THE ADOPTION OF AUTOMATION IN

SCHENKER PENANG LOGISTICS CENTRE 5

(PLC5) WAREHOUSE: A CASE STUDY

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THE ADOPTION OF AUTOMATION IN SCHENKER PENANG LOGISTICS CENTRE 5 (PLC5) WAREHOUSE: A CASE STUDY

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ABSTRACT

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Warehouse automation is one of the technologies implemented in Industry 4.0 and has greatly benefited various industries by increasing productivity, effectiveness, and efficiency in warehouse operations. These technologies have been adopted in most foreign countries, such as Germany, the United Kingdom, and China. Therefore, Malaysia has yet to urge or advise stepping into warehouse automation in the available industry sector. This study was carried out at Penang Logistics Centre 5 (PLC5), Schenker Logistics (M) Sdn. Bhd., to discuss the relationship between advanced technologies and the current warehouse operation in solving the issues that arose. Meanwhile, the data collection process will be done by conducting physical and virtual interviews with middle-level management to obtain the facts necessary to access the current warehouse operations, identify the complications that arise from these operations, and propose appropriate technology to enhance the current operation. Besides, thematic analysis has been used to analyse the data, and the findings obtained are believed to be very legible and usable for PLC5, Schenker Logistics (M) Sdn. Bhd. in future warehouse operations.

Keywords: *Warehouse Automation, Productivity, Warehouse Operations, Technologies.*

ACKNOWLEDGMENT

DECLARATION

We hereby declare that this final year project report is based on our original work except for quotations and citations which have been duly acknowledged. We also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

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This final year project report entitled "**THE ADOPTION OF AUTOMATION IN SCHENKER PENANG LOGISTICS CENTRE 5 (PLC5) WAREHOUSE: A CASE STUDY**" was prepared by **CHUAH YU RU, GOH AI VIN**, and **OOI HUI TIAN**, and submitted as partial fulfilment of the requirements for the degree of Bachelor of Science (Hons) Logistics and International Shipping at Universiti Tunku Abdul Rahman.

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LIST OF ABBREVIATIONS

AGC	Automatic Guided Cart
AGV	Automated Guided Vehicle
AI	Artificial Intelligence
AIDC	Auto ID Data Capture
AMR	Autonomous Mobile Robot
ASRS	Automated Storage and Retrieval System
AVI	Automated Vision Inspection
DO	Delivery Order
E&E	Electrical and Electronics
ERP	Enterprise Resource Planning
FAE	Field Application Engineering
FIFO	First-in, first-out
GIS	Geographic Information Systems
GPS	Global Positioning System
GTP	Goods-to-person
IILS	International Integrated Logistics Services
ITS	Inbound Tally Sheet
IoT	Internet of Things
LANs	Local Area Network

LIFO	Last-in, first out
MIDA	Malaysia Investment Development Authority
ML	Machine Learning
MOF	Ministry of Finance
PDPA	Personal Data Protection Act 2010
PLC5	Penang Logistics Centre 5
RF	Radio Frequency
RFID	Radio Frequency Identification
RNN	Repeating Neural Networks
ROI	Return on Investment
RTV	Return-to-Vendor
SKU	Stock Keeping Unit
SOP	Standard Operation Procedure
UAV	Unmanned Aerial Vehicles
UK	United Kingdom
UN	United Nation
US	United States
WMS	Warehouse Management System
VLM	Vertical Lift Module

CHAPTER 1

INTRODUCTION

1.0 Introduction

Chapter 1 will begin with the background of the study and be followed by the primary problem that is intended to be emphasized, and consequently, it will justify why such a problem is urged to be researched. This chapter also includes the research objectives, research questions, significance of the study, scope of the research, and definition of terms.

1.1 Background of Study

Since 1901, warehouse automation has existed since the steel conveyor belt was introduced, followed by the forklift truck in 1917. Later in the 1950s, the first automated storage and retrieval system (ASRS) was invented. Commercial warehouses began to popularise in the 1960s, and slowly, computer as well as IT solutions started to appear in warehouses in the 1980s. With the help of software-controlled technologies, warehouse operations seem to be more efficient than before. Because of the rapid development of the logistics industry, robotics was first introduced in the 2000s as a part of warehouse operations. The invention of technologies did benefit many in the enterprise, especially when carrying out the inbound and outbound operations in the warehouse (Staff, 2023).

Nevertheless, compared to some of the traditional practises, there is a big discrepancy in the logistics industry revolution that has been performed in the 21st century. The most common thing that can be easily discovered is through the warehouse operation. In a conventional warehouse, the workforce is

widespread as human labour is required to complete multiple warehouse operations such as receiving, storage, putting away, and packing. The labour force is still the primary character controlling most of the warehouse processes. Nevertheless, by entering the 21st century, the new technology of an automated three-dimensional warehouse has been developed and has become the main choice for major enterprises. In another way, an automated three-dimensional warehouse is also known as an unmanned warehouse. The automated warehouse is implementing an automated guided vehicle (AGV) to carry out the inbound and outbound operations. AGV is a driverless transport system used to move various materials in an automated manner (Correia, Teixeira, and Ramos, 2020). For instance, an automatic guided cart (AGC) can be used to load pallets and transport the materials or cargo from one place to another.

Furthermore, an automated warehouse is also equipped with a system named Warehouse Management System (WMS). The warehouse management system is essential for achieving point-to-point tracking of offline goods. It can also regularly analyse statistical data on goods coming in and going out to enable digital management, boost business competitiveness, and produce significant financial gains. Automated warehouses provide a high level of automation, energy conservation, safety, extensive storage, high productivity, and unattended operations (Deng, Mao, and Gan, 2018). According to Veeqo (2018), WMS helped ensure the warehouse operation was more organised as it optimised the efficiency of each process that took place in the warehouse. As a result of the implementation of an automated warehouse, the productivity and efficiency of warehouse operations can be enhanced over time.

