CHALLENGES IN ADOPTING RFID-IoT INTEGRATION IN INVENTORY MANAGEMENT ON SMEs LOGISTIC IN MALACCA.

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DECLARATION OF ORIGINAL WORK

I hereby declared that, apart from certain explanations and parts where sources were clearly referenced, all the work in this thesis titled “Challenges in adopting RFID-IoT in inventory management on (SMEs) logistic in Malacca” was done entirely by myself. No component of the work included in this research project proposal had been submitted in support of any other degree or certification offered by this or any other institute or university of learning.

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DEDICATION

I would dedicate my study to my dear parents, lecturers, and friends, who always inspired and taught me. Also, a big thanks to my dear supervisor and panel for assisting me through this research. I was able to successfully complete my final year project 2 (FYP) with their attention and help.

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ABSTRACT

Small and medium-sized enterprises (SMEs) logistic company are increasingly realizing the value of implementing RFID-IoT integration technology to improve their company performance in the current technological era. The inventory management processes are one area where SMEs logistics can greatly benefit from integration of RFID-IoT. The term “Integration of RFID-IoT “refers to the use of technology and to simplify and automate inventory management processes such as tracking inventory, demand forecasting, supplier management, maintaining real-time awareness of stock locations and status, in addition to optimizing inventory levels. The study explores, challenges in adopting RFID-IoT Integration in inventory management on SMEs Logistic in Malacca, addressing research gaps in understanding specific barriers, such as financial constraints and technological limitations, with the aim of providing insights and solutions to enhance overall company performance. There are two objectives in this study: (1) To explore the understanding of RFID-IoT among SME’s logistics in Melaka, (2) To uncover the reasons of SME’s logistic sector, hesitate to adopt RFID-IoT technology in inventory management in Malacca. A semi-structured interview will be conduct as part of the qualitative technique used for this study. Four respondents to this survey conducted in-person interviews. The answers to the three above-mentioned research objectives will disclose during this interview.

Keyword : SME’s, RFID, IoT, understanding, challenges in adopting

ABSTRAK

Syarikat logistik perusahaan kecil dan sederhana (PKS) semakin menyedari nilai pelaksanaan teknologi integrasi RFID-IoT untuk meningkatkan prestasi syarikat mereka dalam era teknologi semasa. Proses pengurusan inventori adalah satu bidang di mana logistik PKS boleh mendapat manfaat besar daripada integrasi RFID-IoT. Istilah "Integrasi RFID-IoT" merujuk kepada penggunaan teknologi untuk memudahkan dan mengautomatikkan proses pengurusan inventori seperti menjejak inventori, ramalan permintaan, pengurusan pembekal, mengekalkan kesedaran masa nyata tentang lokasi dan status stok, di samping mengoptimumkan tahap inventori. Kajian ini meneroka cabaran dalam mengadaptasi integrasi RFID-IoT dalam pengurusan inventori pada Logistik PKS di Melaka, menangani jurang penyelidikan dalam memahami halangan khusus, seperti kekangan kewangan dan had teknologi, dengan tujuan memberikan pandangan dan penyelesaian untuk meningkatkan prestasi keseluruhan syarikat. Terdapat dua objektif dalam kajian ini: (1) Untuk meneroka pemahaman RFID-IoT dalam kalangan logistik PKS di Melaka, (2) Untuk mendedahkan sebab-sebab sektor logistik PKS, sukar untuk mengadaptasi teknologi RFID-IoT dalam pengurusan inventori di Melaka. Satu temubual separa berstruktur akan dijalankan sebagai sebahagian daripada teknik kualitatif.

Kata kunci: PKS, RFID, IoT, pemahaman, cabaran dalam mengadaptasi

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SMEs	**Small and Medium Enterprise**
IoT	**Internet of Technology**
RFID	**Radio Frequency Identification**
MDEC	**Malaysia Digital Economy Corporation**

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

The background of Challenges in adopting RFID-IoT Integration in inventory management on SMEs Logistic performance in Malacca will be covered in this chapter's opening. Following that, this chapter will define the problem statement considering the study context. As a result, the research's research questions, and research objectives will be determined. The study's limitations and scope will be discussed later. The study's relevance section follows, giving readers information and specifics on how the study benefits the various parties. This chapter's final section, the thesis outline, will go over how the research in chapters one through five flowed.

1.1 BACKGROUND OF THE STUDY

Inventory is being a vital part of well managed supply chain in the company. It is characterized in the balancing of a certain product’s supply and demand. If there is any increase in sales profit of a company, undoubtedly the result is from the efficient inventory management (Alam et al, 2024). In small and medium-sized logistics company, inventory efficiently manage the flow of goods from suppliers to end

customers while reducing cost and maximize customer satisfaction. Inventory tracking, demand forecasting supplier management, and optimize the process are included in this. SME logistic firms can enhance their operational performance, lesser the holding cost, and efficient the overall companies' success by managing inventory very well. Moreover, based on the article mentioned Regional, (2022) that logistic industry being a vital part the process of the supply chain and essential part in the economic growth. Not only are logistics essential to transportation, but they also have a broad use in other domains like equipment layout, warehouse operations, and storage management. The logistics sector in Malaysia is extremely fragmented and made up of numerous small and medium-sized logistics firms. Manufacturers and distributors handle the logistics internally, or they contract out the work to specialized logistics service providers.

According to studies, stated that radio frequency identification system (RFID) known as automatic technology which let computers or other devices recognize items, capture metadata, or manage specific targets using radio waves (Jia et al. 2012). Radio Frequency Identification tags are store data and use radio waves to transfer the data to RFID readers which are constructed with microchips and antennas. Hence, the readers will gather information which will sent to a centralized system to analyse and to process further activities. This method like automation eliminates the need for manual data entry and provides real-time visibility into inventory numbers, and locations. Moreover, RFID can be used to boost the accuracy, efficiency, and security of inventory management systems, and enhance some of beneficial ways in supply chain like less errors, better production, and enhanced traceability. This helps an organization to enhance customer satisfaction and efficient the operation progress in the industries. Internet of Things (IoT) is an emerging paradigm that allows connectivity between electronic devices and sensors which make our life easier (Kumar et al. 2019).

Inventory management procedures across sectors have seen a significant change due to the combination of Internet of Things (IoT) and Radio Frequency Identification (RFID) technologies. RFID when combined with the Internet of Things

network of linked devices, this technology offers unmatched visibility over inventory locations, status and levels. RFID readers receive data from RFID tags automatically, and they subsequently connect with IoT-enabled devices to process and analyse the data. Furthermore, IoT platforms use the massive volume of data gathered from RFID tags to improve decision-making, enhance decision making, and optimize inventory levels. RFID and IoT technology enable organizations to gain a competitive edge in today's dynamic market scenario by supporting initiative-taking inventory management and decreasing stockouts (Khan et al. 2023). Currently, with the ability to easily trace an item's position and efficiently control its movement inside the facility, an RFID-equipped warehouse managing inventory can improve the picking and shipping procedures. Furthermore, the incorporation of RFID data management software is crucial since it facilitates thorough data reporting, analysis, and visualization. Businesses may use this integrated software to manage asset movements, keep an eye on inventory trends, and obtain insightful information about their operations (The SMS Group, 2023).

1.2 PROBLEM Of STATEMENT

The integration of Internet of Things (IoT) and Radio Frequency Identification (RFID) technologies has become a usable way to improve inventory management progress among industries in recent years. Even though, with the potential advantages, Small and Medium Sized Enterprises (SMEs) particularly in logistic industry facing difficulties to implement technologies like RFID and IoT to manage inventory, especially in the Malacca area. SMEs in this area a vital part of the local economy because they are important hub for trade and commerce. Melaka SME Resilience Profile report mentioned that, with 98.5% of all company establishments and 38.2% of the country's gross domestic product (GDP) coming from SMEs, Malaysia's economy is based mostly on them (Tan et al. 2023). Article from The Star, stated that, the GDP statistics for 2022 indicate that Malacca’s economy has grown significantly

in line with the country's economic trends, according to a report by Melaka Hari Ini, with an amazing RM45.5 billion, the state's GDP increased by 8.6% from RM41.9 billion to RM45.5 billion. It is evident from this that Melaka, primarily to the tourism industry, is the primary city in Malaysia that has developed its economic statistics (Murali R.S.N., 2024).

Logistic sector in Malacca is important part for economic growth of Malaysia because of its strategic location and economic**.** Based on the report of Port Economics Management and Policy Rodrigue (2019) review that, connecting the Indian Ocean to the Pacific Ocean and the South China Sea, the Strait of Malacca is an essential waterway for global trade. Because of its position, it serves as a major hub for logistics, handling a sizable amount of the world's maritime trade. About 30% of all maritime traffic worldwide passes through the Strait, and the Port of Singapore dominates transshipment operations in the area, highlighting the Strait's significance. Thus, in this instance, small and medium-sized enterprises are contributing to better logistic performance by assisting large logistic companies. Somehow, in this technologically advanced world, SMEs in the logistics sector are having difficulty utilizing advanced technologies to improve their inventory management performance.

In studies stated that, Small and medium-sized businesses' (SMEs') poor inventory management procedures have a widespread negative impact on business performance. Has faced serious obstacles because of inadequate resources and poor inventory control. These issues have resulted in frequent stockouts, which have interrupted whole operations in supply chain (Kittisak, 2023). Long-term manual processing of inventory documentation leads to data errors, which impedes decision-making. Moreover, erroneous inventory records seriously impair business earnings and cause the company to suffer grave consequences (Kryvakovska, 2019). Other than that, SME logistic company concerns inventory replenishment issues that result from the above-described tracking flaws. Inventory replenishment triggered at the wrong time due to inadequate inventory tracking systems.

In current world, which is among this competitive situation, small and medium (SMEs) in the logistics sector must adopt the digitalization concept to survive and

success in the advance technological world. Studies emphasises that Business operations related to supply chains and relationship management are conduct online (Radicic, 2023). SMEs can increase their operational efficiency while reducing manual errors and resources waste by integrating digital technologies like automation in inventory management system and cloud-based logistics platform.

SMEs may find it difficult to embrace technologies software systems due to the potentially significant initial expenditures. But as they gain more experience with the technology, SMEs can begin with more basic automation and work their way up to more advanced capabilities. Besides, SMEs facing challenges in inventory management issues such as lack of necessary inputs and surplus inventory. Previous studies highlight the points which is the key issues faced my SMEs managers have with inventory management are the use of rule of thumb procedures, the disregard for forecasting random ordering of items, lack of training in use of computers (Alam et al. 2024).

Overall, integration of RFID and IoT technologies into inventory management contribute in significant opportunities to improve the productivity and competitiveness of small and medium sized business in the logistic industry, especially in Malacca area. Here, these companies have substantial obstacles in embracing and successfully deploying new technologies despite the advantages.

1.3 RESEARCH QUESTION

There are two research questions to be listed to allow the researcher to choose the right research methodology and focus on the area related to the topic. The research questions are:

1) What is the understanding of RFID-IoT among SME's logistics in Malacca?

2) Why do SME's logistic sector hesitate to adopt RFID-IoT technology in inventory management in Malacca?

1.4 RESEARCH OBJECTIVES

The research objectives are developed based on the needs of the research question of the study. The entire study will be conducted by using these objectives:

1) To explore the understanding of RFID-IoT among SME's logistics in Malacca.
2) To uncover the reasons of SME's logistic sector, hesitate to adopt RFID-IoT technology in inventory management in Malacca.

