

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF COMMERCE

DEPARTMENT OF ECONOMICS



**THE IMPACT OF BLOCK CHAIN TECHNOLOGY ON BUILDING
RESILIENCE OF LOGISTICS INDUSTRY: CASE OF DHL.**

By:

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**DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE BACHELOR OF COMMERCE (HONOURS)
DEGREE IN SUPPLY CHAIN MANAGEMENT OF BINDURA UNIVERSITY
OF SCIENCE EDUCATION.**

FACULTY OF COMMERCE

JUNE 2025

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ABSTRACT

This study investigates the impact of block chain technology on enhancing supply chain resilience within the logistics industry, focusing on a case study of DHL, a leading global logistics provider. Traditional logistics systems face vulnerabilities stemming from information asymmetry, lack of transparency, and susceptibility to disruptions. Block chain, with its decentralized, immutable, and transparent characteristics; present a promising avenue for enhancing resilience. This research employs a qualitative case study approach, drawing upon DHL white papers, industry reports, and academic literature, to examine the specific applications of block chain across DHL's operations, including track and trace, customs clearance, and supply chain finance. The study analyzes how block chain initiatives contribute to enhanced visibility, reduced transaction costs, and improved dynamic capabilities, which are the key factors in building supply chain resilience. While direct, peer-reviewed empirical studies on DHL's block chain implementations are limited, the synthesized evidence suggests that block chain technology has the potential to improve supply chain resilience by enabling proactive disruption management, fostering greater trust among stakeholders, and streamlining processes. However, challenges related to scalability, interoperability, and regulatory uncertainty must addressed for successful block chain adoption. The findings will contributes to a deeper understanding of the practical implications of block chain for building resilient logistics operations and offer valuable insights for other organizations seeking to leverage this transformative technology.

ACKNOWLEDGEMENTS

The writer expresses deep gratitude to God for providing wisdom, good health, and spiritual guidance throughout their academic journey. The researcher also extended his appreciation to dissertation supervisor Dr B Nkala for offering intellectual support and guidance. Additionally, the author acknowledges the assistance of the Purchasing department staff and students in conducting this study and making it successful. I would like to express the greatest gratitude towards their family and relatives for providing support in various forms such as spending time, offering prayers, providing financial assistance, and giving words of encouragement during their research. Additionally, the author acknowledges his supervisors for collaborating with them and providing academic support. The author expresses blessings to all those who have supported them including all DHL employees and executives to make this project come through.

DEDICATION

My greatest dedication goes to my wife Leona Machadu and my son for their unwavering support, despite the hardship encountered during my academic work that plagued by financial difficulties and scarcity of time for their social interaction with me. Outstanding gratitude to Riozim Limited (my Employer) for all the support financially and expertise rendered to make this project meaningful.

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CHAPTER I

INTRODUCTION

1.0 Introduction

In today's interconnected global economy, the logistics industry stands as the critical infrastructure enabling the movement of goods and services across complex supply chains. The need for resilient logistics operations has become increasingly paramount. Supply chain disruptions, ranging from natural disasters to geopolitical instability, can have severe consequences for businesses, impacting profitability, customer satisfaction, and overall economic stability. This study investigates the potential of block chain technology to enhance supply chain resilience within the logistics industry. Block chain, with its decentralized, transparent, and immutable characteristics, presents an innovative approach to address traditional vulnerabilities in logistics operations. This research will focus on DHL, a leading global logistics provider, to examine the practical applications of block chain in building more robust and adaptable supply chains. The study aims to assess how block chain technology can improve visibility, enhance traceability, and mitigate risks in the context of a large, multinational organization operating in a dynamic and challenging global environment. By understanding DHL's experiences, this research seeks to contribute valuable insights for logistics companies and policymakers seeking to leverage block chain to create more resilient, and efficient supply chains.

1.1 Background of Study

The logistics industry serves as the circulatory system of the global economy, enabling the efficient flow of goods and services that underpin international trade and commerce (Advait Deshpande, 2017). Modern supply chains, however, are increasingly complex and vulnerable to a wide range of disruptions, including natural disasters, geopolitical instability, cyberattacks, and economic shocks (Saad, 2009). Building resilience is the ability to anticipate, prepare for, respond to, and recover from disruptions has become a critical imperative for logistics companies seeking to maintain a competitive edge and ensure business continuity (Serhiy Y. Ponomarov, 2009). Traditional logistics systems often rely on centralized databases and manual processes, creating inefficiencies,

information asymmetry and vulnerabilities to fraud and security breaches (Organization for Economic Co-operation and Development(OECD), 2019). These shortcomings can be particularly acute in developing economies, where inadequate infrastructure, complex customs procedures, and a lack of trust among stakeholders further complicate supply chain operations (World Bank, 2022). Block chain technology, characterized by its decentralized, transparent, and immutable nature, offers a promising solution to address many of these challenges. By providing a shared, tamper-proof ledger for recording transactions and tracking the movement of goods, block chain can enhance visibility, improve efficiency, and reduce the risk of fraud in logistics operations (Saber et al., 2019). This study focuses on DHL, a leading global logistics provider, and its efforts to leverage block chain technology to build supply chain resilience. DHL operates in over 220 countries and territories, managing complex supply chains across diverse industries. As a result, the company is acutely aware of the challenges posed by supply chain disruptions and the need for innovative solutions to enhance resilience (DHL, 2023). DHL has been actively exploring and implementing block chain solutions in various areas of its business, including track and trace, customs clearance, and supply chain finance (Deutsche Post DHL Group, 2018). By examining DHL's experiences, this study aims to provide insights into the practical applications of block chain technology for building supply chain resilience in the logistics industry. This research seeks to provide clarity on how effectively block chain helps to improve resilience in practical logistics scenarios and identify key factors that influence the success of block chain implementations.

1.2 Statement of the problem

While the potential benefits of block chain technology for logistics are widely discussed, there is limited empirical evidence on its actual impact on supply chain resilience, particularly within the context of large, multinational logistics organizations such as DHL. Despite significant investment in block chain initiatives, the specific mechanisms through which block chain contributes to resilience remain unclear. Furthermore, the implementation of block chain technology in logistics is not without its challenges. Issues such as scalability, interoperability, regulatory uncertainty, and the need for collaboration among multiple stakeholders can hinder the successful adoption and deployment of block chain solutions (Kamath, 2018). Therefore, there is a need for in-depth research to assess the impact of block chain technology on building

supply chain resilience within DHL, identify the challenges associated with its implementation, and provide recommendations for maximizing its effectiveness. This study aims to address this gap in the literature by examining DHL's experiences and providing practical insights for logistics companies seeking to leverage block chain to enhance resilience.

1.3 Research Objectives.

1.3.1 To assess the impact of block chain technology on enhancing supply chain visibility and traceability within DHL's logistics operations.

1.3.2 To identify the challenges and opportunities associated with implementing block chain technology for building supply chain resilience at DHL.

1.3.3 To develop recommendations for maximizing the effectiveness of block chain solutions in enhancing supply chain resilience for DHL and other logistics companies.

1.3.4 To identify factors that influences the adoption of block chain technology in logistics chain of DHL.

1.4 Research Questions

1.4.1 How does block chain technology impact supply chain visibility and traceability within DHL's logistics operations?

1.4.2 What are the key challenges and opportunities associated with implementing block chain technology for building supply chain resilience at DHL?

1.4.3 What recommendations to adopt to maximize the effectiveness of block chain solutions in enhancing supply chain resilience for DHL and other logistics companies?

1.4.4 What are the factors that influences the adoption of block chain technology in logistics chain?

1.6 Significance of the study

The findings of this study will provide valuable insights for DHL and other logistics companies seeking to leverage block chain technology to enhance supply chain resilience. The recommendations developed will offer practical guidance for maximizing the effectiveness of block chain solutions and overcoming implementation challenges. Theoretically, this study will contribute to the growing body of knowledge on block chain technology and its application in the logistics industry. By examining DHL's experiences, this research will provide empirical evidence on the impact of block chain on supply chain resilience and contribute to the development of theoretical

frameworks for understanding this phenomenon. The findings of this study may also be relevant for policymakers in development of policies and regulations that support innovation and enhance the competitiveness of the logistics industry.

1.7 Assumptions

- DHL is representative of other large, multinational logistics companies, and its experiences with block chain technology can provide valuable insights for the broader industry.
- The data and information provided by DHL are accurate and reliable.
- Block chain technology has the potential to significantly influence supply chain resilience in the logistics industry.

1.8 Delimitations of the study

The study is deliberately limited to examining the impact of block chain technology on supply chain resilience within DHL. While insights from other logistics providers may be considered, the primary focus will remain on DHL's specific experiences and strategies. This case-study approach allows for a deep-dive analysis of a complex organization. The study will primarily focus on specific applications of block chain technology relevant to supply chain resilience, such as track and trace, customs clearance, and supply chain finance. Other potential applications of block chain in logistics, such as smart contracts or decentralized autonomous organizations (DAOs) are merely considered to extent that they directly relate to the study's focus on resilience. While DHL operates globally, the study will primarily focus on supply chain operations relevant to key markets, chosen based on DHL's strategic priorities and data availability. The study will adopt a specific definition of supply chain resilience, focusing on the ability to anticipate, prepare for, respond to, and recover from disruptions. Other aspects of supply chain performance, such as cost optimization or sustainability, are only considered to the extent that they directly influence resilience. These delimitations intend to ensure that the study remains focused and manageable within the available resources and timeframe, allowing for a thorough examination of the research questions.

1.9 Definitions of key terms

Block chain Technology: A decentralized, distributed, and immutable ledger that records transactions in a secure and transparent manner (Kshetri, 2017).

Supply Chain Resilience: The ability of a supply chain to anticipate, prepare for, respond to, and recover from disruptions while maintaining continuity of operations at

the desired level of connectedness and control over structure and function (Ponomarov & Holcomb, 2009).

Logistics Industry: The sector of the economy that encompasses the planning, implementation, and control of the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements (Council of Supply Chain Management Professionals, n.d.).

Track and Trace: The ability to monitor the location and status of goods as they move through the supply chain, providing real-time visibility and enabling proactive identification of potential disruptions (Atzori et al., 2017).

Smart Contracts: Self-executing contracts written in code and stored on a block chain, automatically enforcing the terms of an agreement when specified conditions are met (Dreyfus, 2018).

Interoperability: The ability of different block chain networks and systems to communicate and exchange data with each other seamlessly (Swan, 2015).

1.10 Chapter Summary

This chapter has introduced the study, outlining the background, statement of the problem, objectives, research questions, significance, assumptions, limitations, delimitations and key definitions. The study will investigate the impact of block chain technology on building supply chain resilience within DHL, a leading global logistics provider. The research will examine specific applications of block chain, such as track and trace and customs clearance, and will identify the key challenges and opportunities associated with their implementation. Through a case study approach, this research aims to provide practical insights for logistics companies seeking to leverage block chain to enhance resilience and to contribute to the growing body of knowledge on this emerging technology. Subsequent chapters will delve into a review of the relevant literature, describe the research methodology, present the findings of the study, and discuss the implications for theory and practice.

CHAPTER II

LITERATURE REVIEW

2.0 Introduction

To observe the research topics of this dissertation this review seeks to examine and assess different literatures relevant to the areas of interest. The review will centre on theoretical and conceptual frameworks to get a base understanding of the research before finally reviewing the empirical evidence available in the field.

2.1 Conceptual framework

Figure 1. 1: Conceptual framework demonstrating block chain features, adoption drivers and barriers, adoption mechanisms and systems , block chain based instruments and in combination with other related technologies and the stakeholders involved.

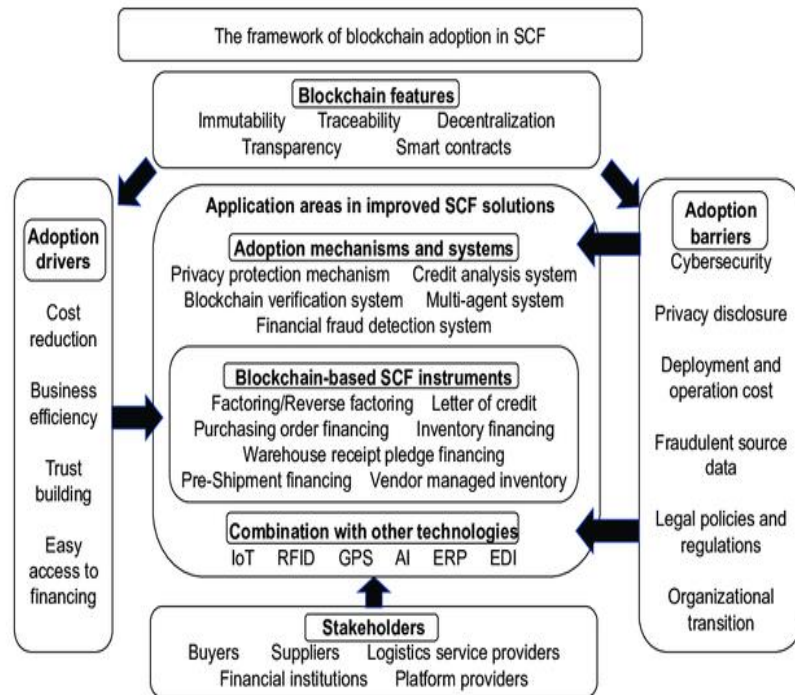
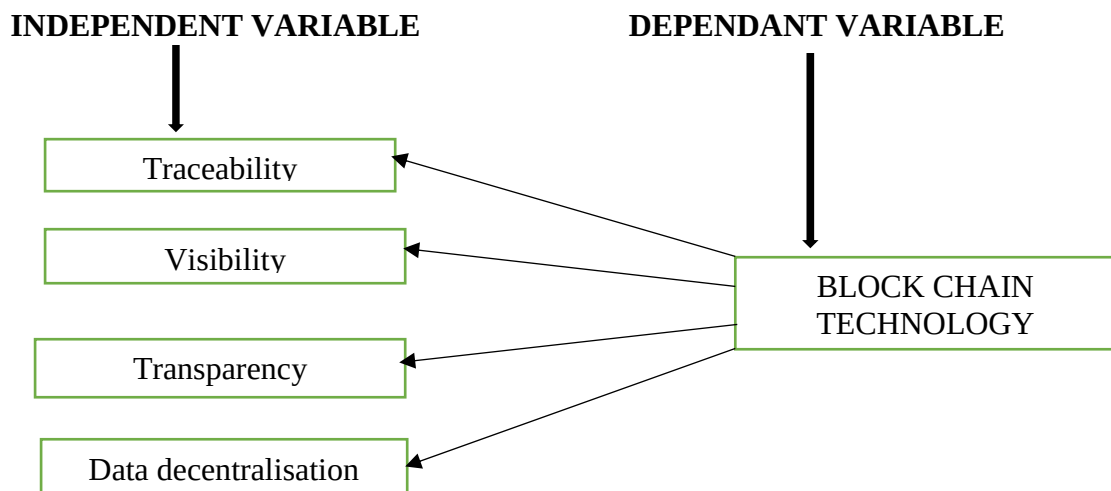


Fig 1.1 Supply Chain Finance and Block chain in Operations Management by (Zhang, 2022).