According to ABI Research, **Appendix 1 – Figure 1.1** illustrates that the revenue for companies that utilise Warehouse Management Systems (WMS) for automation will increase from $3.4 billion in 2022 to $10.7 billion in 2030. The foundation of a warehouse management system is advanced analytics, which use big data to identify supply chain trends. A volatile market can be predicted using artificial intelligence (AI) and machine learning (ML). Without analytics, it would not be feasible to get real-time information that may be used to quickly reach strategic judgements (Luitel, 2022). Moreover, referring to **Appendix 2 – Figure 1.2**, it is obvious that various technologies have now been adopted into warehouse automation worldwide, including blockchain, artificial intelligence, and supply chain 4.0. To elaborate, AI can increase employee productivity by reducing unproductive walking time. When productivity increases, it will indirectly increase potential profits as well. While blockchain is a new and modern type of database, this technology can aid in the resolution of a variety of industrial issues, including trust, transparency, security, and data processing reliability (Golosova and Romanovs, 2018). Thus, automated warehouse technologies can help improve the order fulfilment rate in the warehouse and reduce the occurrence of unwanted accidents.

Based on the U.S. Bureau of Labour Statistics, transportation and warehousing had the second highest injury and illness incident rate with 210,000 total incidents. The requirement for speed grows along with the demand for products. However, for every 1000 employees, injured warehouse workers missed 14.5 days of work on average in 2016. Injuries and fatalities in warehouses would have decreased or been eliminated by now if automation and robotics had been given more attention. By utilising AI-controlled drones to pick,

pack, and ship the goods, it might contribute to the safety of warehouse workers (Tutterrow, 2018). The graph can refer to **Appendix 3 – Figure 1.3**.

As in Malaysia, automated warehouses are not unfamiliar in the sector. For instance, WoodTrees is on a mission to spearhead the automation wave in Malaysia's warehousing industry because they feel that an automated warehouse is a critical component of increasing business performance and productivity (Birruntha, 2021). Whereby the technology adopted in automated warehouses has eased their daily operation and improved security, transparency, and traceability. On the other hand, automation is perceived to improve operations such as production speed and product quality (Huynh, 2020). An automated warehouse could take as little as 6 months to as long as 10 years for an effective return on investment (ROI), and there are many options and levels in an automated warehouse as the costs incurred are according to the selected type of material handling automation technologies. Hence, businesses may just adopt the technologies needed according to their condition and operation. For example, if the business wishes to improve the conventional picking cost range, they can go for $500,000–$1 million system, whereas a semi-automated installation costs about $5 million–$15 million (Viastore, 2016).

1.1.1 Company Background

DB Schenker is the top German-based global logistics supplier in the world. Its mother company is known as Schenker AG, which was founded in 1872 by Gottfried Schenker and has its headquarters in Vienna, Austria. The Chief Executive Officer (CEO) and Chairman of DB Schenker is Jochen Thewes since September 1, 2015. Furthermore, DB Schenker hires more than 76,100

employees in about 1850 locations around the world, including the United States, China, Singapore, Australia, Vietnam, and Malaysia. DB Schenker serves business and trade in the international exchange of commodities through the five modes of transportation: land transportation, air freight, ocean freight, contract logistics (warehousing), and supply chain management. DB Schenker is now leading the automotive logistics, technological, consumer products, trade shows, special transportation, and special events industries.

1.1.2 PLC5, Schenker Logistics (M) Sdn. Bhd.

PLC5 is one of the warehouse branches of Schenker Logistics (M) Sdn. Bhd. located in the industrial area of Penang, Bukit Tengah. Schenker Malaysia is a one-stop logistics supplier that provides integrated logistics services to its customers locally, regionally, and internationally. It was established in 1979 with a total of 28 warehouses with a footprint of more than 2.8 million square feet in 14 strategic locations in Peninsular Malaysia. Other than that, the Malaysia Investment Development Authority (MIDA) granted Schenker Malaysia certification as a provider of international integrated logistics services (IILS) in 2016. Besides, Schenker Malaysia has received formal accreditation from JAKIM under the halal logistics standard MS 2400-2:2019 and possesses the necessary permits and certifications for customs clearance, transportation, warehousing, security, and environmental health and safety. In 2021, Schenker Malaysia received the MOF License Treasury Registrations from the Ministry of Finance (MOF), which is a qualification for the company to participate in government-sector as well as semi-government tenders and contracts.

1.2 Problem Statement

According to Koshal, Natarajarathinam and Johnson (2019), the authors have pointed out that the challenge faced by warehouse industries in Malaysia is to adopt comprehensive automated warehouse. There is a typical challenge experienced by warehouse service providers when implementing smart warehousing, namely their mindset of trying to save the current, obsolete warehouse management system. It is because majority of logistics companies have looked for less drastic alternatives to meet their objectives, but they neglected to re-evaluate the ROI that includes modernising the warehouse software. The supply chain will eventually be disrupted when shipments arrive without sensors or wearable technology to manage the information if the warehouses in Malaysia cannot adapt to these developments (Krishnan and Wahab, 2019). In this case, the competitiveness of the warehouse service providers might be lower compared to the overseas country that adopted automated warehouses. Therefore, warehouse service providers are looking for methods to enhance their operations' efficiency and effectiveness, particularly by investing in new advanced technologies (Kamali, 2019).

