ENABLERS OF THE INTERNET OF THINGS (IoT) ADOPTION: A STUDY ON THE THIRD-PARTY LOGISTICS (3PL) INDUSTRIES IN JOHOR

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DECLARATION OF ORIGINAL WORK

I hereby declare that all the work of this thesis entitled "**enablers of the Internet of Things (IoT): A study on the third-party logistics (3pl) industries in Johor**" is originally done by myself and no portion of the work encompassed in this research project proposal has been submitted in support of any application for any other degree or qualification of this or any otherinstitute or university of learning.

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DEDICATION

I would like to appreciate the dedication of my beloved family members who educated me andmotive me to learn until degree level. And also, I express a deep sense of gratitude to my lecturer whom also my supervisor for my final year project, Datin Dr. Suraya Binti Ahmad and my fellow friends. They have provided me fully support and advice throughout this research. Without their blessing and encouragement, this research is impossible to complete within shortperiod of time.

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ABSTRACT

Internet of Things (IoT) is a system or software that enables the linking and exchanging the information with others by utilizing the internet. IoT system can assist the third-party logistics (3pl) industries to handle their work efficiently because it can help the industry in tracking the data conveniently. Due to the increase of the customer demand especially during the Covid-19 pandemic, IoT service plays an essential role in accelerating the process of logistics in 3pl industries. This research is to study the success factors of 3pl industries in the application of IoT in Johor, Malaysia and to determine the relationship between independent variables (perceived usefulness, perceived ease of use and safety) and dependent variable (success factors of 3pl industries in the application of IoT). Data was collected from 169 respondents who are worked in the 3pl industries and know about the IoT system through questionnaire survey. The relevant data for this investigation were gathered using a stratified random sampling method. Besides, there are several analysis methods had been used in this research which as Cronbach's Alpha analysis, descriptive analysis, Pearson's Correlation analysis and Multiple Regression analysis. The result shows that all the independent variables have a significant relationship with the dependent variable. There were strong relationship between perceived usefulness and perceived ease of use with the application of the IoT in third-party logistics industries. Thus, the contribution of the finding is the 3pl industries will be more understand about the importance of Internet of Things (IoT) and identify the success factors in the adoption of IoT in the industries.

Keywords: *Internet of Things (IoT), third-party logistics (3pl) industries, perceived usefulness, perceived ease of use, safety, success factor of 3pl industries in the application of IoT*

ABSTRAK

Internet of Things (IoT) adalah satu sistem atau perisian yang membolehkan pautan dan pertukaran maklumat dengan orang lain dengan menggunakan internet. Sistem IoT boleh membantu industri logistik pihak ketiga (3pl) mengendalikan kerja mereka dengan cekap kerana ia boleh membantu industri menjejaki data dengan mudah. Disebabkan oleh peningkatan permintaan pelanggan, perkhidmatan IoT memainkan peranan penting dalam mempercepatkan proses logistik dalam industri 3pl terutamanya semasa pandemik Covid-19. Penyelidikan ini adalah untuk mengkaji faktor kejayaan industri 3pl dalam aplikasi IoT di Johor, Malaysia dan untuk menentukan hubungan antara pembolehubah bebas (kebolehgunaan, penggunaan mudah diguna dan keselamatan) dan pembolehubah bergantung (faktor kejayaan industri 3pl dalam aplikasi IoT). Data dikumpul daripada 169 responden yang bekerja dalam industri 3pl dan mengetahui tentang sistem IoT melalui tinjauan soal selidik. Data yang berkaitan untuk penyiasatan ini dikumpul menggunakan kaedah persampelan rawak berstrata. Di samping itu, terdapat beberapa kaedah analisis yang telah digunakan dalam penyelidikan ini seperti analisis Alpha Cronbach, analisis deskriptif, analisis Korelasi Pearson dan analisis Regresi Berganda. Keputusan menunjukkan bahawa semua pembolehubah bebas mempunyai hubungan yang signifikan dengan pembolehubah bersandar. Terdapat hubungan kukuh antara persepsi kegunaan dan persepsi kemudahan penggunaan dengan aplikasi IoT dalam industri logistik pihak ketiga. Oleh itu, sumbangan penemuan adalah industri 3pl akan lebih memahami tentang kepentingan Internet of Things (IoT) dan mengenal pasti faktor kejayaan dalam penggunaan IoT dalam industri.

Kata kunci: Internet of Things (IoT), industri logistik pihak ketiga (3pl), kebolehgunaan, penggunaan mudah diguna dan keselamatan, faktor kejayaan industri 3pl dalam aplikasi IoT

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ABBREVIATION	MEANING
IoT	Internet of Things
3PL	Third-Party Logistics
CPU	Central Processing Unit
UAE	United Arab Emirates
GPS	Global Positioning System
GSM/GPRS	Global System for Mobile/ General Packet Radio Services
RFID	Radio-frequency Identification
LF	Low Frequency
GIS	Geographic Information System
AS/RS	Automated Storage & Retrieval System
NFC	Near-field Communication

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter will perform the background of the study, problem statement, research questionsand objectives, scope and limitation of the study, the significant of study and summary.

1.2 Background of Study

According to legend, the earliest Internet of Things machine was a vending machine atCarnegie Mellon which connected to APRANET in 1970 (Fruhlinger, 2020). In 1999, Kevin Ashton who is a British technologist developed the phrase "Internet of Things" (Fruhlinger, 2020). Initially, the development of IoT was behind the concept. There have been some challenges that influenced the further progress of IoT deployment which are the requirement of costs and the power usage. It is because each internet-connected device has the requirementof a CPU and the method to interact with other internet-connected devices (Fruhlinger, 2020).Today, the adoption of RFID tags has become a great step in the development of IoT due to itsinexpensive cost and as a little transponder that can be attached to any device in helping link to the internet (Fruhlinger, 2020). By having ubiquitous Wi-Fi and 4G, it can connect in any place easily through the wireless connection (Fruhlinger, 2020).

In recent, the Covid-19 pandemic has accelerated the adoption of cutting-edge technology in many industries in order to ensure the operation of the company continuity. Internet of Things (IoT) as the main driver of achieving Industry 4.0 and Smart City development have been invested in many industries to win against the competition during the period of pandemic Covid-19. According to the survey by Gartner who is a leading consultation globally by investment in IoT technology and have the potential in enhancing to RM6,100 billion by 2020 (MyGovernment,

2022). In the area of Asia Pacific, the expectation in the development of IoT is at a rate of 34.1% per year and reach RM203 billion by 2020 (MyGovernment, 2022).

The IoT is a system or software that enables the linking and exchanging the informationwith others by utilizing the internet. By 2020, the number of devices connected through the Internet of Things is estimated to reach 50 billion (Ismail, 2019). A significant amount of information from a variety of places or sources can be gathered easily by the devices through the help of IoT (M, 2019). The IoT assists a corporation or an industry to track their data conveniently (M, 2019). In this case, many industries can handle their work more efficiently by having the help of the IoT systems. Therefore, Malaysia has a road map that is expected to applicate the IoT service among the industries as an additional source for the growth in economics.

According to a recent survey conducted by GT Nexus and Capgemini, 70% of retail and industrial firms have already initiated a digital transformation program in their supply chain operations. Asset tracking is nothing new. Freight and transportation companies use barcode scanners to monitor and manage their inventory. However, new advances are making these scanners obsolete since they can only collect data on broad kinds of things rather than specificones (Meola, 2022). When combined with other IoT technologies, modern asset tracking systems (discussed further below) give significantly more valuable and essential data.

1.3 Problem Statement

Many firms are failing to fulfill increasing order volumes due to the COVID-19 epidemic and fast development in e-commerce since they don't function at the pace required toexecute the orders. They chose to outsource part of their operations rather than risk losing consumers to rivals. And there's no denying that the worldwide epidemic has compelled businesses to rethink their operations in order to survive (Group, 2022). However, as the 3PL industry has grown, customer expectations for on-time and reliable delivery have risen, posing additional challenges (Limited, 2021).

Increasing customer expectations for speedy shipment and real-time

visibility into delivery progress are causing huge issues for 3PLs that haven't kept up with technology (DispatchTrack, 2021). Furthermore, because of COVID-19 lockout zones and travel limitations, 3PL operations suffered from a lack of end-to-end visibility, particularly in last-mile deliveries. These interruptions have an impact on planning, predictability, and consumer satisfaction (Limited, 2021). Furthermore, a lack of coordination among shippers, carriers, and end customers might have a negative impact on the supply chain's seamless operation. As a result, third-party logistics providers will recognize the advantages of investing in smarter technology and software solutions that may deliver a higher return on investment (Flatworld Solutions, 2022).

As shown in the nine pillars of the fourth industrial revolution (IR4.0), the main aspect to assist the industries in enhancing their productivity output is the internet of things (IoT) (Alaloul, Liew, W.A. Zawawi, & Mohammed, 2018; Ibrahim, Esa, & Mustafa Kamal, 2019). The government in Malaysia has implemented various initiatives to support the development of the internet of things (IoT) to help different sectors of industry transition to digitalization (BH Online, 2018). A variety of industries in Malaysia like agriculture, smart cities, manufacturing, oil and gas, and services of healthcare and retail have been provided testbeds in implementing the IoT systems. It is because those well-documented issues in these industries can be addressed with the help of IoT (Malaysiakini, 2021).

According to Alliance News via COMTEX (2022), it stated that the global IoT in the Warehouse Management market is estimated to be worth USD 3.22 billion in 2020 and has an expected growth of about 15% between 2021 and 2027 (MarketWatch News Department, 2022). The statistics stated above are caused by the increase in demand and requirements in the global and consumers, many industries especially 3pl industries must deal with the shortages such as employees, in transporting or handling the items from the fragmented market (Deloitte,2020). Therefore, IoT service plays an essential role in accelerating the process of logistics in 3pl industries in order to tackle the massive challenge for the following years regarding work efficiency to meet the demand of consumers.

The fact that 70% of 3PL organizations still rely on manual paper-based procedures and simple tools like Excel to function demonstrates how difficult technology adoption remains (Vinculum, 2021). However, without the help of technology, it will occur numerous difficulties in many sectors of industries, especially logistics. It is because freight visibility in logistics is essential and it relies on the help of technology. Therefore, the technology like IoT is the need for the logistics industry in the future world. For instance, IoT provider like Roambee has provided their services to many of the 3pl industries in Malaysia such as DHL, KUEHNE+NAGEL, and CEVA logistics by offering shipment visibility and a comprehensive look at customers' cargo during shipping (Roambee Corporation, 2022).

1.4 Research Questions

The researcher determined three research questions in this study:

i. What is the importance of the application of IoT in logistics?
ii. What are the IoT applications for logistics?
iii. What are the success factors of 3PL industries in the application of IoT?

1.5 Research Objectives

In this research, there are three research objectives to be figured out:

i. To identify the importance of the application of IoT in logistics.
ii. To determine the IoT application for logistics.
iii. To understand the success factor of 3PL industries in the application of IoT.

1.6 Scope and Limitation of the Study

In this research paper, the success factors of 3PL industries in the application of IoT are being focused on. The target respondents will be the workers or managers in the 3PL company in Johor. This is because the 3PL company has applied IoT technology in their company. The researcher will conduct

questionnaires to the respondents.

The limitations that emerged during the study of the research are the respondents' inaccurate information and time limitation. logistics and not be able to cover all the logistics in Malaysia. There also existed time limits for researchers due to the amount of finished time being short which is only 10 months.

1.7 Significant of Study

The study's findings are intended to encourage the 3PL industries about the application of IoT. It is essential to raise the knowledge about the importance of IoT in the 3PL industries since the IoT technology is advanced in helping to increase the efficiency of work.

Furthermore, the various of IoT applications for logistics also be determined in this research for a further understanding of 3PL industries. The 3PL industries can integrate the IoT technology strategically in the process of supply chain management.

Besides, developing the success factor of 3PL industries in the application of IoT can help to increase 3PL's confidence in utilizing the IoT device in their workplace. The 3PL can immediately benefit from the knowledge of IoT by lowering the costs and increasing the qualityof service.

1.8 Summary

At last, the outline of the research is covered in this chapter. It went over the study's background, problem statement, research questions, research objectives, scope and limitation of the study, and the significance of the study for the topics of the success factors of 3PL industries in the application of the IoT. The literature review for this study will be discussed in the next chapter. The information presented will be more comprehensive and clear.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the literature review and the appropriate theoretical model will be discussed. The definition of supply chain and logistics, the definition of IoT, the application of the Internet of Things, and the background of the technology acceptance model (TAM) are presented in the literature review. Besides, the dependent variables and independent variables were developed after reviewing the relevant research. The literature review is also necessary for developing a research methodology, whether qualitative or quantitative. The research framework for generating the hypothesis and describing the theory is the finest description in this chapter.

2.2 Supply Chain

A supply chain can be defined as a network that connects to all of the people, companies, resources, activities, and technology that contribute to the production and the sale of goods or services (Kenton, 2021). The supply chain can be a complete process of making and distributing the goods or services, from the earliest stages of acquiring raw materials to the ultimate delivery of the goods or services to the customers. To put it another way, it's a diagram of the whole supply chain that depicts everything from raw materials being turned into useable materials to the final product or service being delivered to customers and other stakeholders along the way (Corporate Finance Institute, 2022).

A company that maps out the supply chain is essential in order to have a strategic plan.It is because defining the supply chain accurately is critical for a company to reach success in their market in the future. Corporate-level strategy development sometimes necessitates judgments on whether or not to focus on a particular line of business or expand into adjacent or unrelated markets. Besides,

raw material extraction and manufacturing are two separate sectors within the supply chain. To have a better understanding of the many stakeholders engaged in each step of the supply chain, a firm may use the supply chain to gain an advantage in new markets that the company may wish to join in the future (Corporate Finance Institute, 2022).