1.5 EXPECTED OUTCOMES

1.5.1 SCOPE OF STUDY

In the context of small and medium-sized firms (SMEs) operating in Malacca, Malaysia's prospering logistics sector, this study focuses on analysing the specifics of RFID-IoT integration in inventory management. With a focus on the area's point of view, the study explores the possibilities and obstacles that SMEs have when integrating RFID and Internet of Things technologies to improve their logistical efficiency. The scope specifically includes several aspects, such as organizational capacities, cost implications, technical preparedness, and regulatory compliance. With a focus on SME's logistics in Malacca, this study intends to evaluate the possible advantages of RFID-IoT integration, including greater warehouse efficiency, cost savings, improved supply chain traceability, automated tracking procedures, and improved inventory visibility. Adoption obstacles can be addressed by government campaigns, educational programs, cooperative models, phased integration strategies, data security protocols, and the exchange of best practices from successful implementations. The study aims to offer insights into the opportunities and challenges faced by small and medium-sized logistics companies in Malacca when implementing RFID-IoT integration for inventory management. It uses a combination of qualitative and quantitative methods, including surveys, interviews, and data analysis. The goal is to improve the operational efficiency and competitiveness of these companies in the market.

1.5.2 LIMITATION AND KEY ASSUMPTION

There are several potential limitations to the study on the difficulties in implementing RFID-IoT integration for inventory management and the affects towards logistics performance of small and medium-sized enterprises (SMEs) in Malacca. These include potential regional specificity, limited generalizability, preconceptions in the methods used to collect data, such as surveys and interviews, restrictions on the availability of operational data, and the correlational nature of the study. The technological expertise and resources of SMEs in the logistics sector that can deploy RFID-IoT technologies may also pose limitations to the study. The study is predicated on certain assumptions, such as the ability of Malacca SMEs to engage and provide accurate information, the suitableness of RFID-IoT technology for their inventory requirements, the quantifiability of technology advantages, consistency of external factors influencing technology adoption, and the ability of the researchers in assessing the obstacles and consequences of RFID-IoT integration. The study's validity and applicability in examining the dynamics of technology adoption in the SME logistics industry in Malacca depend heavily on the acknowledgement of these constraints and presumptions.

1.6 SIGNIFICANCE OF THE STUDY

The research bears importance in obstacles faced by SMEs in Malacca while using RFID-IoT integration for inventory management, since it can improve their logistic performance and boost their operational efficiency. The research can offer significant insights into boosting supply chain traceability, automating tracking procedures, increasing warehouse efficiency, lowering costs, and ultimately improving customer service by addressing the obstacles to technology adoption and examining the advantages of RFID-IoT integration. Through an in-depth examination of these variables, the research might provide useful suggestions to assist SMEs in Malacca in

overcoming obstacles and optimizing their inventory management procedures via RFID-IoT integration. Furthermore, by assessing the most influential component among those affecting RFID-IoT integration in inventory management for small and medium-sized enterprises (SMEs) in Malacca, the study can identify the crucial element that strongly influences the successful adoption of this technology, pointing SMEs in the direction of more efficient tactics and solutions catered to their unique requirements and logistics related difficulties.

1.7 KEY CONCEPT

i) RFID – IoT integration

Using RFID tags, reader and antenna inventory management systems that integrate Internet of Things (IoT) and Radio Frequency Identification (RFID) technology enable real-time tracking and monitoring of inventory goods. A transceiver is another name for the reader. The RFID tags are powered by and activated by a radio frequency (RF) electrical wave. The antenna uses a coil to transform the electrical wave into electrical flow. Next, RFID tags—passive or active, for example, attach themselves to a physical object and respond to the reader by transmitting a second electrical pulse. The Electrically Erasable Programmable Read-Only Memory (EEPROM) component of the RFID tag is used to record data such the product's location, batch ID, unique product ID, and quantity. A computer database will hold all the information in the form of cloud for processing. By improving inventory visibility, accuracy, and efficiency, this integration transforms the methods used in inventory management.

ii) Inventory Management

Inventory management is the application of certain fundamental ideas that are necessary for effective inventory control and optimization. Among these concepts is ordering, which is figuring out when and how much to order to keep your inventory at the right level and efficiently meet demand. Receiving is a crucial component that involves accurately verifying and accepting incoming inventory shipments to guarantee accuracy and quality. The right arrangement and storage of inventory products to optimize space efficiency and accessibility is a key component of storing, which is a crucial component of inventory management. Reducing inventory shrinkage, damage, theft, and obsolescence is all part of the process of minimizing loss. Furthermore, it is imperative to employ Inventory Management Systems and Enterprise Resource Planning (ERP) solutions. These software tools automate and streamline inventory-related processes, improving the overall operational performance, accuracy, and efficiency of inventory management practices.

iii) Small and Medium Sized Enterprises (SMEs)

Businesses classified as small and medium-sized enterprises (SMEs) are those that are situated between the size and scope of large organizations. While the term "SMEs" varies from nation to nation, it typically refers to businesses that are smaller than huge corporations in terms of employees, resources, and yearly revenue. It is often known that SMEs play a significant role in both employment creation and economic growth. Compared to major firms, SMEs are smaller, have fewer employees, and generate less money annually. SMEs in Malaysia are companies with less than 150 workers and less than RM50 million in revenue annually (about USD12.5 million). SMEs in the logistics industry usually collaborate with a network of partner businesses to offer transportation services. For the shipments of their clients, they choose the most economical, secure, and effective routes and means of transportation. For their customers, small and medium-sized logistics firms manage all paperwork and documentation requirements, making sure all the right paperwork is in order and setting up customs clearance as needed.

iv) Adoption challenges

Adoption obstacles for SMEs in Malacca using RFID-IoT integration for inventory management include strong rivalry, quickly changing technology, and the need to deal with problems including high upfront expenses, a need for technical competence, and rejection to change. SMEs in Melaka can improve their logistics efficiency by using IoT-based inventory management solutions to overcome these obstacles and achieve notable gains in inventory visibility, demand predictions, centralized control, optimization, and item tracking.

1.8 SUMMARY

An overview of the overall research is the main goal of this chapter. The study's history, problem statement, research aims, research questions, significance, scope, and limits, as well as a summary, are all included in this chapter. To address the research questions, research objectives are employed, which are derived from the problem statement and the research backdrop. There will be additional discussion of this topic in the literature review chapter that follows.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter explain about the relevant of literature reviewed, which the RFID-IoT, inventory management and logistic performance. The researcher interested in presenting here a few studies of the adoption of RFID-IoT Integration in inventory management on among small and medium enterprises (SMEs) logistic in Malacca. In this chapter also develops the theoretical framework of the proposal.

2.1 Overview of Radio Frequency Identification (RFID) and Internet of Things (IoT)

2.1.1 Overview of Radio Frequency Identification (RFID)

RFID technology employs electromagnetic fields to automatically detect, and track tags attached to items. RFID stands for Radio Frequency Identification. The RFID readers don't need to be in direct line of sight to read the electronically stored information on the tags; they may do it from a distance. Its automated, accurate, and quick data collection capabilities make this technology popular in a wide range of applications, such as inventory management, asset tracking, and access control. In the last decades, previous studies significantly gave an overview regarding RFID technology. Compared to optical identification systems, which use barcodes or QR codes to identify and monitor objects, animals, people, and other entities, radiofrequency identification, or RFID, is a wireless technology that has only modestly permeated the market (Perret et al. 2016).

Researchers have been interested in RFID technology because of its many uses and implications. In recent years, a few research investigations have focused on usage of RFID technology. According to the study, Jha et al., (2019) Emphasize that an example of a planned innovation is Radio Frequency Identification (RFID), which uses radio waves to identify things, retain metadata, and control singular focus on computers or other devices. By connecting an RFID reader to an Internet terminal, the reader may identify, follow, and display the articles that have labels attached to them inclusively, subsequently, and gradually, as needed. (Zhang et al. 2023), RFID can track real time progress by introduced ReActor, a real-time RFID gesture detection system that integrates frequency-domain and time-domain statistical features for high accuracy and low latency. Using gesture-speed-specific classifiers and preprocessing signals to eliminate ambient reflections.

In terms of application of RFID in inventory management, the growth of data centres has led to an increase in the difficulty of manual asset management because of mistakes, labour intensity, and frequent changes in IT assets. The study suggests an RFID-based business data centre information asset management system to address these problems. By automating inventory and management procedures with RFID electronic tags, this solution enhances the precision and efficiency of fixed asset management by providing complete tracking and exact positioning of IT assets across the course of their life cycle (Yuan, et al. 2023). In other hand, Celebi, et al., (2019**)** mentioned that popular automatic identifying technique for use in a variety of applications is radio frequency identification, or RFID. The practical use of RFID technology in logistics warehouse management to calculate forklift costs is the main topic of this study. In a logistics company's warehouse, the suggested RFID-based model tracks forklift movements in real-time, exhibiting effective and significant results in estimating the cost of these activities and indicating potential for useful, real-world inventory management applications.

Moreover, the researched by Munoz-Ausecha, et al., (2021) given an emphasis on applications, security, and privacy, this study examines the most frequently referenced RFID topics through an analysis of 40,677 unique entries from large databases. Enhancing the Internet of Things (IoT), boosting supply chain management, localization, traceability, and logistics are some of the key uses of RFID in inventory management. The analysis sheds light on the most recent developments in RFID technology and its useful applications, emphasizing how RFID may improve inventory control and tracking. The advantages and possible drawbacks of employing Radio Frequency Identification Devices (RFID) in inventory supply chain management and warehouse management were examined by research. The study outlined the shortcomings of the available inventory tracking systems and contrasted them with the benefits and drawbacks of the new generation inventory management system that is being suggested (Khodakivska et al. 2021).

2.1.2 Overview of IoT technology

Internet of Things (IoT) means a network of physically linked objects that are equipped with sensors, software, and other technologies to gather and share data over the internet. These gadgets, which can be anything from commonplace home items to highly advanced industrial machines, can communicate, interact, and carry out activities in an autonomous or semi-autonomous manner, enhancing effectiveness, convenience, and decision-making in a variety of applications.

The ability of the Internet of Things (IoT) to connect smart devices for communication, processing, computation, and real-time situation monitoring has garnered a lot of attention in recent years (Mohanta et al., 2020). In order to guarantee secure connection and data transmission, research has been done on identity and access management for Internet of Things devices (El-hajj, et al,. 2019). Recent research has focused on the integration of IoT with new technologies like blockchain, AI, and machine learning. These innovations could improve the functionality of Internet of Things devices and solve issues with data management, security, and communication protocols (Dogra, et al., 2022).

(Singh, et al. 2019) According to the research, the Internet of Things (IoT) is a network of networked objects that makes use of Arduino and Raspberry Pi technology. It is aimed at professionals and advanced students in electrical and computer engineering, including robotics, it covers programming, device interface, and the fundamentals of the Internet of Things. In the way of agriculture, the author defines that IoT in precision agriculture as a system integrating UAVs and WSNs for efficient crop monitoring. This collaboration enables robust data collection, control, and decision-making, optimizing UAV trajectories and in situ data processing, thereby enhancing agricultural productivity and sustainability (Popescu, et al. 2020). Further, the term "Internet of Things" (IoT) in this context refers to a network of linked devices and technologies that allow for online data exchange. It makes decision-making, resource management, and real-time monitoring of farming conditions easier in smart agriculture. This network optimizes agricultural operations for sustainability and

efficiency by integrating many technologies, including blockchain, cloud computing, wireless communication, and unmanned aerial vehicle (Othmane et al., 2021).

