EXPLORATION OF FIRST-MILE LOGISTICS IN NORTHERN REGION, MALAYSIA.

NUR HANNAN FARZANA BINTI FADZIL

MASTER OF SCIENCE

(TRANSPORTATION AND LOGISTICS MANAGEMENT)

UNIVERSITI UTARA MALAYSIA

MARCH 2025

EXPLORATION OF FIRST-MILE LOGISTICS IN

NORTHERN REGION, MALAYSIA

By:

NUR HANNAN FARZANA BINTI FADZIL

Thesis submitted to

College of Business,

Universiti Utara Malaysia,

in fulfillment of the requirement for the Master of Science in

Transportation and Logistics Management

Kolej Perniagaan
(College of Business)
Universiti Utara Malaysia

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Tarikh: **08 April 2025**
Date:

Nama Pelajar : **Nur Hannan Farzana binti Fadzil**
(Name of Student)

Tajuk Tesis / Disertasi : **Exploration of First Mile Logistics in Northern Region Malaysia**
(Title of the Thesis / Dissertation)

Program Pengajian : **Master of Science (Transportation & Logistics Management)**
(Programme of Study)

Nama Penyelia/Penyelia-penyelia : **Assoc. Prof. Dr. Suhaila Abdul Hanan**
(Name of Supervisor/Supervisors)

Tandatangan

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Abstract

The rapid growth of e-commerce in Malaysia has intensified challenges in first-mile logistics, where shippers and transporters struggle with real-time pickup requests, additional orders, incorrect addresses, vehicle capacity constraints, and outdated systems. These inefficiencies lead to delays, increased costs and dissatisfaction. This study, using a qualitative approach, explores these challenges through interviews with 12 respondents, 6 shippers and 6 transporters, operating within Malaysia's northern region. The findings highlight issues such as poor route optimization, limited vehicle capacity, and reliance on manual processes, which disrupt logistics coordination and cause shipment delays. The significance of this study lies in its practical insights into operational pain points from both shipper and transporter perspectives, providing real-world understanding of first-mile inefficiencies. To improve efficiency, the study recommends dynamic scheduling, real-time tracking, optimized fleet management, and enhanced technology adoption. Strengthening coordination between shippers and transporters and investing in automated logistics solutions are key to optimizing first-mile logistics and enhancing Malaysia's e-commerce supply chain performance.

Keywords: *Logistics Management, First-mile logistics, E-commerce, Logistics Service Providers, Technology Integration,*

Abstrak

Pertumbuhan pesat e-dagang di Malaysia telah meningkatkan cabaran di dalam proses pertama dalam logistik, di mana penjual (penghantar) dan syarikat pengangkutan menghadapi kesukaran dalam permintaan pengambilan tepat masa, pesanan tambahan, alamat yang salah, kekangan kapasiti kenderaan, dan sistem yang kurang maju. Ketidak kecekapan ini menyebabkan kelewatan, peningkatan kos, dan prestasi rantaian bekalan yang lemah. Kajian ini menggunakan pendekatan kualitatif untuk meneroka cabaran yang dihadapi melalui temu bual dengan penjual (penghantar) dan syarikat pengangkutan. Dapatan kajian menunjukkan masalah seperti pengoptimuman laluan yang lemah, kapasiti kenderaan yang terhad, dan pergantungan kepada proses manual, yang mengganggu penyelarasan logisti, menyebabkan kelewatan penghantaran. Bagi meningkatkan kecekapan, kajian ini mencadangkan penjadualan dinamik, penjejakan masa nyata, pengurusan optimum, dan penggunaan teknologi yang lebih baik. Memperkukuh penyelarasan antara penjual (penghantar) dan syarikat pengangkutan serta melabur dalam penyelesaian logistik automatik adalah kunci untuk mengoptimumkan proses atau langkah pertama di dalam logistik di samping meningkatkan prestasi rantaian bekalan e-dagang di Malaysia.

Kata Kunci: *Pengurusan Pengangkutan, Proses Pertama Penghantaran dalam Logistic, E-dagang, Penyedia Perkhidmatan Logistik, Integrasi Teknologi.*

Acknowledgement

I would like to express my heartfelt gratitude to my supervisor, Associate Prof. Dr. Suhaila Binti Abdul Hanan, for her invaluable guidance, insightful feedback, and unwavering support throughout this research. Her expertise and encouragement have been instrumental in shaping this study and refining its direction.

I am also deeply appreciative of my friends and colleagues at Universiti Utara Malaysia, whose shared knowledge, constructive feedback, and willingness to assist have greatly enriched my research journey. Your support and intellectual discussions have been invaluable.

Lastly, my deepest appreciation goes to my family for their unconditional love, patience, and encouragement throughout this journey. Their unwavering belief in me has been a constant source of motivation and strength.

This research would not have been possible without the contributions, guidance, and support of these individuals and institutions. Thank you all sincerely.

Table of Contents

List of Tables

List of Figures

CHAPTER 1: INTRODUCTION

1.0 Introduction

The researcher investigates the problem of first mile transportation in parcel pickup within Northern area in Malaysia. This chapter presents the following content for this study. The research background, problem statement, research questions, research objectives, significance of the research, scope, definitions of key terms, and organization of the thesis were outlined.

1.1 Background of Study

The first mile in the supply chain refers to the initial stage of logistics, where goods are moved from shippers to transporters or a designated warehouse, fulfillment center, or distribution hub. It is a critical phase in ensuring a smooth transition for the rest of the supply chain, particularly in e-commerce logistics, where timely and efficient pickup operations are essential (Onfleet, 2022; DHL, 2021).

The rapid expansion of e-commerce has significantly transformed global supply chains, especially in the first-mile logistics stage. The global e-commerce market is projected to grow from $5.2 trillion in 2021 to $8.1 trillion by 2026, driven by factors such as increasing internet penetration, digital payment adoption, and the rise of online marketplaces (Statista, 2023). This surge in online shopping has placed immense pressure on logistics networks, particularly the first mile, where goods are collected from shippers and moved to fulfillment centers or distribution hubs.

The Asia-Pacific region, led by China, accounts for nearly 60% of global e-commerce sales, with platforms like Alibaba, JD.com, and Shopee dominating the market. In North America and Europe, companies like Amazon, eBay, and Walmart are expanding their supply chain networks to accommodate rising online order volumes. The Middle East and Latin America are also experiencing rapid growth, fueled by increased digital adoption and

logistical advancements (UNCTAD, 2022).

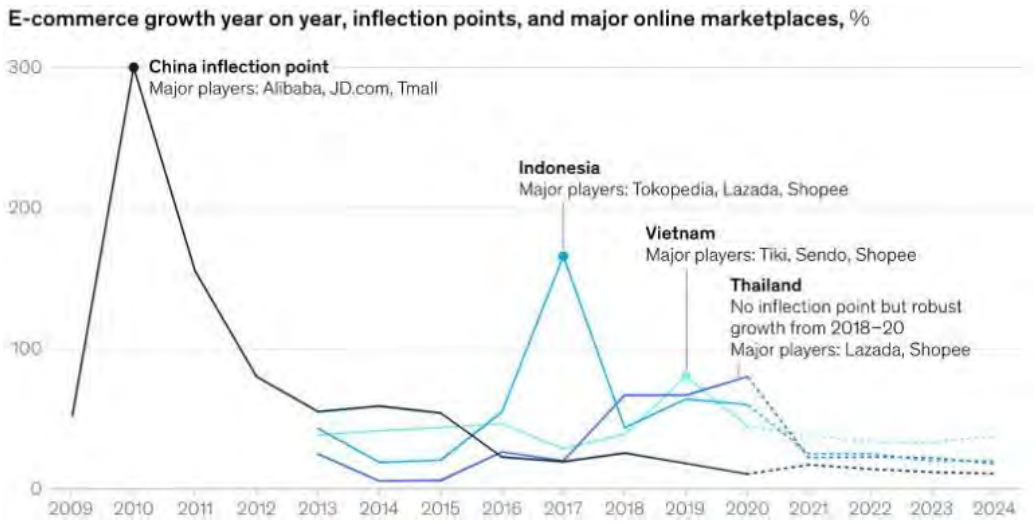

Figure 1: E-Commerce Market in Southeast Asia has Passed Supply-Chain (Qiu, 2024)

In Southeast Asia, e-commerce has witnessed rapid growth, especially following the COVID-19 pandemic, which accelerated digital adoption and online shopping trends. Since the mid-2010s, the region has experienced exponential growth in online transactions, with e-commerce sales increasing fivefold between 2016 and 2021, representing an annual growth rate of 40% (Chen & Feng, 2022). The share of e-commerce in total retail sales surged from 5% to 20% during this period. This transformation has been fueled by greater internet access, the widespread adoption of smartphones, and the emergence of competitive online marketplaces (Lu, Ong, & Chia, 2021).

Malaysia's e-commerce sector has also experienced substantial expansion, driven by technological advancements, improved digital infrastructure, and evolving consumer behavior. As of recent estimates, Malaysia's e-commerce market is valued at approximately USD 4.3 billion, with projections indicating a near doubling to USD 8.1 billion in 2024, supported by a Compound Annual Growth Rate (CAGR) of 18% (J.P. Morgan, 2020). This rapid growth underscores the need to strengthen Malaysia’s e-commerce ecosystem, including improvements in product availability, payment systems, logistics, and regulatory frameworks

to align with global best practices (Aprameya, 2020).

While the industry continues to grow, businesses are now adopting more cautious strategies, prioritizing profitability and sustainability in response to changing macroeconomic conditions. Despite these challenges, the e-commerce industry in Malaysia and the broader Southeast Asian region remains poised for continued expansion, presenting opportunities for businesses, policymakers, and stakeholders to drive further innovation and market development.

A critical component of the e-commerce supply chain is logistics, which ensures the efficient movement of goods from origin to end consumers. Among the various stages of logistics, first-mile delivery plays a pivotal role as the initial phase of transportation. It encompasses the journey products undertake from the merchant's or supplier's location to a warehouse or distribution center (Zhang & Li, 2022). This phase is essential for ensuring smooth subsequent stages of the supply chain, particularly in business-to-consumer (B2C) logistics, where timely and efficient delivery is paramount (Tan, 2023).

First-mile logistics involves multiple processes, such as tracking items ready for shipping, arranging transportation, delivering goods to warehouses, and ensuring proper storage to facilitate efficient last-mile delivery (LogiNext Solutions, n.d.). Merchants may either transport their goods to collection points or drop-off stations themselves or rely on logistics service providers (LSPs) to handle pick-ups from their warehouses or storefronts (Ranathunga, Wijayanayake, & Niwunhella, 2021). While pick-ups can save merchants significant time and effort, they often incur additional fees, depending on the LSP’s terms (Tan, 2023).

Ensuring a seamless first-mile delivery is crucial for the overall efficiency of the e-commerce supply chain. A well-managed first-mile process reduces delays, minimizes disruptions, and sets the foundation for a smooth transition to the subsequent stages of logistics, including last-mile delivery (Tan, 2023).

1.2 Problem Statement

With Malaysia's e-commerce sector projected to reach USD 8.1 billion by 2024 (J.P. Morgan, 2020), the efficiency of first-mile logistics has become increasingly important. The first mile stage, which involves the transportation of goods from shippers or suppliers to distribution hubs or warehouses, is essential to ensuring cost-effective operations, supply chain responsiveness, and customer satisfaction (Mentzer et al., 2001). However, current evidence suggests that this phase of logistics remains underdeveloped in Malaysia.

Operational observations and logistics providers consistently point to recurring issues faced by both shippers and transporters. The lack of digital infrastructure contributes to inefficiencies, often resulting in missed pickups, dispatch delays, and increased logistics costs (FarEye, 2023)

News reports reinforce these operational shortcomings. In 2024, transporters in Selangor reported vehicle shortages and poor connectivity to distribution hubs, prompting exploration of Demand Responsive Transit as a solution (The Star, 2023). National media also reported insufficient government investment in first- and last-mile logistics, especially in urban and semi-urban areas (Focus Malaysia, 2023). Moreover, sudden pickup order changes, address errors, and outdated systems continue to hinder route efficiency (Scholiva, n.d.; Free Malaysia Today, 2023).

The table below summarizes the key first-mile challenges based on recent news findings. These persistent issues prove that both shippers and transporters are significantly impacted by first-mile inefficiencies, leading to higher operational costs, reduced delivery reliability, and poor customer experience. Addressing these challenges is essential for supporting the sustainable growth of Malaysia's e-commerce logistics ecosystem. This research is necessary based on current news reports and recent data, which clearly show that first-mile logistics challenges are still affecting shippers and transporters in Malaysia.