PLC5, Schenker Logistics (M) Sdn. Bhd. is in the prospect of moving toward the goal of warehouse automation in Malaysia. As the world is moving towards to automation and digitalization, it same goes to logistics industry in terms of warehouse. It is due to customers are always emphasizing on the efficiency and effectiveness of the warehouse operation, including the processes from receiving, storing, and shipping. As such, the warehouse with more technologies implemented could ease the entire warehouse operation by eliminating human mistake. It leads to time saving and cost saving when

machineries and robots are responsible to in-charge of the daily operation as they only require regular maintenance. Therefore, when less human labour is needed to work inside the warehouse, the employee turnover would become lower compared to the traditional warehouse, and it would not bring adverse impact in terms of labour shortage to the company.

It is apparent that automation is a vital aspect in warehouse operations and that it brings advantages to PLC5, Schenker Malaysia. Nevertheless, the company is facing some challenges while they are trying to achieve warehouse automation in Malaysia, for example, huge capital for investment as well as skills and knowledge of human labour. Thus, the researchers are fascinated in studying the automation approaches that Schenker Warehouse that could implement in Malaysia and the areas that Schenker Warehouse can work on to improve their warehouse operation. At the same time, personnel are one of the most critical assets that a company has.

1.3 Research Objectives and Questions

There are few challenges in adopting an automated warehouse in warehouse industry. Nevertheless, warehouse automation has become a trend in the logistics industry to enhance its operation efficiency and effectiveness. The research objectives are listed below, followed by the research questions that serve as the guidelines for reaching the main aims.

Research Objectives:

RO1: To assess the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd.

RO2: To identify the problems resulting from the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd.

RO3: To enhance the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd. by automation.

Research Questions:

RQ1: What is the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd.?

RQ2: What are the problems resulting from current warehouse operations of PLC5, Schenker Logistics (M) Sdn. Bhd.?

RQ3: How to enhance the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd. by automation?

1.4 Significance of Study

This research could serve as a guideline to assist logistics companies in implementing technologies inside the warehouse. Furthermore, this research identifies issues regarding warehouse operation and will recommend an appropriate technology for PLC5, Schenker Logistics (M) Sdn. Bhd. in the adoption of warehouse automation. In this case, the company could improve the warehouse operation in terms of efficiency and effectiveness. For instance, automation can enhance warehouse employees' working conditions by eliminating the need for physically laborious duties and allowing them to focus on more skilled and meaningful employment. Hence, this research is vital as it could be a guideline for other logistics companies that wish to shift towards warehouse automation since it introduces various types of technologies that are beneficial to several warehouses, including PLC5.

Moreover, this research allows the logistics company to effectively extend their operations by implementing warehouse automation to optimise procedures and reduce the need for additional manual labour. With it, this can help organisations understand how automation can help them scale and plan for future growth, demonstrate the positive influence of automation on employee working conditions, and maintain a productive and happier workforce. Several considerations and risks to be evaluated have been included in the research and may serve as future references in adopting warehouse automation to boost operations. Besides, companies are able to mitigate the risk and overcome the challenges while adopting warehouse automation, yet they do not understand how automation can give them a competitive advantage or how they can effectively leverage this advantage.

1.5 Scope of Research

This research utilises a case study approach, which purely focuses on PLC5, Schenker Logistics (M) Sdn. Bhd. The company is a warehouse located in Bukit Mertajam, Penang, Malaysia, that mainly stores electrical and electronics (E&E) products. This research aims to assess the current warehouse operation of PLC5 and how technologies could improve warehouse efficiency and effectiveness. Researchers will also analyse the company's existing infrastructure and customers to determine if they are compatible with a shift towards automation. After the researchers have an in-depth understanding of the current warehouse operation and the current level of adoption of automation technology in warehousing, pertinent recommendations will be proposed to the company for overcoming the issues and further improving its operations. An evaluation of the benefits of implementing warehouse automation for the PLC5 will be included as well.

1.6 Definition of Terms

1. **Warehouse Automation:** The process of automating inventory movement into, within, and out of warehouses to customers with the least amount of human intervention (Jenkins, 2020).

2. **Put-away:** An operation that takes place between receiving a shipment from a vendor and having everything stored away in racks and shelves in a warehouse (Natarajan, 2021).

3. **Conventional Warehouse:** Storage facilities and racking systems that are operated by humans rather than automated technologies (Klinkhammer, 2021).

4. **Semi-Automated Warehouse:** A warehouse that combines manual operations with automated management, storage, and transportation systems (Mecalux, 2021).

5. **Stock Keeping Unit (SKU):** A special number used to track an organization's stock internally. SKUs are used by retailers to keep track of their stock and sales in order to generate analytical data (Decker, 2022).

1.7 Conclusion

This chapter has provided an overview of the background of the warehouse industry as well as the problems encountered by most warehouses and the company itself. It also covers the research objectives and questions, which are to access the current warehouse operations of the company, find out what challenges the company is currently facing, as well as enhance the current operation by automation technology. The significance and scope of the study have also been stated in this chapter, followed by the definition of terms.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Chapter 2 consists of the literature review of the study, starting with the theory that guided this research. Besides, this chapter also includes the trend of warehousing, which explains the manual warehouse, semi-automated warehouse, and fully automated warehouse, as well as how these trends bring efficiency to the warehouse operation. Besides, this study also explains various types of technologies as well as their benefits and ends with some challenges in implementing a fully automated warehouse.

2.1 Trend of Warehousing

According to Gee (2023), warehouses started implementing computer and IT systems in the 1980s. Technology that is controlled by software has also been included in warehouse operations. These new technologies provide more precision than before. By automating processes and choices, warehouse automation strives to build a self-sufficient supply chain. Non-value-adding repetitive procedures can be turned into automated tasks through warehouse automation (Gee, 2023). Besides, employees can concentrate on jobs that bring value through automation, such as quality control. The productivity of the entire warehouse operation, including order fulfilment, inventory management, and numerous administrative operations, can be increased by automating physical procedures and data processing (Wu, Li, Li, and Liu, 2020).