FIG 1.2 Conceptual Framework of Dependent and Independent.

Fig 1.2: Showing conceptual framework demonstrating dependent variable (Block chain technology) and its independent variables.



2.2 Theoretical Review

This section presents the theoretical framework that will guide the analysis and interpretation of the study's findings regarding the impact of block chain technology on building supply chain resilience in DHL. This framework draws upon several established theories to provide a comprehensive lens through which to examine the complex relationships between technology, organizational capabilities, and supply chain outcomes. The key theories informing this study are the Resource-Based View (RBV), Transaction Cost Economics (TCE), the Dynamic Capabilities Framework (DCF), and Network Theory.

2.2.1 Resource-Based View (RBV) Model.

The Resource-Based View (RBV) posits that a firm's competitive advantage stems from its ability to acquire, develop, and deploy valuable, rare, inimitable, and non-substitutable (VRIN) resources (Barney, 1991). In the context of this study, block chain technology can be considered a strategic resource that, when effectively leveraged, can contribute to DHL's competitive advantage by enhancing its supply chain resilience. Block chain can enhance supply chain visibility, improve traceability, and reduce the risk of fraud, creating value for DHL and its customers. A resilient supply chain ensures business continuity, reduces disruptions, and maintains customer satisfaction, thus contributing to tangible value creation. While block chain technology itself is not rare, the ability to successfully implement and integrate it into existing logistics operations,

and to leverage it effectively to build resilience, is a skill that few organizations possess. This scarcity provides DHL with a potential competitive edge. Inimitability: The specific way that DHL implements and utilizes block chain technology is difficult for competitors to imitate. This is due to the company's unique organizational capabilities, its relationships with its suppliers and customers, and its tacit knowledge of its supply chain processes. Block chain's combination of transparency, security, and decentralization makes it difficult to substitute with other technologies or approaches. While alternative technologies might address specific aspects of supply chain resilience, they are unlikely to provide the same level of comprehensive benefits as block chain.

2.2.3 Dynamic Capabilities Framework (DCF)

The Dynamic Capabilities Framework (DCF) emphasizes the importance of a firm's ability to sense, seize, and transform its resources and capabilities in response to changing environmental conditions (Teece, 2007). In today's dynamic and unpredictable world, the ability to quickly adapt to disruptions and capitalize on new opportunities is critical for survival and success. Block chain technology can enhance DHL's dynamic capabilities by sensing, seizing, and transforming. Sensing is through providing real-time visibility into the supply chain, enabling DHL to quickly detect potential disruptions and identify emerging trends. Seizing is through enabling DHL to respond quickly to disruptions by re-routing shipments, adjusting inventory levels, and reconfiguring its supply chain network. Transforming through facilitating the development of new business models and innovative supply chain solutions that leverage block chain technology to create new value for customers. By applying the DCF, this study will examine how DHL's advantages block chain technology enhances its dynamic capabilities and build a more agile and adaptable supply chain.

2.2.2 Transaction Cost Economics (TCE) Theory

Transaction Cost Economics (TCE) focuses on minimizing the costs associated with economic transactions, including the costs of searching for information, negotiating contracts, monitoring performance, and enforcing agreements (Williamson, 1985). In traditional supply chains, these transaction costs can be significant due to information asymmetry, uncertainty, and the need for intermediaries. Block chain technology has the potential to reduce transaction costs in logistics by reducing information asymmetry, automating contracts and eliminating intermediaries. Block chain's transparent and shared ledger provides all stakeholders with access to the same information, reducing

the need for costly information gathering and verification efforts. Smart contracts can automate the execution of agreements, reducing the need for manual monitoring and enforcement, and lowering the risk of disputes. Block chain can facilitate direct interactions between buyers and sellers, bypassing traditional intermediaries and reducing transaction fees. By applying TCE, this study will investigate how DHL advantages block chain technology to reduce transaction costs, improve efficiency, and enhance the overall performance of its supply chain. This also shows why certain agents are important to the running of logistics, and why it is critical to take note of them.

2.2.4 Network Theory

Network Theory provides a framework for understanding the structure and dynamics of interconnected systems (Wasserman & Faust, 1994). Supply chains are inherently network-based, involving a complex web of relationships between suppliers, manufacturers, distributors, retailers, and customers. Block chain technology can influence the structure and dynamics of supply chain networks by strengthening relationships, enhancing network visibility and increasing network density. Providing a shared, transparent platform for communication and collaboration, fostering trust and strengthening relationships among network members. Providing end-to-end visibility into the flow of goods and information across the network, enabling better coordination and decision-making. Facilitating the integration of new members into the network, expanding its reach and increasing its resilience to disruptions. By applying Network Theory, this study will examine how DHL advantages block chain technology to shape the structure and dynamics of its supply chain network and build a more resilient ecosystem.

2.3 EMPIRICAL EVIDENCE

This section synthesizes the existing empirical evidence on the impact of block chain technology on building supply chain resilience. While the literature on block chain in logistics is growing, rigorous empirical studies examining its direct impact on resilience are still relatively scarce. This section will critically assess the available evidence, highlighting key findings, limitations, and implications for the current study.

2.3.1 Block Chain and Supply Chain Visibility

(Sahoo, 2022) Conducted a pilot study using a block chain-based traceability system for agricultural products in China. The results showed that the system improved

transparency and reduced the risk of food safety incidents. While this study provided initial evidence of block chain's potential, it is constrained by its small scale and lack of generalizability. (Miguel Pincheira Caro, 2021) Developed a block chain-based platform for tracking and tracing seafood products. The study found that the platform improved consumer trust and reduced the risk of illegal fishing. However, the study focused primarily on consumer perceptions and did not directly measure the impact on supply chain resilience. Dolgui et al. (2020) presented a conceptual model for a blockchain-enabled supply chain that improves visibility and traceability, with the potential to enhance resilience. The model focused on the case of pharmaceutical supply chain. However, the study did not provide empirical data to support the model.

2.3.2 Block Chain and Supply Chain Efficiency

(Henry M. Kim, 2018) Conducted a case study of a block chain-based platform for cross-border payments. The study found that the platform reduced transaction costs and improved settlement times. While this study demonstrated the potential of block chain to improve efficiency, it did not directly address the issue of supply chain resilience. Lin et al. (2019) developed a block chain-based system for managing supply chain logistics. The study found that the system improved efficiency and reduced the risk of errors. However, the study focused primarily on operational efficiency and did not assess the impact on resilience. Cai and Choi (2020) examined the impact of block chain technology on supply chain resilience in the fashion industry. They suggested that adoption of block chain could lead to improved product quality, faster production, and delivery times and reduced operation costs.

Impact of block chain technology on supply chain visibility and traceability within DHL's logistics operations.

Supply Chain Traceability refers to the ability to track the history, location, and application of items throughout the supply chain. Supply Chain Visibility refers to the real-time awareness of the location, status, and condition of products, inventory, and resources throughout the supply chain. Kshetri, 2018 and Saberi et al., 2019 reviewed that Block chain's decentralized and immutable ledger provides a shared, transparent record of transactions and events, enabling stakeholders to track products in real-time and verify their authenticity. This heightened visibility can improve efficiency, reduce fraud, and enhance trust among supply chain partners (OECD, 2018). Specifically,

research indicates that block chain can facilitate tracking the movement of goods, verifying the origin of products, and monitoring environmental conditions such as temperature, humidity during transit (Kamble et al., 2020).

Key challenges and opportunities associated with implementing block chain technology for building supply chain resilience at DHL.

Hofmann & Strewe, 2017 highlighted that implementing block chain technology in supply chains presents both opportunities and challenges. Key opportunities include enhanced supply chain security, reduced transaction costs, and improved efficiency through automation and smart contracts (Butt et al., 2021). However, significant challenges also exist, including, a lack of industry standards and interoperability, scalability limitations, regulatory uncertainty, data privacy concerns, the need for significant upfront investment, and the requirement for workforce training and adaptation (Wong et al., 2020).

Recommendations to adopt to maximize the effectiveness of block chain solutions in enhancing supply chain resilience for DHL and other logistics companies.

(Mutale, 2024), offered recommendations for maximizing the effectiveness of block chain in supply chain management. Key recommendations include, developing clear use cases with measurable business benefits, fostering collaboration and trust among supply chain partners, addressing data privacy and security concerns, investing in workforce training and development, and engaging with regulatory bodies to shape policy development (IBM, 2020). Research also suggests that a phased approach to block chain implementation, starting with pilot projects and gradually scaling up, can help organizations to learn from experience and mitigate risks (Crosby et al., 2016). Organizations needs clearly map the problems block chain is purported to solve and ways of measuring impact. The use of inter organizational systems is also a way of gaining support for the system and buy in from those involved.

2.4 Gap Analysis

Based on the empirical review outlined above, several key gaps in the existing literature regarding the impact of block chain technology on building supply chain resilience in the logistics industry, with a focus on DHL. While numerous studies explore the potential benefits of block chain for supply chain visibility, traceability, security, and

efficiency, there is a distinct lack of rigorous empirical evidence demonstrating the actual impact of block chain implementations in real-world logistics operations. Many studies based on theoretical models, simulations, pilot projects, or surveys of intentions rather than concrete outcomes. This research can address this gap by providing a detailed case study analysis of DHL, a company actively implementing block chain solutions. By examining DHL's experiences, the findings will contribute much-needed empirical data on the actual benefits, costs, and challenges of block chain adoption. There is also lack of In-Depth Exploration of Implementation Challenges; the literature acknowledges several challenges associated with block chain implementation, such as interoperability issues, scalability limitations, regulatory uncertainty, and data privacy concerns. However, there is a need for a more in-depth understanding of the specific challenges that arise during the implementation phase of block chain projects in logistics. The research can fill this gap by conducting in-depth interviews with DHL employees involved in block chain projects. By gathering qualitative data on their experiences, there will be identification of the key obstacles they faced, the strategies they used to overcome them, and the lessons they learned. There is also a relative lack of literature specifically examining block chain deployment and its impact within DHL's unique context. The generalities of research on block chain in logistics may not fully account for DHL's specific operating procedures, technologies, scale, and business relationships. This focus allows for an examination of how a large, global logistics leader is navigating these complexities, offering unique insights.

2.5 Chapter Summary

This research investigates the impact of block chain technology on enhancing supply chain resilience within the logistics industry, using a qualitative, exploratory single-case study of DHL. While existing literature highlights block chains' potential to improve visibility, traceability, and security, significant gaps remain regarding empirical evidence of real-world impact, the intricacies of implementation challenges, the role of organizational context, and the effectiveness of recommended strategies. Through in-depth interviews and document analysis, this study aims to address these gaps by examining DHL's experiences with block chain, identifying key benefits, overcoming challenges, and organizational factors driving (or hindering) successful implementation. The research seeks to provide practical recommendations and to develop a comprehensive framework that is useful for assessing organizational readiness and to

contribute valuable insights for logistics companies seeking to leverage block chain technology to build more resilient and efficient supply chains and the wider academic community. The results of this study will be useful in helping shape future deployment processes.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Introduction

The chapter outlines the research methodology employed to investigate the impact of block chain technology on building supply chain resilience within the logistics industry, focusing on a case study of DHL. The research aims to provide a comprehensive and in-depth understanding of the phenomenon through a qualitative approach, utilizing multiple data sources to ensure the validity and reliability of the findings. The chapter details the research design, data collection methods, data analysis techniques, and ethical considerations that will guide the study.

