reverse logistics and big data for enhanced waste and resource management." *Operational Research in Engineering Sciences: Theory and Applications* 6, no. 2 (2023).
3. Alzoubi, H. M., & Ahmed, G. (2024). Utilizing Artificial Intelligence (AI) in enhancing customer-supplier relationship: An exploratory study in the banking industry. *Uncertain Supply Chain Management*.
4. Bajar, K., Kamat, A., Shanker, S. and Barve, A. (2024), "Blockchain technology: a catalyst for reverse logistics of the automobile industry", Smart and Sustainable Built Environment, Vol. 13 No. 1, pp. 133-178. https://doi.org/10.1108/SASBE-11-2021-0203
5. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, *3*(2), 77-101.
6. Deloitte. (2023). *Global retail returns report: Trends, challenges, and opportunities*. https://www.deloitte.com
7. European Commission. (2023). *Circular Economy Action Plan: Sustainable products for a sustainable future*. https://ec.europa.eu
8. Govindan, K., Soleimani, H., & Kannan, D. (2015). Reverse logistics and closed-loop supply chain: A comprehensive review to explore the future. *European journal of operational research*, *240*(3), 603-626.
9. Hrouga, M., Sbihi, A., & Chavallard, M. (2022). The potentials of combining Blockchain technology and Internet of Things for digital reverse supply chain: A case study. *Journal of Cleaner Production*, *337*, 130609.
10. Gao, X., Wang, Z., Gao, Y., Wang, R., & Bai, Y. (2024). Research on Reverse Channel: Review and Prospects. *Journal of Business-to-Business Marketing*, *31* (2), 141-165.
11. Tsolakis, N., Schumacher, R., Dora, M., & Kumar, M. (2023). Artificial intelligence and

blockchain implementation in supply chains: a pathway to sustainability and data monetisation?. *Annals of Operations Research*, *327*(1), 157-210.
12. Kumar, S., Raut, R. D., Nayal, K., Kraus, S., Yadav, V. S., & Narkhede, B. E. (2021). To identify industry 4.0 and circular economy adoption barriers in the agriculture supply chain by using ISM-ANP. Journal of Cleaner Production, 293, 126023.
13. Sharma, A. K., Srivastava, M. K., & Sharma, R. (2024). Exposition of techno-functional components of intelligent food supply chain: a review and future research agenda. Journal of Business & Industrial Marketing, 39(9), 1928-1949.
14. National Retail Federation. (2023). Consumer returns in the retail industry. https://nrf.com
15. Naseem, M. H., Yang, J., Zhang, T., & Alam, W. (2023). Utilizing fuzzy AHP in the evaluation of barriers to blockchain implementation in reverse logistics. Sustainability, 15(10), 7961.
16. Optoro. (2022). The environmental impact of retail returns. https://www.optoro.com PwC. (2023). Retail fraud trends: The rise of return abuse. https://www.pwc.com
17. Rogers, D., & Lembke, R. (2001). An examination of reverse logistics practices. Journal of Business Logistics, 22(2), 129–148.
18. Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain technology and its relationships to sustainable supply chain management. International journal of production research, 57(7), 2117-2135.
19. Statista. (2024). Global e-commerce returns statistics and trends. https://www.statista.com
20. Subramanian, N., Chaudhuri, A., & Kayikci, Y. (2020). Blockchain applications in reverse logistics. In Y. Kayikci (Ed.), Handbook of research on blockchain technology (pp. 153–171). Springer.
21. Wang, Y., Han, J. H., & Beynon-Davies, P. (2019). Understanding blockchain technology for future supply chains: a systematic literature review and research agenda Supply Chain Management: An International Journal, 24(1), 62-84.
22. Kafeel, H., Kumar, V., & Duong, L. (2023). Blockchain in supply chain management: a synthesis of barriers and enablers for managers. International Journal of Mathematical, Engineering and Management Sciences, 8(1), 15-42.
23. Govindan, K., Soleimani, H., & Kannan, D. (2015). Reverse logistics and closed-loop supply chain: A comprehensive review to explore the future. European journal of operational research, 240(3), 603-626.

This page is intentionally left blank

Scan to know paper details and author's profile

The Impact of Gross Domestic Product on Co2 Emissions (A Case Study of Asian Tiger Countries)

Boburbek Khakimov, Farrukh Turdikulov & Sadibekova Bibisara

Oriental University

ABSTRACT

This research examines the impact of Gross Domestic Product (GDP) on CO2 emissions in four well-developed Asian countries—South Korea, Singapore, Taiwan, and Hong Kong—over the period from 1960 to 2019. To analyze the relationships, regression was performed using the Generalized Least Squares (GLS) method in STATA-14. The results indicate that all regressors are significant, and to address the issue of autocorrelation in the model, an Autoregressive Lag model was used. By adding the lag of an independent variable to the model, the problem of autocorrelation was resolved. Consequently, the model's goodness-of-fit improved, and the significance levels of the regressors were confirmed. Based on the research findings, it can be concluded that the economic growth of these countries leads to an increase in carbon dioxide emissions into the external environment.