With an emphasis on diverse technologies like RFID, the literature on the use of IoT in logistics and supply chain management is growing quickly which helps to improve supply chain transparency (Sunny et al., 2020). Additionaly, Mastos et al., (2020) address the theory-practice gap by demonstrating how IoT technologies affect the performance of sustainable supply chain management. Previous studies and research highlighted that Internet of Things has been applied to logistic and supply chain management. The study presented a general framework for IoT-based quality-controlled logistics, emphasizing the use of IoT in supply chains for fruits and vegetables (Guo et al. 2021). Indeed, a survey conducted by Tan et al., (2021) emphasized the idea of RFID-IoT technology in supply chain management, stressing both its present uses and its potential in the future. Based on author's research highlights the ability of IoT to track and monitor products, activities, and processes, emphasizing its importance in contemporary supply chains. IoT improves visibility and efficiency by streamlining activities in manufacturing, transportation, and storage. Another view is, IoT significantly enhances supply chain transparency and builds partner confidence when used with blockchain technology. By improving interoperability, security, and traceability, this synergy eventually increases the efficiency of contemporary supply chains (Rejeb et al. 2019).

2.1.3 Integration of Internet of Things and RFID

The integration of Radio Frequency Identification (RFID) and Internet of Things (IoT) technologies has generated interest in several fields. The research reviewed the issues and uses of RFID and wireless sensor networks in Internet of Things sensing applications, emphasizing the value of these technologies in improving data collecting and integration (Landaluce et al. 2020**)**. Despite Meng et al., (2021)

argued that RFID and sensing techniques should be combined to increase the effectiveness and convenience of Industrial Internet of Things (IoT) advancements. The research showed how well the system model provides privacy and security by proposing a cloud-based remote RFID authentication mechanism for security in smart IoT applications (Ahmed et al. 2021).

The paper presents a supply chain management model that optimizes and automates logistics jobs using GPS and RFID. Dynamic route and schedule updates are made possible by real-time GPS and RFID data, which reduces travel time and resource consumption. This integrated strategy addresses variations in processing times, improving supply chain management over (Lam, et al., 2019). By using IoT technology in the RFID, logistics companies may track things in real time anywhere in the world by using tracking numbers. The exact location data and status updates provided by this integration enhance the visibility of the supply chain during transit (Unhelker, 2022).

2.2 Integration of Internet of Things and RFID among SME's logistic in inventory management

2.2.1 RFID-IoT in inventory management

An innovative era in supply chain optimization is starting with the integrating of RFID (Radio Frequency Identification) and IoT (Internet of Things) technologies in inventory management. It enables efficient stock management and temperature control by tracking stock and monitoring conditions, triggering alerts for fluctuations. Leveraging IoT-RFID technology, this solution aims to cut food loss and minimize economic and environmental impacts of poor storage practices (Mishra et al., 2020). In other hand, RFID and IoT technologies combine in RFD-IoT inventory management to improve supply chain efficiency which is items are automatically tracked by RFID tags, and real-time data is provided by IoT devices. This integration facilitates autonomous transactions, lowers mistakes, and increases visibility.

Eventually, inventory management in this context relates to hospital data keeping and medical supply tracking. Hospitals hope to increase accuracy and efficiency by combining RFID and IoT technologies (MPhande et al. 2020). Real-time monitoring is made possible by RFID tags and Internet of Things (IoT) sensors, which lower errors and enhance patient safety and care. This article investigates how RFID and Internet of Things technology might improve warehouse inventory management. It suggests a system that uses secure path discovery techniques and dynamic storage location computations to guarantee security (Trab, 2019). A multi-agent simulation shows how the system optimizes storage and reduces security concerns by integrating RFID, IoT, and product cloud-based storage (Othmane, 2021). Next, real-time data integration, predictive analytics, and automation in supply chain operations have been made possible by the integration of RFID and IoT technologies into ERP and SCM

systems. This integration improves production process optimization and inventory monitoring (Oghazi el at.,2024).

2.2.2 RFID-IoT in inventory management among SME's logistics

Small and medium-sized businesses' (SMEs') logistical performance has been demonstrated to be significantly improved by the incorporation of RFID and IoT technology in inventory management. SMEs can enhance their inventory management procedures for value creation by implementing Industry 5.0 techniques, such as utilizing the Internet of Things (IoT) and advanced analytics. These technologies can assist small and medium-sized enterprises (SMEs) in gathering and evaluating vast quantities of data, empowering them to make well-informed decisions on inventory levels, stock replenishment, and order impact (Mashayekhy et al., 2022). While managing inventory properly, SMEs frequently have less resources and face more serious hazards like restricted cashflows, limited storage space, and a larger chance of stockouts (Iqbal et al., 2023). Furtherly, Numerous applications in inventory management have been generated by innovations in RFID-IoT development. It has encompassed environment identification, personnel management, inventory space optimization, equipment maintenance dates, and product identification and tracking (Tan, 2022).

In other point, the use of cloud computing, and IoT technologies has also been emphasized as a critical component in optimizing inventory levels and enhancing warehouse efficiency in the systematic study of the impact of inventory management on SME performance which can give impact of inventory management on SME performance. It has been demonstrated that supply chain performance and competitiveness are improved by the application of techniques like business intelligence, RFID, and IoT in supply chain management. According to the study Tan, (2022), using a Raspberry Pi as a central server, the authors created a low-cost method

for detecting, identifying, and monitoring the goods. According to this study, RFID's wireless sensing capability in a dynamic setting like inventory makes it more suitable for warehouse management. In the suggested system, a passive tag is used because of its minimal interference impact and cheaper maintenance. Sensor connectivity and data gathering are combined to create a highly efficient inventory management system using the open-source NodeMcu IoT platform with an ESP8266–12e Wi-Fi module. A website is designed to track product details such the tag number, position of the storeroom, time, and table description.

The movement of goods from producers to warehouses and from these establishments to the point of sale overseen by inventory management. Purchasing plans that guarantee products are available when needed without having too much on hand for tracking available inventory are among the best inventory management methods for small and medium-sized enterprises (Eveline, 2019). A suitable inventory control system can assist the firm in acquiring effective real-time data (Rizad, 2019). Overall, might be greatly enhanced by SMEs integrating RFID-IoT technology into inventory management. SMEs may improve predictive analytics skills, expedite communication between logistics providers and warehouse operations, and ultimately promote sustainable supply chain performance by skilfully utilizing these technologies.

2.3 Challanges faced by small and medium enterprise (SMEs) in adopting technologies

According to the research Rakesh, (2020), small firms face a challenge even with the emergence of Industry 4.0 technologies in production and supply chains. Cost is identified in the paper as a major barrier for SMEs. Tags, readers, and software must be purchased to set up technologies, which can be very expensive for companies with little funding. Generally, the difficulties small and medium-sized enterprises (SMEs) have implementing technologies are covered in the article. Although, technologies can

enhance business models, but for SMEs, implementing and maintaining these technologies can be costly and time-consuming. Purchasing the equipment, maintaining it, hiring personnel, and compensating service providers are among the significant expenses (Parra, 2020).

Even the study concentrated on IoT adoption, RFID and IoT technology is also subject to the limitations listed. Cost is the primary deterrent SMEs' adoption of new technologies. Similarly, this covers the price of buying the equipment, keeping it maintained, and hiring employees. Despite this obstacle, the survey discovered that businesses prioritize technology and a aware of its advantages for future expansion (Wamba**,** 2016). For example, the article highlights that while RFID-IoT attendance systems offer benefits, drawbacks hold them back (Unnati, 2021). The biggest obstacle is cost, especially for smaller institutions.

Management and employees lack technical knowledge and skills, which is a barrier because adopting training and expertise is difficult for SMEs to manage inventory and is necessary for effective usage of technologies (Usman, 2021). Compare with the study by (Serawitu, 2020**)** emphasized that a major obstacle is the absence of ingrained knowledge and abilities to apply transformation methods. The ineffective skills for communicating the tools and the high turnover of office holders compound this lack of knowledge. A significant obstacle for SMEs, according to the research above, is a lack of ingrained abilities and knowledge necessary to apply transformation tools. Somehow, SMEs find it difficult to implement new technologies in inventory management because of a lack of funding and training, a high staff turnover rate, and inadequate communication. As a result, SMEs should spend money on training, cut down on employee turnover to address these problems.

The adoption of technology in SMEs has been hindered by security and privacy issues. This is because mainly technology devices, which generally have limited processing power and storage, are susceptible to cyberattacks and often do not have sufficient security mechanisms in place (Obaidat, 2020). Therefore, privacy and data security are both emphasized. SMEs must secure sensitive data since they depend on

technology for logistics, but they face challenges due to a lack of resources, a lack of experience, and a lack of attention on security (Khan, 2020). Moreover, to address security weaknesses in software systems inside the technology software, the article proposes security methods such as cryptography, privacy, and authentication, and classifies assaults according to their impact. It emphasizes the difficulties and potential avenues for future security system research, stressing the importance of addressing security and privacy issues when SMEs use software (Kumar, 2021).

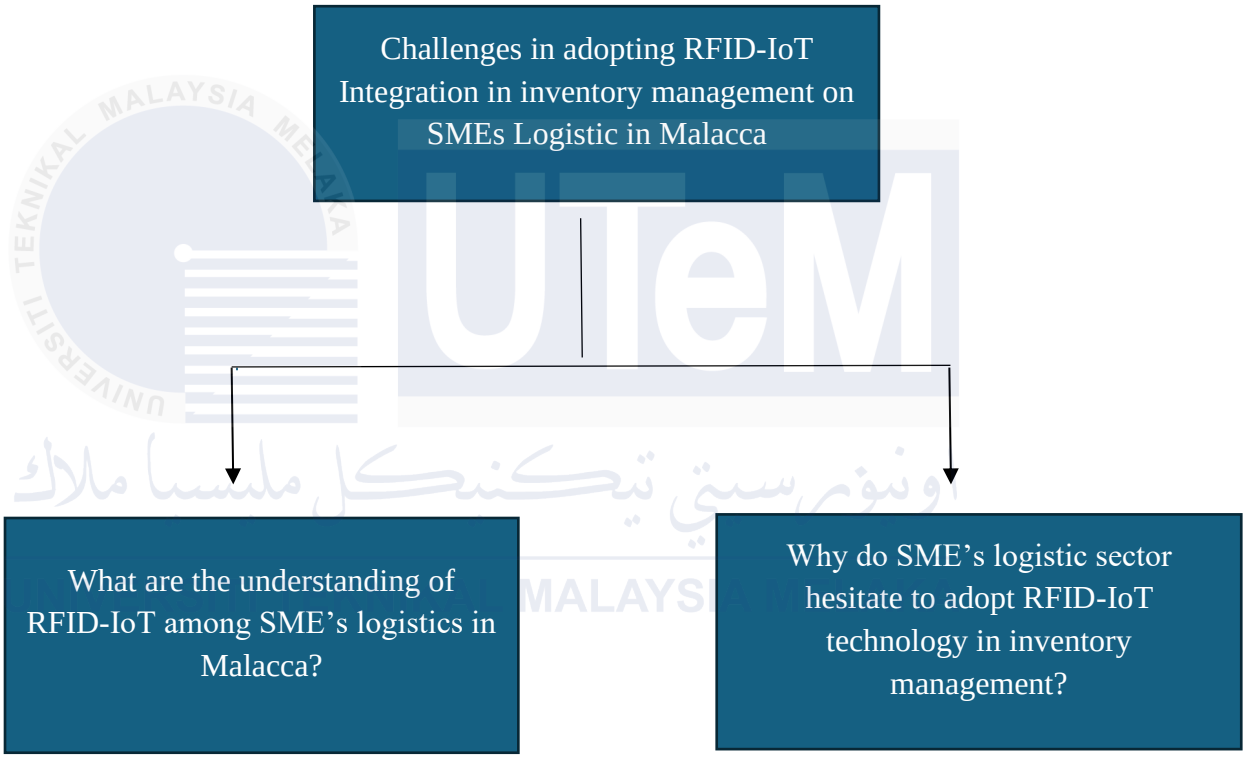
Resistance change is one of the factors being difficult to adopt technologies that concerned by authors in several research. SMEs' hesitation to adopt new technologies due to of their concerns over security, interoperability, and trust (Varriale, 2021). Subsequently, another author mentioned in study that resistance issues as important barriers to SMEs' adoption of technologies to manage inventory. Managing communication interference and data processing about inventories, combining WSNs, and turning systems into sensing platforms are some of the challenges, despite the potential rewards. Thus, wearable sensor technology has increased complexity (Landaluce, 2020). In other point, the study examines, technology adoption in SMEs may be hampered by resistance to change because of worries about compatibility, the need for retraining, and disruptions to productivity (Anuj. 2020).