Based on Kembro and Norrman (2022), a manual warehouse is a storage facility with racking systems that is only operated by human employees instead of automated systems. Manual handling methods are mostly used in a manual warehouse, in which human employees are the ones who will move the goods by picking them up from a collection area and transferring them to another area in the warehouse for packaging and shipping. It is common to see certain forms of automation employed in the handling process, such as forklifts or conveyors, that facilitate better operations in the warehouse. For a typical warehouse to function, pallet racks, forklifts, and pallet trucks are essential.

According to Grosse (2023), the order picking process manually involves a few steps, including setup, search, travel, as well as pick. An employee who oversees order picking will travel to the storage racks by walking or driving and select the necessary goods from the storage areas, which is known as an order picking tour (Wu et al., 2020). To elaborate, every tour starts and ends at the depot, which serves as the hub of activity in the warehouse for order preparation and consolidation before packing and delivery. Before an order is sent, quality control is carried out, in which the employee will obtain related information on a pick list, which can be in paper-based form or on an electrical device, regarding the quantity and order of the goods to be collected (Wu et al., 2020).

In a manual warehouse, inventory will be tracked and replenished manually. Data often cannot be managed efficiently due to the absence of technology to streamline the procedures or enhance their visibility and transparency. Therefore, supply chain problems will arise, for instance, poor accuracy of item selection and delays in order fulfilment due to the lack of real-time synced data the procedures or enhance their visibility and transparency. As

a result, these issues will eventually affect the relationship with customers, leading to reduced sales (Grosse, 2023).

Moving towards a semi-automated warehouse, it is the warehouse that combines automated machinery with human work and intervention. The automated machinery is used to improve the procedures that the warehouse workers are carrying out (Lorson, Fügener, and Hübner, 2022). Each semi-automated warehouse may have a different pattern, as it is flexible enough to allow the operators of the warehouse to decide which sections to operate manually and which sections to automate. Therefore, the operators have the space to choose the level of automation based on the operation's requirements. There are some situations in which it is especially advantageous to apply a semi-automated warehouse, including difficult recruitment and retention of employees, making an unexpectedly large number of mistakes, trying to meet demand while struggling, competing against others, as well as safety concerns for workers or products (Reining, Rueda, Hampel, and Fink, 2018).

At the same time, there are also various advantages that can be provided by semi-automation in a warehouse, according to Bartkowiak, Kunc, Kluska, Myszkowski, and Pabiszczak (2019). First and foremost, it helps reduce errors made by human employees. Repetitive warehouse jobs such as picking and placing tend to cause some kinds of human mistakes. The error rates will be greatly reduced when semi-automation, such as pick-to-light and put-to-light, is used to assist the workers during order picking and placing. Furthermore, Bartkowiak et al. (2019) also mentioned that semi-automation methods help increase the speed of picking. Manual picking times are observed to get slower after employees have done the same job for hours. With an automatic picking

system, items can be continuously picked up at the same rate and delivered to a worker. For instance, a vertical lift module (VLM) tends to raise the average speed of picking as the machine has taken on the responsibility to directly deliver each item to the picker, saving pickers' time and energy because they do not need to walk through aisles to look for every item. Moreover, employee safety can be improved by implementing semi-automation systems. This is because employees no longer need to perform the jobs that require heavy physical labour, and these jobs would be carried out by the systems instead. Besides, vertical lift modules can deliver the items precisely to the picker at an ideal height, so that the pickers do not need to lower their level to pick items from the lower position or go up a high level to pick the items from the upper levels. With a semi-automation system, speech picking gives the picker instructions through a headset, so they do not have to glance down at a reference sheet or RF transmitter all the time (Bartkowiak et al., 2019).

Some examples of semi-automation systems implemented in the warehouse include pick-to-light and put-to-light, voice picking, and pallet runners. In the pick-to-light system, every stock-keeping unit (SKU) is assigned a set of lights, such as a red colour. The operator will know where to pick the right items as the light on the pick face will turn from red to green when the operator scans the order identification in a specified zone. It will also show the operator the quantity to pick when the operator reaches the items. While for the put-to-light system, the operator will select a tote carrying goods from the identical SKU and bring it to the put wall, scan the tote, and every cube that needs that item will have a light beside it with an indicator that shows the amount

required. These systems help to enhance the accuracy of picking and placing while increasing the productivity of each operator (Li, Zhang, and Jiang, 2022).

Other than that, picking using a voice-picking system is more efficient than using RF transmitters or paper. The voice order will instruct the operator to use cart-pick or fork-truck-pick. It can enhance the pick accuracy and increase the pick volume for each operator. Moreover, a pallet runner is a deep-lane storage solution that is semi-automated and distributes pallets using a cart that travels down a track inside the racking system. It is also known as the pallet shuttle system. First-in, first-out (FIFO) and last-in, first-out (LIFO) are the ways that the carts can be designed to fit a range of pallet designs. It works through a lift truck that loads pallets into the system, which are subsequently moved and positioned on the rack by an automatic cart. While the operator moves between lanes, a shipping dock, or another endpoint, the cart will gather and deliver pallets out of the system and eventually deliver the pallets to the designated location (Bartkowiak et al., 2019).