Keywords: gross domestic product, CO2 emissions, GLS method, STATA14, correlation, autoregressive lag model, coefficient of determination.

Classification: DDC Code: 338.9, 363.73874

Language: English

Great Britain Journals Press

LJP Copyright ID: 146445
Print ISSN: 2633-2299
Online ISSN: 2633-2302

London Journal of Research in Management & Business

Volume 25 | Issue 4 | Compilation 1.0

The Impact of Gross Domestic Product on Co2 Emissions (A Case Study of Asian Tiger Countries)

Boburbek Khakimov[α], Farrukh Turdikulov[σ] & Sadibekova Bibisara[ρ]

Annotation

This research examines the impact of Gross Domestic Product (GDP) on CO2 emissions in four well-developed Asian countries—South Korea, Singapore, Taiwan, and Hong Kong—over the period from 1960 to 2019. To analyze the relationships, regression was performed using the Generalized Least Squares (GLS) method in STATA-14. The results indicate that all regressors are significant, and to address the issue of autocorrelation in the model, an Autoregressive Lag model was used. By adding the lag of an independent variable to the model, the problem of autocorrelation was resolved. Consequently, the model's goodness-of-fit improved, and the significance levels of the regressors were confirmed. Based on the research findings, it can be concluded that the economic growth of these countries leads to an increase in carbon dioxide emissions into the external environment.

Keywords: gross domestic product, CO2 emissions, GLS method, STATA14, correlation, autoregressive lag model, coefficient of determination.

*Author*α: Senior lecturer, Oriental University, Tashkent.
σ: Senior lecturer, Oriental University, Tashkent.
ρ: c.e.s, associate professor Tashkent State University of Oriental studies.

I. INTRODUCTION.

The reason we chose this specific topic is that today, the issue of environmental pollution, particularly the problem of carbon dioxide emissions that have a range of negative and harmful effects on living organisms, is becoming one of the most pressing concerns. For the analysis, four countries from Asia, specifically the Asian Tiger countries, were selected. These countries have both developed and developing economies, and the analyses conducted can also be applied to Uzbekistan.

The aim of the research presented in the monograph is to evaluate the impact of economic and environmental policies on the state of the environment and to develop methods for this assessment. To achieve this goal, the following tasks were addressed:

Developing the proposed approach, improving the previously established ones, and creating new mathematical models and methods based on the identified connections between economic and environmental indicators that will allow for the assessment of the impact of various factors on environmental pollution.

The country analysis demonstrates the relationship between GDP growth and CO2 emissions in the Asian Tiger countries.

Based on the constructed pollution functions, conducting a comparative analysis of the impact of economic development on the environment in these countries and neighboring countries (regions) with similar natural-climatic conditions and similar economic structures.

Since the works of J. Forrester, M. Mesarovich, and E. Pestel, significant attention has been given to the environmental consequences of economic development. Since the late 1980s, ecological economics has developed rapidly, including the development of specialized mathematical models.

Among the modern studies in the field of ecological and economic interactions are the works of T. A. Akimova, S. N. Bobylev, I. P. Glazyrina, A. A. Gusev, V. I. Danilov-Danilyan, M.

F. Zamyatina, G. E. Mekush, N. V. Pakhomova, I. V. Sheravniy, R. I., R. I., and others. Special models are developed to assess the interaction of economic and ecological processes, which together describe the behavior of ecological and economic systems and allow for the identification and quantitative assessment of the main factors influencing changes in the ecological situation.

At the same time, the impact of significant factors within a single year and their effect on the environment, as well as their influence on indicators in subsequent years, has not been sufficiently studied.