2.2.1 Supply Chain Management

Keith Oliver first created the "Supply Chain Management (SCM)" as a phrase and utilized the term in the Financial Times interview during the year 1982. After that, numerous domain experts throughout the globe redesigned SCM by establishing integrated systems that therefore expanded specialized supply-chain alliances via Original Equipment Manufacturers (OEM) (Bhardwaj, 2020). For now, supply chain management has become more essential elements in the business process. This chain has several connections that need special knowledge and abilities. A company's total expenses may be reduced, and profitability can be increased, with good supply chain management. When one of the links in the chain fails, it mayhave an adverse effect on the whole chain, resulting in a significant financial loss (Kenton, 2021). Based on the report of Deloitte in 2014, stated that 79 percent of organizations with high-performance supply chains beat their rivals in emerging areas like the UAE and Middle East (Badwi, 2021). Thus, in order to reach the achievement, there have four major elements in the supply chain that should be known.

i. Integration

Strategic planning must begin with integration, which is essential across all phases of communication, information exchange, data analysis, and storage. The technologies that need to connect the whole supply chain should be focused on by the company and make sure the pick of technology is adaptable enough to alter andexpand with the company (Badwi, 2021).

ii. Operations

The company should also have a real-time and accurate operation of the schedule of inventory and manufacturing for guarding the output and predicting thetrends of production and distributions. The company can integrate the operations with the rest of the business and give precise and trustworthy information and current inventory for more effective fulfillment procedures with the help of precise software (Badwi, 2021).

iii. Purchasing

Purchasing is the domain of the supply chain management in order to ensure that the company has the materials to produce or manufacture the goods. The company needs to plan ahead of time and have everything like materials, equipment, and infrastructure that are needed on hand before really needs it, in the case of an emergency (Faris, 2018).

iv. Distribution

When the products purchased by the customers or shoppers have been delivered to their homes or stores, it means that the supply chain is completed. However, transporting goods to their destination requires a meticulous shipping strategy. Logistics software is used by most firms nowadays, regardless of whether they handle their own shipping or outsource it to a third-party logistics (Faris, 2018).

2.3 Logistics

Logistics refers to a crucial element of supply chain management. The planning, execution, and administration of commodities, and services from the origin place to the destination are all included in the logistics (Why Logistics Is Fundamental to Supply Chain Success, 2019).

Besides, to keep up with ever-changing customer expectations, logistics is always adapting and evolving. Many of the customers anticipate getting their purchases in 24 to 48 hours after placing their order through online platforms by

using devices like mobile phones or laptops. In this case, order fulfillment and item delivery must be expedited and sent as rapidlyas possible in the most dependable, cost-effective, and timely ways possible in order for businesses to satisfy customer expectations. Thus, it is essential to create a supply chain logistics design that helps organizations remain focused, save expenses, and move more swiftly and effectively. This results in improved customer satisfaction for the company (Why Logistics Is Fundamental to Supply Chain Success, 2019).

2.4 Third Party Logistics

When a corporation outsources its supply chain and logistics to a third party, it is knownas third-party logistics. A 3PL's services encompass the process which is from collecting to storing to packaging to delivery. Value-added services are offered by certain 3PL businesses, which include additional logistical services such as inventory management, kitting and assembly, postponed packing, procurement, and more. Nowadays, online shopping has risen atan exponential rate, especially during the pandemic Covid-19, and the demand for third-party logistics (3PLs) services has also increased. Since the 3PL service has handled the logistics formany years, they have the experience to streamline the process, faster and more cost-effectivefor the seller (Hadleigh Reid, 2018). The following figure 2.1 shows the process flow of 3PL in logistics.

Figure 2.1: The process flow of 3PL in logistics.

(Source: UrbanFox, 2020)

2.4.1 Types of Third-Party Logistics

Third-party logistics is more convenient and cost saver for the buyers. Every company or individual is utilizing third-party logistics to outsource the products in their daily lives. Below was describing of the type of 3PL since not every 3PL provides similar services and functions.

i. Transportation-based 3PL Services

Transportation-based 3PL services specialize in transportation services that help in shipping goods from one point to another (Hadleigh Reid, 2018). Some of the transportation-based 3PL services also provide a full range of logistical services to their customers. Besides, there are two options for these service providers which are leveraged or non-leveraged. Leveraged 3PLs rely on the assets of other businesses while assets that are owned entirely by the parent company are utilized by non-leveraged 3PLs. For instance, UPS Logistics, FedEx Logistics, and Ryder are all examples of logistics companies that provide transportation-based 3PL services (Muhammad Zahid, 2017).

ii. Warehouse or Distribution based 3PL Services

The warehouse or distribution-based 3PL services are mostly provided by the typical 3PL. The services offered by warehouse or distribution-based 3PL include storing, fulfillment, picking, packing, transporting, and refunding. Customers may outsource all or a significant portion of their fulfillment and warehousing requirements to this sort of 3PL service provider. In addition, the majority of these 3PLs oversee the seller's transportation, determining which shipper to employ, maintaining the connection with the shipper, and improving the seller's shipping strategy (Hadleigh Reid, 2018). Examples of logistics companies that provide warehouse or distribution-based 3PL services are DSC Logistics, USCO, and Exel (Muhammad Zahid, 2017).

iii. Financial-based 3PL Services

The financial-based 3PL are often utilized by bigger eCommerce organizations to enhance the logistics network of the company by offering the services like cost accounting and control. Furthermore, it also provides capabilities for monitoring, booking, tracking, tracing, and inventory control (Hadleigh Reid, 2018). The company that provides these services are CTC, Cass Information Systems, and FleetBoston (Muhammad Zahid, 2017).

iv. Information-based 3PL Services

Information-based 3PL services can be defined as internet-based 3PLs which are mainly concentrated on business-to-business (B2B) transactions. They also leverage electronic marketplaces for transportation and logistical services (Hadleigh Reid, 2018). Transplace, Nistevo, and uShip are the logistics that provideInformation-based 3PL services (Muhammad Zahid, 2017).

2.5 Internet of Things (IoT)

The Internet of Things (IoT) can be defined as the worldwide network of physical itemsthat are currently interconnected to the internet and collecting and exchanging data. With the advent of low-cost computer processors and the widespread use of wireless networks, everything may become a component of the Internet of Things from simple domestic items to the high-tech industrial machinery (Ranger, 2020). The diverse gadgets can exchange real-time information without the need for a human being with the help of the sensors and software which have the ability to connect to all of these gadgets. Our environment is becoming smarter and more responsive to our digital and physical worlds by obtaining the Internet of Things (IoT) (Ranger, 2020). From 2020 to 2025, experts predict of the number of linked IoT devices will expand from 10 billion to 22 billion IoT devices (Oracle, 2021).

2.5.1 Important of IoT Application in Third-Party Logistics

As many of the companies have expanded their business into the online markets due to the new trends, third-party logistics (3pl) play the essential role in helping the process of packaging, shipping and outsourcing (Companies, 2019). To meet the expectation and satisfaction of customers about the faster delivery, the IoT application becomes crucial towards the 3pl industries. The IoT application can helps the company in real-time tracking which enables the employees to monitor the goods movement and precise the goods position at any time. It is also helpful in avoiding the cargo is delayed or deviates from plan (admin, 2021). Therefore, it can be seen that the market requirement has led to the implementation of IoT in 3pl industries (Maulida, Laksono, & Gunarta, 2021).

Besides, IoT is adapted in 3pl industries because of the suitability and effectiveness (Hussein et al., 2019). Data about the supply chain's performance can be automatically gathered by IoT-based systems. When used to the task of predicting customer demand, this eliminates the need for human intervention and, thus, saves time and efforts. However, the granular data that an IoT system can gather effortlessly but would otherwise be hard for humans to handle is even more useful. Each piece of data contributes to more complex forecasting systems, allowing your company to capitalize on swings in demand without raising storage expenses (admin, 2021).

Apart from that, IoT can help in performing a large number of different operations through the cloud computing environment (Chen, Chen, & Yang, 2021). The companies capable in handling a wide range of high-quality data processing jobs. As the Internet of Things (IoT) is implemented, coupled with mobile devices and cloud computing systems, the companies will become more intelligent and efficient (Chen, Chen, & Yang, 2021). This offers the employees the flexibility to adjust in shifting load patterns, particularly when running on the cloud. Therefore, this is a significant helpful for the logistics industries which having the order volumes varies greatly throughout the year (Dejan Boberic et al., 2020).

Furthermore, IoT can gather and display critical safety data, enabling the employees or managers to modify the warehouse environment or robot operations (Schmidt, 2020). In this case, the employees training and education is essential. The employees are adequately trained in using the IoT devices (Chen, Chen, &

Yang, 2021). Employees can concentrate on more complicated activities since IoT can be employed for repetitive task. As a result, this improves the well-being, satisfaction, and output of the workforce (Schmidt, 2020).

i. Transportation

Vehicles, goods, and drivers are typically monitored in real-time using IoT devices. Vehicle, cargo, and driver status data are merged throughout the logistics transportation process in order to increase transportation efficiency, minimize transportation costs, reduce cargo loss, as well as fully comprehend the process. IoTcan help in monitoring the status of vehicles (Song et al., 2020).

Vehicle tracking primarily entails tracking the location and current states of cars,such as their speed, tire pressure, fuel usage, braking system count, and more.Besides, every equipped car may be tracked from anywhere at any time using a vehicle tracking system that's been developed and put in place with the integration of GPS and GSM/GPRS technologies in the system. It is hypothesized that an accurate vehicle positioning system employing RFID technology and GPS andGSM technologies may be developed. The LF communication range (125–134 kHz)is used to create an RFID transponder with a read range of 31cm or less (Song et al., 2020).

On the basis of the Internet of Things, a tracking system for freight is suggested.RFID, GIS, 3G connection, middleware technology, and AI technology are all usedin this system to track and monitor the movement of freight. Data capture, transmission, and information processing are used to achieve real-time freight tracking. IoT and RFID technologies are used to create a dynamic road transport system for risky goods monitoring. Cellular connectivity allows this system to work in conjunction with the highway infrastructure and databases of the information sharing system and to get additional information about hazardous products via information processing (Song et al., 2020).

ii. Warehousing

It is becoming more difficult and necessary to manage warehousing in light of the rapid advancements in both business and technology. We can now employ IoT technology to maximize warehouse area use and monitor the warehouse environment (Song et al., 2020).

ZigBee wireless network technology is used to develop an automated logistics control system for AS/RS that uses the star control structure. Using this method, a 3-D warehouse logistics management system may be made more intelligent, easy, and effective in order to increase operational efficiency (Song et al., 2020).

For monitoring the warehouse environment, a cotton storage-specific IoT architecture has been built. There are several advantages to employing IoT technology in cotton storage management. It can overcome the difficulties of trailing and non-intelligent monitoring, an automated warehouse monitoring systembased on IoT was developed. The warehouse's temperature, humidity, and fire hazards can all be monitored with this design. The warehouse can also be employed GSM/GPRS and wireless radio communication modules in a new approach. To minimize the number of workers required for grain management, it can detect real-time infiltration into warehouses and grain tracking theft (Song et al., 2020).

iii. Loading and Unloading

When it comes to the logistics process, loading and unloading actions emerge and recur often, making them important indicators of both speed and cost. Furthermore, the deployment of IoT-based loading/unloading equipment (such as a forklift) may significantly increase logistics efficiency. Equipment automation, equipment placement, and equipment status monitoring are three of the most common IoT use in this industry right now (Song et al., 2020).

A forklift robot powered by the Internet of Things is shown. In addition to the camera, the system makes use of other sensors such as a

line sensor, a sharp sensor,and others. It's also utilized to construct a remote bridge between robot and warehouse operator over Wi-Fi, so that they may communicate and control the robotfrom afar. As a result of the use of wireless communication technology, a forklift is fully automated with the aid of an exterior and internal sensor (Song et al., 2020). The following figure shows the forklift robot powered by the IoT.

Figure 2.2: The forklift robot powered by IoT

(Source: IndiaMart, 2022)

Automating loading and unloading, monitoring equipment status, and dispatching are all part of the present Internet of Things system. RFID, WiFi, and the like are often used for short-distance communication since the loading/unloading equipment functions within a certain range. When dispatching equipment, mobile communication technology is almost always employed since it requires distant data transfer (Song et al., 2020).

iv. Packaging

The packaging market is shifting from traditional packaging to interactive, aware, and intelligent packaging as a result of the advent of IoT technology. This means that smart packaging may make use of IoT and big data and develop a dynamic connection with sensors on the package like RFID, NFC, and Bluetooth as well as intelligent labeling

(Song et al., 2020).

With the use of a cyber network, IoT-based automated fulfillment packaging systems may achieve high speed and flexibility of operations and real-time information exchange, allowing the robots to complete the packaging job effectively and collaboratively (Song et al., 2020).

In summary, the IoT system's application scenarios in smart packaging, whetherit's product design or packaging application, are mostly short-range. Its primary goal is to make the final result easily readable and recognizable. RFID or NFC are ideal for these kinds of low-power short-range applications because of their low power consumption and limited range. As product packaging intelligence improves,more and more apps will be able to track the status of their products in real-time. As a result, packaging goods must have sensors, embedded processing, and remote connectivity (such as a mobile communication module) in order to meet this application need. Smart packaging will follow suit as a major development trend (Song et al., 2020).

v. Distribution

Intelligent logistics distribution utilizes IoT technology primarily in the management of distribution facilities and the creation of intelligent delivery methods. IoT-based route planning (IRPS) is suggested in an IoT-based system. The distribution center employs IoT technology to detect freight, store and gather information, intelligent warehouse management, and autonomous vehicle dispatching (Song et al., 2020).

2.6 Technology Acceptance Model (TAM)

Davis (1989) created the Technology Acceptance Model as a study model for forecasting individual users' usage and acceptance of information systems and technology. The idea of reasoned action served as the foundation for the technology acceptance model (TAM) (TRA). TAM has been thoroughly examined and verified by several studies that explore the behavior of individual acceptance of technology

in diverse information system designs. TAM's objective is to examine the technology's acceptability and how it may be improved to make it more user-friendly.