In terms of automated warehouses, there are two main types: physical automation and digital automation. Digital automation relies on the use of electronics and software to reduce manual operations and increase the number of suppliers and customers (Harjono, 2019). Digital automation may increase safety, lower legal and operational hazards, and provide enhanced security for warehouses. It can also make enterprise resource planning (ERP) more effective. In this case, manual processes are reduced, and human error is removed. A significant upfront expenditure is required for the installation of digital automation technology (Edmondson, 2022). On the other side, physical automation describes the use of equipment in warehouses to reduce staff work.

Physical automation includes things like robotics and automated guided vehicles. With the help of these devices, employees need to exert little to no physical effort when moving items around a warehouse. The warehouse's efficiency has improved, and its capacity has grown as well with the implementation of physical automation (Macaulay, Buckalew and Chung, 2022).

2.2 Technologies in Digital Automation

2.2.1 Warehouse Management System (WMS)

First and foremost, the most common digital automation software is a Warehouse Management System (WMS). WMS is a collection of procedures and guidelines designed to streamline operations and organise the work of a warehouse's distribution centre while achieving all of the system's goals. It is a database-based computer application system that helps maintain the accuracy of inventory data by recording each transaction in a warehouse (Deng, Mao and Gan, 2018). An inventory management system's primary function is to record when inventory enters and exits the warehouse. The efficiency is increased by starting with the precise location of the stock in the warehouse and optimising the space that is available. WMS analyses the optimum use of floor space based on the task and material characteristics to optimise warehouse flow in order to reduce waste (Faveto, Traini, Bruno and Lombardi, 2021).

Furthermore, utilising a warehouse management system will also make current inventory levels visible. This makes it possible for a business to forecast supply more securely and prevent backorders. WMS frequently makes use of Auto ID Data Capture (AIDC) technologies, including barcode scanners, portable computers, wireless LANs (local area networks), and possibly radio

frequency identification (RFID), to effectively monitor the movement of goods. Once the data has been gathered, it is either synchronised in batches with the database or transmitted wirelessly in real time (Harjono, 2019). The database will generate valuable reports regarding the condition of the inventory in the warehouse. WMS will show the items' location because the movement and placement of goods will be recorded in the system through the scanning of the barcode (Faveto et al., 2021).

FedEx has a well-utilised warehouse management system to provide companies the ability to manage a fulfilment process and expand their direct-to-consumer business without adding more employees. WMS is able to streamline the shipping process at FedEx with smart label printing. It helps to print all packing slips, return forms, and carrier labels in advance for each shipment. Besides, automated label rules, batch label printing, and print-on-demand packaging stations can be used to make the process more efficient and faster (Logiwa, 2022). Additionally, WMS helps FedEx boost sales and keep track of every product with robust software. Mistakes in picking and shipping can be reduced with the implementation of WMS (FedEx, 2022).

2.2.2 Big Data Analytics

Big Data Analytics stimulated the development of inventory monitoring, forecasting, and management, which can further improve supply chain management and warehouse efficiency (Mikalef, Boura, Lekakos and Krogstie, 2019). It is useful in forecasting and predicting demand and acquires deeper insight into consumer behaviour and product performance to forecast the future and make appropriate decisions that will drive the business forward. Consumer

trends are important for the company to promote products and optimise inventory. Hence, warehouse operators may foresee client expectations, increase profitability, and cut down on warehouse waste through effective forecasting. Big data is now being used by businesses to anticipate client preferences while also taking external market considerations into account (Agbehadji, Awuzie, Ngowi and Millham, 2020).

Furthermore, another feature that can be gained from Big Data is real-time visibility. It is possible to keep track of everything, understand the current warehouse operation, and predict when and where the product will arrive at their targeted locations. According to Shahbaz (2020), operation managers can monitor operations minute by minute and spot bottlenecks that slow down supply chain processes. Big data solutions are also being utilised to decrease manufacturing and delivery times, as well as to identify and address warehouse issues that companies were previously unaware of (Agbehadji et al., 2020). These solutions enable firms to grow their operations while providing the same levels of strength and knowledge to both local and international businesses (Shahbaz et al., 2020).

Other than that, Big Data Analytics are used by online merchants like Snapdeal and Flipkart to streamline their management procedures. For example, Flipkart uses big data to guarantee excellent supply chain management. Flipkart enhances its algorithms to precisely estimate delivery dates, increase warehouse automation, and optimise routes through advanced mobile technology (Dutt, 2019). Besides, Amazon also utilises big data in warehouses and fulfilment centres. Amazon is reported to have more than 2,000 historical and real-time data points for each order. More than 150 million users are included in its client

database (Mrkonjić, 2022). The anticipatory shipping model at Amazon totally relies on Big Data and predictive analysis to forecast the goods that are likely to be bought to prepare the goods for delivery by sending them to the nearby distribution hubs, making them ready for shipping as soon as the orders are submitted. As a result, sales and profit margins increase while delivery time and overall cost decrease (Edmondson, 2022). Graph theory is mostly used by Amazon to cut down on shipping costs. With the aid of big data and analytics, graph theory helps in determining the optimal delivery time, route, and better product classification, assisting Amazon in tracking their inventory and partnering with their distributor for managing and tracking inventory (Mahalakshmi and Koppa, 2019).

2.2.3 Internet of Things (IoT)

The Internet of Things (IoT) refers to a group of interconnected, web-connected appliances that enable data to be gathered and shared over a network without the involvement of a human (Zhang, Shang, Alawneh, Yang and Nishi, 2021). Basically, merging the IoT with big data enables optimising the warehouse's operation to a higher level. Warehouses are progressively implementing IoT in the warehouse to enhance decision-making, increase operational effectiveness, enhance customer service, and boost overall company value. A range of sensors is available for a high-functioning warehouse, such as radio-frequency identification (RFID), sensors for machinery and temperature, and automated robots. Sensors allow real-time locationing that helps the picker identify the right location for each SKU (Tejesh and Neeraja, 2018). Besides, they can also communicate data with Warehouse Management System (WMS) and Enterprise

Resource Planning (ERP) for effective inventory management. The application of IoT in warehouse management systems can reduce hazards to people and products as well as avoid workplace accidents by instantly spotting theft, worker negligence, product leakage, and insufficient usage of safety equipment. The IoT system can also decrease the time it takes to make decisions, lessening the impact of these disruptions (Nantee and Sureeyatanapas, 2021).