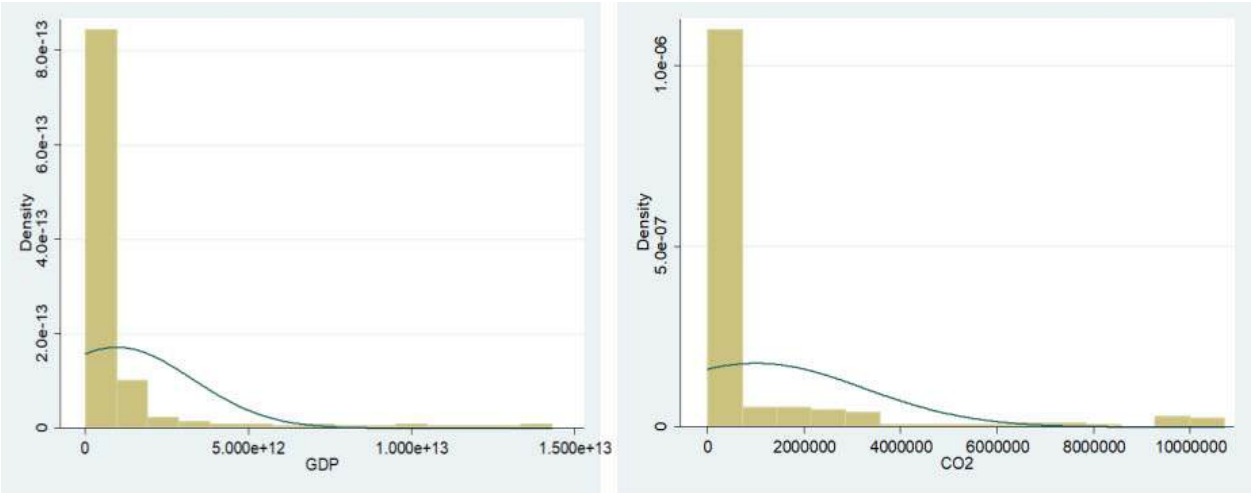
II. METHODOLOGY

```
. sum GDP CO2
```

Variable	Obs	Mean	Std. Dev.	Min	Max
GDP	239	9.64e+11	2.33e+12	5.95e+09	1.43e+13
CO2	237	997993.3	2249859	674.728	1.07e+07

Figure 1: Digital Descriptive Statistics

In the STATA-14 program, the "sum" command is used to view the number of observations, the arithmetic mean, the quadratic mean deviation, as well as the minimum and maximum values.



Figures 2-3: Normal Distribution Analysis

The comparison between statistical indicators and the normal distribution is illustrated in Figures 2-3, where we can observe that our indicators closely approximate the normal distribution.

```
. cor GDP CO2
(obs=236)

             |      GDP      CO2
-------------+------------------
         GDP |   1.0000
         CO2 |   0.9629   1.0000
```

Figure 4: Correlation Analysis.

The results of the correlation analysis show that GDP and CO2 have a strong positive correlation.

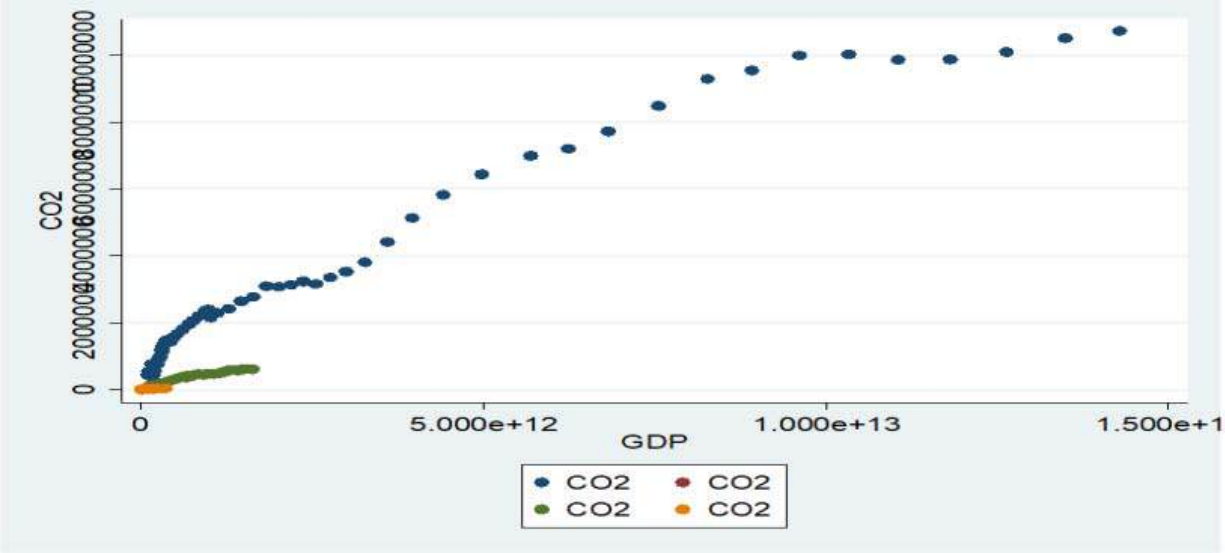


Figure 5

The analysis of carbon dioxide emission indicators by country is presented in Figure 5. Although the patterns may appear different at various scales, the scatter plots of the countries present nearly the same shape.

III. ANALYSIS OF RESULTS

The results of the regression analysis on the collected data are presented in Figure 6.

Source	SS	df	MS	Number of obs	=	236
				F(1, 234)	=	2981.70
Model	1.1068e+15	1	1.1068e+15	Prob > F	=	0.0000
Residual	8.6856e+13	234	3.7118e+11	R-squared	=	0.9272
				Adj R-squared	=	0.9269
Total	1.1936e+15	235	5.0792e+12	Root MSE	=	6.1e+05

CO2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
GDP	9.28e-07	1.70e-08	54.60	0.000	8.94e-07	9.61e-07
_cons	100177.3	42961.42	2.33	0.021	15536.67	184817.9

Figure 6

The results of our regression analysis show that a 1% increase in GDP leads to a 9.28% increase in CO2 emissions. The overall coefficient of determination is 92.72%. Our p-value indicates that the result is statistically significant.