Many SMEs encountered a capital obstacle, according to the findings. Entrepreneurs cannot invest in hiring a qualified worker or implementing information technology in their firm without sufficient funds or financial resources (Rizad, 2019). Based on the research by (Kumar, 2022) SMEs may find it difficult to fully embrace technologies and take use of the advantages of technology due to a lack of funding and resources. Similarly, another author stated that, one of the main causes of SMEs' failure has been financial constraint or a lack of financial resources. SMEs have faced fierce competition in the present business climate. Limited resources being challenges for them to face their competitors in the market (Ambad, 2020).

For SMEs with limited resources, the high costs of adopting new technology which include training and implementation expenses in addition to the technology itself, can be rather difficult (Kumar, 2021). SMEs frequently lack the technical know-

how and personnel needed to effectively adopt and use new technology (Zamani, 2022).

2.3.1 CONCEPTUAL FRAMEWORK



2.1 Conceptual Framework

The purpose of this study is to identify the challenges that Malacca's small and medium-sized businesses (SMEs) have in implementing RFID and IoT integration into their inventory management systems. Although earlier research has addressed the general barriers to technology adoption, the goal of this study is to identify the reasons why SMEs in the logistics industry haven't fully adopted this technology. Researcher investigated challenging matters. Thus, the primary objective here is to understand the

ways in which SMEs in Malacca's logistics sector view and handle RFID-IoT technology, as well as the reasons behind their hesitation to implement it in their inventory departments. Researcher successfully gather information from interviews and conversations with important industry participants that help to overcome these obstacles and improve RFID-IoT adoption.

CHAPTER 3

METHODOLOGY

3.0 Introduction

The research methodology used for this study is highlighted in this chapter. This chapter will outline the research design, methodology selections, data gathering techniques, sample strategy, and data analysis used in the study.

3.1 Research Design

The purpose of the research design is to provide an appropriate framework for a study. Selecting a research approach is a crucial step in the research design process since it determines how pertinent data will be acquired for the study. The objective of the descriptive research design used in this study is to accurately profile the phenomenon of interest. Because it enables the collection of data from a broad range of respondents and offers a thorough description of the research findings, The term "research design" refers to the plan or approach that details how a research study will be conducted. It provides a path map for researchers to explore a particular research question or hypothesis and gather relevant data to meet the study's goals. Enhancing the validity, reliability, and generalizability of research findings is possible with a well-

designed study. There are three fundamental sorts of research designs that can be employed in a study: explanatory, descriptive, and exploratory (Sileyew.K. J., 2019) . For this investigation, the exploratory design will use.

3.1.1 Exploratory Research

In qualitative investigations, exploratory research is a kind of study intended to provide further insight into an unclear topic or issue. It is employed to discover fresh prospects, comprehend customer behaviour, and investigate hard-to-measure phenomena. Because of its adaptability, exploratory research can answer any kind of research question (what, why, how). It can be carried out with qualitative techniques like in-depth interviews, focus groups, and observational studies, and is frequently used to develop formal hypotheses (Tegan George, 2021). The second type, which is used in this study, involves examining an issue that already exists to produce fresh concepts and hypotheses. In exploratory research, qualitative methods are often employed to gather comprehensive, descriptive data.

The researcher interviewed four persons from various logistics organizations, including SMEs' warehouse assistants, logistics coordinator and custom officer of whom had a distinct perspective of view. These interviews not only helped me identify challenges such as low understanding of RFID-IoT technology, high costs, resistance to change, but they also provided researcher with many new recommendations. Some attendees talked about alternatives to RFID-IoT, such as barcode-based inventory systems and manual tracking techniques. It helped researcher comprehend the various options in use and sparked ideas for how to overcome the hurdles of implementing RFID-IoT technology.

3.2 Data collection method

The two primary categories of data collecting that needed to be obtained were primary and secondary data sources. To conduct this study, the researcher used data from both sources.

3.2.1 Primary Data

Primary data are personal experiences that the researcher has collected. Primary data sources include things like surveys, observations, questionnaires, focus groups, case studies, and interviews (Ajayi,V.O.,2017). For this study, the interview method was chosen. They involve a one-on-one or small-group discussion between the respondent and the researcher in which the respondent responds questions the researcher poses. Next, Interviews are done to get information about a certain group of topics. There are differences between surveys and interviews in terms of how much structure is imposed on the dialogue (Maegaret, 2009). Semi-structured interviews are casual discussions, in which the researcher delves deeply into a broad subject that piques their interest, starts posing pertinent questions, and pays close attention to the responses to investigate them deeper (Olenik, 2021). With a semi structured interview form, the researcher gathers primary data throughout the interview. By conducting a semi-structured interview, the researcher can gather more detailed information about the obstacles to implementing RFID-IoT integration in inventory management for the logistics of SMEs (Arabelen, G et. al., 2021).

3.2.2 Secondary Data

Secondary data is information that has will be collect by another organization for a purpose other than the current study work. It is data that is already available and can will be find in a variety of places, such as government agencies, scholarly publications, research facilities, books, internet databases, as well as previous studies. (Ajayi,V.O.,2017) Most of secondary data is about the past of the natural world and is derived from published research, official statistics, news items, diaries, letters, and government reports. The researcher used secondary data to identify the obstacles to the adoption of RFID-IoT, which will exclusively source from books, websites, and online journal papers.

3.3 Sampling Strategy

Sampling, or selecting a subset of subjects or units from a larger population for a study, is an essential part of research (Berndt, 2020). In qualitative research, sampling is used to ensure that rich, diverse data are collected to provide in-depth understanding and insights into the research issue. In qualitative research, sampling will use to ensure that rich, diverse data are collected to provide in-depth understanding and insights into the research issue. Sampling is the process of choosing study subjects or participants. Since quantitative research depends on quantifiable data, it employs bigger samples to guarantee statistical validity and generalizability. Comparatively, because qualitative research analyses data for insights rather than quantifies it, it employs smaller samples and concentrates on reaching saturation, which is the point at which no new information is collected (Aldaihani, 2022).

3.3.1 Purposive sampling

A purposive sample is one whose attributes are specified with the intention of being pertinent to the research. The sample becomes more purposeful the more inclusion and exclusion criteria are established, each for a necessary reason. The sample for this research would include SMEs' warehouse assistants, logistics coordinator and custom officer because they are familiar with, they can offer thorough explanations of the operational, technological, and strategic difficulties associated with implementing RFID-IoT integration in inventory management. Moreover, purposive samples have numerous advantages. For instance, researchers may limit their research to a population of particular interest, homogenize their sample (which reduces inter-subject variance and makes obtaining statistical significance easier), or exclude participants who pose a severe risk of adverse outcomes. Purposive samples have the same drawback as convenience samples, though: the more purposeful the sample, the more constrained the external validity will be (Andrade , 2020). In any case, it is critical to recognize that selection bias is an additional risk associated with purposive sampling. Which people are included in the study is mostly determined by the researcher's judgment and subjectivity. Researchers should be open and honest about their selection criteria and give a justification for their choices to increase the transparency and credibility of the study (Walker, K. 2020).

Purposive sampling guaranteed that research participants were carefully selected based on the study's objectives. It enables the participation of individuals who have been directly involved in logistics and inventory management, such as SMEs' warehouse assistants, logistics coordinator and logistics personnel, whose hands-on experience with operational, technological, and strategic challenges is invaluable for an RFID-IoT integration study. To increase transparency and trust in the study, eligibility requirements are stated and justified while also providing some significant findings.

3.3.2 Sampling Size

In Malacca, Malaysia, the researcher specifically sought out respondents for interviews, including SMEs' warehouse assistants, logistics coordinator and custom officer. Through the interview, the researcher has attempted to achieve the goals of the study. Consequently, the sample size requirements in this qualitative study reflect the expert's judgment rather than being determined by statistical computations. A mathematical model shows that 85% of interface issues can be found by a researcher using a qualitative test with six respondents (Waldegrave, 2020).

With a focus on Ayer Keroh and Batu Berendam, the study investigated the difficulties in implementing RFID-IoT integration in inventory management within SMEs logistics in Malacca. The enormous industrial regions of Malacca, a major port and technology hub in Malaysia, offer a valuable framework for this study (Fam, 2018). The research attempted to uncover strategic, technical, and operational difficulties through interviews with SMEs' warehouse assistants, logistics coordinator and custom officer who dealing with SME logistic companies. This strategy seeks to give a thorough grasp of the obstacles to RFID-IoT adoption in Malacca's SME logistics industry.

Interviews with participants presented their perspectives on strategic and operational problems. While just a small number of participants were sampled, the results were extremely thorough in identifying the main challenges that SMEs encounter while using RFID-IoT technology. These interviews also identified any other alternative ways that are currently in use, such as barcode-based inventory systems, and provided practical advice for how to overcome any challenges in the adoption process. This concentrated strategy guaranteed that the study was in-depth while being manageable.

3.4 Data Analysis

Data analysis transforms the gathered row data into concepts and facts that may be comprehended either qualitatively or quantitatively. It involves analysing the tabulated data to find underlying truths or meanings. It entails disassembling currently complex aspects into smaller, more manageable components and rearranging the components for the sake of understanding. One method of data analysis that assists in describing or interpreting the data through language that conveys information in various. Data analysis in qualitative research often involves repeated rounds of data collection, analysis, and refinement. Throughout the analysis step, new views or pathways can emerge due to the method's adaptability(Dibekulu, 2020). As a result of the qualitative data analysis, the primary obstacles were determined to be high implementation costs, technical complexity, and a shortage of qualified staff. It will take monetary backing, technical support, and focused training initiatives to address these issues.

In this study, data analysis entailed breaking down complex interview responds into smaller components, reorganizing them, and identifying patterns and meanings underlying the data. The interactive nature of the research allowed the researcher to make continual revisions, allowing for a more data collected. It also identified multiple obstacles to RFID-IoT adoption among logistics-related SMEs using qualitative data analysis. The most significant challenges were high implementation costs, technological complexity. Based on these data, it is possible to conclude that solutions to such issues may include financial help, technical guidance, and specialized training programs.

3.4.1 Thematic Analysis

The process of finding and analysing patterns or themes in a data set is known as thematic analysis, and it often leads to fresh perspectives and understanding (Naeem el at., 2023). Similarly, another study mentioned thematic analysis is a technique for methodical organization and analysis of complicated data sets by researchers. Finding themes that can encompass the stories found in the accounts of data sets is what it entails. It entails carefully reviewing and rereading the recorded data to identify. This procedure facilitates the discovery of preliminary concepts or patterns as well as a comprehensive knowledge of the data (Dawadi, 2020).

The survey identified several critical issues, including a lack understanding and knowledge, financial constraints, resistance to change, and reliance on alternative systems such as barcode-based inventory management. This analysis method assisted the researcher in organizing replies into logical narratives that represented shared experiences and views. Theme analysis also helped to a thorough recognize of the difficulties, resulting in practical solutions addressed to the needs of SMEs. Thematic analysis has ensured that the study's conclusions are thorough and based on the participants' experiences.

3.5 Summary

To sum up, this chapter clarified the methodological selection, sample plan, data gathering method, and data analysis instrument employed in the construction of this study. The research methodology employed in this study was the qualitative technique. Following neither in-person interviews with the respondents, the researcher compiles the primary data from their findings. Newspapers, periodicals, and books are a few instances of secondary sources of information. It was utilized to learn more and comprehend the subject. The following chapter presents the data from the field study and the data analysis carried out using a qualitative technique.