3.2 Research Design

Research design refers to a combination of various components of research in a reasonably logical manner so that the research problem efficiently handled, (Khanday and Khaman 2019). This study employs a qualitative single-case study design. A case study approach is appropriate because it allows for a deep exploration of a complex phenomenon within its real-world context (Yin, 2018). Focusing on DHL as a single case enables a detailed examination of the specific ways in which the company is implementing and leveraging block chain technology to build supply chain resilience. A case study design is particularly well suited for this research because it allows for a holistic understanding of the complex interplay between block chain technology, organizational capabilities, and supply chain outcomes within a specific organizational context. DHL chosen as the case study due to its position as a leading global logistics provider, its active exploration and implementation of block chain solutions, and its willingness to participate in this research. DHL's global presence and diverse operations provide a rich and varied context for studying the impact of block chain on supply chain resilience. This research is exploratory, given the nascent stage of block chain applications within the logistics industry. The research seeks to identify key themes, patterns, and relationships between block chain technology and supply chain resilience at DHL, allowing the research direction to evolve with new evidence. The Dynamic Capabilities Framework (Teece, 2007) will guide the study, which explains how firms can adapt, integrate, and reconfigure internal and external competencies to address

rapidly changing environments. Block chain implementation framed as a dynamic capability that enhances DHL's capacity to respond to supply chain disruptions.

3.3 Population and Sampling

This section defines the target population and the sampling strategy for selecting participants.

3.3.1 Population

The target population of 30 persons encompasses all DHL employees and relevant stakeholders who are directly involved in block chain-related projects, supply chain management, IT infrastructure, and operational activities concerning supply chain resilience. This includes individuals ranging from executive management to operational staff actively participating in block chain-driven initiatives.

3.3.2 Sampling

A purposive sampling strategy (Patton, 2015) employed to select participants based on their specific knowledge, experience, and direct involvement in the areas of interest. Snowball sampling considered in identifying additional participants with valuable insights. Purposive Sampling Criteria shall be active participation in block chain implementation projects at DHL, which has direct responsibilities related to supply chain risk management, disruption mitigation, or resilience planning. Expertise in DHL's IT infrastructure, block chain technology, or supply chain operations. The study recruited 15 participants as a sample of analysis. This sample size is appropriate for in-depth qualitative research, allowing sufficient data to achieve data saturation and identify key themes. Potential participants were identified through initial contact with DHL personnel and recommendations from interviewees. The researcher obtained informed consent from all participants, outlining the purpose of the study, data collection methods, and ethical issues.

3.4 Research Instruments

The research will make use of research instruments interviews, questionnaires and DHL data for their records. The choice of these methods was strategic as they provide wide data coverage and give room for triangulation. Triangulation is a critical factor for data analysis and helps in reflecting skewed results reported. Additionally, the methods provided a comprehensive understanding of the variables investigated. More so, the

document analysis protocol used as another instrument in data collection where DHL's white papers, annual reports, press releases and internal reports were used.

3.4.1 Questionnaire

For authentic data, the author distributed questionnaires directly to participants where resources permit and electronically for wide coverage through electronic mail and WhatsApp platforms. The researcher believes such an approach covered all targeted respondents.

3.4.2 Semi-Structured Interview Guide

A semi-structured interview guide was designed to facilitate in-depth interviews with participants. The guide consisted of open-ended questions aimed at eliciting detailed insights into participants' experiences, perspectives, and opinions related to block chain technology and supply chain resilience at DHL.

3.4.3 Document Analysis Protocol

Researcher develop a structured document analysis protocol to guide the collection and analysis of relevant documents. The protocol specified the types of documents collected such as DHL white papers, annual reports, press releases and internal reports.

3.5 Data Collection Procedures

The study sought necessary approvals from DHL's authorities to carry out research with their permission. Such necessary approvals help in getting authority support and incorporated into their work plans. Secondly, the researcher enquired about secondary data from DHL white papers, DHL's IT infrastructure personnel and Industry reports on block chain technology. After such data was established, the author proceeded by distributing questionnaires to respondents either physical hard copies or electronically. For the maximization of response rates, follow-up reminders sent on all electronic questionnaires.

3.6 Data Validity and Reliability

Data validity refers to the extent to which data accurately represents the concept or phenomenon it intended to measure. Data reliability and validity constitutes several considerations, including whether the data collection methods are appropriate, the sampling technique is sound, and whether the measurement instruments used yield consistent and accurate results (Smith et al 2023). High data validity ensures that the conclusions are drawn from data analysis are credible and applicable to real-world

scenarios (Smith et al., 2023). To ensure the trustworthiness and credibility of the research findings regarding the impact of block chain technology on supply chain resilience at DHL, several strategies such as careful study design, rigorous data collection and analysis and thorough evaluation of findings were employed to enhance both the reliability and validity of the data and its interpretation. In qualitative research the concepts of data reliability and validity are often framed as "trustworthiness" and encompass credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985).

3.6.1 Data Validity

Data Validity refers to the accuracy and believability of the findings, ensuring that they accurately represent the perspectives and experiences of DHL employees and stakeholders involved with block chain initiatives. To enhance credibility and validity of data, triangulation across multiple sources was exercised. Publicly available DHL reports and publications, internal documents (if accessible), and semi-structured interviews with a range of DHL personnel (from executive leadership to operational staff) will be compared and contrasted. If a site visit is possible, observation data will be included as a third point of triangulation.

3.6.2 Data Reliability

Data Reliability refers to the consistency and stability of the research findings, ensuring that the research process is transparent and rigorous. To enhance dependability of data, a detailed audit trails throughout the research process were maintained, including research design and rationale, sampling strategy and participant selection criteria, interview guides and data collection protocols (Zhang, 2023). The research design, data collection procedures, and data analysis techniques were clearly and transparently described to allow others to replicate the study. This includes providing detailed information on the theoretical framework, sampling strategy, data collection instruments, and data analysis methods.

3.7 Data Presentation and Analysis

In examining the effects block chain technology in building resilience of logistic in the logistics industry selecting focus on DHL, was essential to adopt robust and systematic data presentation and analysis procedures. In this research, data was collected using a combination of questionnaires, interviews, and document reviews. The questionnaires distributed to DHL project managers, DHL Innovation and Trend research managers,

DHL logistics officers, DHL fleet managers and stakeholders from companies like Accenture a global leading provider of digital solutions, technology and operations who work in collaboration with DHL Express, while interviews to provide qualitative insights from key informants. The research data collected was categorized into core themes relevant to logistic resilient, such as:

- Time efficiency (speed of logistics processes)
- Cost savings (comparison of costs with traditional methods which had middleman)
- Transparency (frequency of corruption or logistics irregularities)
- User satisfaction (feedback from end-users and stakeholders)
- Track and trace (tracking of parcels and payments in digitalized manager)
- Decentralization(change management in handling logistics duties that had enabled spread of logistics management)
- Immutability(once data is recorded into a block and added to the chain, it cannot be altered or deleted)

The data organized under the identified themes to ensure vividness and coherence in presenting the findings. Each section commenced with a concise overview of the theme before delving into specific findings. Tables are used to present quantitative data such as the average time taken for moving the parcel to its last mile delivery before and after the block-chain technology implementation, the frequency of logistics corruption and irregularities, and cost comparisons. Graphs such as bar charts, pie charts and line graphs are used to represent trends in procurement efficiency and cost comparisons. For instance, a line graph can depict the change in processing time throughout the implementation phases, while a pie chart can illustrate the distribution of stakeholder satisfaction levels with the logistics service from DHL. The use of tables enables precise data comparison while ensuring that large amounts of data are digestible at a glance. Graphs create visual interest and help stakeholders quickly interpret trends and relationships in the data. The combination of these formats caters to different learning styles and increases the accessibility of the information presented.

3.8 RESEARCH ETHICS

According to Ton et al (2010) research ethics is defined as norms and standards of behavior that guide moral choices about our behavior and our relationship with others and as such it is important in the natural science such as medicine as well as even in social science that consideration should be given to ethical conducts. Research ethics and corporate governance are major determinants in conducting any research to achieve desired results. Ethics are also principals of conduct and are concerned with what is good and bad, right and wrong. Concerning the study, researcher observed ethics by allowing respondents to participate willingly and voluntarily in the study. The respondent were given room to willingly be part of the study and the respondents were made anonymous by not asking them their names and assuring them that all the information they provided would be totally confidential and treated in the strictest of confidence. Moreover, too many questions or ambiguous questions that may embarrass the respondents not asked and there was openness.

3.9 Chapter Summary

This chapter has presented the methodology used to investigate the impact of block chain technology on building supply chain resilience within the logistics industry, using a single-case study of DHL.

CHAPTER IV

DATA PRESENTATION, INTERPRETATION AND ANALYSIS

4.0 Introduction

This chapter presents and analyses the data collected through questionnaires and semi-structured interviews from 30 participants across different departments within DHL. The purpose of the study was to explore the influence of block chain on the development of resilience in the logistics industry with DHL being the case to focus on the application of resilience. Diagrams and tables support coded thematic analysis. In response to the research objectives, which are supply chain visibility and traceability, block chain challenges and opportunities, and drivers of block chain adoption, the main themes that emerged.

A hybrid qualitative methodology was used, in which the analysis and interpretation of open-ended questionnaire data and interviews were thematically contrasted and compared with the quantitative responses derived from a selection of closed-ended items summarized with the use of basic descriptive statistics. Researcher organized responses under appropriate subheadings and linked, where relevant, to direct quotations from participants to provide the response depth and context. The demographic characteristics of the respondents provided in the first part of the section that give some sense of their range of experience, the kind of departmental position, and access to the technology. This background information is crucial to the comprehension of the data in the following analytical sections.

4.1 Profile of the Respondents

This part presents the profiles of the respondents; there were thirty participants in this study. A representative sample of the respondents taken are workers in different areas of DHL such as logistics operation, supply chain strategy, IT infrastructure, innovation & trend research, compliance, finance and fleet management. The variety in responsibilities facilitates an overall comprehension of how block chain is reshaping functions.

4.1.1 Experience in the Logistics Sector

Researcher asked respondents how long they had worked in the logistics industry. The responses were as follows:

Table 1: Respondents Years of Experience in Logistics Sector

Years of Experience	Number of Respondents	Percentage (%)
Less than 1 year	2	6.70%
1–3 years	5	16.70%
4–6 years	9	30.00%
More than 6 years	14	46.60%
Total	30	100%

The findings indicate that the logistics professionals – the majority of which (46.6 per cent) have over six years of practical experience in the field – tend to work a 4–6 year career in the logistics professionals. This suggests that more than 76% of the participants are experienced professionals who have a deep industry knowledge, increasing the trustworthiness of their opinion on how block chain is applicable to logistics. They have many years of experience in supply chain management, emerging technologies and industry struggles, so their views seem to be educated and pragmatic. The remaining respondents-16. 7% with 1–3 years and 6.7% with <1 year of experience-may offer fresher views, towards lower experience base. This blend maintains a relatively even coverage of both established practices and upcoming trends. The significant representation of experienced professionals gives credibility to the findings, particularly with respect to block chain’s applications for solving logistics inadequacies. Their expressions of this input are likely based on real-world obstacles, which suggests that their positions either in favor or opposed to block chain adoption are very relevant. At the same time, the non-experienced respondents also provide insights into how the more recent entrants of technology perceive technological innovations. These findings indicate that differences in perceived ease of use between industries maybe taken into account by block chain strategy planning, and that effective training and change management are necessary to promote widespread adoption. In general, the expertise of the respondents highlights the applied worth of the findings from the survey.

4.2 Current Position in DHL

Respondents indicated their current positions within the organization. The data summarized in the following statistics:

Table 2 Current Position at DHL

Position	Number of Respondents	Percentage (%)
Logistics Manager	7	23.30%
Supply Chain Specialist	5	16.70%
IT Specialist	4	13.30%
Innovation and Trend Researcher	3	10.00%
Fleet Manager	2	6.70%
Compliance Officer	2	6.70%
Finance and Procurement Officer	3	10.00%
Other (Customs, Warehouse, etc.)	4	13.30%
Total	30	100%

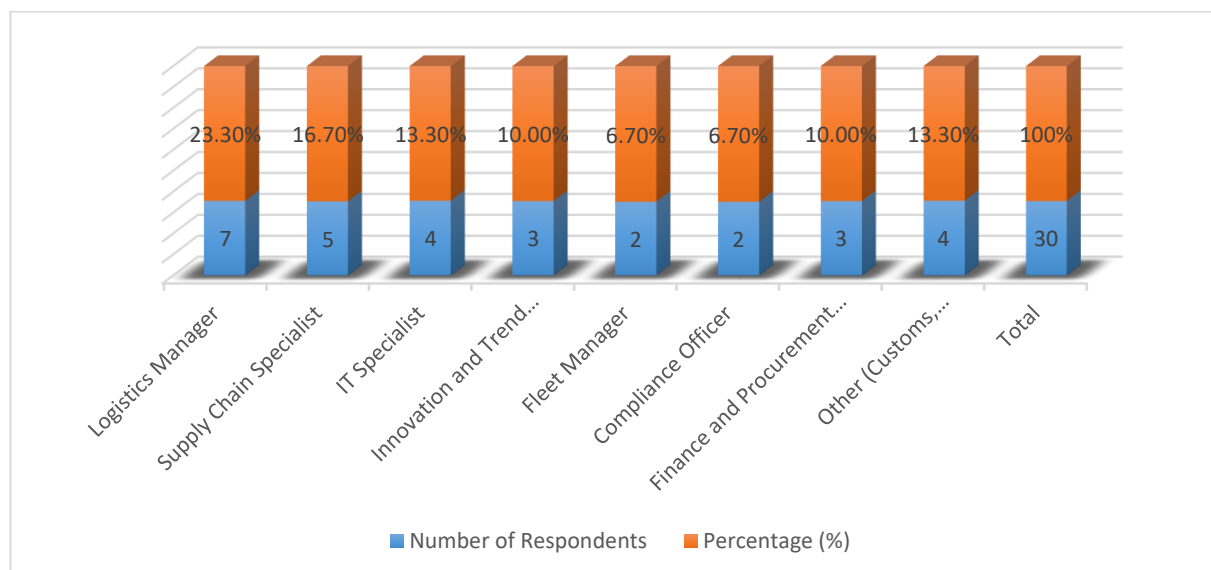


Figure 1: Current Position at DHL

The results submitted showed wide range of functions, to ensure a broad view of the applications in logistics of block chain. Logistics Managers (23.3%) and Supply Chain

Specialists (16.7%), the two largest groups of respondent, offer operational and strategic perspective as they engage in the direct management of coordinating, optimizing, and adopting technology in the supply chain. This dominance indicates that the results are mainly applicable to core logistics activities, including inventory management, transportation, and vendor cooperation. On the other hand, technical experts from IT Specialist (13.3%) have great impact on block chain technology, which exposes the potential of interoperability, system construction and information security that is associated with block chain technology. Innovation and Trend Researchers (10%) add value to the data as they provide prospective insight into block chain and its implications on future logistics models.