It is necessary to check the regression results according to the Gauss-Markov conditions. The results are presented in Figures 7 and 8.

```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of co2

         chi2(1)      =     0.04
         Prob > chi2  =   0.8477
```

Figure 7

Breusch-Godfrey LM test for autocorrelation

lags(p)	chi2	df	Prob > chi2
1	221.918	1	0.0000
2	221.934	2	0.0000
3	222.055	3	0.0000
4	222.082	4	0.0000
5	222.355	5	0.0000

Figure 8

The Breusch-Pagan heteroscedasticity test is presented in Figure 7. According to its results, there is no heteroscedasticity problem in our model. The Breusch-Godfrey test, presented in Figure 8, checks the model for autocorrelation issues. The test results show that autocorrelation exists even at the 5th-order lag. Although we do

not present it here, we also checked that autocorrelation causes issues at all existing lags.

To address the autocorrelation issue in the model, we use an Autoregressive Lag model. By adding the lag of the independent variable to the model, we resolve the autocorrelation problem in the model.

The results of the Autoregressive Lag model are presented in Figure 9. According to these results, the model's coefficient of determination has improved, and the significance levels of the regressors have been confirmed. A 1% increase in GDP leads to a 0.21% increase in carbon dioxide emissions.

```
. reg co2 gdp L.co2
```

Source	SS	df	MS	Number of obs	=	234
				F(2, 231)	=	3216.27
Model	1063.53541	2	531.767705	Prob > F	=	0.0000
Residual	38.1927923	231	.165336763	R-squared	=	0.9653
				Adj R-squared	=	0.9650
Total	1101.7282	233	4.72844722	Root MSE	=	.40662

co2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gdp	.2099356	.0348614	6.02	0.000	.1412487	.2786225
co2 L1.	.8302775	.0276643	30.01	0.000	.775771	.8847841
_cons	-3.463209	.6361157	-5.44	0.000	-4.716539	-2.209879

Figure 9: The results of our research confirmed the views presented in the scientific literature.

IV. CONCLUSION

Based on the conducted research, it can be concluded that the economic growth of countries leads to an increase in carbon dioxide emissions into the external environment. This phenomenon negatively impacts the environment, causes ecological degradation, and leads to the formation of ozone holes. Therefore, this process should be monitored by governments to maintain a balance.

REFERENCES

1. Тагаева Т.А., Гильмундинов В.М., Казанцева Л.К. Оценка влияния факторов загрязнения окружающей среды на здоровье населения в регионах России и мира. Институт экономики и организации промышленного производства СО РАН, 2015 год.
2. Choi, E., Heshmati, A., Cho, Y. An Empirical Study of the Relationships between CO2 Emissions, Economic Growth and Openness. – IZA, Bonn, Germany, 2010.
3. Chikaraishi M, Fujiwara A., Shinji Kaneko S., Poumanyvong P., Komatsu S., Kalugin A. The moderating effects of urbanization on carbon dioxide emissions: A latent class modeling approach // Technological Forecasting and Social Change. 2015. V. 90. P. 302–317.
4. Decoupling Natural Resource Use and Environmental Impacts from Economic Growth. UNEP, 2011. URL: https://www.resourcepanel.org/reports/decoupling-natural-resource-useand environmental-impacts-economic-growth(дата обращения 09.06.2019).
5. Ecological Economics. 2014. Vol. 103. P. 56–67. 34. Guoa L., Qua Y., Wua Ch., Wang X. Identifying a pathway towards green growth of Chinese industrial regions based on a system dynamics approach. Resources, Conservation and Recycling. 2018. Vol. 128. Pp. 143–154. doi.org/10.1016/j.resconrec. 2016.09.035.
6. Официальный сайт Всемирного банка –https://data.worldbank.org/country

7. Ekonometrika asoslari– D. Rasulev, Sh.Nurullayeva, N.Ro'zmetova, M.Muminova (2019).
8. Iqtisodiyot nazariyasi-B.Y. Xodiyev, Sh.Sh. Shodmonov(2017).

Techniques and Means of Forming a Manager's Value-based Orientations in Modern Business

Gurenko Elena

ABSTRACT

This article discusses the techniques and means of forming the value-based orientations of a manager in the context of modern business realities. In particular, emphasis is placed on the transformation of a manager's value chain at different stages of a company's development with the emergence of new technologies and the introduction of digitalization into business processes. Proprietary models of life cycles and assessments of the manager's value-based orientations are developed, allowing to determine the conditions for successful adaptation of the company's work to rapidly changing conditions and maintain competitiveness in the market thanks to the right management decisions.

Keywords: manager, value-based orientations, formation of value-based orientations, digitalization, business.