CHAPTER 4

FINDING AND ANALYSIS

4.0 Introduction

This chapter will present the results of data analysis from the data collection. To collect the researcher has done semi structured interview at Batu Berendam and Ayer Keroh, Malacca via face to face and online. After the data is collected from interviews, transcript was written and use thematic analysis method to analyse data collected from the participants in this study. There was five different sector of logistics companies has been interviewed. It is divided into four sections which are the interview results gained from the perspective of logistic company on the current inventory management practices, awareness and perception of RFID-IoT, challenges in adopting RFID-IoT. Also including the demographic of the respondents.

4.1 Demographic Information

4.1.1 Respondent 1

She was employed here as a coordinator of logistics. The company's primary business is collecting parcel from various company and delivering parcel to the end customer.

4.1.2 Respondent 2

Respondent 2 has been employed at ABC company for 4 years. He has completed Diploma in higher education. He was employees at this company as a warehouse assistant. The company's primary business focus in offering 'One Stop Total Procurement Logistics Services & Solution' to both domestic and foreign clients, covering most of the nation.

4.1.3 Respondent 3

Respondent 3 has been employed at custom office, Malacca almost 10 years. She has completed Degree in higher education. Before promoted as officer she worked as custom clearance clerk. The company's main activities are trade facilitation, border security, data management and analysis, documentation and inspection and anti-fraud and compliance.

4.1.4 Respondent 4

Respondent 4 worked at SME logistic company XYZ at Batu Berendam around 2 years. He has completed Degree in higher education logistics field. He was employees at this company as a inventory clerk. His company's objective is to enhance customer satisfaction by providing excellent customer service. They handling shipping progress and delivering process,

4.2 Understanding of respondents

Table 1: Understanding of RFID-IoT integration among SME logistics companies In Malacca

Respondent	Respondents Statement	Understanding of RFID-IoT integration among SME logistics company
1	*"Err… no. I understand that IoT is about connecting devices,but am not sure how it coexists with RFID. In our case, there is no integration, the RFID scanner simply pushes this information to our computers, and we handle it ourselves. What edition of integration are we talking about?"*	● No integration with the current system ● Basic knowledge of RFID ● Limited understanding of IoT
2	*"Hmmm. Im familiar with the name of the system but not sure about the usage and function of the system".*	● Only familiar with the name of RFID and IoT ● Lack of Applied or Practical knowledge. ● Knowledge Gap
3	*"Well, from what I have seen here in Malacca, IoT is not very familiar or widespread in logistics. RFID is implemented in some companies, but the application is limited; basically, it is just used for scanning items".*	● Limited adoption of IoT ● Basic implementation of RFID

Respondent	Respondent Statement	Understanding of RFID-IoT among logistics field
4	"*Yeah, of course. Radio-frequency identification can be attached on products, while upon scanning , the data transmits in real time to an IoT system. The interesting part is gives you updated stock levels without delay and facilities automatic tracking, rather that by manual counting of items. In fact, with larger operations, it's super efficient, the inventory is a lot more accurate, a lot fewer errors and save a lot of time".* *"Well, we think about it or, indeed, discuss with a couple of times, but actually, this is not called for so far. The one we have here operated well for us, too. We follow just a simple bar-coding system for keeping track, then doing it manually in the database. Well, not exactly automated, still serves for this scale of operation".*	● Known very well ● Automation and accuracy ● Real Time data transmission using IoT ● Efficient in the larger operation ● Not using the system due to handling small quantity of stock.

As shown in the table, these are the understanding about RFID-IoT among logistics companies that collected form the interview with respondent.

4.2.1 Respondent 1

Based on the statement given by the respondent, the employee not having clear picture of integration of RFID-IoT system. This insufficient integration with the current system, a having knowledge about RFID shows that employees in logistics companies having limited understanding of the IoT. This situation could cause problems for businesses looking to implement innovative inventory management technology. According to one expert, for instance, there are major difficulties when SME businesses do not integrate well enough to manage their entire operations, including inventory management (Imamuddin, 2021). Moreover, lack of basic RFID knowledge could prevent this technology from reaching its full potential. Although RFID technology has several advantages, like better inventory control and increased security, those who simply have a basic understanding of the technology might not fully appreciate all its possible uses (Nayak et.al., 2022).

Based on the conversation with the employee, can find out that their company using RFID daily. Their system is centralized, and the information they collect is manually entered and shared with company initial investment owners or partners through our website. Here, the researcher can conclude that they just using the basic system and not using an IoT-enabled or cloud-based system for inventory management.

4.2.2 Respondent 2

Respondent 2 stated that even though they know about the RFID and IoT definition, still few of employees are lack knowledge or not much familiar about its terms. Unfortunately, due to limited exposure they are unable to utilize the usage of RFID technology. This may cause due to lack of interest in understanding about technologies (Kineber, 2023). According to the research, a lack of practical knowledge and understanding is one of the main obstacles preventing advance RFID technology from becoming widely used in warehouse environments. However, the author claims that a few numbers of small and medium-sized businesses are stuck with outdated technology because of a lack of acceptance and as a result, they do not prioritize updating to keep up with the times. The study justified in the way of supporting the idea that among SME's companies adoption of new technologies has identified a number of obstacles brought on by a lack of experience. Although the study only briefly discusses social media tools, it finds that the main obstacle in many technologies related fields, including RFID and IoT, is a general lack of understanding and awareness of the advantages of technology (Chouki et. al., 2022).

Based on the concern, the researcher can discover that since the company has so many subsidiaries, not all the branches or companies use the same system which is RFID-IoT to manage inventory. Here in Malacca, this SME company using manual system like they using Excel system to key in the inventory updates, while some of the branches mainly the main ones are using RFID-IoT technology. Based on the statement given by the respondent, even though they are using Excel, but then they facing biggest issue such as sometimes the stock is missed or incorrectly recorded, the quality of the system is lower, and prone to human error. For instance, some mistake might occur in taking out pallets, so it might cause a delay or confusion. Then, the process is not efficient in comparison with an automated system.

4.2.3 Respondent 3

According to the statement given by the respondent 3, the limited adoption of the IoT and the low adoption of RFID technology across several industries areas are attributed to their relatively early and basic implementations. This is because, although the required infrastructure is present in many businesses, it has not shown itself to be a practical safeguard against disregarding RFID integration into these systems on its own. For instance, RFID is commonly used for inventory control and asset tracking, but its additional benefits such as real-time updates, automation, and interface with other IoT devices are frequently disregarded (Apostol et. al., 2021). Moreover, a lack of understanding or awareness of the long-term benefits of these technologies leads to their limited adoption and often causes their slow or incomplete implementation. Furthermore, research discovered that among rural entrepreneurs, the hugest barrier to adoption is ignorance of technological services and the benefits that come with them. In these groups, lack of knowledge leads to slow adoption and insufficient use of digital services (Kamutuezu et. al., 2022).

Based on the respondent's point of view the researcher can illustrates that the government are handling all the documentation progress regarding inventory checking via manually before update the complete document in the custom system for custom approval and clearance. This is because to avoid several issues that would be discuss in the part of (4.4).

4.2.4 Respondent 4

From the statement given by respondent 4, we can see that this employee well known about the RFID integration of IoT terms and functions. He indicates that RFID tags, when connected with an IoT system, can transmit information in real-time and thus instantly update the stock levels. By using RFID enables optimization and improved decision making within supply chain. The study agreed that advanced RFID in industry 4.0 helps to improve operational progress and reduce cost by automating process and streamline logistic operation (Unhelker et. al., 2022). The respondent further asserts that the system automatically tracks goods, hence no manual counts of items, therefore, more accurate management of inventories, reduced errors, and saved

time. These attributes make the system particularly efficient for larger operation where manual process may be difficult. Based on the research, mentioned that the improvement in financial performance, customer service and efficiency were drawn on operational advantages because of automated tracking with reduced manual intervention due to RFID technology (Masudin et. al., 2020).

According to the discussion, this logistics company using simple barcode system because they mentioned that due to, they are categorized as small to medium business, they don't have the massive volumes of stock that require advanced tracking systems. Therefore, they just using a simple system.

4.3 Respondents overview

Table 2: Respondents overview the Challenges in adopting RFID-IoT integration among SME logistics company

Challenges	Respondents			
	1	2	3	4
a) Cost	X	X		X
b) Lack of understanding	X			
c) Scalability and Complexity	X		X	
d) Lack of expertise	X			
e) Compatibility	X			
f) Data Security issues			X	X
g) Resistance to change			X	X

Table 3: Themes for the Challenges in adopting RFID-IoT

integration among SME logistics companies

Sub – Categories	Categories	Emerging Themes
• High initial investment • Expensive • Purchasing new equipment • Tighter budget • immensely high.	Cost	Challenges adoption of RFID-IoT integration
• Lack of awareness • Unfamiliar • Lack of knowledge	Lack of understanding	
• Overhauling • Advanced • Linking to a cloud-based platform	Scalability and Complexity	
• No in-house IT specialists • Training requirements for existing staff • Need for skilled professionals	Lack of expertise	
Sub – Categories	**Categories**	**Emerging Themes**

• often use basic software • Overweigh	Compatibility	Challenges adoption of RFID-IoT integration
• data transmission • limited cybersecurity measures • afraid of data security	Data Security issues	
• Stick to basic or standalone	Resistance to change	

4.3.1 Cost

Cost means that the total amount of money, time, effort, or resources needed to finish a task. These could be financial, opportunity, or effort related. Emotional or societal effects may also be involved. Making wise business decisions requires having a solid understanding of costs. Below shows the respondents statement regarding the challenges they facing in the way of financial sector.

Respondent 1

"*Additionally, implementing such a system seems complex and costly, especially for a company of our size".*

"There's the initial investment. Setting up an IoT-enabled system requires purchasing new equipment, software, and possibly hiring IT professionals to maintain it. For a small business, this can be a huge burden".

"Setting up an IoT-enabled system requires purchasing new equipment, software and possibly hiring IT professionals to maintain it."

“These systems can get pretty expensive once you start factoring in all the tags, scanners, and supporting technology.”

“The return on investment takes time, and small businesses usually have tighter budgets."

Respondent 2

“The first and foremost would be the cost. RFID-IoT implementation involves a lot of devices, and since the company must manage inventory for the four subsidiaries it has, the costs can become immensely high. Hence, this system is mainly used only at the HQ and a few other branches”.

Respondent 4

"Oh, cost is definitely the biggest one. These systems can get pretty expensive once you start factoring in all the tags, scanners, and supporting technology. For smaller companies like ours, it's hard to justify spending that much when our current system works fine. The return on investment takes time, and small businesses usually have tighter budgets."

SMEs logistics company’s complete adoption of IoT-RFID integration into inventory management is hampered by the high installation costs. During the interview session and based on the respondents statements, it was revealed that the majority of the components use RFID tags and scanners, along with the required IoT infrastructure, which comes at a high initial cost. Businesses that manage inventories across several divisions may find the high level of expenses, which would prevent them from putting the system into full use.

According to the findings, RFID can be quite costly, particularly for businesses that manage inventories across several divisions. As a result, full-scale implementation may be discouraged. The expenses of RFID include a lot of tags, scanners, and required IoT infrastructure (Ugbebor et. al., 2024). Specifically, only headquarters and a small number of branches implement RFID-IoT systems because of money constraints. On the other hand, small budgets and strict budgetary constraints make it difficult for SMEs in general to justify investments in RFID-IoT when manual or barcode methods suitable for them. This limited them to explore towards advance technologies. Some

researchers proved that, which is SME companies find it difficult to defend investments in innovative technologies like RFID and the Internet of Things because of its limited financing and resources. The investigation of more effective solutions is further limited by both technological and economical constraints (Waqar, et. al., 2023).