By including both Fleet Managers (6.7%) Compliance Officers (6.7%) and Finance/Procurement Officers (10%), those niche, but essential facets – including the maintenance of compliance, cost-benefit analysis, and asset tracking. Also, the 13.3% which are under the category of “Other” (I.e., Customs, Warehouse, etc.) can add a finer grained level of detail in verticals such as cross-border trade and inventory reconciliation where block chain’s ‘transparent and unalterable’ nature can bring substantial value. This cross-department representation enhances the validity of the study since it mimics what the organizations faced in actual logistics ecosystems, where block chain adoption necessitates collaboration among multiple departments. The differing viewpoints indicate that interest in the potential of block chain varies by remit but the advantages it holds including greater traceability, reduced fraud and simplified documentation are all common strains heard in the business.

4.2.1 Familiarity with Block chain Technology

Table 3: Familiarity with Block chain Technology

Response	Number of Respondents	Percentage (%)
Yes	22	73.30%
No	8	26.70%
Total	30	100%

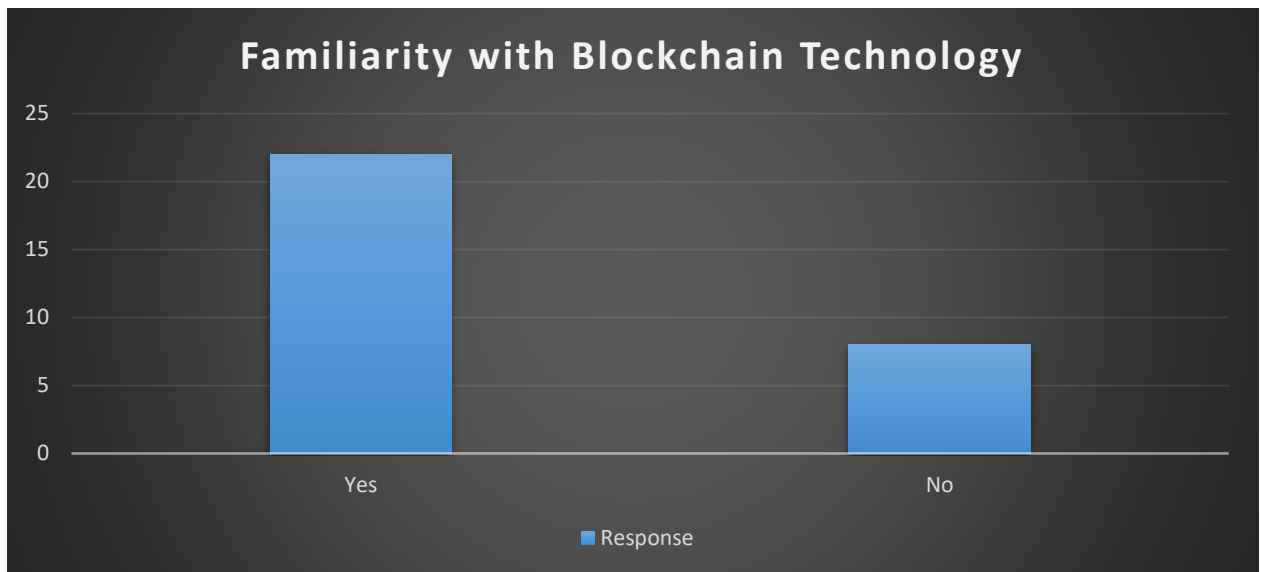


Figure 2: Familiarity with Block chain Technology

The fact that DHL has such a high block-chain awareness rate of 73.3% is a clear sign that the logistics company has been working hard to educate its staff about the new technology. This high level of awareness indicates that block chain initiatives in the enterprise have deepened their reach across differing job roles and departments, establishing an informed employee base that can play a role in serious discussions of how to get value out of it.

For the other 26.7% who have not been involved in block chain, their input is still very valuable as they could be some of the most recent members of staff or work in areas that have yet to utilize block chain applications. Their addition can be useful to reveal a possible lack of awareness or need for further training, in the light of DHL's scaling up their utilization of this block chain. The extremely high rate of acknowledgment with respect to familiarity with block chain also provides very strong support for the survey as a valuable means of obtaining insights into the role of this technology in improving the resilience of logistics as the opinions will undoubtedly be coming from those with sufficient knowledge and experience to make informed responses.

4.3: Gender Distribution

Among the 30 participants, the proportion of females was 40% with the predominant sex distribution being male (60%). This shows a moderate amount of gender representation among the sample, signifying the continued push towards gender inclusivity within the logistics industry dominated by men. The involvement of female

respondents in different functions, from logistics management to IT and compliance, points to increasing diversity within DHL's workforce and provides diversity of opinion in terms of how block chain is being adopted and used across operations. Gender disaggregated data is important, as it ensures that technology transformation efforts, including block chain, cover the experiences of, insights from and needs of a heterogeneous workforce.

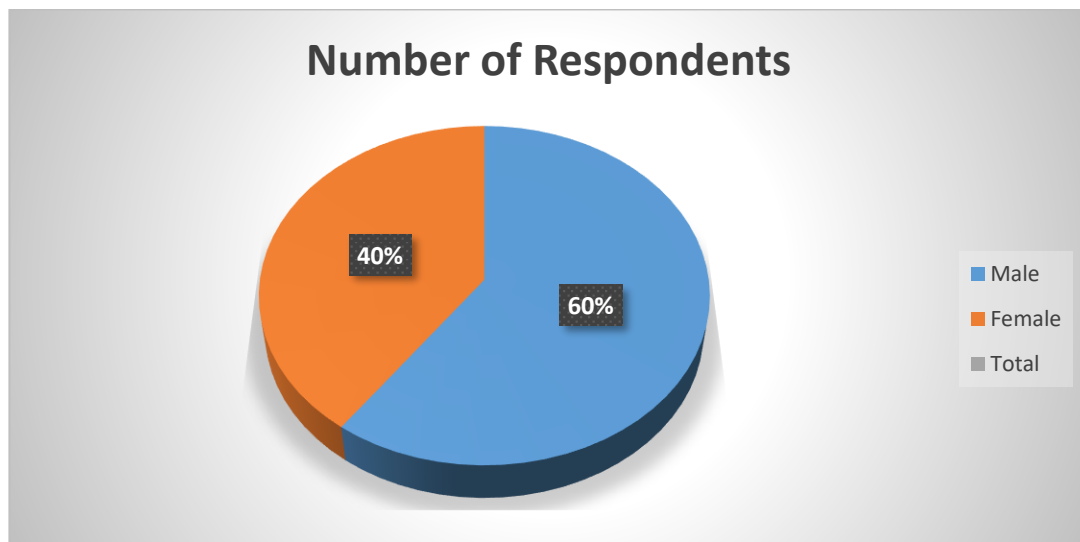


Figure 3: Gender Distribution Chart

4.4: Data analysis: Presentation of research findings

The chapter is based on empirical data sourced through structured questionnaires and interviews with 30 respondents across different departments at DHL. The objectives of the findings are to identify the effects of block chain technology on strengthening supply chain resilience as reflected in the four research objectives in the paper. We employed a mixed methods method, using descriptive statistics and qualitative thematic analysis to generate both numerical (quantitative) trends and interpretive (qualitative) insights from responses. The data was thematically analyzed according to the research objectives, which include supply chain visibility and traceability, challenges and opportunities of block chain, recommendations to maximize the block chain effectiveness and factors influencing the adoption of block chain within DHL logistics chain. Quotes from respondents discussed to give the reader a better sense of actual practice and its reality, while tables and percentages are used to describe trends and to back the interpretation of the findings. The thematic layout allows an integrated and

congruent presentation of the materials, which forms a strong basis for the conclusions in the following chapter.

4.4 Data analysis: Impact of block chain technology on enhancing supply chain visibility and traceability within DHL's logistics operations (Objective 1)

The first objective of the study was to investigate how block chain technology can enhance supply chain visibility and traceability in the logistics operations of DHL. This goal is closely related to the first research question, which was; "How does block chain affects supply chain visibility and traceability in DHL logistics operations. The study collected replies from 30 respondents from different departments to address this. The responses indicated critical dimensions of impact of block chain in logistics in terms of real-time tracking, data reliability, fraud mitigation, and cross-functional visibility.

4.5.1.1 Theme 1: Real-Time Tracking and Reduced Parcel Monitoring Time

The results indicated positive impact of block chain on real-time parcel tracking over DHL's logistics chain. Several respondents pointed out significant reduction in parcel and containers tracking time, including the fact that block chain enabled solutions log every transaction and transfer instantly and permanently. Today, it has become a great deal easier for us to find our cargo and track it in real time with the help of block chain. Moreover, it is no longer a manual update for us. No data is ever out of date and is available for all departments.

Interview Respondent 5:

"Block chain has made it easier to locate and monitor our cargo in real time. We no longer rely on manual updates. The data is always current and accessible by all departments."

Interview Respondent 13:

"Previously, we had to follow a chain of emails or calls to know where the package was. Now, it's visible in real-time on the platform."

More than 83% of respondents to the survey believed "less time spent tracking" is one of the greatest contributions of block chain for DHL in logistics. This discovery highlights the metamorphic effect of block chain technology on supply chain visibility, notably the improvements in real-time tracking features. They observed that with block

chain's decentralized, time-stamped ledger, the position and condition of parcels could be instantly tracked at all points in the supply chain without relying on one off communication or manpower updates. Not only does this speed up the decision-making process, but it also can reduce holdups due to chokepoints in information flow or breakdowns in communication between departments or logistics partners. Thanks to the increased transparency, you can also quickly identify problems such as late shipping, lost shipments and deviations from scheduled routes. This experiential evidence from DHL workers corroborates those from the study of Saberi et al. (2019) state that block chain technology allows continuous and secure data sharing between all parties, offering a single and dynamic description of flows within logistics operations. This is how block chain has enhanced DHL's operational agility, increased service stability and enabled it to deliver its customers a more transparent and responsible way of tracking.

4.5.1.2 Theme 2: Enhanced Data Accuracy and Authenticity

Another benefit often mentioned was an increase in the accuracy of the data. Block chain records are unchangeable so once information is entered it becomes an immutable record. This diminishes the instances of data conflict between different departments.

Interview Respondent 7:

"Inconsistencies used to occur due to human error. Block chain eliminates this since everyone sees the same verified data."

Interview Respondent 19:

"We don't second-guess records anymore. If it's on the block chain, we trust it's valid."

Data accuracy has also increased to a great extent, about 73.3% of those surveyed in the survey claimed, which got improved as an output of block chain implementation in the logistics chain of DHL. A number of participants noted that the key value-add of block chain – immutability – will be, or has already become, the solution to reconciliation problems inherent in shipping records, transaction records or any other documentation. In contrast to legacy systems, which are prone to error, as people have to enter details manually and there are many points of sale or data transfer, with block chain, any source data written to the block-chain cannot be changed or deleted. Survey

takers said his tamper-proof feature has...created a “single version of the truth” that is better for everyone’s decisions in all departments. This precision minimizes the amount of time spent on audits and reconciliations, while adding credibility to the accuracy of logistical information exchanged throughout the organization and beyond. These findings are also in agreement with Kshetri (2018) and Kamble et al. (2020) who contend that the efficacy of block chain in verification can lower human error and creates a more reliable record in extensive supply chains. For DHL, accurate and immediate data is now a value-add that improves planning, execution, and confidence among stakeholders.

4.5.1.3 Theme 3: Improved Traceability of Goods and Documents

Block chain also delivers an auditable trail of the goods from their place of origin and through the chain, which DHL has found beneficial in tracking its logistics. This is a huge benefit and many respondents focused on how valuable this can be especially in high-risk or regulated shipments like pharmaceuticals, electronics, and medical devices. By providing tamper-proof tracking of each transaction or movement, block chain enables DHL to trace the exact logistics journey a parcel has taken at any point, down to who touched it, where it was, and under what conditions. This facility is especially useful for working with customer complaints, customs checks or product recalls.

Interview Respondent 11:

"We can now track where a product came from, who handled it, and when. This level of traceability is especially useful in returns and audits."

Interview Respondent 22:

"Every transaction is traceable, and this helps in investigating delays or anomalies in the supply chain."