Classification: JEL Code: M12, M14, O33

Language: English

Great Britain Journals Press

LJP Copyright ID: 146446
Print ISSN: 2633-2299
Online ISSN: 2633-2302

London Journal of Research in Management & Business

Volume 25 | Issue 4 | Compilation 1.0

Techniques and Means of Forming a Manager's Value-based Orientations in Modern Business

Gurenko Elena

ABSTRACT

This article discusses the techniques and means of forming the value-based orientations of a manager in the context of modern business realities. In particular, emphasis is placed on the transformation of a manager's value chain at different stages of a company's development with the emergence of new technologies and the introduction of digitalization into business processes. Proprietary models of life cycles and assessments of the manager's value-based orientations are developed, allowing to determine the conditions for successful adaptation of the company's work to rapidly changing conditions and maintain competitiveness in the market thanks to the right management decisions.

Keywords: manager, value-based orientations, formation of value-based orientations, digitalization, business.

Author: Russian State University named after A.N. Kosygin (Technologies. Design. Art).

I.INTRODUCTION

The era when an entrepreneur comes up with an idea, launches a business and simply makes a profit is ending. A next generation entrepreneur is not a person who knows how to make money, a computer will do it for him much faster. This is a person who knows how to change lives around himself, his clients, his employees, and investors for the better by making right management decisions based on the values of modern realities and dictating new "rules of the game" in business. Such decisions, in turn, involve, among other things, the implementation of ways to improve the techniques and means of forming managers' value-based orientations.

The techniques and means of forming value-based orientations in general include internal and external factors, that is, everything that falls under the concept of a "social and cultural environment" (family, education, communication, religion, mass media, etc.), and the ways to improve them include theoretically substantiated training and education processes, interaction with people, allowing successful achievement of goals[1]. Within the framework of business processes, they are implemented through various actions or activities that can be carried out at several levels.[2]:

- Administrative lvel: direct influence, official indication of principles or standards, norms of behavior, changes in work schedules, etc. (they are precise and unambiguous, which allows one to quickly adapt to them, focus on them, and refer to them in difficult or controversial situations);
- Psychological level: influence by example, imitation, "exchange of experience", etc. (direct impact on personality and the assimilation of necessary behavioral patterns);
- Symbolic level: slogans, semantic associations, spatial arrangement, etc. (usually emotionally saturated, with a high impact rate);
- economic level: rewards, benefits, bonuses, etc. (stimulate the achievement of the main goal of participation in the company's activities), etc.

For the subsequent development and change of the most visible elements in the manager's value system, such a popular tool as business training can be used (for example, in the form of a business game, business stimulation, strategic

[1] Vorozheikin, I. E. Management of an organization's social development: textbook / I.E. Vorozheikin. – M.: INFRA-M Scientific Publishing Center, 2001. – 266 p.

[2] Steklova, O. E. Organizational culture: textbook / O. E. Steklova. – Ulyanovsk: UlSTU, 2007. – 127 p.

coaching session, panel discussion, etc.), i.e., an active form of training. Unlike, for example, a regular lecture, where participants receive only theoretical knowledge, the training offers the opportunity to gain useful practical experience. But since each manager, like any organization, has its own set of value-based orientations, the development of program training for managers should imply an integrated approach based on different parameters, from the organization development stage, managerial experience of the manager to the specifics of his formation as a person in the family and organization and the development of the state in which he carries out his professional activities.

II. RESULTS AND DISCUSSION

In order to trace the relationship between these elements and the value-based orientations of a manager in the business sphere, a proprietary comparison model was compiled within the framework of this paper on the basis of a positivistic approach[3] (Table 1). It combined the foundations of the theory of life cycles of an organization by I. Adizes and the theory of crowd formation by G. Le Bon[4], allowing us to consider value-based orientations in the context of "person – family – organization – state".

Table 1: Proprietary model for comparing a manager's life cycles, a person, a family, an organization, and the state

Manager's life cycle (work experience)	Human life cycle	Family life cycle	Organization's life cycle	State (civilization) life cycle
Origin (up to 1 year)	Origin	Origin	Nurturing	Origin
Formation (1-5 years)	Infancy	Formation	Infancy	Infancy
Flourishing (5-10 years)	Youth	Flourishing	Youth	Flourishing
Maturity (10-15 years)	Maturity	Maturity	Aristocraticism	Abundance
Reorganization (15-20 years)	Advanced age	Reorganization	Bureaucratization	Flourishing
Degradation (20 years or more)	Old age	Old age	Death	Degradation

According to the results of an empirical study, it was revealed that managers with less than 1 year of managerial experience have such value-based orientations as "systems thinking", "decision making ability" and "stress tolerance"; managers with 1-5 years of experience have "systems thinking", "decision making ability" and "focus on the result"; for managers with 5-10 years of experience, the first lines in the system of value-based orientations are also occupied by "systems thinking", "decision–making ability" and "continuous self-development"; for managers with 10-15 years of experience, these are "systems thinking", "decision-making ability" and "creative thinking and attitude to work"; the most experienced managers (more than 20 years of experience) consider "authority", "responsibility", and "self-confidence" to be their main value-based orientations. The parallel between these value-based orientations of a manager and the value-based orientations of an individual, family, company and state can be traced in this table.