Table 1: Challenges in First-Mile Logistics in Malaysia (Based on News Reports)

Challenge	News Source & Location	Data & Statistics	Retrieve
Unpredictable pickup requests & poor scheduling	Scholiva article on first-mile delivery challenges	No exact figures provided	Scholiva. (n.d.). Exploring First Mile Delivery: Challenges and Innovations. Retrieved from Scholiva.
Vehicle shortages for transporters	The Star (Selangor case, 2023)	No data, but issue discussed in context of DRT plans	The Star. (2023, June 15). Selangor working towards resolving first/last mile connectivity, says MB. Retrieved from The Star.
Lack of real-time tracking/technology	Free Malaysia Today (2023)	Many companies still use manual processes	Free Malaysia Today. (2023, July 3). Big logistics players drive e-commerce but concerns over 'missed opportunities. Retrieved from Free Malaysia Today.
Low government investment in first mile infra	Focus Malaysia (2023)	Allocation deemed inadequate by analysts	Focus Malaysia. (2023). Gov't should beef up first-and-last-mile transportation woes. Retrieved from Focus Malaysia.

Despite the importance of first-mile logistics, there has been limited research focused specifically on this area within Malaysia's e-commerce market. Most studies tend to concentrate on logistics as a whole, without addressing the unique challenges faced by shippers and transporters during the first-mile phase. Other than that, complaints and feedback usually are not well recorded and only assisted on the spot by the players in this process. Since logistics are a fast-moving industry and need real-time solutions, some feedback is neglected whereas it an opportunity for logistics companies to know and improve their services. Different with the last mile delivery, consumer or last customer in the chain have platform to always share their feedback and satisfaction. As consumer expectations for faster and more reliable deliveries continue to rise, addressing the inefficiencies in first-mile logistics is essential for improving overall supply chain performance. This research aims to explore the challenges and opportunities in first-mile delivery from both the shipper and transporter perspectives, with the goal of identifying practical solutions to enhance efficiency and improve the overall customer experience in Malaysia's rapidly expanding e-commerce sector.

1.3 Research Questions

a. What is the current state of first-mile logistics operations in Malaysia's e- commerce sector?

b. What are the primary challenges faced by shippers and transporters in managing first-mile logistics within Malaysia's e-commerce market?

c. What are the primary challenges faced by transporters in managing first-mile logistics within Malaysia's e-commerce market?

d. What strategies can be implemented to improve the efficiency of first- mile logistics in Malaysia’s e-commerce industry?

1.4 Research Objectives

a. To assess the current state of first-mile logistics operations in Malaysia's e- commerce sector.
b. To identify challenges faced shippers in managing first-mile logistics within Malaysia's e-commerce market.
c. To identify challenges faced by transporters in managing first-mile logistics within Malaysia's e-commerce market
d. To propose strategies for improving the efficiency of first-mile logistics in the e-commerce industry.

1.5 Scope of the Study

This study focuses on first-mile logistics in the northern region of Malaysia, specifically Penang, Kedah, and Perlis. These areas were selected due to the growing e-commerce market and the unique challenges faced by small and medium-sized online shippers (SMEs) and third-party logistics (3PL) transporters in this region. With a particular emphasis on packaging, labeling, transportation, and delivery scheduling. By focusing on SMEs and 3PL transporters in the northern region, the study provides focused insights into the challenges of first- mile logistics in Malaysia's e-commerce sector, addressing a gap in research on this topic in the northern part of the country. The research primarily examines the operational efficiency, cost implications, and sustainability of first-mile logistics, excluding other factors like last- mile delivery, which fall outside the study's scope.

1.6 Significance of Study

The efficiency of first-mile logistics is a crucial factor in the success of Malaysia's e-commerce industry, directly impacting supply chain performance, operational costs, and customer satisfaction. While extensive research has been conducted on logistics management in various industries, limited studies have focused specifically on first- mile logistics within

Malaysia's e-commerce sector. This study aims to bridge that gap by assessing the current state of first-mile logistics, identifying key challenges faced by shippers and transporters, and proposing strategies to enhance efficiency

This research is particularly significant for the northern region of Malaysia, including Penang, Kedah, and Perlis, which serve as key economic and trade hubs. These states are home to many small and medium enterprises (SMEs), manufacturers, and e-commerce businesses that rely on efficient logistics to maintain their competitiveness. However, challenges such as pickup time, various types of packaging, inconsistent volume and poor system or devices, create significant bottlenecks in the first-mile logistics process. By analyzing these issues, this study will offer practical solutions tailored to the specific needs of businesses in the northern region, enabling them to optimize their logistics operations and improve overall supply chain efficiency.

The findings of this research are expected to benefit a wide range of stakeholders, including e-commerce shippers, logistics service providers, and policymakers. Business owners and supply chain managers will gain valuable insights into optimizing first-mile logistics, reducing delays, and lowering costs. Logistics companies can use the study's recommendations to improve transportation efficiency, streamline route planning, and enhance coordination with shippers. Additionally, policymakers can leverage this research to develop policies that support infrastructure improvements, digitalization, and sustainable logistics solutions, fostering growth and innovation within Malaysia's e-commerce ecosystem.

Moreover, this study in hope serves as a valuable academic resource for researchers and students in the field of logistics and supply chain management. By contributing to the understanding of first-mile logistics challenges and opportunities, particularly within Malaysia's northern region, this research may help drive improvements in e-commerce logistics and support the broader development of the nation's digital economy

1.7 Definition of Terms

To ensure clarity and understanding, the following key terms are defined as they are used throughout this study.

E-Commerce

E-commerce can be broadly defined as the process of buying, selling, transferring, or exchanging products, services, and information through computer networks, including the internet (Turban et al., 2022). It also involves the use of digital technology and online platforms to facilitate commercial transactions among businesses, consumers, and government entities (Laudon & Traver, 2021). These definitions highlight the digital and transactional nature of e-commerce, which serves as the foundation for modern online business operations.

Supply Chain Performance

Supply chain performance refers to the overall effectiveness of each stage in the supply chain in achieving key objectives such as cost optimization, reducing inefficiencies, improving speed, and meeting customer expectations (ShipBob, 2023). It also encompasses the seamless flow of goods, services, and information from the point of origin to the point of consumption, with an emphasis on efficiency, cost-effectiveness, and customer satisfaction (Intuendi, 2022). Together, these definitions underscore the importance of maintaining a well-coordinated and responsive supply chain to ensure successful operations, especially in the fast-paced e-commerce environment.

Logistics Service Providers (LSPs)

A Logistics Service Provider (LSP) is an outsourced company that offers essential supply chain management services, including transportation, warehousing, and distribution (Penske Logistics). Additionally, LSPs assist businesses in managing broader supply chain functions such as inventory management, shipping, and reverse logistics like returns (NetSuite). These

definitions highlight the critical role LSPs play in supporting end-to-end logistics operations, helping businesses streamline processes and improve overall supply chain efficiency.

First-Mile Logistics

First-mile delivery refers to the initial stage of the logistics chain, where goods are moved from the production facility or manufacturer to a warehouse or courier responsible for further delivery (DHL Logistics of Things). It involves the collection, packaging, and early transportation of products, marking the beginning of the delivery journey before items enter the broader distribution network (Onfleet). These definitions emphasize the foundational role of first-mile logistics in ensuring a smooth and efficient supply chain process.

1.8 Organization of Research

This research consists of five chapters. Chapter 1 introduces the research background, outlining the context, objectives, and significance of the study. Chapter 2 reviews relevant literature on first-mile logistics, supply chain performance, and the challenges faced by shippers and logistics service providers in Malaysia's e-commerce sector. Chapter 3 describes the research methodology, including the approach, data collection methods, and analysis techniques used. Chapter 4 presents the findings of the study, analyzing the current state of first-mile logistics and the challenges faced by stakeholders in the industry. Finally, Chapter 5 concludes the research, summarizing key findings and offering recommendations for improving first-mile logistics in Malaysia's e-commerce sector.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

The rapid growth of e-commerce in Malaysia has reshaped logistics operations, intensifying the need for efficient first-mile logistics to support seamless order fulfillment and delivery performance (J.P. Morgan, 2020). First-mile logistics, defined as the movement of goods from shippers to transporters, warehouses, or fulfillment centers, is foundational to supply chain responsiveness and reliability (Onfleet, 2022). Despite its significance, this area remains underexplored and is frequently disrupted by inefficiencies such as unpredictable pickup requests, last-minute order changes, address inaccuracies, vehicle capacity issues, and the absence of integrated systems (Ali, Lim, & Chen, 2022)

This chapter reviews key literature related to first-mile logistics, e-commerce, supply chain performance, and logistics service providers (LSPs). E-commerce, as defined by Turban et al. (2022), involves buying, selling, and exchanging products via digital networks, highlighting the importance of logistics integration to meet fast delivery expectations. Supply chain performance, which includes cost, speed, flexibility, and service quality, is directly influenced by first-mile efficiency (ShipBob, 2023)

LSPs play a vital role in managing transportation, warehousing, and distribution services (Penske Logistics, 2022). However, reliance on manual operations and outdated tracking systems still persists. The adoption of digital tools such as AI-driven logistics, automated scheduling, and real-time tracking is increasingly recognized as essential for enhancing first-mile efficiency (Zhao, Xu, & Chen, 2022).

This chapter also incorporates global best practices and case studies to identify strategic improvements in Malaysia's first-mile logistics. By addressing operational challenges through digitalization and route optimization, this review supports the development of effective, data-driven solutions for the country's e-commerce supply chain.

2.1 First-Mile Pickup

First-mile pickup plays a crucial role in the e-commerce supply chain, as it involves the initial movement of goods from shippers or shippers to distribution hubs, fulfillment centers, or third-party logistics providers (3PLs). This stage sets the foundation for supply chain efficiency, impacting order fulfillment speed, transportation costs, and overall service reliability. According to Gunasekaran et al. (2020), the efficiency of first-mile logistics directly influences supply chain performance metrics, including delivery accuracy, transit time, and cost-effectiveness. A well-executed first-mile pickup process ensures that shipments reach the next phase of logistics with minimal disruptions, preventing bottlenecks that could impact last-mile delivery and overall customer satisfaction.

An effective first-mile logistics strategy integrates multiple elements, including inventory management, packaging, load consolidation, and transportation optimization. Christopher (2021) emphasizes that seamless coordination between shippers and transporters is essential to reducing lead times and operational inefficiencies. Shippers must focus on inventory forecasting, efficient packaging, and timely dispatching, while transporters need to ensure optimized route planning, real-time tracking, and fleet utilization (Bowersox et al., 2022). Failure to coordinate these aspects can result in delays, increased logistics costs, and poor delivery reliability, which ultimately affect customer satisfaction and business performance.

Moreover, first-mile logistics is significantly impacted by unpredictable pickup requests, additional pickup orders, inaccurate address data, vehicle capacity constraints, and the lack of technology integration. Zhang and Li (2021) highlight that dynamic scheduling systems and AI-driven logistics solutions can mitigate these inefficiencies by enabling real-time adjustments to pick up requests and optimizing fleet utilization. Companies in developed markets like the U.S. and Europe have successfully integrated automated tracking and

predictive analytics to improve first-mile pickup efficiency (Liu et al., 2022).

To understand the complexities of first-mile logistics, several supply chain and logistics theories provide valuable insights. The Resource-Based View (RBV) suggests that firms must develop unique capabilities, such as technology-driven logistics systems and strategic transportation partnerships, to gain a competitive advantage (Barney, 2020). Similarly, transaction cost economics theory emphasizes that minimizing coordination costs between shippers and transporters through digital integration leads to greater efficiency and cost savings (Williamson, 2021).

Additionally, systems theory in logistics states that each component of the supply chain (including first-mile logistics) must function cohesively to optimize performance (Stock & Lambert, 2021). Disruptions in the first-mile stage create inefficiencies across warehousing, transportation, and last-mile delivery, demonstrating the need for an integrated approach that enhances visibility, real-time tracking, and automation (Mentzer et al., 2021).

Global case studies have demonstrated how companies optimize first-mile logistics to enhance efficiency. For example, Amazon has implemented AI-driven predictive analytics to manage first-mile pickups, ensuring faster order fulfillment by aligning warehouse operations with transportation schedules (Kumar & Lim, 2022). Similarly, Alibaba's Cainiao logistics network has developed automated first-mile hubs that integrate real-time tracking, fleet optimization, and AI-powered routing to reduce pickup delays and vehicle underutilization (Chen et al., 2022).