Interview Respondent 3:

"In case of delays, the system shows exactly where the parcel got stuck and whose action is required. That has reduced blame-shifting internally."

Interview Respondent 18:

"We recently had to trace a pharmaceutical consignment that was suspected of being

tampered with. Block chain records helped us confirm handling integrity at every point."

Interview Respondent 26:

"For customs and compliance, traceability through block chain has saved us hours of back-and-forth by providing instant proof of origin and handling records."

Several participants emphasized the increasing traceability brought about by the use of block chain in DHL's logistics systems. *"We've used block chain to add 8-15 degrees of traceability back to the meat cooler and dock area. With 70% of survey respondents indicating an improvement in traceability was "very significant", block chain creates an audit trail of where every item has been on the journey from original to final destination."* Respondents noted that products are traceable through all those checkpoints — who has touched them, and when and under what conditions—with the data is stored in a block chain ledger that all stakeholders can access. This end-to-end traceability has a particularly high value in regulated industries such as pharmaceuticals and electronics where evidence of custody or "chain of custody" is a requirement. In addition, historical information is at hand for inquiries in the event of recall, claims, or delays. These findings are consistent with those by Sahoo (2022), who showed that block chain-based traceability systems greatly enhance the transparency and responsiveness of supply chain, especially in the area of sensitive goods. For DHL, the tangible benefit is taking the guess work out of shipping for clients and regulators alike, who can now, say, track a pile of shipments with a click and identify if get lost or aren't the real deal.

4.5.1.4 Theme 4: Fraud Reduction and Anti-Counterfeiting Benefits

The role of block chain in deterring fraud and counterfeiting came out strongly, with 70% indicating that its implementation has led to a reduction in fraudulent practices and errors in DHL's logistics chain.

Interview Respondent 8:

"We've seen a decrease in cargo theft and falsified documents since block chain records can't be edited or removed."

Interview Respondent 14:

"Invoices and tracking details are protected against manipulation. This has minimized fraudulent activities we used to encounter."

According to respondents, the secure and unmodifiable nature of block chain entries would make it extremely hard to falsify the shipment records, invoices or delivery logs once entered into it. This unchangeable audit trail has dissuaded anyone, or regular business partners, that would have previously taken advantage of a bug in a standard paper tracking system. In addition, being able to confirm authenticity has been helpful in identifying counterfeit shipments or unauthorized diversions of product, for example, in high-cost production or regulated industries. It supports the result of OECD (2018) that block chain reduce the possibility of fraudulent behavior by having a tamper-proof, shared ledger of all transactions. For DHL, this decreased amount of fraud does not just save the company money; it also fosters customer trust, lowers risk, and helps ensure adherence to industry and regulatory regulations.

4.5.1.5 Theme 5: Partner and Cross-Department Collaboration

Most respondents admitted that block chain had already greatly enhanced cooperation within their internal teams at DHL, and with external collaborators. This secured, tamper-proof access to logistics data made certain all relevant parties – from warehouse teams to customs officials and 3PL providers – were dealing with just one set of real-time information. This CDE has helped to banish the blights of miscommunication, duplication of effort, and discrepancies caused by that Khayyam in the works in data. Participants can often felt that before block chain, it was the segregated systems and departments under a single organization that caused the delay and inefficiency, resulting in inconsistent data. Block chain logistics: calling time on asymmetrical information - In summary, the introduction of information symmetry into logistics chains has accelerated the decision-making process, increased accountability and enhanced inter-chain coordination.

Interview Respondent 4:

"With block chain, our suppliers, customs, and internal teams all view the same real-time data. It's reduced coordination issues drastically."

Interview Respondent 27:

"Block chain gave us a common source of truth. We no longer argue about data accuracy with our clients or internal stakeholders."

Interview Respondent 9:

"Before block chain, we had frequent cases where one department had a different version of the order status than another. That rarely happens now because the data is unified and transparent."

Interview Respondent 17:

"Our cross-border shipments used to get delayed due to information gaps between us and customs. Now, they access the same block chain logs, and clearance is faster."

Interview Respondent 21:

"It's easier to coordinate with third-party logistics providers because they no longer have to rely on email chains or system access requests. The block chain record is available instantly to authorized parties."

Interview Respondent 29:

"Internally, block chain has made interdepartmental meetings more productive. Everyone is working from the same dashboard, so less time is spent debating facts and more on problem-solving."

This increased cooperation is in accordance with the findings by Dolgui et al. (2020), who highlighted how block chain in logistics ecosystems creates trust, synchronization and shared visibility among partners. At DHL, we have seen how working from a single source of truth has dissolved data silos and slowed operational friction while promoting agility, speed and high-quality inter-organizational collaboration. Finally, block chain transitioned from a technology solution to the facilitator of cohesion and logistics.

4.5.1.6 Theme 6: Increased Transparency and Stakeholder Trust

Greater transparency and the growth in trust from increased visibility was, in fact, the most far-reaching effect of block chain technology in DHL logistics operations. When

asked about it, respondents were clear that the use of a block chain has led to a network transparency based on confidence and trust: “The transparency on this is absolutely off the scale in my view,” said one. All counter-parties, not only internal departments, but also external partners (suppliers, buyers, carriers), clients and regulators equal and simultaneous access to original good data and time-stamps it in a way that will deter any of your counter-parties or the market from raising your risk (and therefore you having to provide more capital) ‘out of the clear blue sky. In addition, by doing so, block-chain has eliminated the information asymmetry that has too often historically driven mistrust, delays or disputes. The transparency that block-chain enables has also enhanced DHL’s trustworthiness in the eyes of its customers, particularly in sectors that rely heavily on traceability and compliance. Attendees commented on how the end-customer finally has the power and the information - they know they can check on shipping statuses and handle events themselves rather than wait to get the latest internal DHL updates.

Interview Respondent 10:

"Clients trust us more now because we can show them exactly where and when a parcel moved. There's no hiding information."

Interview Respondent 24:

"Block chain has built accountability into our operations. Every action is recorded and viewable. This level of openness was impossible before."

Interview Respondent 2:

"With block chain, we can offer full transparency to government agencies and auditors. This has helped us improve our compliance record and avoid penalties."

Interview Respondent 12:

"Customers used to question the accuracy of our delivery timelines. Now, they can track everything themselves and confirm what we report."

Interview Respondent 15:

"Transparency has become one of our selling points. When we pitch to clients, we highlight block chain as a tool for full supply chain visibility. It's helped us win trust—and contracts."

Interview Respondent 28:

"In the past, partners would dispute transaction logs or delivery handovers. Now that everything is time-stamped and visible, disputes are almost non-existent."

These responses from the respondents are consistent with the work of Mutale (2024) which accentuated that transparency through block chain enhances collaboration with stakeholders due to integrity and verifiability of the associated supply chain processes. In DHL's logistics context, these advances towards transparency have been both operational and reputational. It not only has helped to eliminate internal inefficiencies and external controversy, but has also made the company the industry beacon of integrity and innovative logistics. The introduction of block chain has changed the nature of stakeholder relationships from an assumption- and verification-based arrangement to one based on open, shared, immutable data – a transformation that has put DHL in the driving seat in an ever more digital and accountable logistics sector.

4.5.2 Challenges and opportunities associated with implementing block chain technology for building supply chain resilience at DHL (Objective 2)

The second objective of this research is to understand the challenges and advantages of integrating block chain for building supply chain resilience at DHL. The corresponding research question was, "What are the challenges and opportunities to consider in the context of adopting block-chain technology in order to enhance the supply chain resilience of DHL? Drawing on the feedback of 30 respondents from various departments, the findings identify main themes of the challenges encountered during implementation and the benefits that block chain affords towards enhancing resilience in DHL's logistics operations.

4.5.2.1 Theme 1: High Implementation and Operational Costs

Another theme that came up consistently in all responses was the exorbitant amount of money it costs to bring block chain technology to full scale within DHL. 76.7% percent (n=23) of the women (of 30 members) cited cost as a major barrier. Block chain deployment demands significant investment in tamper-resistant infrastructure, interfacing with legacy systems, and continued technical support. Organizational costs: in addition to the cost of set up, agencies such as DHL are forced to deal with

operational costs, which are not as obvious, including staff training costs, managing the cyber-risk, system compatibility upgrades among others. A lot of the time work is said to be put on hold/block chain projects are not run in full scale or how initially designed due to budget save while it's being built, particularly the regional offices or less digital operational hubs.

Interview Respondent 6:

"Block chain systems don't come cheap. You need secure infrastructure, compatible systems, and constant updates. That's a serious cost."

Interview Respondent 20:

"The licensing, integration, and training costs are heavy, especially for full-scale rollouts. It's not something small teams can adopt easily."

Interview Respondent 14:

"Financial constraints have delayed block chain deployment in some departments. It's hard to justify the cost without immediate returns."

This issue links to the literature, with, for example, one study by Kamath (2018) indicating that cost was a structural barrier to the adoption of block chain, this dependence was most significant for complex logistics companies and larger firms managing global operations. With DHL, the economic barrier is even more significant as disparate hubs are equipped with differing levels of technology and resources. Several respondents also observed that not all regional hubs would invest in block chain if the return on investment were not immediately obvious. In addition, railroads' smaller strategic units lamented budget trade-offs, where block chain had to vie with investment in fleet development, safety and employee training.

4.5.2.2 Theme 2: Lack of Skilled Personnel and Technical Readiness

The second barrier was lack of skills and being unprepared from a technical perspective workforce to execute block chain assuming those buried in its transformation efforts. Among 30 respondents, 21 answered (70%) that the existing internal skills level (in block chain architecture design, smart contract development, and cybersecurity and data integration) clearly proved a barrier to adoption. Although DHL has begun digitizing

logistics, it is widely recognized by respondents that block chain is a new and complex technology, which requires specific knowledge and support. This is because the internal talent pool, and particularly in regional hubs or non-IT functions is not yet keeping up with the speed of technological progress.

Interview Respondent 5:

"We don't have enough people who truly understand block chain's backend. We rely heavily on external consultants and third-party developers."

Interview Respondent 16:

"Technical readiness has been a struggle. Our IT staff are still catching up on the block chain framework and its security model."

Interview Respondent 25:

"Training existing staff takes time, and hiring block chain experts is expensive. That delays implementation, especially in smaller units."

Interview Respondent 8:

"You can't just plug block chain into the existing system. You need architects who understand smart contracts, ledgers, node configurations—it's a niche skillset."

Interview Respondent 11:

"It's not that we don't want block chain—it's that we don't yet have the in-house capability to run and maintain it properly."

A large proportion of respondents also indicated that increasing their technical skills continuously would be necessary to ensure block chain based solutions would not quickly become obsolete or underutilized. This is in line with Hofmann and Strewe (2017) who suggested that employee competence is one of the foundations of a digital transformation. The block-chain-illiteracy was especially obvious in the non-technical department in logistics planning, warehouse operation, and procurement, where most people are used to traditional systems. A few of them told me they were first exposed to block chain in one-shot workshops or overviews that were not enough to allow them to use the technology in practice.

Interview Respondent 13:

"They gave us a workshop on block chain last year, but that was more theory than practical training. Most of us still don't know how to use it."

Interview Respondent 19:

"Unless there's a structured, hands-on training program, many staff members will just avoid the system altogether."

Interview Respondent 23:

"We tried hiring a block chain developer for six months with no success. Everyone with that skillset is already with fintech companies or start-ups."

Moreover, the absence of the technical readiness and internal block chain capability is against the adoption of the technology not to mention its robust and sustainable operation. If there is not the right level of human resources available to fulfill, operate and fix block chain systems, the transformation of DHL's logistics could end up very reliant on third parties and unable to act quickly when the next shockwave hits. DHL faces a world shortage of experienced block chain specialists, making it hard for the company to hire them and keep them, especially outside of headquarter areas.

4.5.2.3 Theme 3: Resistance to Change and Organizational Inertia

Another significant barrier reported by participants was organizational resistance to change, or organizational inertia. Of the 30 interviewees, 19 (63.3%) specifically stated that internal resistance (within the leadership, department and/or individual level) was an impediment to block chain adoption in DHL. The reasons for this vary; there's the fear of being out of a job, the unwillingness to get to grips with new systems and a feeling that well-practiced processes are best, and there's the general cynicism that greets any 'so-called bleeding-edge' tech. Although block chain promises vast operational benefits, its adoption is held back by behavioral and cultural factors, which limit the speed with which digital transformation embraced in established logistics organizations. These are the quotes according to some respondents:

Interview Respondent 1:

"Some employees are skeptical or even fearful of block chain. They think it will automate them out of relevance."

Interview Respondent 23:

"There's a cultural resistance. People prefer what they know, especially if new systems seem complex or disruptive to their routine."

Interview Respondent 4:

"The moment you mention 'block chain' or 'smart contracts,' some team members shut down. They think it's too technical or not their concern."

Respondents also shared that the **transition from familiar manual or centralized systems** to a transparent, tamper-proof platform can feel like a loss of control for those in traditional leadership roles.

Interview Respondent 17:

"For senior staff, block chain feels like a threat. It limits the ability to control information flow, which was often used to maintain authority."

Interview Respondent 9:

"In warehouse teams, there's a fear that full automation using block chain and Internet of Things will make some roles redundant."