The TAM model includes two factors: perceived usefulness and perceived ease of use.Davis defines perceived usefulness as prospective users' subjective likelihood of increasing their work or life performance via the employment of a given application system. The degree to which a potential user anticipates an easy-to-use target system is defined as perceived ease of use. External elements such as social, cultural, and political issues will impact perceived usefulness and simplicity of usage. Users' attitudes will influence their behavioral intentions while utilizing the information system. Davis's technology acceptance model (TAM) in 1989 is shown in Figure 2.3 below.

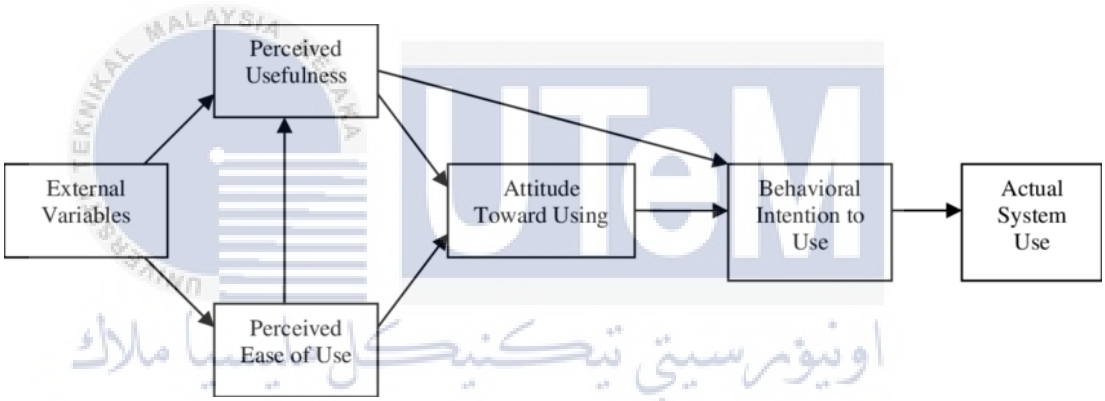

Figure 2.3: Technology Acceptance Model (TAM) of Davis in 1989

2.7 Success Factors of Application IoT in 3PL

2.7.1 Perceived Usefulness

The information that collects from the IoT system is quality. It is because smart sensorsmay be used to detect external physical effects. They gather and store environmental data, suchas humidity, temperature, and shock, which may be used to make inferences about the quality of the product. Rust may be caused by a variety of factors, including temperature and humidity. The sensors must be linked to a network, either cellular or Wi-Fi, in order to continuously upload their data. The preserved data provides historical context for some of the events, which may be

difficult to respond to in real-time. Using the data's time stamps and tracking information, the location may be determined and attributed to it (Christian Capadrutt & MarcusLjung, 2020).

Besides, the transparency of logistics can also be increased with the help of IoT. IoT systems can access, analyze, and provide precise information on the products and containers. It's the best and simplest method to find out whether there's a problem with the cargo in real-time. In terms of real-time tracking, IoT can also assist companies in monitoring their containers at any time (Guki, 2020).

Furthermore, work efficiency can be improved by using the IoT in the 3pl industry. The Internet of Things (IoT) offers a diverse set of linked technologies aimed at workers. Warehouse employees, for example, may utilize smart glasses to simply instruct themselves so that they spend less time executing a job. The Internet of Things (IoT) also collects efficiency-related data and raises knowledge regarding asset and labor resource allocation. Therefore, technological advancements have made it simpler for supply chain administrators to monitor and regulate the performance of all supply chain participants (navata, 2021).

2.7.2 Perceived Ease of Use

Perceive ease of use defines as the degree to which a person feels that utilizing a certain information technology system will be easy (Davis, 1989, p. 320). Besides, perceived ease of use refers to the users are more inclined to adopt an application that is seen as easy to use than another (Davis, 1989). The perceived ease of use is one of the two major variables in the TAM.The attitude toward use, behavioral intention to use and actual usage are all influenced by perceived ease of use (Igi Global, 2022).

IoT is the convenient and usable choice for the 3pl employees or workers. It is because mobile IoT has been developed for the employees to connect and control the connected applications in different locations at any time. Besides, the mobile IoT can access well-established global networks that employ licensed radio spectrum that is free of interference and congestion from rival networks is provided through a connectivity solution (IoT Trends in Transport and Logistics, 2022). Therefore, the mobile IoT is fast and straightforward to control and monitor the

device which has the IoT.

Furthermore, the IoT in 3pl industries is easy to learn. First, the workers need to implement microchips in the products. After that, the workers only need to utilize the RFID which employs radio waves to know the location of the products. These tags may have information not only about the goods and their location, but also about where it is scheduled to be sent, and so on (Kitowska, 2019). The process is easy to carry on and it is not complex. In addition, the ways of tracking and managing the commodities by using the IoT sensors such as RFID are more convenient than a traditional manual recorder by the workers (Kitowska, 2019).The employees can identify the located place of goods speedily. Thus, this IoT system is easier for users to use.

2.7.3 Safety

Safety refers to keeping yourself and others safe from injury or danger. It also implies being cautious in order to prevent accidents (Barry Spud, 2019). The safety of the cargo can also be guaranteed by having the application of IoT. Smart vision camera systems with RFID tags on pallets or products make it possible to identify products. The inventory levels of any product or item may be found by entering them into a database. The location of the item, suchas a particular shelf, should also be documented. It is feasible to reduce inventory levels by understanding where and how much inventory there is. Apart from that, the correct and reliable information can also be provided to the clients with the help of IoT (curatauser, 2021).

Besides, employee safety is also one of the benefits of the Internet of Things on logistics, since it detects equipment flaws long before they become obvious. Connected systems can decrease risks related to employee safety by monitoring equipment conditions in real time and forecasting wear and potential damage (DIGITEUM TEAM, 2021).

Insurance businesses may leverage IoT-based data to provide plans with prices depending on driver behavior, use, and other criteria. It is because insurance companies must be aware of the elements and variables involved when an accident happens. Furthermore, advances in the IoT sector may be used to monitor and

recover stolen automobiles, and tracking systems can be employed by police and other relevant authorities to retrieve a vehicle in the case of theft. In addition, automobile manufacturers are already equipping commercial vehicles with sensors, cameras, and other network-based devices that provide ground-breaking video-based solutions. These systems may be expanded to include sophisticated driver-assisted technologies that assume partial control of a vehicle while driving or parking. This automationmay assist trucks in operating autonomously and avoiding tragic traffic accidents (curatauser, 2021).

2.8 Proposed Research Framework

To describe the variables in the proposed research framework, the technology acceptance model (TAM) is employed. The proposed research framework includes dependent and independent variables. The independent variables include perceived usefulness, perceivedease of use, and safety, all of which have an influence on the dependent variable, which is thesuccess factors of the application of the IoT in the 3pl industries. Figure 2.4 below showed the proposed research framework in line with the research questions and research objectives

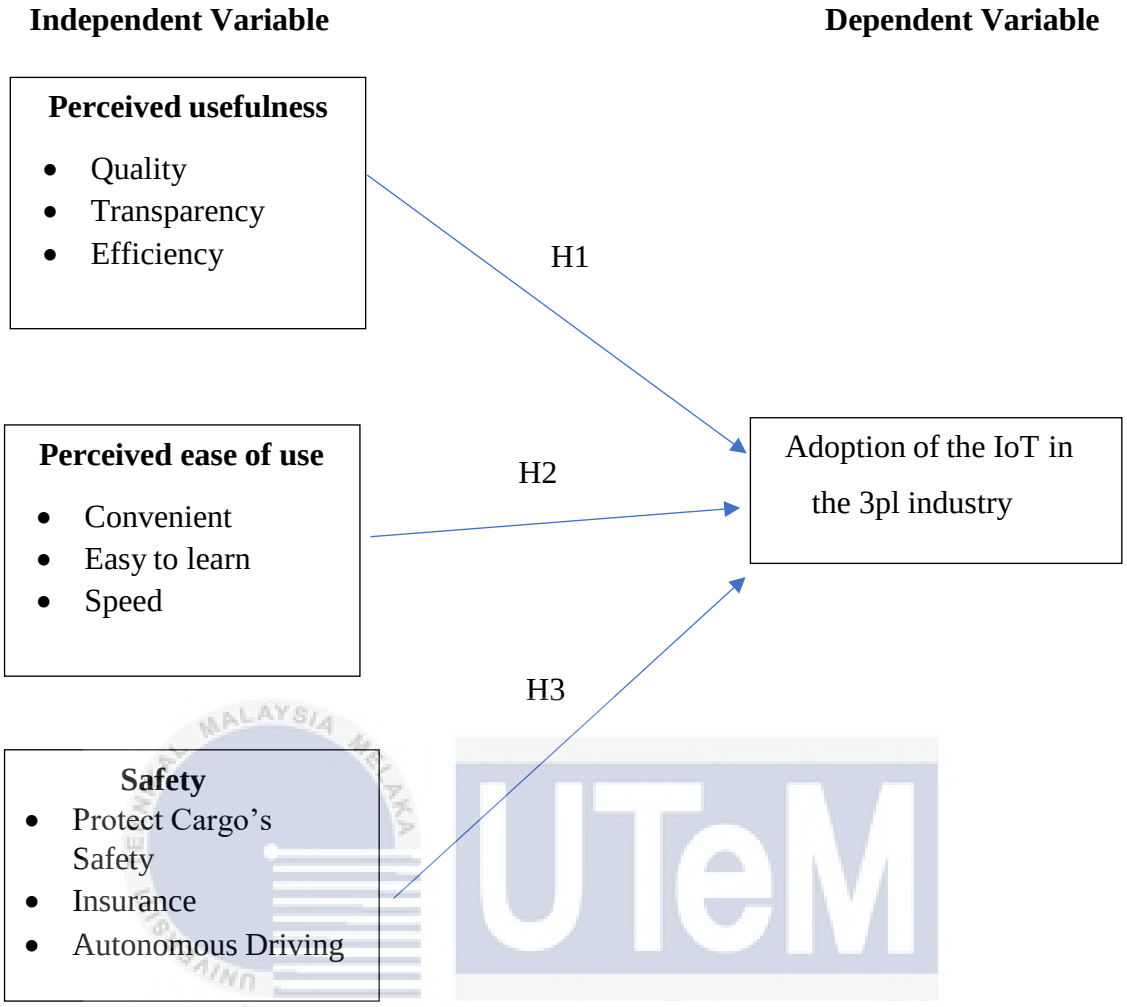

Figure 2.4: Proposed Research Framework of the adoption of the IoT in the 3pl industries.

2.9 Hypothesis

The hypothesis refers to the relationship between independent variables and dependent variables that will be tested during this research. This hypothesis would test whetherit reacts to the research questions and achieve the objectives of the research. There have three hypotheses listed below based on the studies.

i. Perceived usefulness

H1: There is a significant relationship between perceived usefulness and the success factors of the application of the IoT in the 3pl industry.

H0: There is no significant relationship between perceived usefulness and the success factors of the application of the IoT in the 3pl industry.

ii. Perceived ease of use

H2: There is a significant relationship between perceived ease of use and the success factors of the application of the IoT in the 3pl industry.

H0: There is no significant relationship between perceived ease of use and the success factors of the application of the IoT in the 3pl industry.

iii. Perceived safe of use

H3: There is a significant relationship between perceived safe of use and the success factors of the application of the IoT in the 3pl industry.

H0: There is no significant relationship between perceived safe of use and the success factors of the application of the IoT in the 3pl industry.

2.10 Summary

In this chapter, the researcher has discussed the success factors of the application of the IoT in the 3pl industry. The researcher has explained the independent variables (perceived usefulness, perceived ease of use, safety), dependent variable (the success factors of the application of the IoT in the 3pl industry) by using the TAM model and proposed research framework. The hypothesis testing has determined the relationship between independent and dependent variables. Lastly, the research methodology will be discussed in the following chapter.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discussed the research methodology that is commonly utilized when conducting the research study. The exact methods or strategies that are used in finding, collecting, and describing the information of the topic are referred to as research methodology (Heever, 2020). The research design, methodological choices, source of primary and secondarydata, research location, research strategy, time horizon, scientific canons, and data analysis method will be analyzed and described in the research methodology. By following the proper research processes, the data of the research will reliability and valid.

3.2 Research Design

Research design can be defined as a framework of the methods for the researchers in answering the research problems (McCombes, 2021). Through the design of the research, researchers can choose the research methodologies which are appropriate for the research topicand enable them to establish the research for success (McCombes, 2021). The research aim, methods of data collection, and data analysis about the time and location will consist in the research design.

There are several methods for categorizing the research design. According to the goal and the method, the research design can be differentiated into five types which are descriptive research design, correlational research design, experimental research design, diagnostic research design, and explanatory research design. The descriptive research design is mainly utilized by the researcher to engage in articulating the topic of the research through the theory. Correlational research design is a method for assisting researchers in establishing a link between two highly associated variables (Nemanja Jovancic, 2020). The experimental research design refers to a type of research design that demonstrates a relationship between the factors and the impact of a certain event. Diagnostic research design is attempted

to determine the root cause of a certain circumstance or situation. Explanatory research design is utilized for further analysis and describing the views and opinions of the researchers about the topic (Bhat, 2018).

In this research, the explanatory research design was utilized to assess the theories and analyze the relationship between the variables. The factors and the impacts among the dependent and independent variables are analyzed in the explanatory research design. Besides, this design also demonstrates the primary and secondary data which were explored from current and prior case studies and identifies the link between perceived usefulness, perceived ease of use, safety, and the success factors of the internet of things in the 3PL industries.

3.3 Methodological Choices

Methodological choices are essential in guiding researchers to select a method for data collection and analysis. There are three major methodology categories include qualitative, quantitative, and mixed methods (Leaf Group, 2008). Qualitative research utilizes interviews and findings methods for data collection. For quantitative research, it can be defined as the simpler method of gathering and analyzing the data with a big sample size through questionnaires (OpenLearn, 2018). Mixed method research refers to a combination of qualitative and quantitative methods to gather and interpret the data.