In general, IoT sensors that monitor the environment help warehouse operations reduce waste, regulate costs, and maintain product quality (Aravindaraj and Chinna, 2022). In this new era, changes in warehouse operations were triggered by the COVID-19 outbreak to provide secure working conditions. Employees can maintain a safe social distance, individuals with fevers can be easily identified, and contract tracing can be made easier with solutions that integrate sensors that assess body temperature and proximity. Besides, IoT also benefits shipping efficiency. Pallets or cartons can be automatically weighed and measured by a sensor. Sensors also provide accurate measurements that can maximise the use of available space in trucks, railroad cars, or shipping containers (Zhang et al., 2021).

According to DHL (2022), it states that the IoT is becoming one of the most valuable and powerful supply chain tools that could improve the transport and logistics industries. DHL is able to monitor the products as they move around a warehouse or distribution centre and the whole supply chain. IoT allows DHL to track a shipment from the time it is picked until it arrives at its destination (Aravindaraj and Chinna, 2022). Furthermore, GPS-enabled devices are the ideal choice for quality control and loss prevention in the shipping of small packages with DHL because of their compact sizes, extended battery lives,

and powerful signal strengths (Macaulay et al., 2022). Besides, Lee (2022) describes that DHL can detect undesirable light within a container using a light detector. This suggests that the shipment may have been tampered with or damaged. Additionally, IoT also enables safety in the DHL Advance warehouse in Singapore. For example, wearable wireless sensors are used to monitor worker fatigue levels and notify them when a break is necessary. Similarly, alerts were delivered when warehouse workers were near moving the machinery (Digiteum, 2021).

2.2.4 Artificial Intelligence (AI)

Artificial Intelligence (AI) is a subfield of computer science that tries to create machines that can replicate human behaviours and reactions as precisely as feasible (Yang, Li and Rasul, 2021). There are three types of AI: mechanical AI, thinking AI, and feeling AI. First of all, mechanical AI refers to those robots that use them for routine activities like machine translation, clustering and classification algorithms, and remote sensing (Flognman, Grönlund and Falk, 2021). Furthermore, it aims to complete activities that require data processing to make a judgement or decision. AI is able to analyse the unsystematic data to identify patterns and regularities. Besides, text mining, audio recognition, and facial recognition are some examples of thinking AI. These are generally done by machine learning, deep learning, or neural networks (Pervaiz, 2020). Basically, automated vision inspection (AVI) aims to overcome the challenges of manual inspection. AVI utilises arrays of cameras with image processing software to inspect the product to ensure no damage. The vision software can be used to differentiate defective goods such as missing components, dirt or

scratches, cracks, and particles (Yadav and Kennedy, 2023). On the other hand, feeling AI is designed for analysing human emotions and behaviour through methods such as natural language processing, text-to-speech technologies, repeating neural networks (RNN), or chatbots that mimic human speech (Cioffi et al., 2020). Most of the movement work that was formerly done by human workers is now done by AI robots (Pandian, 2019).

Apart from this, human error can lead to inefficiencies and expensive blunders. These errors can be removed by AI, which can also provide accurate data on demand. Machine learning employs algorithms to "learn from experience" and generate useful conclusions for the warehouse. It recognises trends in sensor data and offers actions such as quicker replenishment of almost out-of-stock items, shorter walking paths, and better inventory location (Wilson, Saeed, Pringle, Eleftheriou, Bromiley and Brass, 2021). Besides, voice-picking is made feasible through natural language processing, allowing for safer and hands-free operation for employees (Sunol, 2022). Additionally, computer vision allows for cameras to be placed around the warehouse for end-to-end product tracking. High-risk jobs can be done by robots, leaving humans to handle safer activities (Lucas, 2021).

In addition, researchers have employed analytical AI to estimate the best period to hold small quantities of returned goods at collection stations before they are combined into larger shipments (Yang, Li and Rasul, 2021). AI might assist collection operations using autonomous transport vehicles. Some trucks are now moving merchandise without a driver, utilising a network of sensors, cameras, and radar devices that are connected to an AI supercomputer (Wilson et al., 2021). For instance, Cainiao Network, one of Alibaba's logistics affiliates,

was founded in 2013 to develop a logistics information platform that connected warehouses, distribution centres, and a network of partners (Marr, 2018). The intelligent warehouse management system, digital waybill system, and computerised parcel sorting and dispatch at distribution facilities are all supported by big data and smart technologies (Alizila, 2017). The engineers at Cainiao implement a variety of advanced AI techniques to accelerate the shipping process. For example, the warehouse is utilising geographic information systems (GIS) and AI technologies to train a computer model to identify the fastest and most efficient delivery routes in a range of complicated road networks, including both rural villages and crowded urban regions (Alibaba, 2020). Moreover, "Cainiao" applies AI technology to estimate the size of boxes needed to properly pack shipments that include items of different shapes, sizes, and weights. According to the company, this method lowers the consumption of packing materials by more than 10% (Faggella, 2022).