These results are in agreement with those of Wong et al. (2020), who point out that technological transition is just as much a cultural transition as it is a technical transition. For DHL in particular the technology is there but organizationally the mindset shift to extend beyond proofs of concept and into an enterprise offering is still in the process. Participants highlighted the importance of clear internal communication, ongoing support, and a gradual shift in order to break the status quo and realize the full value that block chain has to offer in boosting supply chain resilience. Inadequate change management reinforced organizational inertia. Block chain rolled out under the banner of DHL innovation: however, some interviewees felt not enough effort spent on getting employees ready for the change, both from the point of view of mindset and operations. Operations dispatch, and compliance employees were the last of the core users to adopt the solution.

4.5.2.4 Theme 4: Regulatory and Legal Uncertainty

Most difficult and long-standing problem, according to the respondents' answers, is the legal and regulatory uncertainty related to block chain. Among the 30, 19 of the respondents are (63.3%) were worried about the absence of a standardized legal framework governing the use of block chain, especially in the field of global logistics, where data flows through diverse jurisdictions. While DHL is often subject to extensive compliance requirements, highlighted that current compliance regimes (internal and governmental) were not currently able to support the decentralized, cross-border infrastructural properties of the block chain. The legal nature of smart contracts and data ownership on distributed ledgers correlates to privacy laws like GDPR in Europe and POPIA in South Africa remained a common theme. Some participants noted that legal departments were reluctant to fully support block chain systems out of concerns about non-compliance or litigation.

Interview Respondent 12:

"There are no clear global standards for block chain. What's acceptable in one country may be a violation in another, especially around data protection."

Interview Respondent 28:

"We're often unsure how smart contracts will be interpreted legally. That makes legal teams hesitant to integrate them into operations."

Interview Respondent 8:

"Regulatory clarity is still lacking, especially around data storage and access rights in block chain systems. Who owns the data? Who's liable in case of a breach?"

Many participants mentioned that with block chain being a distributed system leaning on transparency and tracking, there is a tension between its model and data localization laws, which demand that data sensitive and relevant to a specific country remain in that country. Even though DHL is working within a heavily regulated industry, it's clear from some of the survey responses that its existing compliance mechanisms, be those privately or governmental related, were not entirely suitable for the decentralized, international approach to block chain. One reason was due to legal in-house departments

being too careful or unwilling to fully support block chain systems for fear of being not compliant or sued.

Interview Respondent 3:

"The system might store logistics data in nodes across multiple countries, but some governments want that data held locally. That puts us in a tricky position."

Interview Respondent 21:

"We had to pause a block chain module for customs integration because it was unclear if we were allowed to transmit that data outside our national servers."

Interview Respondent 15:

"We are running two systems side by side—one block chain, one traditional—just to keep compliance happy. It doubles our work."

Interview Respondent 26:

"Until regulators offer a clear policy, we're stuck in limbo. You can't invest fully in a system that may later be deemed non-compliant."

The lack of clarity on the legal treatment of block chains has hampered: - Take-ups due to delays - Pilot sizes due to conservative designs - Full advantage of block chain technology due to mitigated design choices. Some said the caution of legal teams meant that often block chain had to run alongside legacy systems, decreasing effectiveness. These results are in line with that of Butt et al. (2021), who noted that the lack of harmonized global block chain rules is one of the main structural barriers to adoption, especially in sectors such as logistics that are heavily dependent on cross-border collaboration. For DHL, that regulatory unreliability does not just slow down innovation, it also reins in the company's potential to harness the full capabilities of block chain for supply chain resilience. They also indicated a need to be more proactive on regulatory engagement, create digital currency legal frameworks that are unique for block chain, and form stronger industry coalitions to advocate for standard agreements.

4.5.2.5 Theme 5: Opportunity – Enhanced Risk Management and Resilience

While obstacles continue to exist, the interviewees were equally concerned about the opportunities for boosting supply chain resilience offered by block chain. Block chain could enhance our risk management due to enhanced visibility, faster response,

prediction of risk: of the 30 participants, 24 (80%) focused their answers on increased visibility, response speed and predictive planning. For example, 38% of the respondents say that real-time data verification facilitated by block chain would give them the basis to address supply chain issues such as delivery delays, customs clearance holds, supplier non-compliance, and product tampering. Another key point that emphasized is that with block chain, DHL is able to respond to potential deficient situations already in relatively early stages, to mitigate the subsequent escalation impact. The tamper-resistance of data also gives decision-makers confidence in the integrity of information when they make operational decisions.

Interview Respondent 11:

"With block chain, we identify issues faster—whether it's theft, delays, or customs holdups—because the data is immediate and trusted."

Interview Respondent 30:

"Disruption management has improved. The traceable record helps us mobilize the right teams without delays."

Interview Respondent 9:

"We can forecast and simulate supply chain shocks better now, which improves our planning. It has added a level of agility we didn't have before."

Interview Respondent 22:

"Our ability to manage exceptions, like damaged goods or incorrect deliveries, has improved. You can pinpoint where and when things went wrong."

Interview Respondent 17:

"There's no more back-and-forth during disruptions. Everyone looks at the same ledger. That saves hours of confusion and reaction time."

Several participants also pointed out that block chain facilitates interdepartmental collaboration during dislocations, as all departments have access to the same real-time facts. These have confirmed the results from Cai and Choi (2020), insisting on the importance of block chain in promoting agile logistics networks by responding rapidly in line with the changing market and operational environments. For DHL, the ability of block chain to facilitate proactive decision-making, visibility in times of crisis and root-

cause analysis can only help create robustness in the supply chain. One of the participants believe it is more important than ever to have this capability on a global scale to understand real-time risks and the need for coordinated responses to the unpredictable events of the day, which include pandemics, geopolitical instability, and cyber security threats.

4.5.2.6 Theme 6: Opportunity-Strengthened Trust and Partner Engagement

The final theme relating to this objective revolves around block chain to build trust between supply chain partners, and to increase DHL trust for stakeholders. Of 30 respondents, trust was something mentioned by 26 respondents (86.7%) when they talked about what best describes one of the most relevant contributions of block chain to DHL's business. Block-chain is clear, auditable, and time-stamped data records support in resolving disputes quickly and privately, reduce uncertainty and eliminate doubt over the history of shipments, delivery confirmation, or customs documentation. Most participants said they had much better client relationships today, particularly in industries like pharmaceuticals, automotive and electronics where traceability and authenticity are key. External partners as customs, warehousing and logistic third party now have more confidence in DHL's operations transparency.

Interview Respondent 3:

"Our partners trust us more now because they can verify everything themselves. It's not just us telling them—it's on the block chain."

Interview Respondent 13:

"We've noticed smoother negotiations and fewer disputes because records are publicly verifiable. It builds confidence."

Interview Respondent 26:

"Client onboarding is faster when we show them our block chain-enabled tracking systems. It builds credibility instantly."

Interview Respondent 7:

"Previously, customers would raise queries about shipment accuracy. Now, they access real-time data and trust the process."

Interview Respondent 19:

"There's less room for manipulation or error. When customers and partners know the system is tamper-proof, it changes how they view your reliability."

This is in keeping with Saberi et al. (2019), there are inter-organizational trust issues that block chain helps resolve, via shared accountability, audibility and secure validation. For DHL, trust is no longer something soft: business dealings and trust in its business consistency clearly linked to the bottom line. As one of the respondents mentioned, block chain enables DHL to “fight it out based on transparency”—a desired characteristic amongst customers in a digitally perceptive world-market.

4.5.3 RECOMMENDATIONS FOR MAXIMIZING THE EFFECTIVENESS OF BLOCKCHAIN SOLUTIONS IN ENHANCING SUPPLY CHAIN RESILIENCE FOR DHL AND OTHER LOGISTICS COMPANIES (Objective 3)

The third objective of this paper was to provide pragmatic advice on the ways firms may maximize the power of block chain in boosting SC resilience, not just at DHL but also for the whole logistics industry. This was informed by the following research question: What best practices to implement in order to optimize block chain solutions and their impact on the supply chain resilience of DHL and other third-party logistics providers? The responses, and particularly Section D in the questionnaire and the semi-structured interviews, revealed six common themes. Those themes, in fact, reflect a profound level of agreement among respondents about what companies need to do to address the challenges they face in getting block chain projects off the ground, and in driving new value from block chain investments.

4.5.3.1 Theme 1: Training and Upskilling Employees

Of the 30 who responded, 27 (90.0%) said intensive training and upskilling initiatives were crucial for a successful introduction of block chain. Many users thought that a higher level of employee knowledge of block chain principles, platforms, and applications would drive adoption and overcome internal resistance.

Interview Respondent 6:

"We need more than presentations—we need actual system walkthroughs and role-based block chain training."

Interview Respondent 25:

"Most of the resistance comes from fear of the unknown. If people understood how block chain works, they'd be more willing to engage with it."

Interview Respondent 15:

"Training should be continuous. As block chain evolves, so should our internal skillsets."

"People want something practical, tangible," said one respondent, "Not just vague overview or theoretical introduction." Several recommended that DHL invest in certification programs, internal workshops, simulation tools, and department-specific block chain education and modules. This is consistent with IBM (2020), where employee engagement identified to be a foundation for digital transformation, and upskilling comes from increased confidence with the users and system usage.

4.5.3.2 Theme 2: Investment in IT Infrastructure and System Integration

Most (24 of 30, 80 percent) called for more investment in IT infrastructure, particularly to improve the applicability and operational compatibility with existing logistics systems. Respondents also felt that fragmented systems result in technical waste and that the complete potential of block chain is not fully harvestable if it does not integrate with legacy system, including warehouse management systems (WMS), enterprise resource planning (ERP) and Internet of Things (IoT) frailties.

Interview Respondent 2:

"Some of our older systems don't talk to the block chain nodes properly. We need full interoperability."

Interview Respondent 21:

"It's frustrating when we get real-time block chain data but then experience delays because another legacy system isn't synced."

Interview Respondent 10:

"Infrastructure should match ambition. We can't run modern systems on outdated platforms."

Respondents advised DHL to invest in middleware and modular APIs, and collaborate with vendors to improve interoperability, so that block chain platforms can talk to existing enterprise systems. This is in line with Mutale (2024) which underscores that strong and flexible digital infrastructure is necessity in order to scale block chain across complex and decentralized logistics settings. Attendees has emphasized block chain cannot stand-alone - must be built in to the overall digital ecosystem of tools like ERP, WMS, CRM, and IoT platforms. Without integrated deployment, block chain used as a siloed application, eliminating the potential for efficiency gains and resistance to failure. An integrated approach in the center of this strategy with cloud services, smart gateways and real-time analytic hubs would open the doors to data fluidity, reduced latency and the true end-to-end supply chain visibility that block chain places in our hands. Digital connectivity concerns As DHL pursues digital transformation, its infrastructure investment decisions must keep up if it is to avoid fragmentation, duplication and/or overload.

4.5.3.3 Theme 3: Development of a Clear Implementation Strategy

Ensuring a clear and phased organization, 23 respondents (76.7%) identified organization wide block chain rolling out strategy at DHL as the major concern. Block chain has been somewhat fragmented, some of the solutions are experimental with no clear goal or long-term direction. Numerous respondents indicated that pilots at smaller scale have been beneficial for exploring various block chain aspects but that such pilot initiatives need to be underpinned by a detailed plan with timelines, KPIs, departmental roles, a training schedule, how resources would be redeployed and a 'plan b' in case the pilot is not successful. In addition, without that framework, they said, it is hard to develop trust and secure the kind of buy-in needed from stakeholders; especially the operational teams on the ground that you need to actually execute the transition. Ambiguity, multiple participants explained, breeds confusion, internal resistance, and uneven levels of engagement between departments and geographies. Respondents also said a clear road map would not only clarify implementation, but also demonstrates to employees and partners that block chain is not a passing fad, but a strategic investment that fits with DHL's wider digitalization strategy.

Interview Respondent 13:

"There has to be a strategy, not just experimentation. People need to know what's coming, why it matters, and how they fit in."

Interview Respondent 27:

"Piloting is good, but you also need a plan to scale and standardize once the pilot works."

Interview Respondent 18:

"Some of the resistance comes from the lack of direction. Teams don't know if block chain is here to stay or just a passing trend."

The literature by Crosby et al is further, but indirectly, corroborated by the experiences and perceptions of the participants. (2016) who propose a gradual approach for block chain implementation. Under this framework, companies should start small with pilots scoped to validate value propositions and technical feasibility. These pilots can provide the basis for broader implementation architectures in line with company-wide digital strategies. If it were DHL, it would mean that each DHL division (logistics, IT, procurement, compliance, warehouses etc.) was 100% on board and had everything they need to make the block chain work. There is also a need for an explicit road map, which would facilitate resource allocation, develop benchmarks to monitor progress and foster linkages between global and regional offices. Further, an overarching strategy would limit duplication between pilots, promote homogenization across geographies, and make certain that the learning from early adopters are institutional and scaled. Ultimately, a holistic deployment approach will cement block chain as an enduring, fully adopted linchpin in DHL's supply chain process.

4.5.3.4 Theme 4: Strengthening Collaboration with Technology Partners

Of the 22 of 30 participants (73.3%) that responded, the majority called for DHL to improve partnership with technology partners (to better enable block-chain integration). Respondents said that DHL's embedded capacity is good, but not enough alone to develop and operate the end-to-end lifecycle of complex block-chain systems. The engagement of block chain-technology start-up partners, enterprise software providers, fintech-innovators, and research organizations, as well as global logistics consortia, considered important to support these outcomes. Some of them speculated

that by entering into these partnerships, DHL could move faster with deployment and at a lower implementation cost, and have the possibility of accessing the most recent developments in block chain security, smart contracts and integration frameworks." Furthermore, collaborations would enable DHL to take advantage of common infrastructure patterns, cloud-based block chain services and cross-industry best practices, which are already influencing other logistics networks elsewhere. Several of them stressed that their interest was not solely in procurement, but in co-creation and joint pilot development, access to ongoing technical support - to make sure that block chain solutions developed with DHL are fit for DHL's real-world use-cases and rolled out internationally.