The researcher will utilize quantitative methods to investigate the success factors of the application of the Internet of Things (IoT) in third-party logistics (3PL) industries. The data collected via using quantitative research is in the form of numerical, which is then analyzed using statistical methods according to the mathematical methods (Ware, 2022). The main aim of a quantitative research study is to discover the relation between the independent and dependent variables within the population (Ware, 2022). According to Shelby Ware (2022), quantitative research emphasizes numerical and static data, as well as thorough, convergent reasoning rather than divergent thinking. Using the quantitative research methods, the researcher can put the suggested study framework and assess the connection between the perceived usefulness, perceived ease of use, safety, and the success factors of the application of IoT in the 3PL industries.

3.4 Primary and Secondary Data Sources

The primary and secondary data are the two types of data sources that are used in this research. Primary data is original data which are often acquired directly from the source. The aim of collecting the primary data is to solve the problem. The researcher is the one who gathers the data directly from primary sources like surveys, personal interviews, questionnaires, and observations (Formplus, 2020). Researcher collects the primary data by delivering the questionnaires to the respondents in the 3PL industries in Johor. The respondents will be given a series of questionnaire questions to which they indicate their responses by marking the relevant box.

Secondary data refers to data that has already been acquired and is easily accessible from other sources (Juneja, 2019). Secondary data are data gathered by a person unrelated to the research project who collected these data for another reason and at a different period in the past (Ajayi, 2017). According to Victor Oluwatosin Ajayi (2017), the data will become secondary data for the current users when getting to use these data. For instance, journal articles, books, and government publications websites are the sources of secondary data. Secondary data also is ideal for providing background and historical knowledge on a subject or issue, as well as widening one's understanding of a point by exposing one to other people's points of view, interpretations, and conclusions. The researcher can assemble a large amount of information or secondary data and obtain understanding via utilizing Google Scholar, EmeraldInsight, and Proquest for supporting the purpose of the research.

3.5 Research Location

Johor which is located in the south of Malaysia is the primary location that has been chosen for this research. According to Street Directory, there have around 562 as the number of logistics companies in Johor. The targeted respondents are the workers and managers who have used the IoT in the 3PL industries for many years in Johor.

The researcher chooses the Johor state as the research location because the researcher wants to learn more about the success factors of the application of IoT

in the 3PL industries. The study will also look at the importance of the application of IoT in the 3PL industry in Johor state. As a result, the researcher concentrates only on the Johor state in order to collect data and make the analysis faster and easier. The researcher can also learn more about applying IoT in 3PL industries from the respondents of the study.

3.6 Research Strategy

A research strategy is a comprehensive plan for carrying out a research project. A research strategy directs how a researcher plans, executes, and monitors a study. While the research strategy is beneficial on a general level, it must be supplemented by research methodologies that can lead the study activity on a more comprehensive level (Johannesson &Perjons, 2014). The research strategy which instructs the researcher on how to acquire and analyze data are survey, experiment, case study, action research, ethnography, cross-sectional studies, and grounded theory (Open Learn, 2009). The survey method is chosen as the research strategy by the researcher. Data collection via survey strategy is simple to compare since it uses a questionnaire to obtain standardized data from a wide population. Survey strategies may collect quantitative data by evaluating descriptive and inferential statistics, as well as propose probable correlations between variables. The questionnaire will be produced and given to the employees and managers in the 3PL industry that employ IoT.

3.6.1 Questionnaire Design

A questionnaire refers to a set of questions which intended to collect information about the respondents' attitudes, experiences, or views (Bhandari, 2021). The researcher gives the questionnaire to the employees and managers in the 3PL industry in Johor in order to receive primary data for this study. There have three sections of close-ended questions developed in the questionnaire. The first section of the questionnaire investigates the respondents' personal information, such as gender, age, educational level, employment location, department, and the appliance that used IoT in their workplace. The questionnaire's second section focuses on the independent factors such as perceived usefulness, perceived ease to use, and safety. The questionnaire's second and third sections will be scored using

a Likert scale. The Likert scale will be a five-point scale with 1 representing "strongly disagree," 2 representing "disagree," 3 representing "neutral," 4 representing "agree," and 5 representing "strongly agree." The questionnaire will be delivered to the selected respondents using Google form and shared for individuals to answer. The five-point Likert scale was shown in Table 3.1 below.

Table 3.1: Five points Likert Scale

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

3.6.2 Questionnaire Development

Towards setting up the research model and hypothesis of this study, we have provided a justification for the need for research and investigation of enablers of IoT adoption in 3pl industries in Johor, we have also covered the literature regarding the models that were used to understand technology acceptance and technology application. We propose our model to demonstrate the IoT acceptance in 3pl industry. According to the proposed model, there are 3 factors that impact the adoption of IoT in the 3pl industries which are perceived usefulness, perceived ease of use and safety.

In the proposed model, the employees' satisfaction will be used to represent the extent to which the users would like to use IoT in 3pl industries. Others factors such as gender, experience and age will be used in the research as moderating variables in the proposed model during the data collection phase. The experience and age are possible to be controlled. For example, the researcher can collect data from particular range of age or collects data from respondents who are related to the department.

1. **Operationalization of constructs**

The research will be carried out utilizing a quantitative research technique. A well-structured questionnaire will be used as the primary instrument for data collection in this study, which will also be carried out under a positive paradigm. The goal of quantitative research is to gather facts that can be quantified and statistically analyzed to either confirm or deny alternative knowledge assertions

(Apuke, 2017). Additionally, the process of doing quantitative research begins with the formulation of a problem statement, the development of a hypothesis or research question, the evaluation of relevant literature, and the quantitative analysis of data (Apuke, 2017). The enablers of the IoT adoption in 3pl industries in Johor will thus be evaluated quantitatively. A questionnaire was developed for measuring the respondent's observation. Survey was directed towards employees or managers of 3pl industries in Johor. The questionnaire was divided into three sections as shown in Table 3.1.

Table 3.2: Arrangement of research instrument

Section	Category	No. of Items
A	**Demographic profile**	**5**
B	**Technology acceptance**	
	1) Perceived usefulness	**4**
	2) Perceived ease of use	**4**
	3) Safety	**4**
C	**Technology application**	**4**
Total		**21**

2. Section A: Demographic Profile

This section requires the respondent to answer a total of 5 questions to obtain a profile of the respondent and organization, the questions within this section are used to collect information about respondent such as gender and age, while this questions about the organization are used to collect some basic data about the organization such as the duration of employment, job position and employment department. These questions are listed in Table 3.2.

Table 3.3: Demographic profile of respondent

NO.	Item
1.	Gender
2.	Age
3.	Duration of Employment
4.	Job Position
5.	Employment Department

3. Section B: Technology Acceptance

In this section, the technology acceptance model TAM impact on users' satisfaction as an independent variable. TAM will be measured from perspective of perceived usefulness, perceived ease of use and safety. Each of these variables which identified by a number of almost 4 statements and the data collection will largely determine the enablers of adoption of the IoT in the 3pl industries. These statements are constructed in the following table.

Table 3.4: Statement used in indicating technology acceptance

NO.	Statement	Source
	Perceived usefulness	
1.	Using IoT can increase the transparency of logistics.	(Guki, 2020)
2.	Using IoT can enhance the work efficiency compared to the traditional mode.	(navata, 2021)
3.	Using IoT can have an opportunity to monitor the delivery and goods conditions.	
4.	Using IoT can save time and optimize just-in-time delivery.	(Guki, 2020)
	Perceived ease of use	
1.	IoT is usable choice which can connect and control the connected applications in different locations.	(IoT Trends in Transport and Logistics, 2022)
2.	IoT is also mobile friendly which can access well-established global networks.	
3.	The use of IoT in 3pl is easy to learn and is not complex	(Kitowska, 2019)
4.	Tracking and managing the commodities by using IoT are more convenient than manual recorder.	
	Safety	
1.	The safety of the cargo can be guaranteed by having the application of IoT.	(curatauser, 2021)
2.	The inventory levels of products are entered into the database.	
3.	IoT helps in monitoring and recovering stolen automobiles.	
4.	The correct and reliable information can be provided to the clients with the help of IoT.	

4. Section C: Technology Application

The concept of technology application is a widely concept in studying the importance of IoT in the 3pl industry. The importance of IoT needs to be investigated and studied in order to enable the adoption of the IoT in 3pl industries. The statements are constructed in table below.

Table 3.5: Statement used in indicating the technology application.

NO.	Statement	Source
1.	IoT is adapted in 3pl industries because of the suitability and effectiveness.	(Hussein et al., 2019)
2.	The market requirement lead to the implementation of IoT in 3pl industries.	(Maulida, Laksono, & Gunarta, 2021)
3.	IoT can help in performing a large number of different operations through the cloud computing environment.	(Chen, Chen, & Yang, 2021)
4.	The employees are adequately trained in using the IoT devices.	(Chen, Chen, & Yang, 2021)

3.6.3 Sampling Design

In this research, the researcher uses probability sampling as the sampling design. Probability sampling can be defined as a sampling strategy in which the researcher selects samples from a larger population using a probability-based method (QuestionPro, 2018). By using probability sampling, it has a possibility for every individual in the population for getting chosen (McCombes, 2019). Besides, when there is a paucity of funds and time for the researcher to collect data from a large population, sampling design is critical.

A probability sample can be chosen in a variety of methods which are simple random sampling, systematic sampling, stratified sampling, and cluster sampling (McCombes, 2019). In this research, simple random sampling is chosen by the researcher. It is because it reflects the current population of the study, and the researcher can only quantify sampling mistakes using random techniques. The researcher chooses employees or managers in 3PL industries asa sample since this

study focuses on the application of the IoT in 3PL industries.

According to Street Directory, there have around 562 as the number of logistics companies in Johor. The average population of workers or managers in 3PL industries is about 91,943. Based on the table of Krejcie and Morgan (1970), the researcher will choose about 383 respondents who are the middle or senior management in 3PL industries in Johor and have the knowledge about the application of IoT in their workplace to contribute in this survey. The following table 3.2 shows the determining sample size of a known population (Krejcie and Morgan, 1970).

Table 3.6: Determining the sample size of a known population

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

3.6.4 Pilot Test

A pilot test is a short preliminary study performed in research to evaluate a planned research study before it is performed on a larger scale. The main goal of a pilot study is to assess the feasibility of the intended big research. The pilot test may also be used to determine the expenditures and sample size required for the

larger investigation (workplace testing, 2018).A pilot test will be conducted with 30 3PL industry employees or managers who are chosen by the researcher. The relevant questionnaires of the research study will be tested on the respondents by the researcher. This testing will take around a week for the researcher to complete. The opinions and ideas will be examined and included in the survey's final questionnaire. Lastly, this project will gather pilot test data before distributing the questionnaire to respondents.

3.7 Time Horizon

The Time Horizon refers to a period of time in which the project is expected to be completed. There are two kinds of temporal frames based on the research onion: cross-sectional and longitudinal. When there is a pre-determined duration for data gathering, this is referred to as the cross-sectional time horizon. A longitudinal time horizon is the collecting of data over a lengthy period of time, such as when a person reaches a particular age or when the seasons change throughout the year (Stainton, 2019).

Due to the time constraints, the researcher intends to conduct a cross-sectional study in this research. This study will be completed by the researcher during a brief period of time, from March 2022 to March 2023. From August 2022 to November 2022, the questionnaire will be sent to responders through an online Google form. The researcher will gather and evaluate questionnaire data from November 2022 to January 2023. Finally, in March 2023, provide the results of the data gathered.

3.8 Scientific Canons

Saunders et al. (2016) stated that the scientific canon inquires about validity and reliability.

3.8.1 Validity

The accuracy with which a technique measures what it is designed to measure is referred to as its validity. There have 2 types of validity in this research such as internal validityand external validity (Middleton, 2019). Internal validity relates to how properly the independent variable may be presented to create the observed

effect. External validity can be defined as the degree to which the findings of the research may be extrapolated outside the sample and the results can be applied to different persons and situations (BRENDAN HUFFORD, 2019). The use of external validity may be increased by conducting the tests in a natural environment and selecting respondents using random sampling. Additionally, construct validity is also a kind of validity. Construct validity is used to determine how the test should be assessed.

The researcher gathers the data for this research by using a survey questionnaire and evaluates the connection between the dependent and independent variables. The success factors in the application of the IoT in the 3PL industry are the dependent variable whereas the independent variables are perceived usefulness, perceived ease of use, and safety. The quantitative questionnaire should be designed to fit the study subject, research question, and research purpose. As a result, the employees or the managers in 3PL industries are the primary groups in our study when it comes to external validity. The researcher must comprehend the population sample size as well as the study's findings. To avoid mistakes and prejudice, the researcher needed to receive advice from the supervisor.

3.8.2 Reliability

The consistency with which a technique assesses something is referred to as reliability. If the same result can be consistently obtained by employing the same procedures under the same conditions, the measurement is called reliable (Middleton, 2019). There are many methods for determining reliability.

In this research, the Cronbach's Alpha approach was utilized by this researcher to measure the reliability of the variables. The value includes an alpha coefficient ranging from 0 to 1. If the result is negative, it means that something is incorrect with the data. When Cronbach's Alpha values are more than 0.7, it is regarded acceptable, greater than 0.9 is considered good, and equal to or greater than 0.9 is considered exceptional. While less than 0.6 is deemed unsatisfactory, less than 0.5 is considered intolerable. Table 3.3 below showed the table of Cronbach’s Alpha Values (Saunders et al., 2016).

Table 3.7: Cronbach's Alpha Coefficient Range and Strength of Association

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

3.9 Data Analysis Method

Data analysis is a process that often includes many actions such as data collection, cleansing, and organization (Maryville University, 2021). According to Zikmund (2003), data analysis is the process through which a researcher uses a statistical instrument, such as the Statistical Package of Social Sciences (SPSS), to examine data obtained from respondents. Furthermore, many types of analytic methodologies are applied in this research, including descriptive analysis, Pearson's correlation analysis, and multiple regression analysis.