In Southeast Asia, Lazada and Shopee have strengthened first-mile operations by using smart logistics warehouses, reducing transit times and optimizing shipment consolidation (Qiu, 2024). These case studies highlight that technology adoption, automation, and collaborative logistics partnerships are key drivers of first-mile efficiency.

Global best practices in first-mile logistics include real-time shipment tracking, automated scheduling, digital address verification, and route optimization algorithms. Onfleet

(2022) recommends that logistics providers implement GPS-enabled tracking and AI-powered demand forecasting to manage fluctuations in pickup requests and optimize delivery routes. DHL Logistics (2021) has successfully reduced first-mile inefficiencies by integrating digital warehouse management systems and IoT-powered fleet tracking, which improves coordination between shippers and logistics providers.

According to Penske Logistics (2023), that collaborative logistics partnerships between e-commerce shippers, 3PLs, and transporters lead to more reliable first-mile pickups and reduced operational costs. Businesses in Malaysia's e-commerce sector must adopt these best practices, leveraging digitalization and automation to enhance first-mile performance and overall supply chain resilience.

An optimized first-mile logistics system is essential for ensuring efficient supply chain operations, reducing costs, improving delivery speed, and enhancing service reliability. Research demonstrates that integrating digital tracking systems, automated scheduling, and AI-driven logistics solutions can significantly streamline first-mile operations, benefiting both shippers and logistics providers. Industry case studies and best global practices indicate that companies investing in logistics technology, dynamic scheduling, and fleet optimization outperform competitors in supply chain efficiency.

For Malaysia's e-commerce sector, strengthening first-mile logistics through technology-driven solutions, collaborative logistics strategies, and digital supply chain integration will be critical in maintaining operational efficiency and ensuring customer satisfaction. As first-mile logistics continues to evolve, adopting proven best practices and leveraging global innovations will enable logistics stakeholders to overcome operational inefficiencies and achieve long-term supply chain success.

2.1.1 Challenges in First-Mile Logistics

First-mile logistics is a critical stage in the e-commerce supply chain, ensuring smooth

transitions from shippers to distribution hubs or fulfillment centers. However, both transporters and shippers face several operational challenges during the pickup process, which can negatively impact efficiency and overall customer satisfaction. These challenges include handling real-time pickup requests, vehicle capacity limitations, difficulty in merging new pickup orders, lack of system and technology integration, and inaccurate address and location information. Addressing these inefficiencies is essential for improving supply chain performance, reducing costs, and enhancing service delivery in Malaysia's e-commerce industry.

2.2 Handling Real-Time Pickup Requests

Managing real-time pickup requests is one of the most complex challenges in first-mile logistics, as it requires logistics providers to accommodate unpredictable and last-minute pickup demands. These requests often deviate from predefined schedules, making it difficult for shippers and transporters to coordinate effectively. The irregularity of pickup requests leads to delays, increased operational costs, and inefficiencies in fleet utilization, affecting overall supply chain performance.

According to Zhang and Li (2021), fluctuating pickup demand, particularly during peak shopping seasons and high demand periods, presents significant scheduling difficulties for logistics providers. The unpredictability of customer orders forces transporters to constantly adjust their pickup schedules, which often leads to delays and inefficient resource allocation. Traditional static scheduling models, which rely on fixed routes and pre-planned pickup times, lack the flexibility to accommodate sudden fluctuations, resulting in supply chain disruptions and missed delivery deadlines.

Additionally, Wolf (2017) highlights that many logistics companies continue to use outdated scheduling and dispatch systems, making it difficult to handle real-time adjustments efficiently. Without advanced dynamic scheduling tools, logistics providers struggle with empty vehicle trips, excess fuel consumption, and increased transportation costs. These

inefficiencies negatively impact on overall supply chain performance, leading to delays in order fulfillment and higher operational expenses.

Another key factor complicating real-time pickup management is poor communication and lack of digital integration between shippers and transporters. Many e-commerce shippers fail to provide accurate pickup estimates, forcing logistics providers to make last-minute adjustments, which creates delays and inefficiencies in fleet deployment and route planning. In some cases, transporters are forced to reschedule pickups or reroute vehicles at short notice, leading to longer waiting times and decreased service reliability.

A major limitation in real-time pickup logistics is the continued reliance on manual scheduling methods, such as telephone-based coordination and spreadsheets. These methods lack automation and real-time visibility, making it difficult for logistics providers to track and optimize routes dynamically. Rahman and Ismail (2022) suggest that logistics providers who still depend on manual scheduling methods often struggle with slow response times, inefficient fleet allocation, and higher operational costs due to the inability to optimize resources effectively.

Other than that, transport capacity constraints make it difficult to accommodate unexpected real-time pickup requests. If a vehicle is already at full capacity, transporters may have to reschedule or decline new pickup requests, causing further disruptions in order processing and fulfillment timelines. This issue is especially critical during peak demand periods, when shipment volumes exceed the normal operating capacity. Chen et al. (2022) emphasize that inadequate vehicle capacity management not only contributes to delays but also increases the risk of shipment rejections, forcing businesses to either seek alternative transportation or delay deliveries, both of which negatively impact supply chain efficiency.

Ultimately, the lack of an optimized real-time pickup system leads to supply chain inefficiencies, delayed shipments, and rising operational costs. Without dynamic scheduling, better coordination, and improved tracking mechanisms, logistics providers continue to face

challenges in adapting to sudden pickup changes, affecting the reliability of first-mile logistics operations.

2.3 Vehicle Capacity Limitations

Transporters, particularly those utilizing small vehicles such as vans or 3 to 5-ton lorries, often face capacity limitations, especially during peak demand periods. These constraints make it difficult to manage fluctuating shipment volumes, as transporters must estimate loads in advance, often leading to discrepancies between planned and actual parcel volumes. When shipments exceed capacity, logistical bottlenecks occur, delaying deliveries and increasing operational inefficiencies.

One major issue is the variability in parcel sizes and packaging compliance. Oversized or improperly packed shipments create loading inefficiencies, reducing the number of parcels a vehicle can transport on a single trip. Chen et al. (2022) emphasize that inconsistent parcel dimensions contribute to wasted space and suboptimal fleet utilization, making it difficult for transporters to maximize their vehicle load efficiently. As a result, additional trips may be required, increasing fuel consumption, labor costs, and overall transportation expenses.

Shippers, particularly those handling diverse product inventories or experiencing sales-driven demand spikes, face challenges in aligning shipment volumes with available transport capacity. Sudden surges in orders strain logistics operations, forcing last-minute adjustments to fleet allocation and delivery schedules. Without adequate capacity management strategies, transporters struggle to optimize vehicle loads, leading to delayed pickups and inefficient routing.

Furthermore, vehicle capacity constraints directly impact first-mile logistics performance, as limited space often results in partial load dispatches or shipment rejections. When transporters cannot accommodate excess parcels, businesses must either seek alternative transport solutions or delay shipments, affecting supply chain efficiency. Liu et al.

(2023) suggest that real-time capacity tracking systems and load-balancing strategies can help reduce these inefficiencies, ensuring that vehicles operate at optimal capacity without unnecessary delays.

Vehicle capacity limitations present a significant challenge to first-mile logistics, affecting delivery timeliness, cost efficiency, and supply chain reliability. Addressing these issues requires proactive fleet management, improved load consolidation techniques, and better forecasting models to enhance transportation efficiency and ensure seamless logistics operations.

2.4 Difficulty Merging New Pickup Orders

Integrating new pickup orders into established delivery routes presents a significant challenge in first-mile logistics, especially when these orders arrive at short notice. The need for last-minute adjustments forces transporters to modify pre-planned routes, often leading to disruptions in scheduling and inefficiencies in resource allocation. The unpredictability of new orders makes it difficult to maintain operational consistency, affecting both delivery timelines and fleet utilization.

Li et al. (2021) highlights that last-minute order integration complicates route optimization, particularly in urban areas where traffic congestion, varying road conditions, and tight delivery windows further limit flexibility. When new orders alter pre-established delivery routes, transporters must recalculate distances, adjust fleet assignments, and redistribute loads, all of which increase travel time and operational costs. The challenge is intensified during peak seasons, where an influx of orders creates bottlenecks that further strain logistics networks.

Inadequate routing technology and manual scheduling methods further hinder efficient integration of new pickup requests. Zhang and Wang (2022) suggest that logistics providers relying on static route planning struggle to accommodate sudden changes, resulting in delayed

pickups and missed service windows. These inefficiencies not only affect transporters but also impact shippers who depend on timely dispatches to meet their fulfillment deadlines.

Moreover, resource constraints such as limited vehicle availability and driver fatigue make it even more difficult to accommodate unexpected orders without causing delays to existing shipments. Chen et al. (2023) emphasize that without real-time optimization tools and dynamic scheduling, last-minute order requests often disrupt overall logistics efficiency, leading to higher costs and lower service quality.

Effectively managing new pickup orders requires better demand forecasting, advanced routing algorithms, and real-time fleet coordination to prevent service disruptions. These improvements may help transporters to improve on route inefficiencies, leading to delays, increased costs, and reduced reliability in first-mile logistics operations.

2.5 Lack of System and Technology Integration

One of the major challenges in first-mile logistics is the lack of modern technological integration, which affects both transporters and shippers. Many courier services still rely on manual record-keeping and communication methods, leading to errors, inefficiencies, and operational disruptions. The absence of automated tracking systems increases the risk of misplaced shipments and processing delays, making it difficult to maintain supply chain accuracy and reliability.

According to Liu and Zhang (2021), outdated IT systems and inconsistent data entry contribute to parcel mismanagement, particularly when shipment details are incorrectly logged or updated. Without real-time tracking solutions, logistics providers struggle to maintain visibility over shipments, increasing the likelihood of delays and lost parcels. Additionally, the lack of digital coordination between shippers and transporters results in inefficient scheduling, poor fleet utilization, and frequent miscommunication regarding pickup and delivery times.

Furthermore, Zhao et al. (2022) emphasize that logistics companies relying on manual processes face difficulties in handling complex operational demands, particularly during high-volume periods. The inability to automate scheduling, optimize routing, or track shipments in real time forces transporters to operate reactively rather than proactively, leading to higher operational costs and reduced efficiency.

Without these advancements, first-mile logistics inefficiencies maybe will continue to hinder overall supply chain performance, increasing costs and affecting customer satisfaction.

2.6 Inaccurate Address and Location Information

Inaccurate address data poses a major challenge in first-mile pickup operations, leading to delays, misrouted shipments, and increased operational costs. This issue frequently arises when shippers provide incorrect location details, making it difficult for transporters to locate pickup points efficiently. In cases where shippers operate from multiple sites, discrepancies in address records further complicate the logistics process, negatively impacting pickup accuracy and service reliability.

According to Zheng and Zhang (2021), errors in location data create significant inefficiencies in delivery timelines, harming the reputation of logistics providers and reducing shipper credibility. When transporters spend excessive time searching for incorrectly recorded pickup locations, their fuel consumption increases, and fleet scheduling becomes disrupted, causing a ripple effect of delays across the supply chain.

Additionally, poor address accuracy complicates route optimization, making it difficult for transporters to consolidate pickups and optimize fleet efficiency. Chen et al. (2022) highlight that logistics providers lacking automated address verification systems struggle with failed pickups, increased rerouting efforts, and greater resource wastage. Without standardized address formatting and real-time location verification, transporters face unnecessary detours, unfulfilled pickups, and misallocated fleet resources.

To mitigate these issues, logistics companies need to adopt digital address validation systems and AI-driven route optimization tools to ensure greater accuracy in pickup coordination. Addressing inconsistent location data will enable transporters to improve scheduling efficiency, reduce fuel costs, and enhance first-mile logistics performance.

These challenges underscore the need for improvements in first-mile logistics, including enhanced coordination, better technology integration, and refined operational processes. By addressing these inefficiencies, companies can improve overall supply chain performance, reduce operational costs, and enhance customer satisfaction. Implementing dynamic scheduling systems, improving vehicle capacity management, integrating modern tracking technologies, and ensuring accurate address data are essential steps toward optimizing first-mile logistics in Malaysia.

Figure 2: Key Challenges in First-Mile Logistics

The mind map summarizes key challenges in first-mile logistics based on the literature review, focusing on issues faced by shippers and transporters. The literature highlights that real-time pickup requests create scheduling difficulties for transporters and delays for shippers, while additional pickup orders disrupt planned routes. Wrong pickup addresses lead to wasted time and fuel, increasing operational inefficiencies. Vehicle capacity issues arise

when transporters struggle with space limitations, causing rejected or delayed pickups. Lastly, the lack of system and technology results in tracking errors, missing parcels, and reduced visibility. The literature suggests that addressing these challenges through automation, real-time tracking, better route planning, and improved communication can significantly enhance first-mile logistics efficiency.