Interview Respondent 3:

"Our partners trust us more now because they can verify everything themselves. But internally, we also need trusted technology partners to make these systems robust and scalable."

Interview Respondent 8:

"Working with tech firms gives us insight into what works elsewhere, especially with interoperability and cybersecurity."

Interview Respondent 16:

"Open collaboration leads to standards. It's better than each logistics firm reinventing the wheel in isolation."

Interview Respondent 6:

"Most of our successful block chain experiments involved external support from companies that specialize in distributed ledgers. We need more of that."

Interview Respondent 20:

"The logistics world is too complex to go it alone. Strategic alliances help us share costs, risks, and lessons."

Interview Respondent 29:

"Some of the most effective systems we've seen in customs tracking and real-time

verification were built with outside innovation partners. We shouldn't be afraid to open up."

This finding is similar to previous studies by Saberi et al. (2021) who stress that cross-sector collaboration between the public and private sectors can increase the likelihood of successful rollout of block chain by allowing the pooling of resources, and reducing technological fragmentation and promoting interoperability. For DHL, that enhanced partnership between carriers and partners is not simply about gaining more tools — it is about the co-creation of solutions to pressing, globally relevant logistics issues like regulation, customs clearance, and risk and cross-border integration. These relationships would have featured public-private innovation hubs, block chain consortia, such as the Block chain in Transport Alliance (BiTA), and pilots with universities or government agencies. Crucially, deep partnerships would also enable DHL to help shape global block chain standards, meaning that the systems the company invests in today will continue to be interoperable, sustainable and broadly adopted across the other participants in the extended supply chain. These collaborations will ensure that DHL retains its position as a frontrunner in block chain development, enabling its systems to respond dynamically as new industry challenges and technology trends emerge on a global scale.

4.5.3.5 Theme 5: Improvement of Regulatory Engagement and Compliance Frameworks

Nineteen (63.3%) of them expressed the need for DHL to be more proactive and strategic in its approach to regulatory engagement and block chain compliance strategy. Participants indicated that legal uncertainty, in particular, in relation to data sovereignty, smart contracts, digital signatures and cross-border sharing of information, and was one the key barriers to more widespread application of block chain. Respondents felt that DHL should not sit back and wait for external regulation to catch up, but should actively engage with policymakers, regulators and industry bodies to influence positive regulation and guidelines that balance innovation and risk. Furthermore, recommendation that DHL to set up internal governance regimes, such as specialized compliance task forces and legal-technical departments, which guarantee compliance for all future block chain systems in regulatory environments of today and tomorrow. i) Several participants stressed the need to have embedded expertise of

compliance on block-chain pilot teams to secure alignment right from the beginning, and not having afterwards restrict legal requirements.

Interview Respondent 28:

"We need to work with governments, not just wait for them. Being part of regulation development will help shape better, flexible rules."

Interview Respondent 12:

"If DHL helps design block chain-friendly compliance models, we gain first-mover advantage."

Interview Respondent 19:

"Compliance shouldn't be a barrier. If we align early with regulators, we can roll out with more confidence and less risk."

Interview Respondent 7:

"There should be internal compliance experts reviewing every block chain use case, especially those involving personal or cross-border data."

Interview Respondent 22:

"Customs and legal authorities want transparency, but they also want data localization. DHL should be leading the discussion on how to balance both through smart contracts and permissions."

Interview Respondent 17:

"Some of our best compliance outcomes came from partnering with authorities early. That should be standard practice for block chain rollouts."

These findings are congruent with the research of Butt et al. (2021), who stated that the lack of regulatory clarity, in particular, has been causing a reluctance in the adoption of disruptive innovation such as block chain on a cross-border level. As a world leader in the field of logistics, DHL can shape the law through its market position and practical experience. By engaging in policy working groups, trade dialogues and block chain governance forums, DHL can help ensure future regulation reflects the realities of how global supply chains work. What's more, by creating their own internal pathways to compliance and playbooks with best-in-class legal for smart contracts and narrowly

tailored regionally specific audit protocols, DHL would not only be giving irreversible levels of confidence to stakeholders, but also could live on the block chain without legal exposure. As the regulatory environment around digital ledgers develops, DHL's capability to participate early and constructively will also become a source of competitive advantage and a means of mitigating operational and reputational risk.

4.5.4 FACTORS INFLUENCING THE ADOPTION OF BLOCKCHAIN TECHNOLOGY IN THE LOGISTICS CHAIN OF DHL (Objective 4)

The last objective of the research was to explore the most influencing factors for the adoption of block chain technology in the DHL logistics chain. Based on the study question: What are the determinants of adoption of block chain technology in the logistics chain? Findings: Feedback collected from the Section E questionnaire as well as interviews have shown that DHL acknowledges the strategic importance of block chain however, several internal and external factors tend to influence when and how DHL considers itself fit and ready to implement the technology. Cost: Considerations and Training This section describes the three prevailing themes that arose in the analysis across all 30 participants: (1) cost considerations; (2) technical infrastructure readiness; and (3) employee training and digital literacy

4.5.4.1 Theme 1: Implementation Costs and Budget Prioritization

Interview Respondent 6:

"We operate under tight capital controls. Unless block chain can show clear, near-term ROI, it's hard to justify prioritizing it over fleet maintenance or warehouse upgrades."

Interview Respondent 15:

"Most departments want block chain, but costs—especially licensing and integration—are a real barrier."

Interview Respondent 11:

"It's not just the technology. You need to fund training, security, maintenance—it adds up."

This is commensurate with Kamble et al. (2020) who note that the perceived financial risks and the availability of capital have a high impact on the rate of EM adoption in SCM. Respondents suggested that DHL offer funding in stages with clear ROI targets,

allowing executives to invest money as the technology demonstrates its value in each stage of deployment.

4.5.4.2 Theme 2: Technical Infrastructure and System Compatibility

The second dominant theme was the technical readiness of the infrastructure, in which 21 participants (70%) believed that the compatibilities of the systems and the digital maturity affect the speed and the extent to which the block chain adopted. A number of participants were worried about the division between new block chain systems and DHL has established systems, not least legacy ERPs and warehouse management solutions that were meant not to work with distributed ledgers

Interview Respondent 2:

"Some of our platforms are 10 years old. Integrating block chain into those systems without significant upgrades is almost impossible."

Interview Respondent 18:

"Block chain performs well in pilot environments, but scaling across regions with varying IT capabilities is a challenge."

Interview Respondent 20:

"If the system isn't cloud-ready or API-compatible, we're stuck. You can't connect block chain to everything seamlessly."

These findings supported by the view of Mutale (2024) who argued that to have a successful prostate adoption; the new block chain platform should be part of a digitally converged landscape, where the block chain would be an extension of a larger integrated digital system or ecosystem. Respondents advice DHL to invest in middleware platforms, modern APIs, and digital integration hubs which will make it possible to scale in the future and make additions to and connect with either DHL's or partner systems. Many attendees worried about incompatibility between new block chain infrastructure and DHL's established systems, including legacy ERPs and warehouse management tools that do not interact with decentralized ledgers.

4.5.4.3 Theme 3: Employee Awareness, Training, and Digital Literacy

The third most common issue was DHL employees 'awareness and digital literacy, by 20 (66.7%) respondents. The lack of understanding how block chain works could

contribute to the slow adoption and inefficient use of technology moving forward in Wallops' remaining community members who are not technical in nature, they suggested. Facing this situation, the respondents indicated, quite a few employees, who were in departments like warehousing, dispatch and procurement, were not acquainted to proper introduction or hands-on training on how they could deploy block chain in their job.

Interview Respondent 5:

"Some staff hear 'block chain' and think it's related to Bitcoin. That misconception slows everything down."

Interview Respondent 13:

"Without basic training, block chain feels like an extra burden. People avoid what they don't understand."

Interview Respondent 26:

"There's no point in deploying block chain systems if the end users don't feel confident using them."

These findings are in agreement with that of Saberi et al. (2019) noted that leadership support as well as the technological knowledge of users are crucial facilitators in successfully adopting block chain technology. This is where DHL can tackle the issue by integrating a continuous block chain education, which includes role-based training and programs for peer learning and practical simulations, to foster confidence, and engagement at all levels of the organization. In the face of this, the respondents said, very few of the employees in areas such as warehousing, dispatch and procurement had given an introduction or hands-on training on how they can utilize block chain in their role.

4.6 Chapter Summary

The chapter developed and discussed data from a questionnaire with 30 interviewees from different departments in DHL to investigate how block chain technology is affecting supply chain resilience. Conclusion through a well-constructed questionnaire and case studies that block chain has significantly improved supply chain visibility and

traceability by means of real-time tracking, accurate data, fraud mitigation, and organizational transparency. Respondents recognized that block-chain has potential to simplify parcel tracking, enhance partner collaboration, and bolster stakeholder confidence – key levers of operational resilience. These benefits were confirmed by the feedback of participants and were consistent with the literature emphasizing that block chain is an enabling tool for logistics management.

Under its merits however, the chapter has revealed certain challenges in terms of operating costs, lack of in-house technical capacity, resistance from the status quo, and regulatory ambiguity. However, respondents made some actionable suggestions as to how to combat these barriers, including the need to invest in employee training, upgrade IT systems, have clear implementation plans, and proactively work with regulators and technology partners. Moreover, findings showed that at DHL, the enactment of block chain influenced by factors like financial preparedness, system fit with current environment and employee's digital preparedness. The results provided in this chapter provide a holistic perspective on the possibilities and challenges of using block chain in resilient and transparent logistics activities that will pave the way for specific conclusions and recommendations in the next chapter.

CHAPTER 5: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Summary of the Study

The research attempts to investigate the influence of block chain technology on strengthening logistics resilience in DHL as a case study. The study originated from the increasing challenges of transparency, efficiency, and agility in global logistics, especially after the economic instability, the regulatory shocks, and the changing customer requests shaking up the logistics landscape. Our study had four main objectives: to evaluate the impact that block chain has on supply chain visibility and traceability; to consider the challenges and opportunities of adopting this technology at DHL; to propose recommendations on how to optimize block chain capabilities; and to understand the main drivers affecting the adoption of block chain. To meet these objectives, a mixed-methods research design was adopted, utilizing quantitative data from a questionnaire survey with qualitative information obtained from semi-structured interviews with 30 participants with a range of roles across departments in DHL.

The study found that block chain notably enhances visibility, traceability, and trust in DHL's supply chain, resulting in more effective tracking, greater data accuracy and better cooperation among all those involved in the supply chain. However, amid these benefits, there were also significant obstacles stemming from high implementation costs, lack of skilled staff, organizational change resistance, and uncertain regulatory provisions. However, the results indicated that there is clearly strategic growth and risk management potential of block chain provided with the right training and investment in infrastructure, clear strategies of implementation, and regulatory involvement. Lastly, the research revealed that the internal readiness-technical as well as cultural-is critical for the successful implementation of block chain. In conclusion the study met its purpose and objective, answered the research question and supply DHL and other logistics companies values about how operations involving block chain can be utilized as a mean of creating a more solid and transparent logistic system.

5.2 Block chain and Supply Chain Visibility and Traceability

The result of the research finds out that block chain has significant benefits for supply chain visibility and traceability in DHL's logistics activity. More than 63% of Chapter 4 respondents felt block chain created substantial value for real time tracking, while 70% felt its contribution to traceability was substantial. This information already will

be in the hands of all supply chain members thanks to block chain's decentralized, time-stamped ledger, meaning all parties will be able to view and verify shipment data at any point. This enhanced transparency, mitigates fraud, shortens the time required to track parcels, and safeguards the fidelity of handling records - an essential consideration in regulated industries such as electronics and pharmaceuticals. Respondents also agreed that block chain helps remove data silos and creates a single view of data, driving accountability and efficiency. Thus, in addition to enhancing the accuracy of operations, block chain also strengthens customer trust, compliance and this in turn leads to a more robust logistics landscape.

5.3 Implementation Is Hindered by Key Challenges

However, the study found that block chain adoption is limited due to a number of challenges. As detailed in Chapter 4, more than 70% of survey respondents identified high implementation costs such as licensing fees, infrastructure changes and system maintenance as a significant impediment. In addition, there is a lack of trained professionals in the fields of block chain architecture and design, as well as smart contract development skills, within DHL, which hinders the organization's ability to effectively run and scale block chain solutions. Resistance to change was also a common factor, with respondents stating that cultural inertia and ignorance were barriers, primarily for the non-technical staff, to the introducing of the technology. Furthermore, legal and regulatory ambiguity — particularly around data-privacy needs, smart-contract terms, and cross-border compliance — causes pause that must be navigated carefully. Together, these issues are all slowing down a full-scale integration, limiting pilots and increasing dependence on outside consultants so that block chain adoption is becoming more complex and more resource-heavy than first expected.