4.3.2 Lack of understanding

Lack of awareness, knowledge, or comprehension on a specific topic, idea, or procedure is referred to as "lack of understanding." It's a vital part for a company to run their operation successfully. As example, when there is not familiar with the system or its advantages may hesitate or make mistakes. The respondent's remarks regarding the issues are included below.

Respondent 1

"Well, one of the main reasons is a lack of understanding and lack of awareness about IoT technology. Many of us aren't familiar with how it works or how it could benefit our operations".

Respondent 2

"Surely. These are very stringent, and there is a lack of knowledge regarding how such systems work and their benefits. Manually, we declare the thing to avoid any complexity we can".

The conversation illustrates the organization's extreme lack of knowledge of IoT technologies. Respondent 1 points to a knowledge gap that prevents the company from making the most of the technology and many employees are not aware of how the Internet of Things works or how it could enhance their operations. According to a study, a major obstacle to IoT adoption is the ambiguity surrounding ROI. The inability to compute ROI using established methods and the ambiguity around payback period make decision-making difficult (Shahriar et. al., 2024).

Additionally, the company continues to reduce perceived complexity using manual methods. As Respondent 2 noted, it is further highlighted by the lack of knowledge regarding the functioning of IoT devices and their possible advantages. The company is resistant to embrace IoT and still using more basic methods because of this lack of knowledge about the technology and its advantages. Based on researcher point of view, due to their lack of understanding and training, small and medium-sized businesses face significant obstacles when it comes to adopting IoT digital technologies and leading them to continue using traditional methods (Parab et. al., 2023).

4.3.3 Scalability and Complexity

Scalability refers to a system, process, network, or organization's ability to successfully handle increased demand, burden, or expansion without sacrificing performance, functionality, or quality. The term "complexity" describes how difficult it is to comprehend or apply a system or process, or how complicated it is. Because there are frequently several interconnected elements or variables at play, the process becomes even more complex.

Respondent 1

"*Additionally, implementing such a system seems complex and costly, especially for a company of our size".*

Respondent 3

"Then there is the complexity in the implementation of this system. From the government side, we don't have an integrated IoT system with logistics companies because it involves lots of procedures and approvals. You have to deal with multiple agencies, and that takes time."

These statements show that, to being difficult to integrate into current operations, SMEs find it difficult to integrate an IoT system since it requires advanced

technological terms. These problems are made worse by the lack of standardized standards across IoT devices, which makes system interoperability extremely difficult. The study also demonstrated that the easy integration of different technologies to enable communication across devices made by different department is being hindered by a lack of standardized protocols (Jawad H.M et. al., 2019). Scalability issues arise when trying to expand the IoT infrastructure in conjunction with growth, which puts additional strain on an already constrained set of resources.

According to the government, the intricacy stems from the need to contact numerous authorities, go through several procedures, and obtain numerous licenses, all of which delay execution. Ineffective data exchange and decentralized activities result from the government's absence of an integrated IoT platform. As a proof, the report stated decentralized procedures and inefficient data sharing may result from the lack of an integrated IoT platform (IoT Advisory Board Report, 2024).

4.3.4 Lack of expertise

The state known as "lack of expertise" occurs when a person lacks the abilities, know how, or experience required to complete a task successfully. It may make it more difficult to solve problems, make decisions, and be productive in general. This constraint could result from inadequate instruction, training, or hands-on experience in a specific field. Usually, getting the right training, experience, or expert advice helps people get over it. Based on the statement below can illustrates that the SME logistics companies facing this issue to adopt RFID-IoT integration system mainly to manage inventory.

There are, few respondents raise certain concerns.

Respondent 1

"Second, there's a lack of expertise. We don't have in-house IT specialists who understand IoT. Training existing staff or hiring new talent would add to the cost and take time".

The absence of internal IoT competency is one of the major issues, as was mentioned during the conversation. The organization now lacks IoT-experienced IT staff, which has a direct impact on the capacity to implement and oversee IoT-related projects. Operations are delayed, IoT system troubleshooting and optimization are ineffective, and there is a greater need for outside experts or vendors, all of which raise expenses (Agarwal et. al., 2024).

4.3.5 Compatibility

Compatibility known as the degree to which systems, methods, software, or hardware from one device may function with another without requiring significant modifications. Smooth operation is described by standard compliance, accessibility in applications, and hardware and software compatibility. Operations disruption, inefficiency, and data transmission issues might result from incompatibility.

There are certain issues raised by a few of respondent.

Respondent 1

"Lastly, there's the issue of compatibility. Our current system is centralized and relatively simple. Integrating IoT might mean overhauling our entire infrastructure. Plus, ensuring compatibility with our existing operations and the systems used by our courier partners would be another challenge".

Respondent 4

"Another thing is compatibility. Small companies often use basic software, and upgrading to advanced systems might require replacing or heavily modifying what we already have."

The comment drawn attention to the difficulty of incorporating IoT into a centralized system that already exists in their company. Because of the intricacy of IoT technology, the organization's current infrastructure may need to undergo major adjustments. The cost and resources required to replace the system, including the price of new hardware and software, as well as the estimated time needed for the replacement, should be evaluated through data analysis. Since it includes an evaluation

of the costs and resources required for system replacement, from the previous decades there isa theory that the system failures and the recovery process using hardware and software impact system performance, which helps assess the time and cost implications of replacing or upgrading systems (Kumar et. al., 2024).

Other than that, based on the statement, ensuring that an IoT system works well with the platforms that courier partners use and with the company's current operations is a second level of challenge. This is because integrating this new element may be a little tricky because it can necessitate modifying or temporarily stopping the current processes.

4.3.6 Data Security Issues

Any risks or weaknesses that may compromise the confidentiality, integrity, or availability of the data are Attacks, illegal access, inadequate encryption, human mistake, and system defects are some of the problems that could lead to data loss, abuse, and breaches.

Various concerns which represent a threat to sensitive data are referred to as data security issues.

a) Unauthorized access

b) Malware attacks

c) Data breaches

Here at below, a number of respondents raise certain concerns.

Respondent 3

"There are a few reasons. First, the companies and stakeholders are afraid of data security from a privacy point of view".

Respondent 4

"Plus, there's the concern of data security IoT systems involve a lot of data transmission and protecting that data can be a challenge for companies with limited cybersecurity measures."

The responses from the respondents 3 and 4 point to a serious issue with data security in Internet of Things devices. Although both subjects voice concerns about data breaches and privacy issues, respondent 4 talks about how hard it is to safeguard the data supplied by IoT systems, particularly for companies with inadequate cybersecurity defences. This worry makes companies less likely to use IoT technologies.

The report claims that users will be afraid to use IoT systems because of lax data protection laws, particularly in industries that handle sensitive data. The primary problems are the general vulnerability of networked devices, potential data leakage, and unauthorized access. According to the study, the huge quantities of data being transferred by IoT systems have resulted in issues with data security and privacy. It claims that companies without the proper cybersecurity safeguards face the risk of creating weaknesses that might be quickly taken advantage of by cybercriminals (Delcourt et. al., 2020).

4.3.7 Resistance to change

When people, groups, or organizations are reluctant or opposed to changes in long standing customs, procedures, or organizational structures, this is referred to as resistance to change. It usually stems from a fear of the unknown, a sense of helplessness, uncertainty, or unease with new techniques or technologies. Resistance may prevent change from being implemented successfully and can take the form of diminished productivity, active opposition and techniques for progressive implementation.

Here, several respondents mention certain problems.

Respondent 3

"*Exactly. Many companies stick to basic or standalone inventory systems because they're cost-effective at first, but these systems just can't keep up as things scale."*

Respondent 4

"Yeah, exactly. We're a small-to-medium business, so we don't have the massive volumes of stock that require advanced tracking systems. The barcode system is simple, efficient, and cost-effective for us. We've looked at the pros and cons of upgrading, but for now, the investment in RFID and IoT doesn't seem worth it."

SME's logistics company frequently oppose change when it comes to updating their inventory systems, as demonstrated by the responses from Respondents 3 and 4. According to Respondent 3, basic inventory systems are inexpensive in the short run, but as a business expands, they become less effective. Respondent 4 claims that because of the nature of their business, the barcode they currently use is enough and that their requirements do not warrant the use of such a costly method as tracking systems that are represented by RFID and IoT.

This generally reflects their resistance to change, where costs are a worry, perceived complexity of newer technologies, and overall satisfaction with the current situation serve as obstacle. Here, the study stated that the same point which is smaller businesses don't feel the need to switch from low-cost options like barcodes right once (Chen et. al., 2023).

4.4 Summary

In summary, the data collected from interview are analyzed by using the thematic analysis. The data analysis conducted in this research includes a demographic information, understanding of respondents regarding RFID-IoT integration and the challenges to adopt integration of RFID-IoT in inventory management among SME's logistics companies. From this researcher found about the challenges for adopting the system for inventory management. After the data analysis, the results of the data analysis will help the researcher to continue the chapter 5 and discuss the interpretation and discussion of the results, limitations, significant and recommendations for the overall study.

Chapter 5

CONCLUSION

5.0 Introduction

As the result has been discussed in chapter 4 by researcher, this chapter will underline the conclusion and comment concerning the finding. The research objectives and questions have been answered in this chapter on knowing the understanding and challenges on adopting the RFID-IoT integration among SME's logistics companies. Furthermore, there are some suggestions, significant and limitation of research that given by researcher for further research will also discuss as a reference to continue the study in-depth on this research which related to RFID-IoT integration.

5.1 Research Recommendations

The research contributes to the SME logistics company via improve in the way of understanding the opportunities and difficulties associated with RFID-IoT integration into inventory management in Melaka area. Using the features of SMEs in this area as a focus, this study emphasized the understanding of employees regarding the technology or inventory system which can improve overall organizational performance, inventory accuracy and operational efficiency. The adoption of such technology could be challenging due to various factors that illustrates in the Chapter 4 such as cost, lack of understanding, scalability and complexity, lack of expertise,

compatibility, data security issues, and resistance to change. The researcher use thematic analysis to collect the data above to achieve the research objectives.

The management structure for the ready adoption of RFID-IoT, workshops, training on understanding and raising employee awareness, support in providing resources, and an organizational culture that embraces technological advances, mainly the owner and the manager of the company, all of which must be actively adopted by the top management team, are a few crucial building capacity measures that all SME logistics firms in Malacca must implement. It is crucial for the organization's top leadership to steer it toward a strategic goal involving the implementation of technology to increase inventory management efficiency.

In addition, working together with government agencies and business partners can be very important for getting over financial obstacles. The cost of implementing RFID-IoT systems can be lessened for SMEs with access to funding programs, subsidies, and technical. Additionally, pilot initiatives that demonstrate successful implementation in comparable organizations might offer useful insights and boost SME’s confidence. SME logistics companies in Melaka can position themselves to acquire a competitive edge in the industry, improved inventory control, and increased operational efficiency by tackling these issues and utilizing the knowledge gathered from this study.

Overall, the study concluded that to fully benefit from RFID-IoT technology, which will provide improved inventory management and operational performance for long term competitiveness in the logistics sector, SMEs in Malacca must work to overcome these obstacles.

5.2 Direction for future studies

This study mainly used a qualitative approach to determine the obstacles SMEs in Melaka face while implementing RFID-IoT technology in their inventory management procedures. The quantitative methodology can be used to supplement future research, even though this method offered a comprehensive perspective. Future research, for example, might use the results by surveying or piloting more SMEs to gather quantifiable data that would support the study and demonstrate the findings' generalizability (Leisenring et. al., 2020). These financial feasibility factors, whether determined by cost-benefit analysis or by creating strategic frameworks tailored to SMEs, may also lead to workable solutions for addressing the issues raised.