2.7 Relationship Between the Challenges with First Mile Transportation

Inefficiencies in first-mile logistics, such as handling real-time pickup requests, vehicle capacity limitations, integrating new pickup orders, lack of technology integration, and inaccurate addresses can significantly disrupt the supply chain, leading to delays, increased costs, and reduced customer satisfaction. For transporters, these challenges result in operational inefficiencies, higher fuel consumption, and scheduling conflicts. Shippers, on the other hand, face issues like delayed pickups, unreliable tracking, and potential loss of business due to unmet customer expectations. Addressing these first-mile challenges is crucial for both parties to ensure a seamless and efficient supply chain, ultimately enhancing service quality and profitability (ClickPost,2021)

2.8 Chapter Summary

This chapter provides a comprehensive review of literature on first-mile logistics in Malaysia's e-commerce sector, focusing on its role in supply chain performance. It explores key logistics functions such as order fulfillment, transportation management, supplier coordination, and route optimization.

The discussion highlights the relationship between efficient first-mile logistics and overall supply chain effectiveness, emphasizing the impact of streamlined operations on cost reduction, delivery speed, and customer satisfaction. Additionally, the chapter identifies challenges faced by shippers and transporters, such as infrastructure limitations, coordination

inefficiencies, and technological gaps.

Furthermore, the review examines existing strategies for improving first-mile logistics and identifies areas requiring further research. The findings underscore the need for tailored solutions that address local challenges in Malaysia's e-commerce landscape. Overall, this chapter reinforces the critical role of first-mile logistics in ensuring a seamless and efficient supply chain.

CHAPTER 3: METHODOLOGY

3.0 Introduction

This chapter focuses on the use of methods to execute this research. Selections for all the elements of research methodology are justified

3.1 Research Design

Qualitative and quantitative are the two common research approaches that researchers use to conduct their studies. In a quantitative approach, researchers focus on gathering numerical data, allowing them to measure and analyze research outcomes objectively (Taherdoost, 2022). In contrast, a qualitative approach emphasizes understanding human experiences, perceptions, and behaviors through non-numerical data.

This study employs a qualitative research approach to explore the challenges and inefficiencies of first-mile logistics in Malaysia's e-commerce sector. A qualitative approach allows for an in-depth understanding of the experiences, perceptions, and operational difficulties faced by both courier service providers and online shippers. Given that first-mile logistics involves human-driven decision-making, real-time operational challenges, and subjective experiences, a qualitative method is best suited for capturing detailed insights, context-specific issues, and the underlying reasons behind inefficiencies. Unlike quantitative data, which focuses on numerical trends, qualitative research helps uncover practical challenges, communication gaps, and process inefficiencies that impact first-mile logistics. By gathering insights from key stakeholders, this research aims to identify key challenges and propose effective strategies for optimizing first-mile logistics operations.

3.2 Population, Sample and Unit of Analysis

The population for this study comprises all stakeholders involved in first-mile logistics within Malaysia's e-commerce sector. This includes courier service providers, transporters, and

online shippers play a critical role in ensuring the smooth movement of goods from shippers to distribution hubs. Understanding the challenges faced by these stakeholders is essential for identifying inefficiencies and optimizing first-mile logistics processes to improve supply chain performance.

To obtain a representative sample, courier service providers and e-commerce shippers from the northern region of Malaysia specifically Penang, Kedah, and Perlis were selected. The sample obtains 6 courier companies per region, with participants including hub managers and pickup drivers from various courier companies. They provide insights into operational challenges such as fleet utilization, route optimization, and scheduling, while pickup drivers share their experiences with vehicle capacity limitations, last-minute pickups, and real-time operational issues. Additionally, 6 online shippers per region were interviewed to understand their perspectives on first-mile logistics, including pickup arrangements, system reliability, and communication challenges with transporters. This diverse sampling approach ensures a comprehensive understanding of the issues affecting both logistics providers and e-commerce shippers.

The unit of analysis in this study focuses on transporters and shippers who are involved directly in e-commerce supply chain. But the focus and studies are in the first mile process. Key areas of analysis include scheduling issues related to real-time order handling and cut-off times, vehicle capacity constraints affecting load consolidation and oversized shipments, and difficulties in route optimization due to traffic conditions and last-minute pickups. The study also examines the impact of technological limitations, such as outdated tracking systems and reliance on manual processes, which can lead to inefficiencies and parcel mismanagement. Furthermore, address and location inaccuracies are analyzed to understand how incorrect or unclear pickup locations contribute to delays and additional costs for logistics providers.

3.3 Sampling Design

Sampling is the process of selecting a representative subset of a population to gain insight into a particular subject. Researchers commonly use two types of sampling techniques: probability sampling and non-probability sampling. In probability, sampling, each member of the population has an equal chance of being selected, ensuring random and unbiased representation. Conversely, non-probability sampling involves selecting participants based on specific criteria, often requiring researchers to use their judgment to ensure relevant data collection (Lehdonvirta et al., 2021).

For this study, purposive sampling, a type of non-probability sampling, is employed to ensure that only participants with direct involvement in first-mile logistics operations are selected. This method is chosen to gather relevant insights from courier service providers, transporters, and online shippers (shippers), who actively engage in first-mile pickup processes. The sample is drawn from the northern region of Malaysia, specifically Penang, Kedah, and Perlis, where e-commerce and logistics activities are growing rapidly.

The total sample size in this study is guided by the saturation principle, which is commonly used in qualitative research to determine when sufficient data has been collected. Saturation occurs when additional interviews no longer yield new themes or insights, indicating that the data collected is rich and adequate for analysis (Fusch & Ness, 2015). In this research, a limited number of in-depth interviews were conducted with both shippers and transporters. Although the sample is small, the responses were highly repetitive, with participants consistently highlighting the same operational challenges. This repetition confirms the legitimacy and consistency of the problems faced in Malaysia's first-mile logistics. Therefore, expanding the sample further was deemed unnecessary, as new interviews were unlikely to add meaningful variation to the findings (Guest, Bunce, & Johnson, 2006).

The sample size is carefully chosen to ensure in-depth data collection while remaining feasible within the study's resource and time constraints. This approach allows for a well-rounded understanding of first-mile logistics challenges and potential optimization strategies. By incorporating perspectives

from both transporters and shippers, the study aims to provide applicable and effective recommendations that can enhance operational efficiency and improve overall logistics performance in Malaysia's e-commerce sector (Robbins, 2020).

3.4 Instruments and Interviews Preparation

To gather relevant insights from participants involved in first-mile logistics operations within Malaysia's e-commerce sector, a structured interview was conducted. This interview is carefully designed to ensure comprehensive coverage of various aspects related to first-mile logistics challenges, operational efficiency, and potential areas for improvement.

The interviews were conducted in semi-structured, allowing for flexibility while ensuring that key topics are addressed. This approach enables participants to express their experiences, challenges, and perspectives in more detail, leading to a deeper understanding of first-mile logistics processes (Lorraine, 2023). The interviews covered a range of topics, including pickup scheduling, vehicle capacity management, integration of technology in logistics operations, real-time order handling challenges, and communication between shippers and transporters.

To ensure clarity and consistency, a guiding set of questions were prepared, focusing on both quantifiable aspects (frequency of delays, vehicle load capacity issues) and qualitative insights (personal experiences with first-mile logistics inefficiencies and suggested improvements). Additionally, to gauge participant perspectives on operational challenges and solutions, a Likert-style response framework incorporated into some interview questions, allowing respondents to indicate their level of agreement or disagreement with specific logistics-related statements (Scales, 2006).

This structured interview approach ensures that key points in first-mile logistics are thoroughly explored, while also providing participants with the opportunity to share firsthand experiences and potential solutions. The collected data were analyzed to identify patterns and

develop strategies for optimizing first-mile logistics operations in Malaysia's e-commerce sector.

3.5 Questions during Data Collection

A combination of open-ended and Likert-style questions used in this research to assess the respondents' perspectives on logistics issues, allowing for both qualitative insights and structured analysis.

The interview began with general background questions to establish the participant's role and experience in first-mile logistics. This is followed by discussions on pickup scheduling and operational challenges, where participants provide insights into real-time order management, last-minute order fluctuations, and factors contributing to pick up delays. The next section focuses on vehicle capacity and route optimization, where transporters shared their challenges related to vehicle limitations, parcel volume planning, and route management.

Another critical area covered in the interviews is technology and system integration. Participants discussed the effectiveness of existing logistics management systems, issues related to manual processes or outdated tracking methods, and potential technological improvements that could enhance operational efficiency. Furthermore, the study explored communication and coordination challenges between shippers and transporters, particularly regarding miscommunication, inaccurate pickup locations, and the need for better collaboration.

Finally, the interview concluded with a section on challenges and improvement strategies, where respondents provide their views on the biggest obstacles in first- mile logistics and suggest potential solutions. The insights gained from these interviews were analyzed to identify patterns, challenges, and best practices, ultimately contributing to strategies for improving first-mile logistics efficiency in Malaysia's e-commerce sector.

Table 2: Questions during Data Collection

Main Issue	Interview Questions
Real-Time Pickup Requests	How do you usually handle real-time or sudden pickup requests?
	What challenges do you face when managing pickups that are not scheduled in advance?
	How do last-minute pickup requests affect your overall delivery planning or resource allocation?
Additional Pickup Orders	What happens when new pickup orders are added to your route after planning is complete?
	Can you describe the impact of these additional orders on delivery schedules and routing?
	How do you usually respond or adjust when unexpected pickup requests are received during operations?
Wrong Pickup Addresses	How often do you encounter incorrect pickup addresses?
	What are the consequences when a pickup address is wrong or unclear?
	What do you think causes these address-related errors, and how can they be prevented?
Vehicle Capacity Issues	What difficulties do you face in managing parcel volume with the available vehicle space?
	How do you plan for capacity during high-demand periods or sales events?
	What happens when shipments exceed the planned vehicle capacity?
Lack of System and Technology	What kind of logistics systems or technology are currently in use for managing pickups?
	How do manual processes or outdated systems affect your ability to track and manage shipments?
	What kind of technology do you think would improve visibility and reduce tracking errors?
Overall Operational Insights	Of the challenges discussed, which one impacts your logistics operations the most and why?
	Based on your opinion, what would be your top recommendation to improve first-mile logistics performance?

3.6 Data Collection Procedures

This study employs a qualitative data collection approach to gain an in-depth understanding of first-mile logistics challenges in Malaysia's e-commerce sector. The primary data collection method used in this research is semi-structured interviews conducted with key stakeholders, including courier service providers (hub managers and pickup drivers) and online shippers (shippers) across Penang, Kedah, and Perlis.

The interviews are conducted face-to-face or via online platforms, depending on the availability of participants. Each interview follows a semi-structured format, allowing respondents to provide detailed insights into their experiences while ensuring that all key topics, such as pickup scheduling, vehicle capacity, technology adoption, and communication issues are covered systematically. The semi-structured nature of the interviews ensures that both predetermined and emerging themes are explored, making the data collection process more flexible and insightful.

To ensure accuracy and reliability, all interviews are audio-recorded with participant consent and later transcribed for analysis. Additionally, field notes are taken during the interviews to capture non-verbal cues, contextual observations, and additional comments that may not be explicitly stated but are relevant to the research. This helps in identifying patterns, key themes, and critical challenges affecting first-mile logistics operations.

The study also includes secondary data collection, where existing literature, industry reports, and previous research studies related to first-mile logistics, e-commerce supply chain management and transport efficiency are reviewed. This secondary data supports the analysis

of primary data by providing context, comparisons, and validation of findings from the interviews.

By utilizing semi-structured interviews, field observations, and secondary data analysis, this study ensures a comprehensive and multi-perspective approach to understanding the inefficiencies in first-mile logistics and identifying potential strategies for improvement in Malaysia's e-commerce sector.

3.7 Data Analysis Technique

The data collected in this study were analyzed using thematic analysis, a widely used qualitative research method for identifying, analyzing, and reporting patterns (themes) within data. Thematic analysis allows for systematic categorization of interview responses, helping to uncover key insights into first-mile logistics challenges and optimization strategies (Braun & Clarke, 2021). This method is particularly suitable for this research as it enables the identification of common issues faced by courier service providers and online shippers while ensuring a structured interpretation of qualitative data.