5.4 There are Strategic Opportunities

While hurdles remain, there were several tactical openings identified by the study for DHL to leverage its logistics prowess with block chain. A very high majority of the respondents saw the potential benefits of block chain in transforming risk culture, enabling real-time data-enabled decision-making, and trust creation with internal and external parties. More than 80% of respondents said the ability of the block chain to assist in the detection and mitigation of disruption—like shipment delays, inventory

losses and fraud—is a priority for resilience. In logistics environments with high risk, DHL is able to rapidly trace the root cause of a problem and take corrective actions immediately. In addition, through the transparency of the block chain, relationships with suppliers, customs authorities and customers strengthened; thus, DHL can become a more reliable and trusted logistics partner. If leveraged intentionally through a mapped execution strategy, these strategic advantages could cement DHL's competitive position in international logistics, enabling delivery of more valuable data driven, disruption-resistant services.

5.5 Adoption is motivated by Internal Readiness

The research also shows that adoption DHL Block chain depends significantly on its organizational readiness. Chapter 4 noted that adoption is not a question only of technological availability but is the product of a range of factors (on technology, finance, digital infrastructure maturity and employees' digital literacy). About 8 in 10 mentioned a budget was a critical consideration, and 7 in 10 a compatible system. Moreover, over 65% of respondents highlighted the importance of training employees and raising awareness to curb fear, resistance, and misuse of block chain systems. It was clear that DHL's capacity to implement and scale block chain successfully is contingent on (a) a supportive organizational culture, (b) strategic leadership, and (c) congruent digital transformation policies. Without such enablers, block chain could become another isolated IT project instead of a cross-functional business strategy. Therefore, internal preparedness-across resources, infrastructure, and people-is the bridge that could make block chain's promise real and scalable.

5.6 Assessing the Research Problem and Questions

The research problem addressed the following question: "How can block chain technology be effectively grounded in order to improve supply chain resilience in the logistics industry, with a special focus on DHL's business activities?"

This challenge comprehensively tackled through an extensive study of the impact of block chain on critical logistics aspects including visibility, traceability, trust, and disruption management. Survey participants shared both real-life use-cases and impediments to block chain implementation, enabling the research to propose evidence-based suggestions. All four RQs -use and impact of block chain, challenges and opportunities, strategic recommendations and adoption factors -- were detailed

analyzed and answered using well-defined themes. Accordingly, it is acknowledged that the research question is (RQ) successfully answered and the contribution of the study is both practical and theoretical in the context of logistics and digitization of supply chain.

5.5 Recommendations

As per the results and implications of the study, the strategic measures are suggested which shall provide guidelines for DHL to implement and scale the block chain technology for the improvement of supply chain resilience. The proposals alleviate the main organizational, technological and regulatory barriers indicated by the surveyed agents: high costs, lack of internal expertise, business process aversion, system rivalry and regulatory ambiguity. Acknowledging that the application of block chain is not just technological, rather a transformation process, this set of recommendations presents a methodical, evidence-informed approach to the sustainable deployment. This approach is selective with respect to the block-chain use case and technology selection and provides insights from the technical perspective of the block chain that the interested actors/users can consider. Key points are provision of concrete employee training, IT system modernization, staged strategy for rollout, cooperation among the multiple actors, and performance-based assessment. Adhering to these principles will allow DHL to individually leapfrog current limitations and fully tap into the potential of block chain as a strategic enabler of transparency, efficiency and agility in its end-to-end logistics operations around the world. The recommendations designed to help ensure that block chain forms an integral and value-adding part of DHL's multi-year digitalization journey.

5.6 Rationalize Practical Training and Awareness Activities

Perhaps the most compelling theme was the requirement management systems have to train their staff well if block chain projects are to succeed. DHL should create and institutionalize hands-on hands on training programs that are more than just introduction courses or technical session. Specific to roles in the organization, these programs need to help staff understand how block chain influences their daily responsibilities and departmental goals. For example, warehouse personnel, they need to learn how block chain improves tracing, procurement people will need training on the simplifications that smart contracts bring to the procurement process (less fraud, less paperwork).

In addition, DHL should incorporate block chain awareness in the company's current employee training program; thereby new and existing employees systematically made aware of the technology. A combination of e-learning modules, workshops, certified, and mentorship from in-house "block chain champions," recommended. DHL is busting the myth and getting low-skilled workers onboard with block chain, facilitating the rollout through a change management-friendly, user-friendly approach, building confidence, and embedding a grassroots culture of innovation.

5.7 Upgrade IT Systems for Smooth Integration

The research found out that there are a lot not compatible with block chain technology regarding the logistics and enterprise systems of DHL that limit its scalability and capability. DHL needs to focus on IT modernization as a key enabler of its block chain strategy. This entails modernizing legacy infrastructure, developing cloud-based environments, building custom middleware and encapsulated APIs to facilitate transfer of data between block chain systems and legacy enterprise applications including ERP, CRM and WMS.

Investment is also needed in data security, system or cross-system operability, and network scalability especially for businesses operating worldwide who are subject to multiple jurisdictions and supply chain partners. With a robust digital foundation in place that keeps track of all DHL shipments around the world, the hope is that "block-chain will not be in a silo as some nice and tasty innovation, but one which is actually integrated into an overall logistics system," says Staib, enabling block chain to function as an integral part of DHL's logistics infrastructure. This will not only increase block chain performance, but also provide better real-time visibility, operational efficiency, and partner collaboration.

5.8 Develop a Rollout Plan in Phases

Another important suggestion is that DHL should create and implement a structured phased plan for the implementation of block chain. Instead of rolling out the technology across the entire organization from day one, DHL should start with high-impact, low-risk pilot projects that will enable them to track high-value shipments or digitalize customs clearance processes. These pilots needs tracking to gauge success, with agreed-upon metrics covering timesaving, cost impacts, and stakeholder satisfaction.

Upon receiving tangible results from the pilot projects, DHL can use modular aspects of the solution to scale to other departments and regions, which will be facilitated with

feedback loops, stakeholder support, and organizational change management initiatives. This incremental regimen follows digital transformation best practices and ensures that lessons learned inform all stages of deployment, which both reduces risk and increases organizational alignment. A well-defined plan can also help to create realistic expectations, increase transparency, and gain leadership buy-in at every step of the rollout.

5.9 Engage outside Innovators and Regulators If you find potential nontechnical partners that are interested in your efforts, consider meeting with them.

For successful roll out of block chain, it is not just a matter of in-house efforts, it has to be collaborative with outside partners – block chain vendors, fintech firms, academic researchers and regulators. DHL should actively seek out collaborations with technology innovators capable of providing technical expertise, plug-and-play solutions, and inside access to new technology trends. Developing pilot solutions in collaboration with such partners lowers development costs and allows DHL to deploy systems that make sense for today and tomorrow.

Alongside, DHL has to take a lead in influencing the regulatory front. DHL can also advocate for the laws for block chain adoption through the policymakers, industry bodies, and cross-border trade associations. There is a broader opportunity for DHL to be a thought leader in the area of ethical and secure digital supply chains, to influence global norms around data privacy, digital contracts, and block chain governance. Such external partnerships are essential to help spur innovation, maintain legal compliance, and to be part of a bigger block chain ecosystem that serves not only DHL, but also the logistics industry as a whole.

5.10 Establish Metrics to Prove ROI and Fuel Expansion

To make the block chain investments sustainable in the future, it is necessary to define and implement a set of KPIs that track the benefit provided by the block chain solutions operated in the network of DHL. These KPIs need to go beyond technical measures and measure the results of a solution (e.g., decrease in fraud rate, increase in customer satisfaction, decrease in average dispute resolution time, increase in shipment accuracy, and increase in delivery speed).

Through incorporating these KPIs into DHL's existing operations dashboards, it can track block chain's impact in real time and make a fact-based assessment of whether, when and how to scale adoption throughout the organization. Routine performance audits and post-implementation reviews will also facilitate ongoing enhancements, helping to ensure that the execution of block chain installations remains in step with business needs and user requirements. Showing a solid ROI is important to not just stake holding investment for the future, but also to gain trust and help drive enterprise-wide acceptance.

5.11 Implications of the Study

This paper has some important implications for the logistics companies who are contemplating to pioneer block chain technology. It shows that block chain is not a mere technological appendage; it is a strategic catalyst of resiliency, efficiency and confidence. However, the effectiveness of AI determined by how well organizations prepare their people, process and platform. For DHL, that translates into innovation that is in line with digital readiness; block chain does not stand alone, but as part of a broader digital transformation model.

5.12 Directions for Future Work

However, the Nowi team (2010) did not conduct an empirical study with DHL's customers, technology partners, or/and regulatory bodies. Furthermore, comparative research of several logistics companies would have deepened the understanding of sector wide barriers. Furthermore, with the maturation of block chain technology, future research would be able to probe deeper into the integration of block chain with other emerging technologies such as artificial intelligence, machine learning, and Internet of Things (IoT) to support end-to-end intelligent supply chain.

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APPENDIX 1: Letter of Approval

BINDURA UNIVERSITY OF SCIENCE EDUCATION
FACULTY OF COMMERCE



23 May 2025

To whom it may concern

Dear sir/madam

RE: APPLICATION FOR AUTHORITY TO CONDUCT RESEARCH.

I do hereby apply for authority to conduct a research at your organization. I am part four student studying towards a degree in Purchasing and supply with Bindura University of Science Education. My topic is “The Impact of Block Chain technology in building resilience of logistics industry: Case of DHL”. I am kindly requesting for assistance with information and data from your organization as well as authority to respond to my questionnaires.

I am in great hope of your response.

Yours faithfully

Gwashure Russell

B221607B

Purchasing student

Appendix 2: Questionnaire

RESEARCH QUESTIONNAIRE

Research Topic: The Impact of block chain technology on building resilience of the logistics industry: Case of DHL

Introduction

Thank you for participating in this research questionnaire. This study aims to understand how Block Chain Influence resilience of logistics chains in using DHL a leading global logistics firm as an example. Your responses will be instrumental in achieving this objective.

Confidentiality

All your responses shall kept strictly confidential. I shall anonymize the data you provide and solely use it for research purposes.

Instructions

Please answer all questions to the best of your ability. Some questions require seeking qualitative insights (opinions).

Please indicate your answer by putting a tick/ x in the box.

Section A: Background Information

1 How long have you worked in the logistics industry?

- | | |
|-------------------|--------------------------|
| Less than 1 year | ☐ |
| 1-3 years | ☐ |
| 4-6 years | ☐ |
| More than 6 years | ☐ |

2 What is your current position?

- | | |
|-------------------------|--------------------------|
| Logistics Manager | ☐ |
| Supply Chain Specialist | ☐ |
| IT Specialist | ☐ |
| Other (please specify) | |

.....

3 Do you have experience and familiarity in working with block chain technology in DHL?

- | | |
|-----|--------------------------|
| Yes | ☐ |
| No | ☐ |

If “YES”, how familiar are you with block chain technology?

Very familiar ☐

Somewhat familiar ☐

Section B: Impact of Block chain Technology on Supply Chain Visibility and Traceability

4 To what extent do you believe block chain technology enhances supply chain visibility within DHL?

Very significantly ☐

Moderately ☐

Slightly ☐

Not at all ☐

5 How does block chain technology contribute to improved traceability of products and information in DHL's logistics operations?

Very significantly ☐

Moderately ☐

Slightly ☐

Not at all ☐

6 What specific benefits have you observed in visibility and traceability since implementing block chain solutions? (Select all that apply)

Reduced tracking time ☐

Increased data accuracy ☐

Decreased errors and fraud ☐

Improved collaboration with partners ☐

Other (please specify)

.....

Section C: Challenges and Opportunities in Implementing Block chain Technology

7 Have you experienced challenges in supply chain visibility within DHL's logistics operations?

Yes ☐

No ☐

8 What are the main challenges you see in implementing block chain technology in DHL's logistics operations? (Select all that apply)

High implementation costs ☐

Lack of skilled personnel ☐

Resistance to change from staff ☐

Technical difficulties in integration ☐

Insufficient regulatory framework ☐

Other (please specify)

.....9

9 What opportunities does block chain technology present for enhancing supply chain resilience at DHL? (Select all that apply)

Increased transparency ☐

Faster decision-making processes ☐

Improved risk management ☐

Enhanced trust among partners ☐

Other (please specify)

.....

Section D: Recommendations for Maximizing Block chain Effectiveness

10 What measures do you believe would help maximize the benefits of block chain technology in DHL's logistics operations? (Select all that apply)

- Training and upskilling employees ☐
 Investment in IT infrastructure ☐
 Development of a clear implementation strategy ☐
 Collaboration with technology partners ☐
 Improvement of regulatory standards ☐
 Other (please specify) ☐

11 Please rate the importance of the following factors for the successful adoption of block chain technology: (Please Tick)

Factors	Very Important	Neutral	Less important	Not Important
Management Support	☐	☐	☐	☐
Financial Resources	☐	☐	☐	☐
Technical Readiness	☐	☐	☐	☐
Company culture and innovation	☐	☐	☐	☐
Legislative Support	☐	☐	☐	☐

Section E: Factors Influencing Block chain Adoption

12 To what extent do you agree with the statement: "The level of understanding of block chain technology among employees affects its successful adoption"? (Please Tick)

Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

13 Which of the following factors do you think have the most significant influence on the adoption of blockchain technology in DHL's logistics chain? (Select up to 3)

- Implementation costs ☐
 Business benefits ☐
 Management support ☐
 Technical infrastructure ☐
 Regulatory environment ☐
 Employee training levels ☐
 Competitive pressure ☐
 Other (please specify) ☐

Section F: Additional Comments

14 Please share any additional thoughts or suggestions regarding the implementation of block chain technology in DHL's logistics operations:

Russel

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