3.9.1 Descriptive Analysis

Descriptive analysis is a sort of data analysis that helps to explain, illustrate, or summarize data points in a constructive manner so that patterns might develop that meet all ofthe data's conditions (Rawat, 2021). Measures of central tendency include mean, median, and mode, while measures of dispersion include variance, standard deviation, and percentage. Descriptive analysis is used to examine the information from respondents and turn raw data into a more understandable and interpretable manner. It is also used to characterize respondents' demographic backgrounds using percentages and frequencies (Hayes, 2022). In this study, descriptive analysis is used to distinguish gender, age, employment location, and

department among respondents who use IoT technologies in their workplace in 3PL companies.

3.9.2 Pearson's Correlation Analysis

Pearson's correlation coefficient assesses the strength and directionality of the relationship between the independent variables and dependent variables (Stangroom, 2019). Pearson's Correlation Coefficients are a statistical test used to measure the connection between two variables. It is also necessary to calculate the likelihood of the correlation coefficient occurring by chance for data taken from a sample. Pearson's correlation coefficient ranges from -1 to +1, representing perfect negative and perfect positive correlations, respectively. Meanwhile, the number 0 denotes a completely independent correlation (Saunders et al., 2016). The following figure 3.1 shows the Pearson's Correlation Coefficients.

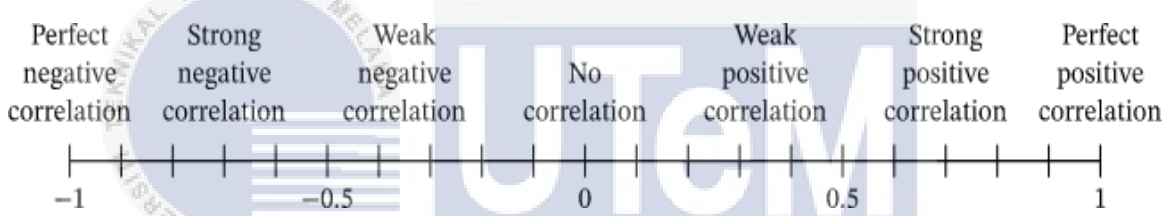

Figure 3.1: Pearson's Correlation Coefficients

(Source: Nagwa, 2022)

3.1.1 Multiple Regression Analysis

Multiple regression analysis refers to a statistical tool that allows researchers to evaluate the strength of the cause-and-effect connection between three independent variables and one dependent variable (Saunders et al., 2016). In this study, the researcher must understand the link between the independent factors (perceived usefulness, perceived ease of use, and safety) and the dependent variable (the success factors of the application of the IoT in the 3PL industries). Multiple regression analysis may assist the researcher in determining which independent factors have the greatest influence on the dependent variable. The multiple regression analysis equation is shown below.

Equation of MRA: Y = a + bX1 + cX2 + dX3

Where:

Y = Dependent Variable (Effectiveness of biometric technology in smartphone)

a = Constant value or Intercept

b = Influence of X1 (Perceived usefulness)

c = Influence of X2 (Perceived ease of use)

d = Influence of X3 (Safety)

X1, X2, X3 = Independent variables

3.10 Summary

Finally, the researcher described the strategy she utilized to acquire data and material for this chapter. In this study, the researcher will use an explanatory research design and a quantitative methodology. The questionnaire will be delivered to 3PL industries' workers or managers using Google form as a primary data source, with academic papers, the internet, and books serving as secondary data sources. This survey will take place in Johor. In cross-sectional time, the researchers will undertake questionnaire design, sample design, and pilot testing. The scientific canon of reliability and validity is examined in this chapter. The Statistical Package for Social Science (SPSS) will be used to examine the data, and descriptive analysis, Pearson's correlation coefficients, and multiple regression analysis will also be explained.

CHAPTER 4

DATA ANALYSIS AND DISCUSSION

4.1 Introduction

The data analysis result that was collected from the respondent through the questionnaire will be discussed and presented in this chapter. The researcher used the IBM Statistical Package for the Social Science (SPSS) Statistics software version 28.0 to analyze the data collected. In this chapter, it will include the descriptive analysis, Pearson's Correlation analysis, Multiple Regression Analysis and ANOVA analysis to determine the relationship between dependent variable and independent variables. The questionnaire is distributed to the third-party logistics (3pl) industries in Johor through an online survey by using Google Forms. There are three parts in the questionnaire (refer to Appendix 1). In the section A of the questionnaire is the demographic profile of respondents. The section B of the questionnaire determines the enables of the IoT adoption towards third-party logistics industries while the section C of the questionnaire determines the application of the IoT in the third-party logistics industries. Likert scale is being used to test in the section B and section C in the questionnaire.

4.2 Pilot test

Pilot test is conducted before the data collection process to reach the target respondents. The pilot test is a small-scale trial that enables the researcher to evaluate the questionnaire in order to eliminate issues when respondents answer to the questions and the data recording issue (Saunders et al., 2016). A pilot test was conducted with 30 employees in 3pl industries selected by the researcher. The researcher was taking one week to complete the pilot test. According to Bartlett (2013), the aim of the pilot test was to assess the validity of the questionnaire and the reliability of the results.

4.2.1 Validity Test

Validity test had been conducted in this research. 15 items were included in this questionnaire were valid. Hence, the internal validity can be observed in this pilot test which determines the relationship between the dependent variable and independent

variables.

4.2.2 Reliability Test

Reliability test can be done by using Cronbach's Alpha to measure the consistency in this research. It measures the amount to which the scale's items are internally consistent. It is used to verify that questions with positive and negative content should not be combined.

Table 4.1: Cronbach's Alpha for Pilot Test

(Sources: SPSS Output)

Reliability Statistics			
	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Perceived Usefulness	.610	.604	4
Perceived Ease of Use	.682	.630	4
Safety	.735	.736	4

Table 4.1 indicates the value of Cronbach's Alpha is represents all dependent and independent variables. There are 30 respondents of 3pl industries involved in this pilot test. From Table 3.3 in Chapter 3 has been mentioned that Cronbach's Alpha coefficient range. For perceived usefulness and perceived ease of use, both of them had questionable strength of association as the Cronbach's Alpha value is between 0.6 to 0.7. For the safety, it is considered as acceptable strength as the Cronbach's Alpha value is between 0.7 to 0.8.

4.3 Descriptive Statistics on Demographic Profile

A descriptive analysis is used to analyze the demographic profile of respondents which are gender, age, duration of employment, job position, and employment department. The SPSS output presents the frequency, percent, valid percent, and cumulative percent. The questionnaires were distributed through Google Form to the target respondents. There are 169 respondents responded to the questionnaire after the data collection.

4.3.1 Gender

Table 4.2: Gender of Respondents

(Sources: SPSS Output)

A1. Gender / Jantina

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female / Perempuan	78	46.2	46.2	46.2
	Male / Lelaki	91	53.8	53.8	100.0
	Total	169	100.0	100.0	

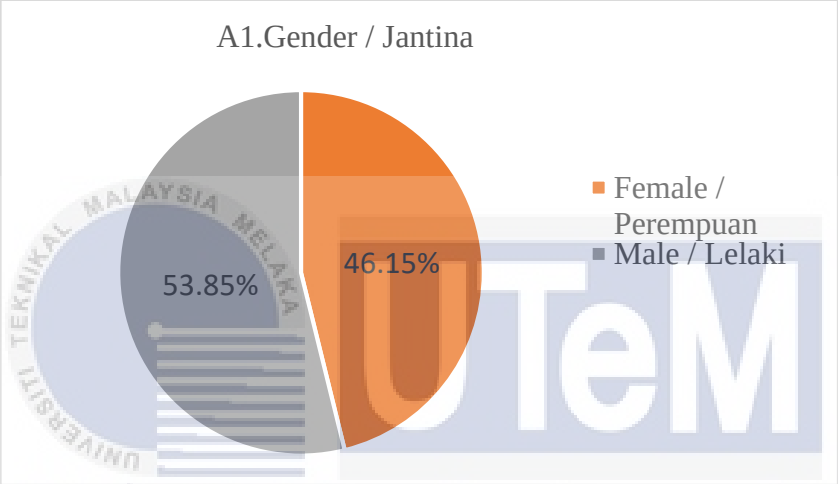

Figure 4.1: Gender of Respondents

Table 4.2 showed the gender of 169 respondents in this research. There are 78 female respondents which were around 46.2% and 91 male respondents which were around 53.8%. Thus, the majority of the respondents in this research were male.

4.3.2 Age

Table 4.3 Age of Respondents

(Sources: SPSS Output)

A2. Age / Umur

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-23 years old / 18-23 tahun	25	14.8	14.8	14.8

	24-29 years old / 24-29 tahun	67	39.6	39.6	54.4
	30-35 years old / 30-35 tahun	41	24.3	24.3	78.7
	36-41 years old / 36-41 tahun	27	16.0	16.0	94.7
	42 years old and above / 42 tahun dan ke atas	9	5.3	5.3	100.0
	Total	169	100.0	100.0	

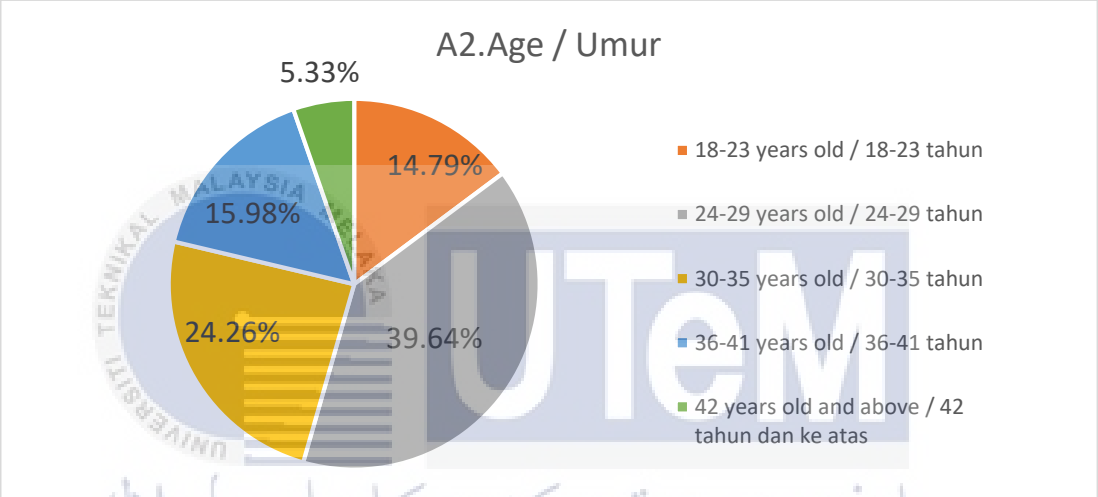

Figure 4.2: Age

As illustrate in Table 4.3 shows the age range were 18 years old to 42 years old and above. The age range of 24-29 years old with 67 or 39.6% is the most of the respondents that participate in this research. The least respondents were in the range of 42 years old and above which was 9 respondents and 5.3% only. In addition, there are 41 (24.3%) respondents who age between 30 to 35 years old, 27 (16%) respondents of 36 to 41 years old, and 25 (14.8%) respondents were 18 to 23 years old had completed the questionnaire in this research.

4.3.3 Duration of Employment

Table 4.4 Duration of Employment of Respondent

(Sources: SPSS Output)

A3. Duration of Employment / Tempoh Pekerjaan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below 5 years / 5 tahun ke bawah	66	39.1	39.1	39.1
	5-10 years / 5-10 tahun	53	31.4	31.4	70.4
	21-30 years / 21-30 tahun	8	4.7	4.7	75.1
	11-20 years / 11-20 tahun	42	24.9	24.9	100.0
	Total	169	100.0	100.0	

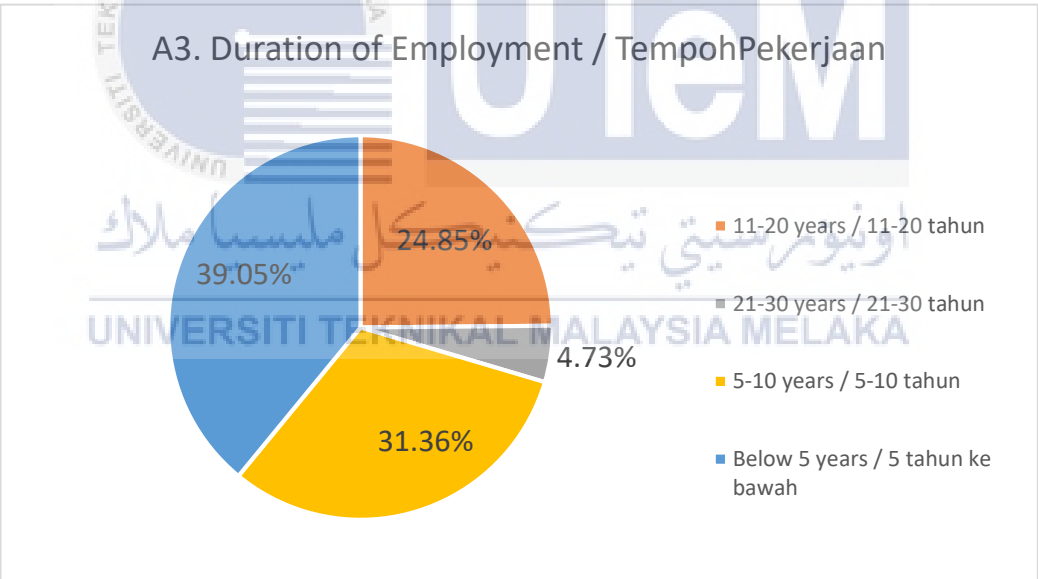

Figure 4.3: Duration of Employment

Table 4.4 shows the duration of employment of 169 respondents. The respondents include 11 to 20 years, 21 to 30 years, 5 to 10 years and below 5 years. The majority of duration of employment is below 5 years is 66 respondents (39.1%). The least of respondents were in the duration 21 to 30 years which was 8 respondents and 4.7%. Furthermore, 53 (31.4%) respondents in the duration between 5 to 10 years, and 42 (24.9%) respondents in the duration between 11 to 20 years.