The data collected in this study analyzed using thematic analysis, following the six-step framework proposed by Braun and Clarke (2021). The first step, familiarization with data, involves transcribing the interview recordings, thoroughly reading and re-reading the responses, and taking initial notes to gain a deep understanding of the data. This step ensures that the researcher becomes fully immersed in the dataset. The second step, generating initial codes, focuses on identifying significant words, phrases, and recurring patterns related to pick up scheduling, vehicle capacity issues, technology challenges, and communication inefficiencies. These codes help in systematically categorizing the data for further analysis.

The third step, searching for themes, involves grouping related codes into broader categories that represent key challenges and insights in first-mile logistics. For instance, responses related to pick up delays, vehicle capacity limitations, and technology inefficiencies

may be clustered under a common theme such as operational inefficiencies. The fourth step, reviewing themes, refines these initial groupings by ensuring they accurately reflect the data. During this phase, any overlapping or unclear themes are reorganized to enhance clarity and coherence.

In the fifth step, defining and naming themes, final themes are clearly defined to represent distinct patterns in the data.

This process ensures that each theme meaningfully contributes to addressing the research objectives. Lastly, the sixth step, producing the report, involves interpreting the themes, supporting them with excerpts from interview responses, and linking findings to the broader literature on first-mile logistics challenges and optimization strategies. By following this structured approach, thematic analysis allows for a comprehensive and systematic understanding of the key issues affecting first-mile logistics operations in Malaysia's e-commerce sector.

Additionally, descriptive statistics are used to analyze numerical data from Likert-scale responses within the interview framework. Descriptive statistics help summarize trends, frequencies, and patterns in first-mile logistics operations, making it easier to quantify qualitative insights (Miles, Huberman, & Saldaña, 2022).

To ensure credibility and reliability, triangulation is applied by cross-referencing interview findings with secondary data from industry reports, logistics studies, and academic literature (Flick, 2021). This process helps to validate insights and minimize potential bias in data interpretation.

By employing thematic analysis, descriptive statistics, and triangulation, this study ensures a comprehensive and systematic examination of first-mile logistics inefficiencies and provides actionable recommendations for improving e-commerce supply chain performance in Malaysia.

3.8 Ethical consideration

This research was conducted in adherence to established ethical guidelines to ensure the protection of participants' rights and data confidentiality. Information consent was obtained from all participants before their involvement in the study. Each participant was clearly informed about the purpose of the research, the nature of the data being collected, and how their responses would be used. Obtaining informed consent is an essential ethical responsibility in research to ensure that participants willingly take part with full awareness of their role (Xu et al., 2020).

Additionally, confidentiality and anonymity were strictly maintained throughout the research process. Participants' personal details, such as names, company affiliations, and contact information, were not disclosed to any third party, and all data were stored securely to prevent unauthorized access. Responses were anonymized in the final report to protect the privacy of individuals and organizations involved.

Furthermore, participants were given the freedom to withdraw from the study at any stage without any consequences, ensuring voluntary participation. The research also adhered to ethical standards by ensuring that the data collected was used solely for academic purposes, avoiding any misuse or manipulation of information. By upholding these ethical considerations, this study ensures transparency, respect for participants, and integrity in the research process.

3.9 Chapter Summary

This chapter explains the research methodology used in this study, which follows a qualitative approach to explore first-mile logistics challenges in Malaysia’s e- commerce sector. Semi-structured interviews were conducted with courier service providers (hub managers and pickup drivers) and online shippers (shippers) from Penang, Kedah, and Perlis to gather insights into their experiences and challenges. A purposive sampling method was used to select participants directly involved in first-

mile logistics. Around 10 to 30 respondents were chosen to provide a balanced perspective from both transporters and shippers. The collected data was analyzed using thematic analysis, following Braun and Clarke's (2021) six-step framework, while descriptive statistics helped summarize key trends.

To ensure ethical compliance, informed consent was obtained, personal information remained confidential, and participants had the freedom to withdraw at any time. This chapter highlights the structured approach used to collect and analyze data, ensuring reliable and meaningful findings to improve first-mile logistics efficiency in Malaysia's e-commerce sector.

CHAPTER 4: DATA ANALYSIS

4.0 Introduction

This chapter presents the findings of the study based on the qualitative data collected from key stakeholders involved in first-mile logistics within Malaysia's e-commerce sector. The data analysis follows a thematic approach, identifying patterns and insights drawn from interviews and case studies. The results are structured to address the research objectives, which include assessing the current state of first-mile logistics, identifying key challenges faced by shippers and transporters, and proposing strategies for improvement. Key themes emerging from the data are discussed, highlighting their impact on supply chain performance.

4.1 Demographic Profile and Respondents

This section provides an overview of the demographic profile of the respondents, comprising six (6) transporters and six (6) shippers from Northern Malaysia, specifically Penang, Kedah, and Perlis. These respondents were selected based on their involvement in first-mile logistics, representing both transportation service providers and shippers who rely on efficient first-mile operations for their businesses.

State/Location Distribution

The study ensures a balanced geographic representation by interviewing respondents from Penang, Kedah, and Perlis, with equal participation from both transporters and shippers. This allows for a comparative analysis of logistical challenges faced across different states.

Transporter Profile

The transporters interviewed work for leading logistics service providers such as Ninja Van Malaysia, Shopee Express, Lineclear, GDex, DHL, and J&T Express. Their experience ranges from 2 to over 7 years, providing insights into both newcomers and seasoned professionals in the industry. Notably, major courier companies operating in Malaysia were

represented, which enhances the credibility and relevance of the findings regarding first-mile logistics efficiency.

Table 3: Transporter details (n=6)

Respondent	State	Experience	Company
T1	Penang	2-3 years	Ninja Van
T2	Penang	3-5 years	Shopee Express
T3	Kedah	5-7 years	Lineclear
T4	Kedah	2-3 years	Gdex
T5	Perlis	>7 years	DHL
T6	Perlis	3-5 years	J&T Express

Transporter (n=6)

Shipper Profile

The shipper respondents come from diverse businesses, including Noor Fatin Shamin Binti Hambali, Nur Earn Resources, Lesong Bestari Marketing, NN Trading BZ, Pioneer Premier Sdn Bhd, and MHK Group Sdn Bhd. These businesses have experience levels varying from 2 to over 7 years, reflecting both new and established players in the e-commerce sector. Their input provides a comprehensive understanding of first-mile logistics challenges from the shipper's perspective, particularly in managing transportation, packaging, and coordination with logistics providers.

This demographic profile ensures that data is collected from individuals with practical experience in first-mile logistics, enabling a well-rounded qualitative analysis of operational challenges, technological adoption, and stakeholder coordination in the Northern Malaysia e-commerce sector.

Table 4: Shippers details (n=6)

Respondent	State	Experience	Company
S1	Penang	>7 years	Noor Fatin Shamin Binti Hambali
S2	Penang	3-5 years	Nur Earn Resources
S3	Kedah	2-3 years	Lesong Bestari Marketing
S4	Kedah	5-7 years	Nuraz Naila Trading_Bz
S5	Perlis	>7 years	Pioneer Premier Sdn Bhd
S6	Perlis	2-3 years	Mhk Group Sdn Bhd

Shipper (n=6)

4.2 Thematic Analysis

Thematic analysis was conducted to identify recurring patterns in the first-mile logistics challenges reported by shippers (S1-S6) and transporters (T1-T6). Four major themes emerged from the interviews: real-time pickup requests, new pickup orders, wrong addresses, vehicle capacity issues, and lack of technology. Each theme was derived from respondent feedback, with direct excerpts provided to support the findings.

Table 5: Thematic Analysis – Transporter Feedback

Theme	Transporter Feedback	Remarks/Discussion
Real-Time Pickup Requests	T1: "Sometimes, we receive last-minute pickup requests, and adjusting schedules is difficult."	Transporters face difficulty adjusting schedules, causing delays and operational stress.
New Pickup Orders	T3: "Adding new locations to our routes disrupts planning and creates inefficiencies."	New orders added post-routing cause disruptions and reduced delivery efficiency.
Wrong Addresses	T5: "We waste fuel and time when we arrive at the wrong address due to incorrect information."	Incorrect addresses waste fuel and driver time, increasing costs.
Vehicle Capacity Issues	T2: "Limited vehicle space during peak seasons makes it hard to manage to increase parcel volume."	Limited space in vehicles causes an inability to manage parcel surges.
Lack of Technology	T4: "Errors in tracking make it difficult to provide accurate updates to customers."	Manual tracking leads to errors and poor customer communication.

Table 6: Thematic Analysis – Shipper Feedback

Theme	Shipper Feedback	Remarks/Discussion
Real-Time Pickup Requests	S2: "There are frequent delays in pickups because transporters cannot accommodate sudden requests."	Shippers face reliability issues due to unfulfilled sudden pickup demands.
New Pickup Orders	S4: "Late pickups happen when we send orders from a new location that isn't in their usual route."	Out-of-route locations disrupt delivery plans, causing delays.
Wrong Addresses	S6: "Address mistakes lead to delivery rejections, causing delays in shipping orders."	Incorrect data from shippers results in failed deliveries.
Vehicle Capacity Issues	S1: "Sometimes our shipments are rejected because there isn't enough space in the transporter's vehicle."	Shippers suffer from rejection during high-volume due to vehicle space limits.
Lack of Technology	S3: "We often lose visibility of parcels in transit, leading to missing shipments."	Lack of real-time parcel tracking creates uncertainty and loss.

4.3 Real Time Pickup Request

Real-time pickup requests refer to the immediate or on-demand collection of goods from a designated location for transportation or delivery. Unlike scheduled pickups, these requests require transporters to adjust their logistics plans dynamically to accommodate sudden changes in demand. This process often results in route disruptions, scheduling inefficiencies, and operational challenges, particularly in high-demand industries such as e-commerce and express delivery services. According to Buske (2023), real-time pickups are crucial for meeting customer expectations in fast-paced logistics environments, but they require advanced scheduling systems and adaptive resource allocation to function efficiently.

Transporter Perspective

Transporters in Malaysia reported difficulties in handling real-time pickup requests, which frequently disrupt existing logistics schedules and create inefficiencies. Transporters expressed frustration with adjusting their routes at short notice.

Transporter Feedback: "Sometimes, we receive last-minute pickup requests, and adjusting schedules is difficult."

These findings indicate that unpredictable pickups force transporters to divert from their planned routes, leading to delivery delays, inefficient fleet utilization, and increased operational costs. The primary challenges associated with real-time pickup requests for transporters include scheduling conflicts, fleet overextension, and increased fuel and labour expenses due to unplanned detours.

Shipper Perspective:

Shippers also experience service delays and inconsistencies due to transporters' inability to accommodate real-time pickup requests.

Shipper Feedback: "There are frequent delays in pickups because transporters cannot accommodate sudden requests."

This unreliability affects the shipper's ability to meet delivery promises and maintain supply chain reliability. Missed pickups directly impact order fulfilment timelines, especially for businesses operating on tight delivery schedules or dealing with high order volumes.

The issue of real-time pickup requests is not unique to Malaysia and has been observed in other countries. In China, during peak sales periods such as Singles' Day, logistics companies experience up to a 40% increase in real-time pickup requests, which significantly disrupts existing delivery schedules and overwhelms fleet capacity (Zhang et al., 2021). To manage this, companies such as JD Logistics and Alibaba's Cainiao have invested in AI-driven scheduling and predictive logistics models to optimize pickup coordination and reduce inefficiencies. These international case studies validate the findings in Malaysia, proving that real-time pickup requests present universal challenges in logistics (Liu, Wang, & Li, 2022; Rahman & Ismail, 2022). However, countries with advanced logistics infrastructure and technology adoption, such as China, have been able to mitigate some of these issues through automation, predictive analytics, and AI-driven systems.

4.4 New or ad hoc pickup Orders

New pickup orders refer to the addition of unexpected pickup locations that are not part of the pre-planned or regular pickup routes. These orders require transporters to adjust their schedules and routes dynamically, often causing disruptions in logistics planning and inefficiencies in resource allocation. In fast-moving supply chains, particularly in e-commerce, businesses frequently face last-minute pickup requests, forcing logistics providers to adapt. According to Forbes (2024), one of the biggest challenges in last-mile and first-mile logistics is optimizing delivery routes to accommodate unexpected orders, as poor route integration leads to delays and increased fuel consumption.

Transporter Perspective:

Transporters reported difficulties in managing route adjustments and resource allocation when new pickup orders were added.

Transporter Feedback: "Adding new locations to our routes disrupts planning and creates inefficiencies."

These unplanned pickups force transporters to deviate from established routes, resulting in longer travel distances, increased fuel use, and strained delivery schedules. Transporters also face fleet utilization problems as vehicles become overloaded, which reduces efficiency and increases labour costs. Poor route optimization, as pointed out by GEODIS (2023), significantly reduces overall logistics performance.