It is clearly seen that both the manager, the person, the organization, and the state go through very similar stages of development, at each of which they encounter certain problems that are more or less similar and go through periods of

[3] Con, I. S. Positivism in sociology. – L., 1965.
[4] Le Bon, G. Psychology of peoples and masses. – Publishing house: Socium, 2016. – 384 p.

crisis, which, in turn, are characterized by a certain set of value-based orientations. For example, when analyzing the second stage of the cycle "formation – infancy – becoming – infancy – infancy" in more detail, it can be noted that for a person it is a period of functional development, which is possible for him only subject to interaction with adults; for a family it is the period from the birth of the first child to their inclusion in external social structures (children kindergarten, school); for an organization – when it is founded in a physical sense, and its manager takes on financial risks; for a state, it is a period of subordination until its people overthrow the oppressor or move to other territories. Similarly, a manager at the formation stage (1-5 years of managerial experience) strongly depends on personal connections and the help of other specialists (such as a child from his parents or the people from their oppressor): if he loses faith in himself, in the idea, the company will end its activities. The delegation process has not yet been formed in a young company, there are no processes for transferring and managing information; for this reason, everything is limited to the manager, who takes part in every event of a small company. That is why, at an early stage of development, the manager should use his own example to show involvement in work, focus on results, focus all efforts on improving customer service, demonstrating value-based orientations that will correspond to the company's value-based orientations at a specific stage of its development

(Table 3.2.1). In other words, this comparative life cycle model is universal and, extending into several categories at once, represents a person (supervisor) or a group of people (subordinates) who have been striving for a single goal for some time. Due to this "synchronicity" in development, one can predict possible changes in the system of a manager's value-based orientations in the business sphere and take appropriate measures to improve it in a timely manner to achieve the desired result.

However, it must be understood that everyone involved in the chain of creation of a particular value-based orientation must be aware of everything that is happening in the world, otherwise there is a risk of being late in the endless race for new technologies and digital resources[5]. In this sense, a cyclical pattern can be traced again: each round of development is faster and more complex, and the countdown begins with industrial revolutions that "promote" a new approach to production and consumption methods[6].

- Industry 1.0 (1784) – "mechanization"; production operates on water and steam based mechanisms; economic development is based primarily on "successful" inventions.
- Industry 2.0 (1870) – "electrification", mass production using assembly lines; at its core, as at the heart of the first revolution, is general-purpose technology[7], which by itself does not increase the efficiency and effectiveness of the company, but contributes to the creation of other technologies that improve these indicators; the emphasis is already on the evidence base of scientific achievements.
- Industry 3.0 (1969) – "automation"; automation of production processes using electronics and computers; economic development at the expense of a "new" class of entrepreneurs – cosmopolitan, multilingual, educated and sociable, whose goal is the global market.
- Industry 4.0 (2011) – "digitalization" or "smart factory", combining devices, data analysis and artificial intelligence for greater automation of processes; the main goal is to mass produce a product and maximize profit by increasing productivity and reducing costs; labor market flexibility increases – some professions disappear, others become remote[8].
- Industry 5.0 (currently being formed, although some companies are already

[5] Mumford, L. The myth of the machine. Technology and the development of mankind / translation from English: T. Azarkovich, B. Skuratov (Chapter 1). – M: Logos. – 2001. – 408 p.

[6] Buldygin, S. S. The concept of the industrial revolution: from the concept to the present day // Bulletin of Tomsk State University. – 2017. – No. 420. – p. 91-95.

[7] Cameron, R. A brief economic history of the world. From the Paleolithic to the present day. – M., 2001. – 544 p.

announcing the use of Industry 6.0 technologies[9])

- "personalization", interaction of humans and technologies with a focus on humans. In other words, business in the era of the fifth revolution is not about changes within the organization, as in the era of the fourth revolution, but a focus on the external environment, where customers live and where money directly comes from. In other words, Industry 5.0 is about new processes of change aimed at closer cooperation between man and machine, systematic prevention of waste (including electronic waste) and squander, balancing digital development and the ESG agenda, as well as new opportunities for companies [10]and a new set of values for their managers, where the main value-based orientations are "sustainable development", "environmental friendliness", "customer orientation" and "personalization".

Since Industry 5.0, combining people and technology into one system, includes all previous "digital" experience into an existing reality that cannot exist and develop without a person, when studying the value-based orientations of a business manager, it would be advisable to improve the proprietary model for evaluating value-based orientations (Table 2), supplementing it with so-called digital value-based orientations, which in the framework of this paper are defined as human interaction with the digital environment, aimed at obtaining the best results.

[8] Sudas, L. G., Yudina, M. A. Managerial imperatives of the industry 4.0 / L. G. Sudas, M. A. Yudina. – Moscow: Moscow University Press, 2021. – 152 p.

[9] Sergey Glazyev: "The bacchanalia of negative forecasts must not program us for failure" // Business Online electronic newspaper. – 2022. – URL: https://www.business-gazeta.ru/article/550442 (date of visit: March 23, 2025).