4.3.4 Job Position

Table 4.5 Job Position of Respondent

(Sources: SPSS Output)

A4. Job Position / Jawatan Pekerjaan					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Team Leader	3	1.8	1.8	1.8
	Team leader	1	.6	.6	2.4
	Team Lead	1	.6	.6	3.0
	Chief executive officer (CEO) / Ketua pegawai eksekutif	5	3.0	3.0	5.9
	Marketers	1	.6	.6	6.5
	Supervisor	50	29.6	29.6	36.1
	Group leader	2	1.2	1.2	37.3
	Executive / Eksekutif	80	47.3	47.3	84.6
	Manager / Pengurus	12	7.1	7.1	91.7
	Assistant Manager	4	2.4	2.4	94.1
	Assistant manager	4	2.4	2.4	96.4
	Assistant	6	3.6	3.6	100.0
	Total	169	100.0	100.0	

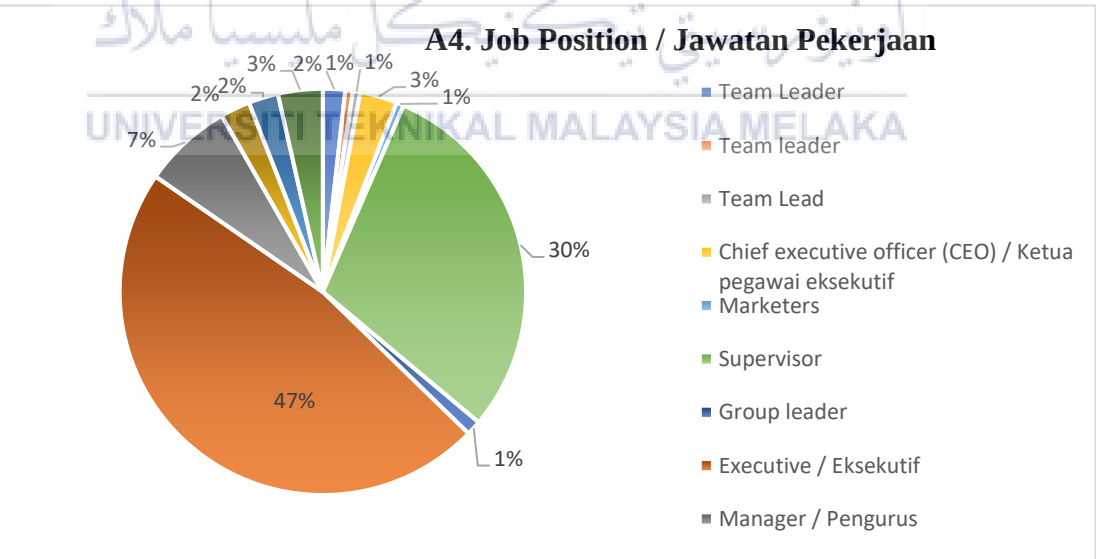

Figure 4.4: Job Position

Table 4.5 described the job position of 169 respondents. The highest totals of 80 respondents with the percentage of 47.3% were executive. Then, there were 50 respondents with the percentage of 29.6% were supervisor. 12 respondents were

manager with the percentage of 7.1%. There were only 8 respondents with the percentage of 4.8% were assistant manager. Furthermore, 6 (3.6%) respondent were assistant, 5 (3%) respondents were chief executive officer (CEO) and team leader, 2 (1.2%) respondents were group leader, and 1 (0.6%) were marketers.

4.3.5 Employment Department

Table 4.6 Employment Department of Respondent

(Sources: SPSS Output)

A5. Employment Department / Jabatan Pekerjaan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Warehousing and distribution / Pergudangan dan pengedaran	40	23.7	23.7	23.7
	Traffic or transportation management / Pengurusan lalu lintas atau pengangkutan	36	21.3	21.3	45.0
	Packaging / Pembungkusan	47	27.8	27.8	72.8
	Inventory management / Pengurusan inventori	46	27.2	27.2	100.0
	Total	169	100.0	100.0	

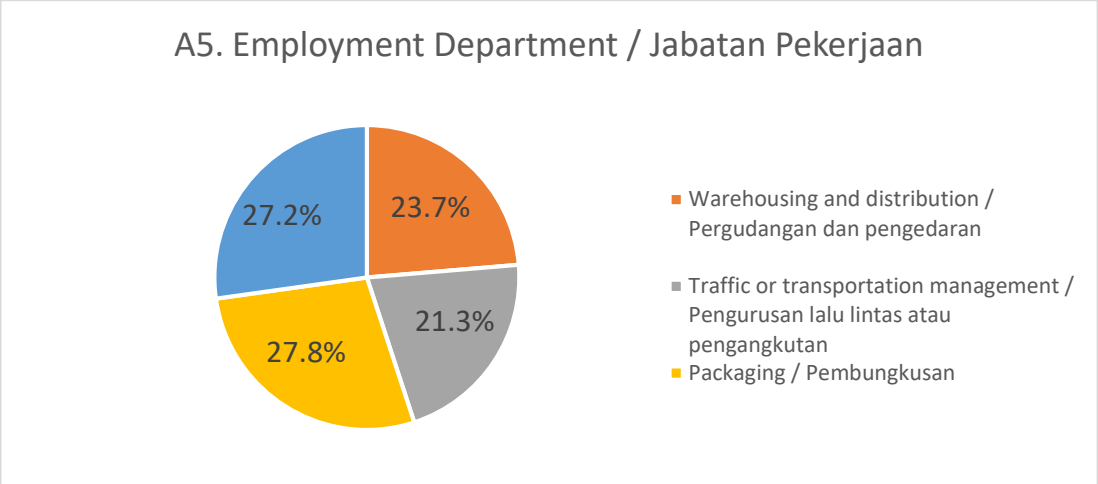

Figure 4.5: Employment Department

From table 4.6 showed 47 respondents and 27.8% from packaging department is the mostly respondents in this research survey. The second mostly respondents are from inventory management department which was 46 (27.2%) rather than those from warehousing and distribution department around 40 (23.7%). Otherwise, these from traffic or transportation management was the least which was 36 (21.3%).

4.4 Descriptive Statistics on Independent Variables

The descriptive analysis is utilized to analyze the independent variables in this study, which were Perceived Usefulness, Perceived Ease of Use, and Safety. The measurement of central tendency was carried out. Through descriptive analysis, the mean, medium, and mode of variables are determined.

4.4.1 Independent Variable: Perceived Usefulness

Table 4.7: Perceived Usefulness preferred by Respondents

(Sources: SPSS Output)

		Using IoT can increase the transparency of logistics.	Using IoT can enhance the work efficiency compared to the traditional mode.	Using IoT can have an opportunity to monitor the delivery and goods conditions.	Using IoT can save time and optimize just-in-time delivery.
N	Valid	169	169	169	169
	Missing	0	0	0	0

Mean	4.09	4.43	4.07	4.38
Median	4.00	5.00	4.00	5.00
Mode	4	5	4	5
Std. Deviation	.697	.737	.704	.764

**. Mode: 1 = Strongly Disagree; 2 = Disagree, 3 = Neutral; 4 = Agree; 5 = Strongly Agree

From Table 4.7, the mode showed that the respondents strongly agree with the statement about using IoT can enhance the work efficiency compared to the traditional mode and the using IoT can save time and optimize just-in-time delivery the most. The next followed by the statement about using IoT can increase the transparency of logistics and the used of IoT can have an opportunity to monitor the delivery and goods conditions with mode agree.

4.4.2 Independent Variable: Perceived Ease of Use

Table 4.8: Perceived Ease of Use preferred by Respondents

(Sources: SPSS Output)

		IoT is usable choice which can connect and control the connected applications in different locations.	IoT is also mobile friendly which can access well-established global networks.	The use of IoT in 3pl is easy to learn and is not complex.	Tracking and managing the commodities by using IoT are more convenient than manual recorder.
N	Valid	169	169	169	169
	Missing	0	0	0	0
Mean		3.85	3.94	4.14	4.09
Median		4.00	4.00	4.00	4.00
Mode		4	4	4	4
Std. Deviation		.794	.721	.774	.801

**. Mode: 1 = Strongly Disagree; 2 = Disagree, 3 = Neutral; 4 = Agree; 5 = Strongly Agree

From Table 4.8, the mode showed the statements about IoT is usable choice which can connect and control the connected applications in different locations, IoT is also mobile friendly which can access well-established global networks, the use of IoT in 3pl is easy to learn and is not complex, and tracking and managing the commodities by using IoT are more convenient than manual recorder with mode agree.

4.4.3 Independent Variable: Safety

Table 4.9: Safety preferred by Respondents

(Sources: SPSS Output)

		The safety of the cargo can be guaranteed by having the application of IoT.	IoT can help in decreasing risks related to the employee safety by monitoring equipment conditions in real time.	IoT helps in monitoring and recovering stolen automobiles.	The correct and reliable information can be provided to the clients with the help of IoT.
N	Valid	169	169	169	169
	Missing	0	0	0	0
Mean		4.15	3.82	4.08	4.34
Median		4.00	4.00	4.00	5.00
Mode		5	4	4	5
Std. Deviation		.945	.729	.735	.858

**. Mode: 1 = Strongly Disagree; 2 = Disagree, 3 = Neutral; 4 = Agree; 5 = Strongly Agree

From Table 4.9, the mode showed that the respondents strongly agree with the statement of the safety of the cargo can be guaranteed by having the application of IoT and the correct and reliable information can be provided to the clients with the help of IoT. The next followed by the statement about IoT can help in decreasing risks related to the employee safety by monitoring equipment conditions in real time and IoT helps in monitoring and recovering stolen automobiles with mode agree.

4.5 Pearson's Correlation Coefficient Analysis

Pearson's Correlation Coefficient (r) is a statistical tool to measure the strength of the linear relationship between dependent variable and independent variables. It is also used to assess the strength of relationship between the variables from data statistics (Saunders et al., 2016). Table 4.10 below showed the guidelines of Pearson's Correlation Coefficients for the interpreting correlation range of the R-Values.

Table 4.10: Pearson's Correlation Coefficients

(Source: Saunders, Lewis and Thornhill, 2016)

Pearson's Correlation Coefficient (R-values)	**Interpretation**
±0.70 to ±1.0	Very strong relationship
±0.40 to ±0.69	Strong relationship
±0.30 to ±0.39	Moderate relationship
±0.20 to ±0.29	Weak relationship
±0.01 to ±0.19	No relationship

Table 4.11: Correlation Analysis for all variables

(Source: SSPS Output)

Correlations					
		Perceived Usefulness	Perceived Ease of Use	Safety	Application of The IoT in Third-Party Logistics Industries
Perceived Usefulness	Pearson Correlation	1	.283**	.335**	.416**
	Sig. (2-tailed)		.000	.000	.000
	N	169	169	169	169
Perceived Ease of Use	Pearson Correlation	.283**	1	.114	.415**
	Sig. (2-tailed)	.000		.141	.000
	N	169	169	169	169
Safety	Pearson Correlation	.335**	.114	1	.387**
	Sig. (2-tailed)	.000	.141		.000
	N	169	169	169	169
Application of The IoT in Third-Party Logistics Industries	Pearson Correlation	.416**	.415**	.387**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	169	169	169	169

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.11 showed the correlations between the independent variables and dependent variable. The independent variables in this research are perceived usefulness, perceived ease of use and safety while the dependent variable is application

of the IoT in third-party logistics industries.

The correlation value for the perceived usefulness was 0.416 with significant level 0.000 ($p<0.01$). This showed that there was a strong relationship between perceived usefulness and application of the IoT in third-party logistics industries. Next, the correlation between perceived ease of use and effectiveness of biometric technology in smartphone was 0.415 with significant level 0.000 ($p<0.01$), this showed that there was a strong relationship between perceived ease of use and application of the IoT in third-party logistics industries. Lastly, the correlation between safety and the application of the IoT in third-party logistics industries was 0.387 with significant level 0.000 ($p<0.01$), this showed that there was a moderate relationship between safety and the application of the IoT in third-party logistics industries.

4.5.1 Perceived Usefulness

Table 4.12: Correlation between Perceived Usefulness and Application of The IoT in Third-Party Logistics Industries

(Source: SSPS Output)

Correlations			
		Perceived Usefulness	Application of The IoT in Third-Party Logistics Industries
Perceived Usefulness	Pearson Correlation	1	.416**
	Sig. (2-tailed)		.000
	N	169	169
Application of The IoT in Third-Party Logistics Industries	Pearson Correlation	.416**	1
	Sig. (2-tailed)	.000	
	N	169	169
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 4.12 showed the correlation between perceived usefulness and the application of the IoT in third-party logistics industries. Based on the table above, the value of Pearson's Correlation Coefficient is 0.416 which means that there were a strong relationship between perceived usefulness and the application of the IoT in third-party logistics industries. The correlation is significant at the 0.01 level (2-tailed) and it proved all two perception have efficiency of $p<0.001$. Therefore, when

perceived usefulness is increased, the application of the IoT in third-party logistics industries will be increased.

4.5.2 Perceived Ease of Use

Table 4.13: Correlation between Perceived Ease of Use and Application of The IoT in Third-Party Logistics Industries

(Source: SSPS Output)

Correlations			
		Perceived Ease of Use	Application of The IoT in Third-Party Logistics Industries
Perceived Ease of Use	Pearson Correlation	1	.415**
	Sig. (2-tailed)		.000
	N	169	169
Application of The IoT in Third-Party Logistics Industries	Pearson Correlation	.415**	1
	Sig. (2-tailed)	.000	
	N	169	169
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 4.13 showed the correlation between perceived ease of use and the application of the IoT in third-party logistics industries. Based on the table above, the value of Pearson's Correlation Coefficient is 0.415 which means that there were a strong relationship between perceived ease of use and the application of the IoT in third-party logistics industries. The correlation is significant at the 0.01 level (2-tailed) and it proved all two perception have efficiency of $p<0.001$. Therefore, when perceived ease of use is increased, the application of the IoT in third-party logistics industries will be increased.