Shipper Perspective:

Shipper's experience disruptions when new pickup requests fall outside the transporter's regular route, leading to late or missed collections.

Shipper Feedback: "Late pickups happen when we send orders from a new location that isn't in their usual route."

This delay in pickups affects the fulfilment process and delivery timelines, making it harder for shippers to maintain consistency in their operations. These disruptions also cause downstream delays in the supply chain, leading to poor customer experience and decreased trust in logistics providers.

The challenges of new pickup orders are not limited to Malaysia. In the United States, similar issues have been reported, especially by small logistics operators managing urban deliveries. Jaillet et al. (2022) emphasized that dynamic pickup and delivery requests increase operational costs and decrease route efficiency, particularly when logistics systems are not flexible or automated. To overcome these issues, global companies are adopting predictive analytics tools that account for road and traffic conditions to improve dynamic planning (Gupta & Sharma, 2022). For Malaysia's logistics sector, adopting such innovations could significantly improve efficiency, reduce disruptions, and support

more resilient first-mile logistics networks.

4.5 Wrong Addresses

Wrong pickup addresses in logistics refer to errors or inaccuracies in the specified locations where goods are to be collected. These errors can result from typographical mistakes, outdated location data, or miscommunication between shippers and transporters. Address inaccuracies cause significant inefficiencies in supply chain operations, leading to wasted resources, increased costs, and delivery delays. According to ShipScience (2023), incorrect addresses are a leading cause of failed pickups and missed deliveries, often forcing transporters to reroute and make additional trips, which increases operational expenses.

Transporter Perspective:

Transporters frequently encounter incorrect pickup addresses that lead to delays and wasted fuel, ultimately increasing operational costs.

Transporter Feedback: "We waste fuel and time when we arrive at the wrong address due to incorrect information."

This situation disrupts scheduling, forces unplanned detours, and results in a waste of both time and fuel. The need to locate the correct address causes inefficiencies, especially in high-volume e-commerce environments where timely pickups are essential.

Shipper Perspective:

Shippers, on the other hand, face delays in order processing when incorrect pickup addresses result in rejections or failed collections.

Shipper Feedback: "Address mistakes lead to delivery rejections, causing delays in shipping orders."

This not only slows down the fulfilment process but also affects customer satisfaction and

supply chain reliability. Shippers may need to reschedule pickups, relabel parcels, or handle complaints from customers due to late deliveries.

Two major issues arise from wrong pickup addresses. First is Resource Wastage, where transporters are forced to spend additional time and fuel searching for the correct pickup locations. Second is Delivery Delays, where inaccurate address data causes disruptions in route planning, leading to missed or delayed pickups, reduced customer satisfaction, and compromised supply chain efficiency (DHL Logistics of Things, 2021).

A relevant example is Pos Laju Malaysia, the country's leading courier provider. According to a case study on their logistics operations, incorrect pickup addresses have caused delivery personnel to reroute frequently, increasing fuel usage and operational costs. To address this, Pos Laju implemented a digital address verification system that allows senders to validate locations before dispatching. The system cross-references address entries with mapping data to minimize errors.

Additionally, Pos Laju adopted real-time communication tools, allowing drivers to verify location details with customers before making the trip. This system significantly improved address accuracy and reduced delays. However, many smaller logistics companies still rely on manual address input and paper-based systems, which makes them more vulnerable to such inefficiencies.

The Pos Laju case shows that implementing automated address verification and real-time tracking tools can enhance first-mile logistics accuracy and efficiency. Standardizing these practices across the logistics sector in Malaysia could reduce errors, save operational costs, and improve coordination between shippers and transporters—ultimately boosting overall supply chain performance.

4.6 Vehicle Capacity Issues

Vehicle capacity issues in logistics occur when the demand for transporting goods surpasses

the available space in transportation vehicles. These constraints can lead to shipment rejections, delivery delays, and increased operational costs, particularly during peak seasons or sudden demand surges. According to Tan et al. (2022), insufficient fleet capacity is one of the major bottlenecks in supply chain efficiency, causing disruptions in delivery schedules and additional costs due to multiple trips. These challenges are particularly evident in e-commerce and perishable goods transportation, where timely deliveries are critical.

Transporter Perspective:

Transporters in Malaysia reported consistent difficulties due to limited vehicle space, especially during peak e-commerce seasons when parcel volume increases sharply.

Transporter Feedback: "Limited vehicle space during peak seasons makes it hard to manage increasing parcel volume."

When faced with more packages than capacity allows, transporters are forced to either delay pickups or make multiple trips, increasing fuel consumption, time spent, and overall costs. This disrupts delivery schedules and reduces operational efficiency, especially for small- to mid-sized courier operators with limited fleets.

Shipper Perspective:

Shippers expressed that their shipments are sometimes rejected due to a lack of available space in transport vehicles.

Shipper Feedback: "Sometimes our shipments are rejected because there isn't enough space in the transporter's vehicle."

This creates uncertainty for shippers trying to meet delivery deadlines. When shipments are postponed, businesses risk dissatisfied customers, failed order fulfilment, and damaged reputations, particularly in high-demand seasons such as sales campaigns or festive periods.

Two major consequences emerge from vehicle capacity constraints in first-mile logistics.

First is Shipment Delays: When vehicles reach full capacity before all scheduled pickups are completed, transporters are forced to postpone some collections. Second is Increased Operational Costs, to meet demand, logistics providers must deploy additional vehicles or perform multiple trips, both of which add fuel and labour costs to operations.

Vehicle capacity issues are not unique to Malaysia. Across the ASEAN region, including Vietnam, Thailand, and Indonesia have similar patterns have emerged. In Vietnam, new logistics regulations implemented in 2025 added pressure to fleet capacity.

A study by Nguyen et al. (2023) found that regulations requiring truck drivers to rest 15 minutes after every 4 hours of driving significantly reduced trip frequency and fleet efficiency. According to CEL Logistics (2025), 80% of logistics companies in Vietnam reported moderate to severe disruptions due to these laws, especially for long-distance hauls. Adding to the strain are rising fuel prices and demand spikes during peak seasons. Some companies attempted to compensate by overloading vehicles, but this led to safety incidents and regulatory penalties (Reuters, 2025). These developments demonstrate how external factors, such as policy changes and rising operational costs—can worsen existing vehicle shortages and undermine logistics performance.

The study's findings show that vehicle capacity issues significantly impact first-mile logistics in Malaysia, leading to shipment delays, increased costs, and customer dissatisfaction. The Vietnam case reinforces the reality that regulatory constraints, when combined with rising costs and fluctuating demand, can severely limit transport availability and reduce logistics efficiency (Ali, Lim, & Chen, 2022).

4.7 Lack of Technology

In the logistics sector, a lack of technology refers to the insufficient adoption or integration of digital tools and systems that enhance operational efficiency, visibility, and decision-making. This deficiency often leads to inefficiencies, increased operational costs, and reduced competitiveness.

In modern e-commerce-driven logistics, where speed and accuracy are crucial, the absence of advanced technology disrupts service quality and supply chain coordination.

Transporter Perspective:

Transporters in Malaysia reported that the lack of reliable tracking systems hinders their ability to update customers and manage logistics effectively.

Transporter Feedback: "Errors in tracking make it difficult to provide accurate updates to customers."

This lack of real-time data visibility affects scheduling, route adjustments, and transparency with clients. Without digital systems to manage deliveries, transporters often resort to manual methods, increasing the risk of human error and delays.

Shipper Perspective:

Shippers similarly experience difficulties due to limited technological integration, especially when monitoring parcel movements post-pickup.

Shipper Feedback: "We often lose visibility of parcels in transit, leading to missing shipments." This lack of parcel visibility leads to uncertainty in fulfilment processes, shipment losses, and poor customer satisfaction. It also restricts their ability to provide accurate updates to customers, which is critical for maintaining trust and service quality.

Two main issues stem from a lack of technology in logistics operations. First is Operational Inefficiencies. Manual processes and outdated systems result in slow processing, tracking errors, and delays. Second is Limited Visibility. Without real-time tracking systems, both transporters and shippers are unable to monitor the location or status of parcels, resulting in shipment mismanagement and customer dissatisfaction.

A study published in *Sustainability* highlights similar issues in Sub-Saharan Africa, where limited digital skills among supply chain workers significantly affect logistics performance. The

study notes that the lack of employee training and digital infrastructure leads to increased human error, poor service delivery, and high operational costs. Moreover, fragmented supply chains and inadequate logistics systems have made it difficult for providers in the region to adopt modern logistics technologies efficiently. These findings echo Malaysia's challenges, showing how insufficient tech adoption can create bottlenecks across different logistics environments.

The lack of technological adoption in first-mile logistics, manifested through poor tracking systems and reliance on manual processes, undermines both operational performance and customer experience. Addressing these issues requires investment not only in digital tools such as real-time tracking and automated scheduling, but also in workforce training to ensure smooth technological implementation and sustainable improvement in logistics service delivery.

4.8 Comparison with Existing Literature

The thematic analysis of transporters and shippers' feedback aligns with previous studies highlighting inefficiencies in first-mile logistics. The real-time pickup request challenge identified in this study supports Zhang and Li (2021), who argue that fluctuating pickup demands create scheduling inefficiencies. Like Wolf (2017), this study confirms that static scheduling methods fail to accommodate real-time adjustments, leading to delivery disruptions.

The issue of vehicle capacity limitations, as noted by Chen et al. (2022), is reaffirmed in this research, where transporters report difficulties in managing high parcel volumes, especially during peak periods. The findings suggest that inadequate fleet space leads to shipment rejection, further exacerbating supply chain inefficiencies.

Additionally, the difficulty of merging new pickup orders into existing routes, as highlighted by Li et al. (2021), was observed in this study. Both transporters and shippers emphasized that last-minute pickups disrupt planning, making it difficult to maintain delivery schedules. This aligns with existing research indicating that new orders create bottlenecks that

delay deliveries and compromise service quality.

A significant problem identified in this study is the lack of system and technology integration, which mirrors Liu and Zhang (2021). Participants confirmed that outdated tracking systems lead to shipment mismanagement and communication gaps, reinforcing Zhao et al.'s (2022) argument that manual logistics processes hinder efficiency.

Finally, the issue of inaccurate address and location data found in this study is consistent with Zheng and Zhang (2021), who argued that incorrect location details cause delays, increase operational costs, and reduce courier reliability.

4.8.1 Unexpected Insights and Contradictions

While previous studies suggested that technology adoption is the primary drive for improving first-mile logistics, the findings from this study indicate that operational inefficiencies, such as vehicle capacity constraints and scheduling conflicts, pose a greater challenge than technology alone. Even transporters with tracking systems still struggle due to limited fleet space and inefficient pickup scheduling.

Additionally, while Li et al. (2021) highlighted last-minute pickup orders as a major problem, this study found that some transporters attempt to accommodate these requests at the cost of delaying existing schedules, demonstrating a trade-off between flexibility and efficiency.

4.9 Chapter Summary

This chapter presents an analysis of the collected data using thematic analysis, highlighting key challenges in first-mile logistics within Malaysia's e-commerce sector. The findings reveal that real-time pickup management, vehicle capacity limitations, difficulty in merging new orders, lack of technology integration, and inaccurate address data significantly impact supply chain efficiency. Operational inefficiencies, particularly fleet capacity constraints and scheduling conflicts, were identified as more pressing concerns than technology adoption

alone. The study emphasizes the importance of dynamic scheduling, improved route planning, and enhanced tracking systems to mitigate these challenges. Addressing these inefficiencies surely help improve logistics performance, reduce operational delays, and enhance overall supply chain effectiveness in Malaysia's growing e-commerce industry.

CHAPTER 5: DISCUSSION AND CONCLUSION

5.1 Introduction

In this chapter, the key findings of the study will be summarized, aligning them with the predefined research objectives and the challenges identified in first-mile logistics within Malaysia's e-commerce sector. The implications of these findings will be discussed, highlighting their relevance to both industry practices and existing literature. Additionally, practical recommendations will be provided to improve first-mile logistics efficiency and address accurate improvements. The chapter concludes with an acknowledgment of the study's limitations and suggestions for future research to further explore and address first-mile logistics challenges.