[10] Pine, J., Gilmore, J. The economy of impressions. – Publishing house: Alpina Publisher. – 2021. – 384 p.

Table 2: Improved proprietary model for evaluating a manager's value-based orientations

Company life cycle and purpose	Manager's command role	Type of manager with value-based orientations	Digital value-based orientations
1. Nurturing (creating and developing a deep and committed idea)	Chairman, collectivist	Transformer (development, changes, dynamic successes)	Customer focus, sustainable development, personalization, environmental friendliness, striving for innovation, openness to new information, responsibility for the reliability and safety of content transmitted to the information environment, creativity and its manifestation in the context of algorithmic solutions, etc.
2. Infancy (development)	Thinker, shaper, scout	Transformer (development, changes, dynamic successes)	
3. Childhood (clear definition of activities)	Shaper, performer, finisher	Transformer (development, changes, dynamic successes)	
4. Youth (process structuring)	Performer, chairman, collectivist	Fighter for justice (honesty, objectivity, equality)	
5. Flourishing (long-term business retention)	Chairman, scout, shaper	Power-seeker (power, expansion of zones of influence and authority, increase of assets)	
6. Stabilization (profit-making)	Chairman, finisher, shaper, collectivist	Power-seeker (power, expansion of zones of influence and authority, increase of assets)	
7. Aristocraticism ("survival")	Chairman, appraiser, collectivist	Power-seeker (power, expansion of zones of influence and authority, increase of assets)	
8. Early bureaucratization (minimization of risks and business costs)	Chairman, collectivist	Power-seeker (power, expansion of zones of influence and authority, increase of assets)	
9. Bureaucratization and death (search for new opportunities)	Scout, thinker, shaper	Transformer (development, changes, dynamic successes)	

Thus, according to the improved proprietary model of value-based orientations, digital value-based orientations are an essential attribute of the value system of a modern business manager, and do not depend directly on the company's life cycle, that is, on its strategic goal at a certain stage of development. This can be explained by the fact that digital and information technologies, as well as Industry 5.0 with all its components (long-term forecasts and planning, digital twins, blockchain, modular structures, etc.)

– these are the current conditions of any business existence, which cannot be circumvented or ignored without prejudice to the development of the organization.

That is, the entire value chain of the manager (at all stages of the company's development) is changing with the advent of the latest technologies and "smart" products[11], which, however, would hardly have happened without the formation of a new approach to managing the company's life cycle, in this case– digital. Hence, there is a need to introduce such a concept as "digital life cycle management of a company." Within the framework of this study, digital life cycle management of a company will be understood as a comprehensive concept that

differs significantly from "traditional" management practices, which allows to completely update all business processes and resources of the company taking into account new realities and change the system of a manager's value-based orientations, improving the methods and techniques of their formation, and which can be given the following characteristics[12]:

1. speed – the transition from one company life cycle to another is carried out with a shortened response time, since using high-performance computing significantly accelerates the time required to achieve the company's goal at a particular stage of the life cycle;
2. scalability is the ability to expand the goal set by a company within a certain life cycle;
3. intelligence, i.e. the inclusion of powerful analytics tools in management practices to predict the market situation:
4. Connectivity is a single, transparent and integrated flow of information to maintain the "functionality" of the entire company life cycle.

Based on the above, modern business management boils down to digitalizing the company's life cycle. In order for this process to take place consciously and comprehensively, with sound management decisions based on digital value-based orientations, and to meet the conditions and goals of the company at each stage of its development, it is necessary to understand the structure and sequence of levels of business digitalization. Taking as a basis the 5 stages of digital business transformation proposed by the American CEOWORLD Magazine[13] and superimposing them on the improved proprietary model for assessing value-based orientations (Table 2), the proprietary model of the company's digital life cycle was obtained.

It is clearly seen that the digital life cycle of a company, which in the framework of this study is understood as the company's complete transition to digital mode, with an innovative business model and digitally savvy staff, is one of the key stages of the transformation process in modern conditions that will ensure the company's future functioning and growth. In other words, in order to achieve full digitalization, a special digital culture must be formed in the company (understanding why digitalization is needed, willingness to make changes, desire and aspiration to learn, focus on customer needs, etc.) which will help to successfully and quickly move forward not only in the process of transition to digital format, but also in the process of other transformations. However, despite the fact that digital culture in itself is not something difficult to achieve and possible only in the largest IT companies, the level of its formation in Russian small and medium-sized businesses is still at an early stage, and the older these companies are, the more difficult the transformation process is.

It should also be emphasized that the political situation in the world and various restrictions related to the sanctions crisis are forcing businesses to go online today – the only way for many organizations to survive in such restrictive conditions. This requires managers not only to develop and improve their digital orientations, but also to be able to differentiate them for effective use in offline and online spaces.