Further study might be done to investigate whether these outside variables such as government incentives, relevant laws, and vendor assistance really facilitate the RFID-IoT technology adoption process. Comparisons across regions or industries may also highlight best practices and scalable solutions that SMEs in Malacca could use to get past obstacles like expertise and cost. Using both qualitative and quantitative data, a mixed-methods approach helps to better understand the adoption of RFID and IoT. This method works well for researching how RFID-IoT adoption affects SMEs numerically as well as through individual experiences and challenges.

5.3 Achievement of research aims and objectives

5.3.1 Fulfilment of objective 1

'To explore the understanding of RFID-IoT among SME's logistics in Malacca'

According to the study, most workers in Malacca's SME logistics industry are familiar with RFID, particularly when it comes to scanning and verifying things to keep inventory. Nevertheless, only a small number of employees were able to describe the "Internet of Things," or IoT, and how it interacts with RFID. Many respondents had no idea how RFID and IoT will work together to improve inventory management procedures by presenting real-time data. Such a gap of knowledge implies a partial lack of understanding of the region's full potential for combining RFID with IoT systems. Additionally, Moreover, the results show that the factories covered in Chapter 4 do not have a substantial RFID-IoT implementation because the SMEs in the Malacca region have not yet embraced such systems. According to this, RFID integration with IoT is still mainly unexplored and underutilized in the local logistics industry, even though it is acknowledged and employed to some degree for inventory management.

5.3.2 Fulfilment of objective 2

'To uncover the reasons of SME's logistic sector, hesitate to adopt RFID-IoT technology in inventory management in Malacca.'

This study analyses the main obstacles that Malacca SMEs face when attempting to use RFID-IoT technology for inventory monitoring. Among the factors found are the following:

a) Cost

A significant obstacle to the adoption of RFID-IoT technology is the substantial upfront expenditure. It is exceedingly expensive for SMEs with limited funds and resources to purchase RFID tags, IoT sensors and system infrastructure support.

b) Lack of understanding

Although most workers are familiar with RFID technology, few are aware of what IoT is, how it expands RFID's capabilities, and the potential advantages. This is another reason to avoid switching to more complicated, potentially costly systems before being informed of their benefits.

c) Scalability and complexity

For SMEs, the scalability of RFID-IoT systems and the perceived complexity of installation pose further challenges. Many small and medium-sized businesses might not have faith in their capacity to handle the complexity of setting up and maintaining the systems or grow the technology to meet their needs. Most small and medium-sized enterprises in the Malacca region lack the technical knowledge required to successfully deploy and oversee RFID-IoT systems. Businesses are reluctant to invest in such systems because they fear operational disruptions or inefficiencies if there is no qualified staff to supervise the installation and continuous operation.

d) Lack of expertise

Many SMEs in the Malacca region lack knowledge in how to use technological terms required to successfully deploy and oversee RFID-IoT systems. Businesses are reluctant to make the investment because they are concerned about possible operational disruptions or inefficiencies if there is no qualified staff to supervise the installation and continuous operation of such systems.

e) Compatibility

The incompatibility with current systems is an additional obstacle. For inventory management, many SMEs in the area currently employ conventional techniques like barcode systems. Integration with these previous technologies is necessary for the shift to RFID-IoT technology that requires integration with this system which can be challenging in the wise of cost and can consume the time.

f) Data security issues

Whenever new technologies are adopted, data security risks arise. SMEs may be worried about the security and privacy of inventory data since the integration of IoT into RFID systems generates a large amount of data that is delivered and stored. The difficulty to adopt RFID-IoT systems is hampered by such concerns about data breaches and illegal access to private company information.

g) Resistance to change:

When it comes to RFID-IoT integration, resistance to change is the main element that has led to a sense of hesitancy to adopt new technologies. Many SMEs don't want to disrupt their business since they have established inventory management procedures.

5.4 Significant of study

This study plays an important role in assisting many stakeholders understand the situation with the use of RFID-IoT technology in the inventory management of SMEs in Malacca. These findings will be valuable for small and medium-sized enterprise logistics companies in terms of practical benefits and problems associated with implementing an RFID-IoT system. Such insights will assist SMEs in optimizing inventory management processes,
reducing human labour while increasing operational accuracy and efficiency.

This implies that the study highlights specific challenges that SMEs experience, like cost limits which policymakers and government organizations such as Malaysian Digital Economy Corporation (MDEC) should be aware and make decision to upgrade the technology usage among SME's companies. This information can be used to establish targeted rewards, training programs, and subsidies to assist SMEs in adopting digital technology, aligned with Malaysia's Industry 4.0 strategy.

The study is also useful to the logistics industry, as it identifies difficulties like as scalability and compatibility that affect SMEs. RFID-IoT solution vendors can apply these insights to create cost-effective, scalable, and user-friendly systems for

small firms. Additionally, students may receive research papers to read when conducting research or studying the RFID-IoT integration system. This study approach assured that its adoption had a favourable impact on specific agencies, the government, policies, industry, and students, all of which contributed to Malaysia's overall economic growth.

5.5 Limitation of studies

This study has offered insight into the challenges and potential for RFID-IoT adoption in inventory management among SMEs in Malacca, nevertheless, many limitations should be noted. The first drawback is the study's geographical length. The research focuses solely on SMEs in Malacca and may not be representative of SMEs in other states or areas of Malaysia. Different areas will have varying levels of technological adoption, infrastructure, and industrial needs, which may affect the generalizability of results. The study is mostly qualitative in nature, with thematic analysis primarily derived from interviews with a small number of respondents. While this gives valuable knowledge, it may be missing in broader statistical confirmation, which may be obtained through a more quantitative investigation. It is stated that additional research with larger sample sizes and quantitative surveys could make up for these limitations. Lastly, it focuses on specific obstacles such as cost, lack of knowledge, and technical expertise. These are, indeed, essential considerations but, other features, such as long-term benefits, return on investment, and external factors such as government incentives and vendor support, have not been thoroughly investigated; a comprehensive approach would therefore add to the numerous amounts of information gathered.

5.6 Conclusion

In conclusion, this study provided insight into how SMEs in Malacca use RFID-IoT technologies to manage their inventories. It also emphasizes the fact that technology may significantly improve inventory procedures to achieve high accuracy, efficiency, and cost control. Although RFID-IoT has been successfully implemented in bigger businesses, SMEs face significant obstacles due to financial restrictions, technical skill limitations, and resistance to change, among other issues. These difficulties must be solved so that SMEs do not fall behind in the industry 4.0 transformation.

On the other side, the findings revealed that, despite awareness of the potential benefits of RFID-IoT, its adoption by SMEs remains hindered by several concerns, including high costs, incompatibility issues, and unprepared workforces. This necessitates personalized approaches that include government assistance, training programs, and scalable solutions to aid in the adoption of sophisticated technologies. Once these obstacles are overcome, SMEs can transition from traditional to efficient and automated inventory management procedures, resulting in increased growth and competitiveness in the broader logistics business.

Furthermore, the transition from manual inventory management to the use of RFID and IoT is crucial in modernizing supply chain processes. This could improve decision-making, reduce labor costs, and assist SMEs in adapting to global technological advances. In this regard, current research recommends using RFID-IoT technology as the key to long-term and innovative inventory management. This requires a focus on technological adoption and overcoming highlighted difficulties, allowing Malacca SME's to benefit from new opportunities, improve operational efficiency and ultimately contribute to Malaysia's higher economic growth in the industry 4.0 years of age.

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APPENDIX

APPENDIX I

Gantt Chart of Final Year Project (FYP 1)

Appendix
Gantt Chart PSM 1

Week/ Activities	Time Scale (Week)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FYP talk															
Meering with supervisor & Briefying about FYP 1															
Discussion Chapter 1															
Completion of Chapter 1:															
Proceeding with chap 1 and explore to other chapters															
Discussion Chapter 2															
RO & RQ Construction															
Discussion Chapter 3: Research Method															
Check Chapter 1 & 2															
Check Chapter 1, 2 & 3															
Presetation 1															
Revised of FYP 1															
Submission of FYP 1															

APPENDIX II

Gantt Chart of Final Year Project (FYP II)

Appendix
Gantt Chart PSM 2

Week/ Activities	Time Scale (Week)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Briefing for FYP 2															
Brainstorming for data analysis															
Discussion of questionnaire															
Questionnaire development															
Correction															
Submission of questionnaire															
Data collection															
Do analysis															
Do findings															
Recheck data analysis															
Chapter 5															
Full report															
Preparing poster for Viva presentation															
FYP 2 Presentation															
Correcting report based on Panel's comments															
Submission of FYP 2															

APPENDIX III

University Interview Permission Letter

Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya,
76100 Durian Tunggal,
Melaka, Malaysia.

+606 270 1000
+606 270 1022
www.utem.edu.my

FAKULTI PENGURUSAN TEKNOLOGI DAN TEKNOUSAHAWANAN
Tel : +606 270 8002 | Faks : +606 270 1043

Rujukan Kami (Our Ref): UTeM.700-2/2/8 (50)
Rujukan Tuan (Your Ref):
Tarikh (Date): 23 Oktober 2024 /20 Rabiulakhir 1446H

KEPADA PIHAK YANG BERKENAAN

اَلسَّلَامُ عَلَيْكُمْ وَرَحْمَةُ اللهِ وَبَرَكَاتُهُ

Dan Salam Sejahtera,

Tuan/Puan,

MEMOHON MENDAPATKAN MAKLUMAT DAN KAJIAN KES UNTUK MENYIAPKAN TUGASAN PROJEK

Dengan segala hormatnya perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pelajar berikut adalah merupakan pelajar **Program Ijazah Sarjana Muda Fakulti Pengurusan Teknologi dan Teknousahawanan (FPTT)**, Universiti Teknikal Malaysia Melaka (UTeM):

No	Nama	No. Matrik	Kursus
1	THIVIYA A/P PARANIKUMAR	B062110079	Ijazah Sarjana Muda Pengurusan Teknologi Dengan Kepujian (Pengurusan Rantaian Bekalan Dan Logistik) - BTMS

3. Pelajar tersebut perlu menyiapkan satu tugasan bagi Projek Sarjana Muda (PSM II) - BTMU 4084 untuk tahun akhir pengajian. Sehubungan dengan ini pihak kami amat berbesar hati sekiranya pihak tuan dapat memberi peluang kepada pelajar berikut untuk menyempurnakan tugasan tersebut di organisasi tuan.

Sekian, harap maklum.