5.2 Recapitulation and Summary of Findings

The research on first-mile logistics in Malaysia's e-commerce sector reveals several critical challenges affecting supply chain efficiency. The study identifies five major issues: handling real-time pickup requests, difficulty in merging new pickup orders, inaccurate address data, vehicle capacity limitations, and lack of technology integration. These issues contribute to operational inefficiencies, delivery delays, shipment rejections, and increased logistics costs. One of the issues found is the unpredictability of real-time pickup requests, which disrupts scheduling and causes inefficiencies in the supply chain. Without dynamic scheduling systems, transporters struggle to manage fluctuating pickup demands, especially during peak seasons. The lack of real-time route optimization results in missed pickups, delays, and inefficient resource allocation.

The study also highlights difficulties in merging new pickup orders into existing routes, which affect delivery timeliness and efficiency. Last-minute orders require route re-optimization, but without advanced routing technology, transporters' experience increased transit times, unoptimized delivery schedules, and higher fuel costs. This issue particularly

impacts logistics service providers (LSPs) that operate on tight delivery windows.

Another challenge is inaccurate address and location data, which causes unnecessary delays and increased transportation costs. Transporters frequently struggle to find the correct pickup locations, wasting time, fuel, and operational resources. This issue negatively impacts service reliability and shipper credibility, reinforcing the need for better address validation systems, GPS tracking, and digital mapping technologies.

Vehicle capacity constraints pose a significant challenge, as small transport fleets are often unable to accommodate high parcel volumes, particularly during peak demand periods. This results in shipment rejections, increased delivery times, and supply chain bottlenecks. Without proper fleet expansion and optimization, transporters face operational inefficiencies and increased costs.

The lack of system and technology integration further exacerbates these challenges, as many logistics providers still rely on manual tracking and outdated communication methods. Without automated tracking, real-time scheduling, and digital logistics platforms, transporters experience shipment mismanagement, inefficient fleet utilization, and poor customer satisfaction. This finding emphasizes that operational inefficiencies such as fleet capacity constraints and scheduling conflicts have a greater impact on logistics performance than technology adoption alone. Even with tracking systems in place, transporters still face challenges due to limited fleet space and inefficient scheduling.

Overall, these findings suggest that first-mile logistics performance in Malaysia can be improved by implementing dynamic scheduling strategies, optimizing vehicle capacity, adopting advanced tracking systems, and ensuring accurate address validation. Addressing these inefficiencies will lead to better logistics performance, reduced operational delays, and enhanced supply chain reliability in Malaysia's fast-growing e-commerce industry.

5.3 Discussion

The discussions are presented according to the research objective. As such, this section first elaborates the relationship between operational challenges and first mile performance in.

5.3.1 Objective 1 - To assess the current state of first-mile logistics operations in Malaysia's e-commerce sector.

The first research objective, as detailed in Chapter 4, examines the current state of first-mile logistics operations in Malaysia's e-commerce sector and their impact on overall supply chain performance. The findings highlight several critical challenges, including handling real-time pickup requests, vehicle capacity constraints, and inefficient scheduling, all of which contribute to delays, increased costs, and reduced service reliability (Nguyen et al., 2023).

The unpredictability of real-time pickup requests disrupts scheduling and causes inefficiencies in the supply chain. Without dynamic scheduling systems, transporters struggle to manage fluctuating pickup demands, especially during peak seasons. According to Tan et al. (2022), logistics companies that fail to implement real-time tracking and adaptive scheduling face increased inefficiencies, leading to service failures and missed deliveries. By integrating AI-driven scheduling tools and real-time tracking, transporters can adjust their routes in response to last-minute pickups, reducing disruptions and improving delivery reliability (Mitra & Ghose, 2021).

Optimizing vehicle capacity management is essential for enhancing fleet efficiency in first-mile logistics. Research by Kumar et al. (2023) indicates that logistics providers in Southeast Asia face severe fleet underutilization due to capacity mismatches and fluctuating shipment volumes. By improving load planning and utilizing real-time demand forecasting, transporters can reduce the risk of rejected shipments and maximize vehicle utilization (Lee & Zhang, 2022). Efficient capacity management leads to better cost control, improved

delivery timelines, and enhanced supply chain performance (Ali et al., 2021).

Poor scheduling practices create delays and increase operational costs. Studies by Chen et al. (2023) show that manual scheduling in logistics operations results in 30-40% longer transit times, impacting both service quality and fuel efficiency. The implementation of dynamic scheduling and AI-powered optimization models can improve pickup request management, ensuring better coordination between shippers and transporters (Gupta & Sharma, 2022). Transporters with adaptive scheduling systems have been able to reduce transit times by up to 25%, minimizing operational inefficiencies (Rahman & Ismail, 2021).

To fully address these challenges, logistics companies must invest in digital transformation, particularly in AI-driven logistics management, automated route optimization, and smart tracking solutions (Zhao et al., 2022). Many transporters still rely on manual processes, but transitioning to digital platforms significantly enhances operational efficiency (Liu & Tan, 2023). Although integrating these technologies requires infrastructure investment and workforce training, their long-term benefits, including cost reduction, improved service quality, and enhanced supply chain resilience, outweigh the initial implementation costs (Forbes Insights, 2023).

To improve first-mile logistics operations in Malaysia's e-commerce sector, companies must address key operational inefficiencies such as real-time pickup request handling, vehicle capacity constraints, and scheduling challenges. These issues have been identified as major contributors to delays, increased costs, and poor supply chain performance (Nguyen et al., 2023; Tan et al., 2022). Implementing technology-driven strategies and best practices can significantly enhance operational efficiency and service reliability.

One of the most effective solutions is the adoption of AI-powered scheduling and route optimization systems. Dynamic scheduling tools can help transporters adjust pickup routes in real-time, ensuring better coordination between shippers and transporters. Studies show that companies that integrate AI-driven logistics management can reduce missed pickups and

rescheduled deliveries by up to 30% (Rahman & Ismail, 2021). Additionally, predictive analytics allows logistics providers to anticipate peak demand periods and proactively allocate fleet resources, minimizing disruptions caused by last-minute pickups (Zhao et al., 2022).

Optimizing vehicle capacity utilization is another critical strategy for enhancing first-mile logistics performance. Load-balancing software can maximize fleet usage, preventing wasted space in transport vehicles and reducing shipment rejections (Lee & Zhang, 2022). In countries like China and Singapore, collaborative transportation models have been implemented where multiple logistics providers share vehicle space to accommodate fluctuating shipment volumes, significantly improving delivery efficiency and cost management (Kumar et al., 2023).

Furthermore, real-time tracking and digital mapping solutions can enhance logistics visibility and reduce inefficiencies. Many transporters still rely on manual processes that lead to miscommunication and shipment mismanagement. Implementing IoT-enabled tracking systems provides real-time shipment updates, allowing shippers to monitor deliveries and optimize dispatch operations (Liu & Tan, 2023). Additionally, automated address validation tools can prevent incorrect pickup location data, reducing wasted resources and ensuring more efficient deliveries (Gupta & Sharma, 2022).

By adopting these best practices, Malaysia's logistics sector can significantly improve first-mile logistics efficiency. Countries like China and the United States have demonstrated that investing in AI-driven logistics, automated tracking, and predictive analytics leads to faster deliveries and lower transportation expenses (Nguyen et al., 2023). As Malaysia's e-commerce market continues to expand, integrating technology-based logistics solutions will be crucial to achieving a more efficient and resilient first-mile logistics system.

5.3.2 Objective 2 - To identify the primary challenges faced by shippers in managing first-mile logistics within Malaysia's e-commerce market.

The Shippers, particularly small to medium-sized shippers in Malaysia's e-commerce sector, face multiple logistical challenges during the first-mile stage of delivery. As the first operational link in the supply chain, shippers are responsible for preparing orders, ensuring address accuracy, labelling packages correctly, and coordinating with transporters. However, due to rapid order surges, especially during festive or promotional periods, many shippers struggle to meet pickup readiness in real time.

A recurring issue for shippers is the lack of automation and digital tools to streamline order processing. Many rely on manual order creation and handwritten labels, which increases the risk of packaging errors and misaddressed parcels (Lee, Zhang, & Liu, 2023). These manual processes delay the handover process to transporters and often result in delivery errors. Moreover, some shippers operate from multiple pickup points or home-based businesses, making it difficult for transporters to locate them if address standardization is not practiced. WareIQ (2023) notes that without integrated digital mapping or address validation, the pickup process becomes inefficient and inconsistent.

Another significant challenge is communication and scheduling coordination with transporters. Shippers often request pickups based on their internal timelines, which may not align with transporter routing schedules. This misalignment leads to missed pickups or delays. Research by Fareye (2023) highlights that communication gaps between shippers and logistics partners increase the likelihood of service disruptions and inefficiencies. Additionally, many shippers lack real-time shipment visibility once the parcel is picked up, which limits their ability to provide accurate updates to customers—ultimately affecting customer satisfaction and business credibility.

Lastly, inadequate packaging remains a major bottleneck. E-commerce products, especially fragile or high-value items, require secure and standardized packaging. When shippers fail to

adhere to packaging guidelines, transporters are forced to reject parcels or incur damage risks during transit. This not only increases return rates but also adds to operational costs and reduces the perceived reliability of the shipper (Upper Inc., 2023).

To overcome these issues, there is a clear need for shippers to embrace integrated logistics software, automated labelling systems, and enhanced training in first-mile processes. Improved collaboration with transporters, address validation tools, and real-time pickup coordination platforms will empower shippers to reduce errors and strengthen their role in the e-commerce supply chain.

5.3.3 Objective 3 - To identify challenges faced by transporters in managing first-mile logistics within Malaysia's e-commerce market.

Transporters play a crucial role in bridging the gap between shippers and fulfilment centres. However, their operations in the first-mile stage are often hindered by unpredictable pickup requests, capacity limitations, inefficient route planning, and a lack of technology integration. These challenges severely impact their ability to maintain service consistency and timely deliveries.

One of the most pressing issues transporters faces is real-time pickup disruption. Many e-commerce shippers submit pickup requests at the last minute, forcing transporters to deviate from pre-planned routes. This sudden change leads to scheduling conflicts, missed pickups, and inefficient fleet utilization. Fareye (2023) explains that without adaptive scheduling systems, transporters cannot efficiently accommodate these demands, resulting in increased operational stress and customer dissatisfaction.

Vehicle capacity limitations also present a significant hurdle. Transporters, especially small and mid-sized logistics providers, often operate with a limited fleet of vans or 3 to 5-ton lorries. During high-demand periods, available vehicle space is insufficient to meet fluctuating parcel volumes. Tan et al. (2022) reported that poor capacity planning leads to shipment rejection

and the need for additional trips, thereby increasing costs and fuel consumption. Inconsistent parcel sizes and improper packaging from shippers further complicate loading efficiency.

Transporters also face challenges related to route planning and dynamic order integration. When new pickup orders are added to a route mid-operation, transporters must manually reroute, often without adequate tools or real-time traffic data. This inefficiency causes delivery delays and resource wastage. Jaillet et al. (2022) highlight that without predictive routing software, transporters are unable to maintain service efficiency in dynamic environments.

A major technology-related barrier for transporters is the continued reliance on manual tracking and reporting systems. Many transporters operate without GPS-based fleet management tools or real-time communication platforms, which makes it difficult to monitor pickup success, driver locations, or parcel conditions. As a result, they are unable to provide accurate delivery updates to shippers or end-customers (Liu, Wang, & Li, 2022). This lack of system integration leads to shipment mismanagement, miscommunication, and reputational damage.

To address these issues, transporters need to invest in digital fleet management solutions, route optimization platforms, and driver training in first-mile coordination. Establishing centralized communication systems and adopting predictive analytics for routing and scheduling can significantly improve transporter performance and reduce inefficiencies in the first-mile phase.

5.3.4 Objective 4 - To explore and propose strategies for improving the efficiency of first-mile logistics in the e-commerce industry.

Improving first-mile logistics efficiency is essential for Malaysia's e-commerce sector, as it directly influences delivery performance, operational costs, and overall supply chain sustainability. The study highlights key challenges such as unpredictable pickup requests, vehicle capacity constraints, inefficient routing, outdated technology, and inaccurate address

data, all of which contribute to delays, increased costs, and poor service reliability (Nguyen et al., 2023) To address these issues, several effective strategies must be implemented, focusing on technological advancements, optimized resource allocation, and enhanced coordination.

One of the most impactful solutions is investing in dynamic scheduling and real-time tracking systems, which enable transporters to adjust routes dynamically based on demand fluctuations. According to ParcelPerform (2023), real-time data analytics and AI-driven logistics platforms help optimize delivery schedules, reducing transit times and improving vehicle utilization. Countries like China and the U.S. have successfully adopted AI-powered route optimization systems, leading to faster deliveries and cost reductions (Zhao et al., 2022). Without such investments, Malaysia's logistics providers will struggle to manage increasing e-commerce demands efficiently.