2.3 Technologies in Physical Automation

2.3.1 Drones

According to Hossain (2022), a drone is a robotic aircraft that is also commonly known as "unmanned aerial vehicles" (UAVs). Remote control of drones is possible with the use of GPS and onboard sensors. This market is predicted to increase by $29 billion by 2027, with an approximate 20% annual growth rate, especially in warehouse automation, as warehouse managers can eliminate boring and hazardous duties by using drones for these purposes (Wawarla, Maghazei, and Netland, 2019). Moreover, the concept video of Jeff Bezos'

envisioned drone-based delivery system was made public by Amazon in December 2013 (Uddin, 2020).

Basically, a remote control is needed to control the drones, as radio waves can easily transmit the information. Most drones today have Wi-Fi capabilities, allowing users to transmit video to a computer, tablet, or smartphone. Whereas GPS is generally used to provide position information to mobile applications, routes can also be reprogrammed by using GPS. Once this function has been set up, the drone may be released and will fly sequentially to each of the designated GPS sites (Uddin, 2020). The automation of existing warehouses is now heavily reliant on drones due to their ability to fly and hover independently, avoid obstacles in various warehouse layouts, navigate within, land exactly, and work in fleets (Wawarla, Maghazei, and Netland, 2019).

2.3.2 Automated Guided Vehicle (AGV)

Automated Guided Vehicles (AGV) are driverless vehicles that are widely used in material handling to transport materials or objects from one location to another without any accompanying operator (Yang and Pang, 2020). Besides, Dash and Rakesh (2018) have mentioned that an AGV system exists when a group of AGVs work together in a well-controlled manner. AGVs are typically used for the movement of items in commercial warehouses, and they have various characteristics, including greater adaptability and lighter weight, as well as simpler assignment execution. Based on Yang and Pang (2021), there are several different varieties of AGVs, with weight-carrying capacities ranging from a few kilogrammes to several hundred tonnes, depending on the loads that they move.

The guidance and navigation system, communication system, power system, and management system are all crucial components of an AGV system.

Moreover, AGVs are vehicles that can adhere to a predetermined guiding path with the use of vehicle programming and a stop selection mechanism system. Generally, the most common fixed-path AGVs will use a defined path and various types of guiding, including magnetic tape, lasers, ultrasound sensors, and infrared sensors (Hasan, Abidin, Mahmud, and Said, 2019). In addition, tuggers, unit loaders, and fork trucks are examples of the most common AGVs, and the use of AGVs increases flexibility since the flow channels can be simply chosen from a variety of alternative paths or may be changed to accommodate new locations (Dash and Rakesh, 2018). For instance, AGVs were used in lean production by Japanese car manufacturers to ensure just-in-time delivery of needed materials between production lines and storage locations. Additionally, over alternatives like human labour or conveyors, AGV systems have significant advantages in logistics. High levels of automation, adaptability to changing needs, flexibility in movement and space utilisation, and sustainability in use are the main benefits provided by the AGVs (Yang and Pang, 2020).

In addition, AGV technology has been widely employed for logistics automation in a variety of industrial settings because of its benefits. For instance, BMW promotes the creation of fully automated, digital management-based logistics systems to support automobile manufacturing and distribution in their factories (Yang and Pang, 2020). All in all, AGVs' technology had improved space utilization, lower operating costs overall, and simpler integration with other automated systems in most of the warehouse operations (Dash and Rakesh, 2018). Therefore, AGV technology has currently undergone substantial

development and found creative uses as a result of the global trend towards digitalization and automation (Yang and Pang, 2020).

2.3.3 Goods-to-person (GTP) or AS/RS System

According to SkyIntelligence (2018), Goods-to-person (GTP) refers to a transport system that links the automated storage or retrieval technology to the workstations. With the use of goods-to-person systems, a predetermined number of the requested goods will be delivered via a technical system to the order picker's location (Winkelhaus, Zhang, Grosse and Glock, 2022). A study shows that the implementation of the GTP system can effectively save up to 60% of the time required for pickers to walk to and look through stored things within their working time. For instance, Amazon deployed 4,000 robots like Kiva (a type of floor robot) in a single warehouse and successfully cut their fulfilment cycle from 90 minutes to 15 minutes (StyIntelligence, 2018).

Likewise, the GTP system can also be classified into three categories, including shelf-based picking, bin-based picking, and robotic picking. Shelf-based picking refers to when the whole shelf or tray of merchandise is delivered to the operator during picking processes, whereas individual bins or totes are provided to the operator for bin-based picking, and delivery robots will transport things to a human operator inside a closed shelf system. To illustrate, carousels are one of the examples of shelf-based picking that offers throughput at rates of 100 to 400 lines per hour and enables picking numerous orders at once with light-directed picking technologies. Crane-based mini-load AS/RS and robotic shuttles are examples of bin-based and robotic picking (Kardexremstar, 2019).

As a type of shelf-based picking system, a vertical carousel travels in both directions around a track using a motor to power a set of carriers coupled to a chain drive. At the operator's instruction, these automated storage and retrieval systems transport slow- to medium-velocity objects securely and promptly to an ergonomic workstation. With throughput rates ranging from 100 to 400 lines per hour, higher rates can be achieved by using batching stations that enable simultaneous picking of several orders and light-directed picking technologies. On the other hand, a horizontal carousel consisting of extremely dense storage bins is frequently installed in groups, known as pods, to maximise the throughput. Throughput rates of 150 to 450 lines chosen per hour can be achieved because of this, which provides great storage density and outstanding space usage at a far cheaper initial expenditure (Kardexremstar, 2019).