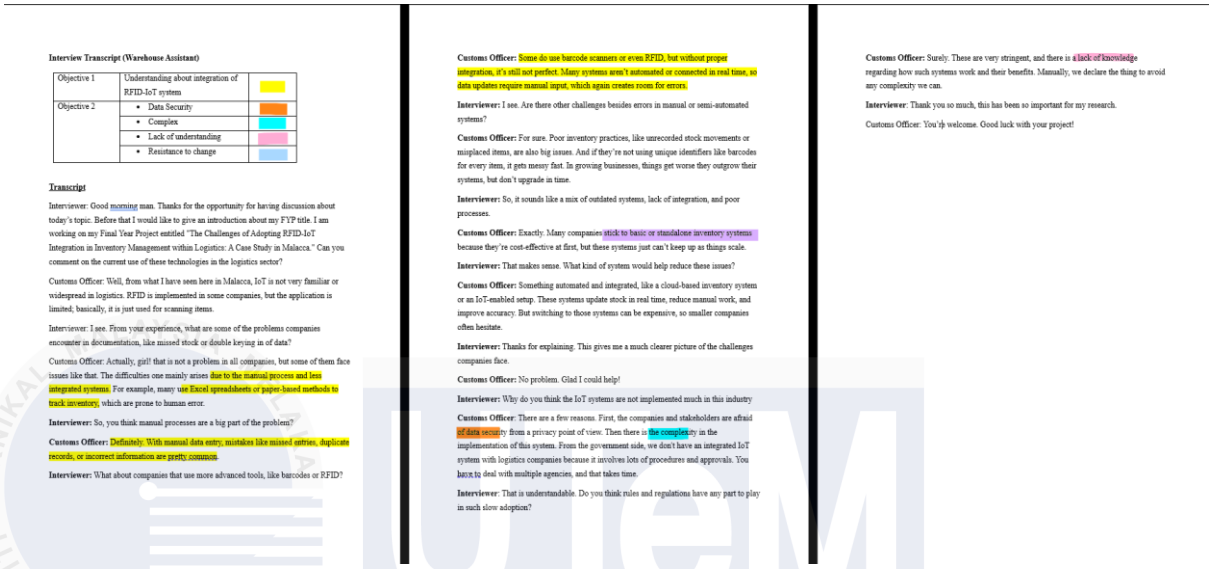
"MALAYSIA MADANI"
"BERKHIDMAT UNTUK NEGARA"
"KOMPETENSI TERAS KEGEMILANGAN"

Saya yang menjalankan amanah,

DR. MOHD AMIN BIN MOHAMAD
Timbalan Dekan (Akademik)
b.p : Dekan
Fakulti Pengurusan Teknologi dan Teknousahawanan

APPENDIX IV

Interview Transcript with colour code



Interview Transcript (Warehouse Assistant)

Objective 1	Understanding about integration of RFID-IoT system	
Objective 2	• Data Security	
	• Complex	
	• Lack of understanding	
	• Resistance to change	

Transcript

Interviewer: Good morning man. Thanks for the opportunity for having discussion about today's topic. Before that I would like to give an introduction about my FYP title. I am working on my Final Year Project entitled "The Challenges of Adopting RFID-IoT Integration in Inventory Management within Logistics: A Case Study in Malacca." Can you comment on the current use of these technologies in the logistics sector?

Customs Officer: Well, from what I have seen here in Malacca, IoT is not very familiar or widespread in logistics. RFID is implemented in some companies, but the application is limited; basically, it is just used for scanning items.

Interviewer: I see. From your experience, what are some of the problems companies encounter in documentation, like missed stock or double keying in of data?

Customs Officer: Actually, girl! that is not a problem in all companies, but some of them face issues like that. The difficulties one mainly arises due to the manual process and less integrated systems. For example, many use Excel spreadsheets or paper-based methods to track inventory, which are prone to human error.

Interviewer: So, you think manual processes are a big part of the problem?

Customs Officer: Definitely. With manual data entry, mistakes like missed entries, duplicate records, or incorrect information are pretty common.

Interviewer: What about companies that use more advanced tools, like barcodes or RFID?

Customs Officer: Some do use barcode scanners or even RFID, but without proper integration, it's still not perfect. Many systems aren't automated or connected in real time, so data updates require manual input, which again creates room for errors.

Interviewer: I see. Are there other challenges besides errors in manual or semi-automated systems?

Customs Officer: For sure. Poor inventory practices, like unrecorded stock movements or misplaced items, are also big issues. And if they're not using unique identifiers like barcodes for every item, it gets messy fast. In growing businesses, things get worse they outgrow their systems, but don't upgrade in time.

Interviewer: So, it sounds like a mix of outdated systems, lack of integration, and poor processes.

Customs Officer: Exactly. Many companies stick to basic or standalone inventory systems because they're cost-effective at first, but these systems just can't keep up as things scale.

Interviewer: That makes sense. What kind of system would help reduce these issues?

Customs Officer: Something automated and integrated, like a cloud-based inventory system or an IoT-enabled setup. These systems update stock in real time, reduce manual work, and improve accuracy. But switching to those systems can be expensive, so smaller companies often hesitate.

Interviewer: Thanks for explaining. This gives me a much clearer picture of the challenges companies face.

Customs Officer: No problem. Glad I could help!

Interviewer: Why do you think the IoT systems are not implemented much in this industry

Customs Officer: There are a few reasons. First, the companies and stakeholders are afraid of data security from a privacy point of view. Then there is the complexity in the implementation of this system. From the government side, we don't have an integrated IoT system with logistics companies because it involves lots of procedures and approvals. You have to deal with multiple agencies, and that takes time.

Interviewer: That is understandable. Do you think rules and regulations have any part to play in such slow adoption?

Customs Officer: Surely. These are very stringent, and there is a lack of knowledge regarding how such systems work and their benefits. Manually, we declare the thing to avoid any complexity we can.

Interviewer: Thank you so much, this has been so important for my research.

Customs Officer: You're welcome. Good luck with your project!

APPENDIX V

Consent Form

CONSENT FORM
Challenges in adopting RFID-IoT Integration in inventory management on SMEs Logistic performance in Malacca

I have read, or have had read to me, and I understand the Information Sheet. I have had the details of the study explained to me, any questions I had have been answered to my satisfaction, and I understand that I may ask further questions at any time. I have been given sufficient time to consider whether to participate in this study and I understand participation is voluntary and that I may withdraw from the study at any time. **Signing this form means that you have agreed to be a part of the study.**

	Please tick box	
	YES	NO
• I confirm that I have read and understand the information sheet for the study and have had the opportunity to ask questions		
• I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.		
• I agree to take part in the above study.		
• I agree to the interview being audio recorded		
• I agree to the interview being video recorded		
• I agree to the use of anonymized quotes in publications		

Declaration by Participant:

I _____ hereby consent to take part in this study.

_____ Date: _____
(Signature of participant)

_____ Date: _____
(Signature of researcher)

Contact Information

Name of researcher:
Full address:
Tel:
E-mail:

APPENDIX VI

Interview protocol

Fakulti Pengurusan Teknologi dan Teknousahawanan
Universiti Teknikal Malaysia Melaka

SEMI-STRUCTURED INTERVIEW PROTOCOL

Project Title:
CHALLENGES IN ADOPTING RFID-IoT INTEGRATION IN INVENTORY MANAGEMENT ON SMEs LOGISTIC IN MALACCA.

1. **Interviewer Name**	
2. **Participant ID#**	
3. **Participant's name**	
4. **Participant's position**	
5. **Interview Date (dd/mm/yyyy)**	☐☐ / ☐☐ / ☐☐☐☐
6. **Participant agrees for interview to be digitally recorded**	Yes ☐ No ☐
7. **Time Interview Began (hhmm-24hr clock)**	☐☐☐☐
8. **Time Interview Ended (hhmm-24hr clock)**	☐☐☐☐

Semi-structured Interview Guide

- Room setup – locate in a quiet place to improve the recorded sound quality. The interview may be conducted at the interviewee's office or premise (to suit the interviewee's convenience).

- Follow the following steps to complete the interview session:
  - **Step 1:** Complete Q1 – 5 above before the interview.
  - **Step 2:** Read Section A below to participant.
  - **Step 3:** At the beginning of the interview, introduce yourself; thank participant for taking part in the interview.
  - **Step 4:** Request permission from interviewees to record the conversation; tick the appropriate box for Q6.
  - **Step 5:** Turn on audio recorder if acceptable, document time the interview begins in Q7 above, and conduct an interview.
  - **Step 6:** Complete demographic questions that can be find in Section A.
  - **Step 7:** Proceed with the interview questions.
  - **Step 8:** At the end of the interview, thank the participant and ask if she/he has any further questions; document the time the interview ended in Q8 above.
  - **Step 9:** Ask if the participant is interested in being re-contacted with study results; if yes, document appropriate email. Inform participant that her/his email address will not be linked with her/his study data.

Interviewer: Please read the following to participants at the beginning of the interview.

SECTION A: Information about this study

Opening remarks:

Assalamualaikum/Hello/Good day, thank you for taking time out of your busy schedule to speak with me today. My name is [redacted] and I am a student from the Faculty of Technology Management and Technopreneurship at Universiti Teknikal Malaysia Melaka. I realize you are busy, and I really appreciate your time.

Before we begin, I'd like to tell you more about the research I'm doing and what I will do with the information you tell us. Let me explain you more about my research and what I plan to do with the data you give me before we get started. This study aims to comprehend the obstacles and possibilities associated with small and medium-sized businesses' (SMEs) use of RFID-IoT technology for inventory management in Malacca's logistics industry.

We want to know why certain companies are hesitant to use this technology, what advantages or challenges they see, and what resources could help them successfully integrate RFID-IoT solutions. Our goal is to gain a better understanding of your viewpoints and experiences in order to pinpoint important areas where SMEs require more help, direction, or resources in order to fully utilize these technologies.

As described in the consent form provided to you earlier, participating in this interview is voluntary. You can choose not to answer a question or stop the interview at any time.

With your permission, I would like to audio-record the interview. The audio-recording will be stored on a secure server and destroyed after the findings of this research are published. Despite being taped, I would like to assure you that the discussion will be anonymous. The tapes will be kept safely in a locked facility until they are transcribed word for word. The transcribed notes of the focus group will contain no information that would allow individual subjects to be linked to specific statements. It would help if you tried to answer and comment as accurately and truthfully as possible. However, if you do not want the interview audio recorded, I will take detailed notes throughout the interview instead.

The interview will take approximately [ ] hours/minutes.

Can I turn on the audio recorder now?
[If yes, begin audio recording now.]
[If no] That's okay, I'll take detailed notes as we talk.

Do you have any questions for me at this point? Information about who to contact if you have questions about the study after our time today, can be found in the informational sheet.
[If yes, answer the participant's questions, then complete the demographic questions.]
[If no, proceed with completing the demographic questions.]

Ok, let's get started!

Demographic questions:

Before we dive into the main questions, I'd like to start with a few demographic questions. These questions are just to help us understand a bit more about your background and experiences, which can provide valuable context for your responses.

Please feel free to share as much or as little as you're comfortable with. If you prefer not to answer a particular question, that's completely fine. Let's begin with some basic background information.

10. **Can you tell me your age or age group?**
    If you prefer, you can just tell me the range, such as 25-34, 35-44, and so on.

11. **How would you describe your educational background?**
    For example, whether you have a high school diploma, a bachelor's, or any advanced degrees.

12. **What's your current position or job title, and what are your primary responsibilities?**
    This helps us understand your role within the organization.

13. **How long have you been working in this field?**
    You can answer in years, or ranges like '1-3 years,' or 'more than 10 years.'

14. **Which industry do you work in?**
    For example, technology, healthcare, finance, or any other field.

15. **How would you describe your level of experience with _____?**
    Beginner, intermediate, advanced, or expert?

16. How familiar are you with RFID-IoT technology and how it's used in inventory management?

17. How do you think RFID-IoT could improve inventory process in your company?

18. How do you currently track inventory?

APPENDIX VII

Interview Questionnaire

Student from Universiti Teknikal Malaysia Melaka (UTeM)

FINAL YEAR PROJECT:

CHALLENGES IN ADOPTING RFID-IoT INTEGRATION IN INVENTORY MANAGEMENT ON LOGISTICS IN MALACCA

Questions

Section A

1) Can you describe the current inventory management system your company uses?

2) What are the biggest challenges you face in managing inventory with the current system?

3) How does your current system handle inaccuracies or inefficiencies in stock management?

Section B

1) Are you familiar with RFID-IoT technology and its applications in inventory management?

2) What factors do you think are preventing the adoption of RFID-IoT in your organization?

3) What are the technical challenges or limitations that you think would arise during the adoption process?

Section C

4) How do you think RFID-IoT technology would integrate with the current systems in use?

5) What would be you recommendation as an employee in SME's company to develop your companies inventory system by using RFID-IoT system?

For Interviewee

Name :

Position :

Name of Organization :