Vehicle capacity optimization and fleet management also play a crucial role in minimizing operational inefficiencies. Studies by Upper Inc. (2023) indicate that logistics providers that adopt load balancing and fleet-sharing models can reduce fuel consumption by up to 20% and improve last-mile delivery efficiency. Fareye (2023) further supports this claim, stating that automated fleet management solutions enable transporters to better allocate resources, preventing shipment delays and reducing empty truck movements. Investing in such strategies will ensure that Malaysia's logistics providers remain competitive in an increasingly digital and automated global supply chain (Kumar & Lim, 2023).

Another critical factor is the implementation of AI-driven automated routing and logistics management systems. Many transporters in Malaysia still rely on manual dispatching, leading to inefficient scheduling and lost shipments (Gupta & Sharma, 2022). Research by Fareye (2023) highlights that AI-driven logistics platforms have helped businesses reduce logistics-related delays by 25% in markets like Singapore and India. Adopting automated logistics management software in Malaysia can significantly streamline order processing, improve communication between transporters and shippers, and enhance route optimization (Rahman & Ismail, 2022).

Address accuracy is another major contributor to logistics inefficiencies. A study by

WareIQ (2023) found that incorrect pickup addresses increase transportation costs by up to 15% due to wasted fuel and additional driver hours. Implementing AI-powered address validation systems and GPS-integrated mapping technologies can reduce failed pickups, improve shipment accuracy, and enhance logistics performance (Lee & Zhang, 2023). Companies in China and India have already integrated digital address verification tools, reduced delivery failures and improving first-mile pickup efficiency by 30% (Ali et al., 2022).

Investing in technology-driven first-mile logistics solutions is crucial for several reasons. Firstly, e-commerce demand in Malaysia is rapidly increasing, and without automated scheduling, vehicle optimization, and digital tracking systems, logistics providers will struggle to meet consumer expectations (Nguyen et al., 2023). According to Forbes Insights (2023), companies that fail to digitize logistics operations risk losing market share due to inefficiencies and higher operational costs.

Secondly, manual logistics processes are no longer sustainable in a competitive e-commerce ecosystem. Research by Tan et al. (2022) states that businesses that do not invest in logistics automation experience up to 40% more delays and a 25% increase in fuel costs compared to those that have adopted AI-driven tracking and dispatching systems. This demonstrates the need for Malaysian logistics providers to transition from manual systems to digital-first solutions.

Lastly, government regulations and environmental sustainability efforts are pushing logistics providers to optimize their operations. Studies by Zhao et al. (2022) indicate that governments in ASEAN countries are encouraging the adoption of green logistics technologies, such as AI-powered fleet optimization and real-time emissions tracking. Companies that invest in digital logistics platforms and automated fleet management not only improve efficiency but also align with sustainability regulations, reducing their carbon footprint and fuel consumption (Rahman & Ismail, 2022).

Developed countries have successfully implemented AI-driven logistics solutions,

resulting in improved delivery times, reduced costs, and increased customer satisfaction (Zhao et al., 2022). For Malaysia to remain competitive in the growing e-commerce market, logistics providers must prioritize digital transformation, real-time scheduling, and smart logistics integration.

5.4 Recommendation and Implication of the Study

The findings from this study provide both academic and practical implications that are vital for enhancing the efficiency of first-mile logistics in Malaysia's rapidly growing e-commerce sector.

On the practical front, the research highlights significant operational challenges experienced by shippers and transporters, such as unpredictable real-time pickup requests, vehicle capacity limitations, last-minute order changes, inaccurate pickup address data, and insufficient technology integration. Addressing these issues is essential for reducing delivery delays, minimizing operational costs, and improving service reliability. Logistics companies are strongly encouraged to adopt AI-driven scheduling systems and real-time tracking technologies, which have been proven in other markets to reduce delivery delays by up to 25% and improve resource utilization by 20%. Additionally, vehicle capacity management should be optimized using dynamic fleet planning and route balancing tools to accommodate fluctuating parcel volumes, especially during peak sales periods.

Another crucial recommendation is the implementation of automated address verification systems to avoid delivery failures caused by incorrect or incomplete location data, which can also reduce fuel consumption and improve delivery precision. Moreover, better communication and collaboration between shipper and transporters should be established through shared logistics platforms or digital integration, ensuring improved coordination, shipment visibility, and pickup planning.

The role of government and policymakers is equally significant in supporting infrastructure

development and incentivizing digital transformation, including smart warehouses, urban logistics hubs, and automated distribution centres. International examples from countries like China, India, and Singapore have shown that government-backed digitalization efforts and AI adoption can drastically improve first-mile efficiency and customer satisfaction.

From an academic standpoint, this study contributes to closing the existing knowledge gap in first-mile logistics research, which has historically been overshadowed by last-mile delivery studies. Through qualitative interviews and thematic analysis, the study offers empirical evidence of real-world challenges encountered by 12 participants (6 shippers and 6 transporters), thus providing a grounded understanding of how inefficiencies manifest in Malaysia's logistics landscape. This adds to the body of literature on supply chain performance by emphasizing the foundational role that first-mile logistics plays in overall supply chain responsiveness and reliability.

It also reinforces the theoretical understanding that logistics performance is not only affected by external customer-facing operations but also by internal coordination, route optimization, and technology readiness. The study supports the need for future research to incorporate system-based and adaptive logistics frameworks that explore how various internal and external variables interact to affect performance.

Ultimately, the research offers a dual contribution: it presents practical strategies for logistics stakeholders to enhance efficiency, and it enriches academic discourse by highlighting first-mile logistics as a critical area of study in supply chain management. By aligning both scholarly and industry perspectives, the study aims to inspire more targeted research and practical innovation in first-mile logistics, paving the way for a more integrated, technology-driven, and sustainable logistics ecosystem in Malaysia.

5.5 Limitations of the study and Suggestion

While this research provides valuable insights into first-mile logistics challenges and improvement strategies in Malaysia's e-commerce sector, several limitations must be acknowledged. One of the main limitations is the qualitative research approach, which relies on interviews and thematic analysis. While this method offers in-depth insights, it lacks statistical generalizability compared to quantitative study. A larger-scale quantitative survey could strengthen the findings by providing measurable data on logistics inefficiencies and operational performance. A mixed-methods approach incorporating both statistical data and qualitative insights could further enhance the study's reliability and improve the generalizability of results.

Another limitation is the geographic focus on Northern Malaysia. This study specifically examines first-mile logistics in Penang, Kedah, and Perlis, which may not fully represent logistics challenges in other regions. Urban logistics hubs like Kuala Lumpur face different issues such as traffic congestion and higher shipment volumes, while rural areas may struggle with infrastructure constraints affecting pickup efficiency. Future research should expand its scope to include a broader range of locations to provide a more comprehensive understanding of first-mile logistics nationwide.

Additionally, this study primarily captures the perspectives of transporters and shippers, without extensive input from policymakers, third-party logistics (3PL) providers, and technology developers. A more inclusive approach involving all logistics stakeholders would provide a broader and more balanced view of the industry's inefficiencies and potential improvements. Future research should incorporate industry-wide perspectives to ensure practical and policy-driven recommendations for enhancing logistics efficiency.

Another limitation is the lack of extensive previous research on first-mile logistics in Malaysia. Most existing studies focus on last-mile delivery or overall supply chain logistics, leaving first-mile logistics as an underexplored area. This study helps bridge that gap, but

more empirical research is needed to develop data-driven models for optimizing first-mile operations. Future research should analyze logistics cost structures, fleet management efficiencies, and AI-based scheduling models to build a stronger foundation for first-mile logistics optimization.

Technological advancements and market conditions in logistics are constantly evolving. As new technologies such as AI-driven logistics solutions, automated scheduling, and predictive analytics become more widely adopted, the challenges and solutions identified in this study may change over time. Future research should continuously evaluate how emerging technologies impact first-mile logistics efficiency and explore the long-term effects of digital transformation in supply chain management.

To address these limitations, future research should expand the geographic scope to include both urban and rural regions, providing a more holistic understanding of first-mile logistics performance. Conducting quantitative research will help measure the impact of operational inefficiencies on supply chain performance, while mixed-methods studies can enhance the reliability of findings. Additionally, investigating the role of artificial intelligence, automation, and predictive analytics in optimizing first-mile logistics will provide valuable insights into improving scheduling, vehicle utilization, and route optimization.

Further research should also analyze the economic impact of logistics inefficiencies to help policymakers and industry leaders develop cost-effective solutions. Evaluating government support initiatives for digital transformation in logistics could drive industry-wide improvements. Moreover, including more stakeholder perspectives from policymakers, 3PL providers, e-commerce shippers, and technology developers will provide comprehensive insights into first-mile logistics challenges and innovations.

By addressing these gaps, future research can contribute to a more efficient, technology-driven, and sustainable first-mile logistics system. Expanding research on AI-driven scheduling, automated tracking, and logistics cost optimization will provide valuable

insights for industry stakeholders. Policymakers, logistics companies, and technology developers must collaborate to ensure a seamless and efficient first-mile logistics framework that enhances Malaysia's e-commerce growth and supply chain competitiveness.

5.6 Conclusion

This research set out to achieve three key objectives, Firstly to assess the current state of first-mile logistics operations in Malaysia's e-commerce sector and analyze their impact on overall supply chain performance, Secondly to identify the primary challenges faced by both shippers and transporters in managing first-mile logistics within Malaysia's e-commerce market, and Third to propose strategies and solutions for improving the efficiency of first-mile logistics in the e-commerce industry.

The study highlights several major inefficiencies in Malaysia's first-mile logistics operations, including unpredictable pickup requests, vehicle capacity constraints, route optimization issues, lack of technology integration, and inaccurate address data. These challenges negatively impact overall supply chain performance, leading to delays, increased operational costs, and reduced service reliability. Addressing these inefficiencies is critical for ensuring a more responsive, cost-effective, and competitive logistics system in Malaysia's e-commerce sector.

To improve first-mile logistics operations, the study recommends implementing dynamic scheduling systems, optimizing vehicle capacity utilization, investing in real-time tracking and automated logistics technology, improving address validation processes, and enhancing coordination between shippers and transporters. By integrating these solutions, logistics providers can streamline operations, reduce inefficiencies, and enhance the reliability of first-mile logistics services. Additionally, collaborative efforts between logistics companies, policymakers, and technology providers will be necessary to drive digital transformation, improve infrastructure, and develop smarter logistics frameworks that can

support Malaysia's rapidly expanding e-commerce industry.

Despite the valuable insights provided by this research, several limitations must be acknowledged. The geographic scope was limited to Northern Malaysia, and a qualitative approach was used, which, while offering in-depth insights, lacks statistical generalizability. Furthermore, first-mile logistics remains an underexplored area, with most research focusing on last-mile delivery and overall supply chain logistics. These limitations suggest the need for future studies on technological advancements, economic impacts, and nationwide logistics strategies that can further optimize first-mile logistics operations.

By overcoming first-mile inefficiencies, Malaysia's e-commerce sector can enhance delivery reliability, reduce logistics costs, and strengthen its logistics infrastructure to meet future growth demands. Continued research, investment in smart logistics technology, and strong industry-government collaboration will be key to ensuring a resilient and efficient first-mile logistics system that can support the evolving needs of Malaysia's digital economy.

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CONSENT FORM FOR RESEARCH INTERVIEW

Research Title:
Exploration of First-Mile Logistics in Northern Region, Malaysia

Researcher:
Nur Hannan Farzana Binti Fadzil
Master of Science (Transportation and Logistics Management)
Universiti Utara Malaysia

Purpose:
This study explores challenges in first-mile logistics from the perspectives of shippers and transporters in Northern Malaysia. The goal is to identify inefficiencies and suggest improvements.

Procedures:
You will participate in a **15–40-minutes semi-structured interview** about your experiences. With your consent, the interview may be **audio-recorded** for accuracy.

Confidentiality & Voluntary Participation:
Your response will be **confidential**. Participation is **voluntary**, and you may withdraw at any time without consequences. Your insights will contribute to academic research and potential logistics improvements.

Contact:
For questions, contact:
Nur Hannan Farzana Binti Fadzil
Master of Science (Transportation and Logistics Management)
Universiti Utara Malaysia

Phone:016-9391048
Email: hannfar232@gmail.com

Consent Declaration:
I, _____, confirm that:

☑ I understand the study's purpose and voluntarily agree to participate.

☑ I understand my responses will remain confidential.

☑ I consent to audio recording (if applicable).

☑ I may withdraw at any time without consequences.

Signature: _____
Date: _____