III. CONCLUSIONS

Thus, having considered the techniques and means of forming value-based orientations among managers in modern business, we can conclude that they are implemented through various events and actions (business trainings, seminars, inviting specialists, introducing a bonus system, etc.) and allow the organization to successfully achieve its goals. In addition, the study showed that in the current realities, in order to successfully implement a company's activities at all stages of its development, it is not enough to simply restructure outdated production and information processing processes; it is also necessary to restructure and improve the system of a manager's value-based orientations.

[11] Schaeffer, E. Industry X.0 Advantages of digital technologies for production / Eric Schaeffer; translation from English.: Tochka Publishing Group – 2019. – 320 p.

[12] Kulagin, V. Digital@Scale: Desktop book on business digitalization / V. Kulagin, A. Sukharevsky, Yu. M. Meffert. – Intellectual literature. – 2020. – 293 p.

[13] Stages of digital transformation: what will you have to go through? // RB.RU. – 2019. – URL: https://rb.ru/story/digital-transformation-stages / (date of request: March 20, 2025).

REFERENCES

1. Buldygin, S. S. The concept of the industrial revolution: from the concept to the present day // Bulletin of Tomsk State University. – 2017. – No. 420. – pp. 91-95.
2. Cameron, R. A brief economic history of the world. From the Paleolithic to the present day. – M., 2001. – 544 p.
3. Con, I. S. Positivism in sociology. – L., 1965.
4. Kulagin, V. Digital@Scale: Desktop book on business digitalization / V. Kulagin, A. Sukharevsky, Yu. M. Meffert. – Intellectual literature. – 2020. – 293 p.
5. Le Bon, G. Psychology of peoples and masses. – Publishing house: Socium, 2016. – 384 p.
6. Mumford, L. The myth of the machine. Technology and the development of mankind / translation from English: T. Azarkovich, B. Skuratov (Chapter 1). – M: Logos. – 2001. – 408 p.
7. Pine, J., Gilmore, J. The economy of impressions. – Publishing house: Alpina Publisher. – 2021. – 384 p.
8. Schaeffer, E. Industry X.0 Advantages of digital technologies for production / Eric Schaeffer; translation from English.: Tochka Publishing Group – 2019. – 320 p.
9. Sergey Glazyev: "The bacchanalia of negative forecasts must not program us for failure" // Business Online electronic newspaper. – 2022.–URL: https://www.business- gazeta. ru/article/550442 (date of visit: March 23, 2025).
10. Stages of digital transformation: what will you have to go through? // RB.RU. – 2019. – URL: https://rb.ru/story/digital-transformation-stages / (date of request: March 20, 2025).
11. Steklova, O. E. Organizational culture: textbook / O. E. Steklova. – Ulyanovsk: UlSTU, 2007. – 127 p.
12. Sudas, L. G., Yudina, M. A. Managerial imperatives of the industry 4.0 / L. G. Sudas, M. A. Yudina. – Moscow: Moscow University Press, 2021. – 152 p.
13. Vorozheikin, I. E. Management of an organization's social development: textbook / I.E. Vorozheikin. – M.: INFRA-M Scientific Publishing Center, 2001. – 266 p.

Great Britain Journal Press Membership

For Authors, subscribers, Boards and organizations

Great Britain Journals Press membership is an elite community of scholars, researchers, scientists, professsionals and institutions associated with all the major disciplines. Great Britain memberships are for indivi - duals, research institutions, and universities. Authors, subscribers, Editorial Board members, Advisory Board members, and organizations are all part of member network.

Read more and apply for membership here:
https://journalspress.com/journals/membership

For Authors

Author Membership provide access to scientific innovation, next generation tools, access to conferences/seminars/ symposiums/webinars, networking opportunities, and privileged benefits. Authors may submit research manuscript or paper without being an existing member of GBJP. Once a non-member author submits a research paper he/she becomes a part of "Provisional Author Membership".

For Institutions

Society flourish when two institutions Come together." Organizations, research institutes, and universities can join GBJP Subscription membership or privileged "Fellow Membership" membership facilitating researchers to publish their work with us, become peer reviewers and join us on Advisory Board.

For Subscribers

Subscribe to distinguished STM (scientific, technical, and medical) publisher. Subscription membership is available for individuals universities and institutions (print & online). Subscribers can access journals from our libraries, published in different formats like Printed Hardcopy, Interactive PDFs, EPUBs, eBooks, indexable documents and the author managed dynamic live web page articles, LaTeX, PDFs etc.

GO GREEN AND HELP
SAVE THE ENVIRONMENT

JOURNAL AVAILABLE IN

PRINTED VERSION, INTERACTIVE PDFS, EPUBS, EBOOKS, INDEXABLE DOCUMENTS AND THE AUTHOR MANAGED DYNAMIC LIVE WEB PAGE ARTICLES, LATEX, PDFS, RESTRUCTURED TEXT, TEXTILE, HTML, DOCBOOK, MEDIAWIKI MARKUP, TWIKI MARKUP, OPML, EMACS ORG-MODE & OTHER

support@journalspress.com
www.journalspress.com

*THIS JOURNAL SUPPORT AUGMENTED REALITY APPS AND SOFTWARES