4.5.3 Safety

Table 4.14: Correlation between Safety and Application of The IoT in Third-Party Logistics Industries

(Source: SSPS Output)

Correlations			
		Safety	Application of The IoT in Third-Party Logistics Industries
Safety	Pearson Correlation	1	.387**
	Sig. (2-tailed)		<.001
	N	169	169
Application of The IoT in Third-Party Logistics Industries	Pearson Correlation	.387**	1
	Sig. (2-tailed)	<.001	
	N	169	169
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 4.14 showed the correlation between the safety and the application of the IoT in third-party logistics industries. The Pearson Correlation Coefficient value is 0.387 which is a moderate relationship between the safety and the application of the IoT in third-party logistics industries. The correlation is significant at the 0.01 level (2-tailed) which proved that the two perceptions have efficiency of $p<0.001$. Therefore, safety will not have large impact on the application of the IoT in third-party logistics industries.

4.6 Multiple Regression Analysis

Multiple regression analysis is used to measure the significant relationship between independent variables (perceived usefulness, perceived ease of use, and safety) and dependent variable (application of the IoT in third-party logistics industries). It is a statistical tool to measure the relationship of strength of a cause and effect between independent variables and dependent variable.

Table 4.15: Model Summary of Multiple Regression Analysis

(Source: SSPS Output)

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.579[a]	.335	.323	.31644
a. Predictors: (Constant), Perceived Usefulness, Perceived Ease of Use, Safety				

Table 4.15 showed the model summary that illustrates the relationship between the independent variables and dependent variable. The correlation coefficient value (R) is 0.579. This showed that there was a moderate correlation between the variables. Next, the coefficient of determinant, R square showed value of 0.335 which means that the application of the IoT in third-party logistics industries were affected by independent variables with 33.5%. The other 66.5% was other factors which are not involved in this research. The adjusted R square showed 32.3%.

Table 4.16: ANOVA Analysis

(Source: SSPS Output)

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.313	3	2.771	27.673	.000[b]
	Residual	16.522	165	.100		
	Total	24.835	168			
a. Dependent Variable: Application of the IoT in Third-party Logistics Industries						
b. Predictors: (Constant), Perceived Usefulness, Perceived Ease of Use, Safety						

Table 4.16 showed the F-test value was 27.673 with a significant level 0.000. The significant level was lower than 0.05 thus the researcher can conclude that there is a significant relationship between independent variables (perceived usefulness, perceived ease of use, safety) and dependent variable (application of the IoT in third-party logistics industries). The null hypothesis would be rejected as the significant level of regression model is below 0.05.

Table 4.17: Coefficient of Multiple Regression Analysis

(Source: SSPS Output)

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.143	.339		3.371	.001
	Perceived Usefulness	.215	.064	.234	3.357	.001
	Perceived Ease of Use	.325	.068	.318	4.799	.000
	Safety	.208	.052	.272	4.039	.000
a. Dependent Variable: Application of the IoT in Third-party Logistics Industries						

Table 4.17 showed the beta value of independent variables which perceived usefulness (IT) was 0.215, 0.325 for perceived ease of use (AM) and 0.208 for safety (FT). Based on ascending order, the least significant of beta value was safety, then came with perceived usefulness and perceived ease of use have the most significant beta value. The linear equation of Multiple Regression Analysis (MRA) was Y = a + bX1 + cX2, thus Application of the IoT in Third-party Logistics Industries = 1.143 + 0.215IT + 0.325AM + 0.208 FT

4.7 Hypothesis Testing

i. Perceived Usefulness

H1: There is a significant relationship between perceived usefulness and the success factors of the application of the IoT in the 3pl industry.

H0: There is no significant relationship between perceived usefulness and the success factors of

the application of the IoT in the 3pl industry.

Accept H1

Table 4.17 showed the result of coefficient of multiple regression analysis. The significant value of perceived usefulness toward the application of the IoT in third-party logistics industries is 0.001 which is lower than 0.05. Therefore, there is a significant relationship between perceived usefulness and the success factors of the

application of the IoT in the 3pl industry. The alternative hypothesis (H1) is accepted and null hypothesis (H0) is rejected.

ii. Perceived Ease of Use

H2: There is a significant relationship between perceived ease of use and the success factors of the application of the IoT in the 3pl industry.

H0: There is no significant relationship between perceived ease of use and the success factors of the application of the IoT in the 3pl industry.

Accept H2

Table 4.17 showed the result of coefficient of multiple regression analysis. The significant value of perceived ease of use toward the application of the IoT in third-party logistics industries is 0.000 which is lower than 0.05. Therefore, there is a significant relationship between perceived ease of use and the success factors of the application of the IoT in the 3pl industry. The alternative hypothesis (H2) is accepted and null hypothesis (H0) is rejected.

iii. Safety

H3: There is a significant relationship between perceived safe of use and the success factors of the application of the IoT in the 3pl industry.

H0: There is no significant relationship between perceived safe of use and the success factors of the application of the IoT in the 3pl industry.

Accept H3

Table 4.17 showed the result of coefficient of multiple regression analysis. The significant value of safety toward the application of the IoT in third-party logistics industries is 0.000 which is lower than 0.05. Therefore, there is a significant relationship between perceived safe of use and the success factors of the application of the IoT in the 3pl industry. The alternative hypothesis (H3) is accepted and null hypothesis (H0) is rejected.

4.8 Discussion of Findings

The data analysis results showed there is a positively impact between perceived usefulness, perceived ease of use, and perceived safe of use towards the application of the Internet of Things (IoT) in the third-party logistics (3pl) industries.

RO1: To identify the importance of the application of IoT in logistics.

In this research objective, the researcher had used SPSS software to prove the results of the explanatory factor. From the Table 16, the F-test value was 27.673 with a significant level 0.000. The significant level was lower than 0.05 thus the researcher can conclude that there is a significant relationship between independent variables (perceived usefulness, perceived ease of use, safety) and dependent variable (application of the IoT in third-party logistics industries). It also classified the importance of the application of IoT in logistics.

H1: There is a significant relationship between perceived usefulness and the success factors of the application of the IoT in the 3pl industry.

The result showed the perceived usefulness was able to affect the success factors of the application of the IoT in the 3pl industry in the hypothesis 1. The p-value of perceived usefulness was 0.001 and it is lower than 0.05 according by the coefficient of multiple regression analysis in table 4.17. From the result showed that the perceived usefulness has a significant relationship with the success factors of the application of the IoT in the 3pl industry. Therefore, it cannot deny that the IoT is essential to obtain in the logistics. The IoT application can assist the organization with real-time tracking, allowing the staff to keep track of the movement of the items and determine their specific location at any moment (Admin, 2021). Based on the table 4.7, it is highlight by the statement of using IoT can increase the transparency of logistics which most of the respondent agree with the statement with the mode agree.

In conclusion, the significant value was less than 0.05 so the null hypothesis (H0) was rejected and the alternative hypothesis (H1) was accepted. There is a significant relationship between perceived usefulness and the success factors of the application IoT in 3pl industries and it can conclude that the IoT application is crucial to utilize in logistics.

H2: There is a significant relationship between perceived ease of use and the success factors of the application of the IoT in the 3pl industry.

According to Kitowska (2019), the ways of tracking and managing the commodities by using the IoT sensors such as RFID are more convenient than a traditional manual recorder by the workers. The employees can identify the located place of goods speedily. Thus, this IoT system is easier for users to use. Based on the table 4.7, the mode showed that the respondents agree with the statement about tracking and managing the commodities by using IoT are more convenient than manual recorder. Besides, the SPSS output showed a significant result between perceived ease of use and the success factors of the application of the IoT in the 3pl industry. The significant value was less than 0.05 so the null hypothesis (H0) was rejected and the alternative hypothesis (H2) was accepted.

In conclusion, the IoT application is essential to utilize in logistics. It is because that fact that the IoT is easy in using and it is not complex. According to the respondents' demographic background, most of the respondents only have the least duration of employment which is below 5 years. This demonstrates they still can handle and utilize the application of IoT in logistics.

H3: There is a significant relationship between perceived safe of use and the success factors of the application of the IoT in the 3pl industry.

According to Curatauser (2019), it is feasible to detect items using smart vision camera systems and RFID tags on pallets or other objects. Any product or item may be entered into a database to find its inventory levels. Additionally, the item's position, such as a specific shelf, should be noted. By knowing where and how much inventory there is, inventory levels may be decreased. Based on the table 4.11, the significant value of safety toward the application of the IoT in third-party logistics industries is 0.000 which is lower than 0.05. This indicated that the safety would impact and affect the success factors of the application of the IoT in the 3pl industry. In Table 4.9, the respondents strongly agree that the safety of the cargo can be guaranteed by having the application of IoT and the correct and reliable information can be provided to the clients with the help of IoT. For this reason, it can prove that IoT is crucial to be adopted in the logistics.

RO2: To determine the IoT application for logistics.

Third-party logistics companies may employ IoT devices to capture enormous amounts of important data and use it to enhance their own performance. Improved routing, more accurate inventory management, and increased visibility for both the company's partners and customers can be achieved with the help of IoT analytics (Globecon, 2017). Based on the table 4.16, the F-test value was 27.673 with a significant level 0.000. The significant level was lower than 0.05joho thus the researcher can conclude that there is a significant relationship between independent variables (perceived usefulness, perceived ease of use, safety) and dependent variable (application of the IoT in third-party logistics industries). Researcher had explained that the success factor of different function of application IoT in different sectors like warehousing, transportation, loading and unloading, packaging and distribution can improve the performance in logistics. The researcher examines the different application of IoT mentioned which affecting the work productivity at the logistics workplace through several of literature review. The objective 2 had been achieving.

RO3: To understand the most success factor of 3PL industries in the application of IoT.

The attitude toward use, behavioral intention to use and actual usage are all influenced by perceived ease of use. (Igi Global, 2022). From the coefficient of multiple regression table, it showed that the beta value of perceived ease of use was 0.318 which is the highest value compare to the perceived usefulness and safety. Based on this value, the researcher can concludes that the perceived ease of use is the variable that most influential. Besides, from the Table 4.9, the mode showed that the respondents agree with all the statement about the perceived ease of use is affected the enablers of application IoT in 3pl industries.

Furthermore, the respondents of this research mostly are in the position of executive which the frequency in the job position of demographic backgrounds is about 80. It can prove that the executives in the 3pl industries are more understanding about the application of IoT since they are the person who accessing the worker output and knowing the overall work processes. Thus, perceived ease of used can be determined as the most success factors of 3pl industries in the application of IoT since the employees can handle the IoT application in a few time and thus increase the number of output.

4.9 Summary

In Chapter 4, the researcher has analysed the data collected from the respondents. All of the data was done by utilizing SPSS software ver. 28.0. The researcher imported the data into SPSS and used reliability analysis for pilot test, descriptive analysis, Pearson's Correlation Coefficient analysis, Multiple Regression analysis and ANOVA analysis. The data outputs showed the relationship between independent variables and dependent variable. The result showed all the independent variables (perceived usefulness, perceived ease of use and safety) have a significant relationship with the dependent variable (the success factors of the application of the IoT in the 3pl industry). In next chapter, the searcher will discuss about the results outcome, fulfilling RO, limitation and recommendation of the overall research.

CHAPTER 5

RECOMMENDATION AND CONCLUSION

5.1 Introduction

This chapter discussed about the conclusion of the overall result and summary of the findings of this research. The summary of the findings is elaborated in the first section of this chapter while justification of research objectives is explained in the second section. In addition, the limitation of this research is included in the third section of this chapter. Lastly, the recommendations for the future research are described in the last section of this chapter.

5.2 Summary of the Findings

The researcher finished the data analysis of the demographic variables. The total respondents were 169 and demographic background provided from them included gender, age, duration of employment, job position and employment department. From the data output, the majority respondents were male. The major age range of respondent was 24 to 29 years old. For duration of employment and job position, most of the respondents were worked below 5 years and worked as executive. Last but no least, for the employment department in logistics, the majority of respondents were worked under packaging department.

In the Pearson's Correlation Coefficients analysis, the correlation analysis and the relationship of three independent variables and one dependent variable had been tested. The independent variables were perceived usefulness, perceived ease of use and safety while the dependent variable was the application of the IoT in third-party logistics industries. There were strong relationship between perceived usefulness and perceived ease of use with the application of the IoT in third-party logistics industries. There was a moderate relationship between the safety and the application of the IoT in third-party logistics industries.

In the Multiple Regression analysis, the relationship between independent variables and dependent variable had been determined. The correlation coefficient value (R) showed that there was a moderate correlation between the variables. Based on ANOVA analysis, the researcher can conclude that there is a significant relationship between independent variables as the significant level of regression model is below

0.05.

For the hypothesis testing, the perceived usefulness, perceived ease of use, and safety have a significant relationship with the application of the IoT in third-party logistics industries. Thus, alternative hypothesis (H1, H2, H3) is accepted and null hypothesis (H0) is rejected.

5.3 FULFILMENT OF RESEARCH OBJECTIVES

The results of the research will be the result of the study in seeking the marketing challenges of high-tech SMEs. This research will provide results that have important research objectives related to the factor influencing the growth, the marketing challenges faced, and the most dominant challenges of high-tech SMEs.

5.3.1 To identify the importance of the application of IoT in logistics.

The research has successfully found out the success factors that influencing the application of IoT in 3pl logistics. According the questions in questionnaire, the importance of the IoT had increased the interest of 3pl logistics to adopt the IoT. As a result of the importance of the application of IoT in logistics, the researcher can conclude that there is a relationship between the independent variables (perceived usefulness, perceived ease of use, and safety) and the dependent variable (the success factors of the application of the IoT in 3pl industry). Hence, the usefulness, easier of using and safety of IoT aim to let the 3pl logistics industry aware about the importance of IoT and thus influencing the success factors of application of IoT.

5.3.2 To determine the IoT application for logistics.

The researcher concludes that the perceived usefulness, perceived ease of use and safety are the success factors of the application of IoT in 3pl industries. This is due to the fact that different functions of IoT at different department also aim in improving the efficiency in the IoT due to its usefulness, ease to use and safety. Therefore, the 3pl industries will desire to adopt the IoT in the workplace. The independent variables (perceived usefulness, perceived ease of use and safety) is important to increase the awareness of the 3pl industry in adopting the IoT. In conclude, three hypotheses in this research show that it is all significant.

5.3.3 To understand the most success factor of 3PL industries in the application of IoT.

The most success factor of 3PL industries in the application of IoT is perceived ease of use. The researcher determined that perceived ease of use affects the success factor of 3pl in the application of IoT. This is based on the fact that the 3pl industries can easy to learn the IoT since there is not complex. The second question on perceived ease of use is IoT is mobile friendly which can access well-established global networks. Since nowadays most of the people having their mobile phone and knowing well about the function of the mobile, the IoT that can access well and easy to function in the mobile devices is also a great success factors of 3pl industries in the application of IoT. From the coefficient of multiple regression table, it showed that the beta value of perceived ease of use was 0.318 which is the highest value compare to the perceived usefulness and safety. Based on this value, the researcher can concludes that the perceived ease of use is the variable that most influential.

5.4 Limitation of the Study

There were a number of limitations in this study, such time constraints, sample size and population, limited experience and knowledge and respondent truthfulness. The researcher had a limited amount of time since the researcher only had four months to gather the data. Additionally, the researcher only has a limited amount of time to distribute the questionnaire to respondents and could only conduct the study in the state of Johor. The questionnaire also remained unanswered by the respondents after the researcher sent it through email since they are unwilling to spend their time to complete it. According to the sample size and population data, the researcher was expected to receive 383 responses. Unfortunately, this study only had 169 respondents. Thus, the consistency and accuracy of the data output will decline.

The second limitation was linked to the third-party logistics' understanding about the IoT. Some respondents are not using the appliances of IoT in the third-party industries and not really understand about the application of IoT. Moreover, the respondents which varies of job position and duration of employment had an impact on how they responded to the question. The third limitation of this research is lack of honesty when they answered the questionnaire. Some respondents are not giving a fully corporation to answer the survey. Instead of thoroughly reading the questions, they just ticked the answer. Therefore, it will occur bias when choose a correct answer

for the survey.

5.5 Recommendation for the Future Study

In this research, the researcher has studied about the enablers of application of Internet of Things (IoT) in the third-party logistics (3pl) industries. Researcher had suggested some of the recommendation for the future researcher who was conduct the similar research.

The first recommendation is the future researchers have the option of distributing and gathering data from various states in Malaysia. Respondents from various states can have varying opinions about the enables of IoT is used in the 3pl industries. Results based on the huge population's data could be exact and accurate.

Next, the background of respondents is the area that future researchers must concentrate on. Respondents' various backgrounds could differ significantly. The target responders must be familiar with Internet of Things (IoT) and must regularly use the application of IoT in the 3pl industry. In addition, the understanding of using the application of IoT will be change by the duration of employment. The respondents with low duration of employment (below 5 years) are one of the limitations because they are not familiar on utilizing the IoT in their employment department.

Lastly, future researcher can use mixed method to obtain the better result in future research studies. The future researcher can conduct the research by using questionnaire, interviews and laboratory experiments to obtain specific information on perceptions and views of the IoT.

5.6 Concluding Remark

In conclusion, this research focuses on the study of the enable of the Internet of Thins (IoT) adoption: a study on the third-party logistics (3pl) industries. The results show the three hypotheses which is perceived usefulness, perceived ease of use and safety which indicated in Chapter 2 is accepted. The perceived usefulness, perceived ease of use, and safety is a significant relationship with the success factors of the application of the IoT in the 3pl industry, thus alternative hypotheses (H1, H2, H3) are accepted. The findings of the study will benefit the 3pl industry as they can refer to this research to figure out the importance of IoT application to increase efficiency.

At the end of this chapter, the researcher explained the summary of the findings, limitations, and recommendations of the study. In the summary of the findings, the

researcher concluded the result based on data analysis and discussion in Chapter 4. For the limitation, the researcher listed out the problem facing in this research such as time constraints, sample size and population, limited experience and knowledge, and respondent truthfulness. For the recommendation, the researcher was giving suggestions to make the future study more perfect. The recommendation included a large sample size, background of the respondents, and using qualitative methods.

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APPENDIX A

SURVEY QUESTIONNAIRE

ENABLERS OF THE INTERNET OF THINGS (IoT) ADOPTION: A STUDY ON THE THIRD-PARTY LOGISTICS (3PL) INDUSTRIES IN JOHOR

Dear Sir/Miss/Madam,

My name is Chin Shi Ying. I am a final year student of Universiti Teknikal Malaysia Melaka (UTeM) in Bachelor of Technology Management (Supply Chain Management and Logistics) with Honors. I am currently conducting my research study with the title of "Enablers of the Internet of Things (IoT) adoption: a study on the third-party logistics (3pl) industries in Johor."

The main purpose of this survey is to study the adoption of the IoT in the 3pl industries in Johor. This questionnaire is containing three parts which are section A, B and C. Therefore, I need your help and cooperation to complete this questionnaire which takes about 10 minutes. The information that is collected is used for the academic purpose only and the private information are highly confidential. Your cooperation is highly appreciated. Thank you.

Sincerely,
Chin Shi Ying
Email address:
Contact number:

Supervised by,
Datin Dr. Suraya Binti Ahmad
Email address:
Falculty of Technology Management and Technopreneurship
Universiti Teknikal Malaysia Melaka (UTeM)

*Required

Section A: Demographic Profile

Bahagian A: Latar Belakang Demografi

This section is to collect the information of respondents about the personal background. Please answer the question below by selecting the appropriate option.

Bahagian ini adalah untuk mengumpulkan maklumat responden tentang latar belakang peribadi. Sila jawab soalan di bawah dengan memilih pilihan yang sesuai.

1. A1. Gender / *Jantina* *

   Mark only one oval.

   - ◯ Male / Lelaki
   - ◯ Female / Perempuan

2. A2. Age / *Umur* *

   Mark only one oval.

   - ◯ 18-23 years old / 18-23 tahun
   - ◯ 24-29 years old / 24-29 tahun
   - ◯ 30-35 years old / 30-35 tahun
   - ◯ 36-41 years old / 36-41 tahun
   - ◯ 42 years old and above / 42 tahun dan ke atas

3. A3. Duration of Employment / *Tempoh Pekerjaan* *

   Mark only one oval.

   - ◯ Below 5 years / 5 tahun ke bawah
   - ◯ 5-10 years / 5-10 tahun
   - ◯ 11-20 years / 11-20 tahun
   - ◯ 21-30 years / 21-30 tahun

4. A4. Job Position / *Jawatan Pekerjaan* *

Mark only one oval.

- ◯ Executive / Eksekutif
- ◯ Manager / Pengurus
- ◯ Chief executive officer (CEO) / Ketua pegawai eksekutif
- ◯ Other: _____

5. A5. Employment Department / *Jabatan Pekerjaan* *

Mark only one oval.

- ◯ Inventory management / Pengurusan inventori
- ◯ Traffic or transportation management / Pengurusan lalu lintas atau pengangkutan
- ◯ Warehousing and distribution / Pergudangan dan pengedaran
- ◯ Packaging / Pembungkusan
- ◯ Other: _____

Skip to question 6

Section B: Enables of The IoT Adoption Towards Third Party Logistics Industries
Bahagian B: Membolehkan Penggunaan IoT Ke Arah Industri Logistik Pihak Ketiga

This section is to determine the success factors of application of the IoT towards third party logistics employees. Please rate and select the satisfying level (1-5) that best reflects your opinions towards the questions.

Bahagian ini adalah untuk menentukan faktor kejayaan aplikasi IoT terhadap perkerja logistik pihak ketiga. Sila nilai dan pilih tahap memuaskan (1-5) yang paling menggambarkan pendapat anda terhadap soalan.

Scale / Skala:

1	2	3	4	5
Strongly Disagree / *Sangat Tidak Setuju*	Disagree / *Tidak Setuju*	Neutral / *Neutral*	Agree / *Setuju*	Strongly Agree / *Sangat Setuju*

6. Part 1: Perceived usefulness / *Kebolehgunaan* *

Mark only one oval per row.

	1	2	3	4	5
Using IoT can increase the transparency of logistics. / Penggunaan IoT boleh meningkatkan ketelusan logistik.	◯	◯	◯	◯	◯
Using IoT can enhance the work efficiency compared to the traditional mode. / Penggunaan IoT boleh meningkatkan kecekapan kerja berbanding mod tradisional.	◯	◯	◯	◯	◯
Using IoT can have an opportunity to monitor the delivery and goods conditions. / Penggunaan IoT boleh mempunyai peluang untuk memantau keadaan penghantaran dan barangan.	◯	◯	◯	◯	◯
Using IoT can save time and optimize just-in-time delivery. / Penggunaan IoT boleh menjimatkan masa dan mengoptimumkan penghantaran tepat dalam masa.	◯	◯	◯	◯	◯

7. Part 2: Perceived ease of use / *Penggunaan Mudah Dilihat* *

Mark only one oval per row.

	1	2	3	4	5
IoT is usable choice which can connect and control the connected applications in different locations. / IoT adalah pilihan yang boleh digunakan yang boleh menyambung dan mengawal aplikasi yang disambungkan di lokasi yang berbeza.					
IoT is also mobile friendly which can access well-established global networks. / IoT juga mesra mudah alih yang boleh mengakses rangkaian global yang mantap.					
The use of IoT in 3pl is easy to learn and is not complex. / Penggunaan IoT dalam 3pl mudah					

dipelajari dan tidak rumit.					
Tracking and managing the commodities by using IoT are more convenient than manual recorder. / Menjejak dan mengurus komoditi dengan menggunakan IoT adalah lebih mudah daripada perakam manual.	○	○	○	○	○

8. Part 3: Safety / *Keselamatan* *

Mark only one oval per row.

	1	2	3	4	5
The safety of the cargo can be guaranteed by having the application of IoT. / Keselamatan kargo boleh dijamin dengan menggunakan aplikasi IoT.	◯	◯	◯	◯	◯
IoT can help in decreasing risks related to the employee safety by monitoring equipment conditions in real time. / IoT boleh membantu dalam mengurangkan risiko yang berkaitan dengan keselamatan pekerja dengan memantau keadaan peralatan dalam masa nyata.	◯	◯	◯	◯	◯
IoT helps in monitoring and recovering stolen automobiles. /	◯	◯	◯	◯	◯

IoT membantu dalam memantau dan memulihkan kereta yang dicuri.					
The correct and reliable information can be provided to the clients with the help of IoT. / Maklumat yang betul dan boleh dipercayai boleh diberikan kepada pelanggan dengan bantuan IoT.	⬭	⬭	⬭	⬭	⬭

Skip to question 9

Section C: Application of The IoT In The Third-Party Logistics Industries

Bahagian C: Penggunaan IoT Dalam Industri Logistik Pihak Ketiga

This section is to determine the success factors of application of the IoT in the third party logistics industries. Please rate and select the satisfying level (1-5) that best reflects your opinions towards the questions.

Bahagian ini adalah untuk menentukan faktor kejayaan aplikasi IoT dalam industri logistik pihak ketiga. Sila nilai dan pilih tahap memuaskan (1-5) yang paling menggambarkan pendapat anda terhadap soalan.

Scale / Skala:

1	2	3	4	5
Strongly Disagree / *Sangat Tidak Setuju*	Disagree / *Tidak Setuju*	Neutral / *Neutral*	Agree / *Setuju*	Strongly Agree / *Sangat Setuju*

9. Application of The IoT In The Third-Party Logistics Industries / *Penggunaan IoT Dalam Industri Logistik Pihak Ketiga* *

Mark only one oval per row.

	1	2	3	4	5
IoT is adapted in 3pl industries because of the suitability and effectiveness / IoT diadaptasi dalam industri 3pl kerana kesesuaian dan keberkesanannya.	◯	◯	◯	◯	◯
The market requirement lead to the implementation of IoT in 3pl industries. / Keperluan pasaran menerajui pelaksanaan IoT dalam industri 3pl.	◯	◯	◯	◯	◯
IoT can help in performing a large number of different operations through the cloud computing environment. / IoT boleh membantu dalam melaksanakan sejumlah besar operasi yang berbeza melalui persekitaran pengkomputeran awam.	◯	◯	◯	◯	◯

The employees are adequately trained in using the IoT devices. / Pekerja dilatih dengan secukupnya dalam menggunakan peranti IoT.					

Thank you for your participation. The data collected are for academic purpose only.

Terima kasih atas penyertaan anda. Data yang dikumpul adalah untuk akademik sahaja.

APPENDIX B

Gantt Chart of Final Year Project (FYP) 1

WEEK/ ACTIVITIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
FYP talk									MID SEMESTER BREAK							
Search for FYP topic																
Meeting with supervisor																
Topic discussion																
Title confirmation																
RO & RQ Construction																
Submission Chapter 1																
Submission Chapter 2																
Submission Chapter 3																
First draft of FYP 1																
Submission of FYP 1																
Presentation 1																
Revised of FYP 1																

APPENDIX C

Gantt Chart of Final Year Project (FYP) 2

WEEK/ ACTIVITIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Create Questionnaire	■	■							MID SEMESTER BREAK							
Distribute Questionnaire			■	■	■											
Collect Questionnaire						■	■									
Analysis Data								■		■						
Submission Chapter 4											■					
Submission Chapter 5												■				
Proposal Correction													■	■		
Slide Preparation															■	
Submission of FYP 2																■
Presentation 2																■