Furthermore, GTP systems aim to decrease idle times and boost order picker frequency by limiting the amount of labour that needs to be done by human operators. In several situations, they create discrete workstations with set pick stations. These systems also affect other factors, including space needs and warehouse investment costs. The technology needs of the warehouse are often industry specific. For instance, most e-commerce warehouses needed technological support to ensure that orders could be picked effectively since they would often be handling a varied workload, tiny orders, huge product assortments, and tight delivery deadlines (Winkelhaus et al., 2022).

2.4 Warehouse Automation in Developed Countries

2.4.1 Warehouse Automation in China

According to Kamali (2019), one of the top countries in warehouse automation right now is China. To automate its warehouses and distribution centres, the nation has recently made significant investments in the development of cutting-edge technologies like robotics, artificial intelligence, and the internet of things (IoT). In China, smart warehouses are built with structural upgrades to cover all the latest technologies, higher ceilings, and stronger air conditioning to make activities run smoothly and efficiently, saving labour costs, reducing errors, and increasing productivity (Kamali, 2019). These days, China has the world's fastest-expanding economy and is experiencing what has been termed a second industrial revolution. Its expansion has influenced new supply chain trends, including the impact of technology development on warehousing. Smart warehousing has been completely mechanised and automated on account of the development and use of robots in the economy, which have significantly increased due to recent Chinese government efforts. From its 2015 level of 0.36, the government plan "Made in China 2025" aims to boost the robot density to 1.5 (Bárcia et al., 2020).

With over one million employees, Foxconn is the world's largest electronics contract manufacturer in China. It announced in 2011 plans to install one million robots over the next three years, with an anticipated 50,000 robots in service by 2015. The trend towards automation is continuing, and Foxconn plans to invest more than $300 million in Internet of Things, Artificial Intelligence, and robotics research over the next five years. These automated warehouses were able to lower operational costs per warehouse by about 20%

and increase warehouse capacity per square foot (Bárcia et al., 2020). Besides, JD.com launched an automated warehouse in Shanghai that only employs four workers. To illustrate, the warehouse consists of controllers and camera systems that are able to connect with existing robot arms to enhance autonomy and intelligence (Houser, 2018). As a result of this connection, robot arms that can pick, move, and pack items have been created, and other robots are now able to convey packages to trucks and loading docks by zipping across the warehouse floor. Although there are only four workers in the warehouse, it can handle 200,000 orders a day (FreightWaves, 2019). After implementing warehouse automation, JD.com successfully increased the warehouse space by 85%, which indicates the automation can optimise the warehouse space (Houser, 2018).

2.4.2 Warehouse Automation in the United States

According to the research from Shutters (2021), they have stated that the U.S. leads the world in warehouse automation thanks to its cutting-edge technology and substantial e-commerce sector. The sector is changing dramatically due to the rise of e-commerce, which has boosted demand for quick, efficient warehousing operations while simultaneously introducing new levels of complexity in order assembly and shipment. Retailers with a physical presence have struggled to build new direct-to-consumer fulfilment strategies as they strive to meet evolving consumer expectations about product variety, affordability, and delivery timelines—all of which are powered by Amazon's sophisticated logistical infrastructure. Amazon has made significant investments in robotics and automation to boost productivity and cut costs. (Shutters, 2021)

Furthermore, the warehouses in the U.S. are mostly automated because COVID-19 is based on aggregate economic consequences and does not consider potential changes in job requirements for specific occupations during the following ten years. Specifically, even though this research employs the knowledge and abilities needed for today's employment, those needs may change by 2029 due to COVID's long-term effects as well as general trends in technology, education, and innovation. Such adjustments to occupational criteria are common. The technological change in warehouses has promoted more effective order fulfilment as a company's top objective. This involves using labour-saving technologies for regular, small-batch retail replenishments and high-volume order pickup for e-commerce retailers with a small amount of stock on hand. Warehouse operators place high significance on discovering ways to minimise headcount and/or boost throughput by reorganising this activity because picking individual items to assemble orders "each picking" requires a huge number of people. (Gutelius and Theodore, 2021)

Other than that, according to Singh (2020), a good example is Chewy Inc., a pet food retailer, which established the first automated warehouse in United States. The objective for Chewy to establish an automated warehouse is to improve worker safety, improve delivery speed, and minimise product damage during fulfilment and delivery. According to the CEO of Chewy revenue increased by 40% in 2019 after investing in automation technology. Chewy generally targets reducing warehouse traffic and eliminating heavy lifts for workers to enhance throughput and reduce injuries (Garland, 2021). The workers are moving around in the manual warehouse and walking miles per shift to pick the goods. Therefore, it implements Goods-to-people systems such as conveyor

belts and pneumatic rollers. The high-speed sortation systems will deliver the goods to pickers by using conveyor belts. Based on the words of Cosgrove (2020), it successfully shortens the lead time between the order being dropped and the order being loaded onto a truck. Besides, Chewy also invested in box-building machines and auto-packing machines. These machines can produce custom-made boxes based on the product's dimensions. It enhances the packing process and reduces the amount of corrugated and packaging materials used per order, which is more environmentally friendly (Quast, 2020). The company also mentioned that they faced labour shortage issues, and workers are bargaining for high salaries, so by utilising box building machines and auto-pack machines, Chewy was able to cut down on labour costs (Garland, 2021).

2.4.3 Warehouse Automation in Sweden

In the upcoming years, development towards automated warehouses will accelerate in Sweden. Several systems and technologies will be created and integrated among several material-handling nodes. According to the survey conducted by Kembro and Norrman (2022), there has been an increase of 22% in the number of Swedish retailers willing to make large investments in automation. The number of retailers that are not investing at all in automation successfully decreased from 32% to 8%. It indicates a strong increase in the overall degree of automation within Swedish retailers. Based on Kembro and Norrman (2022), companies' preference to implement automation technologies for storage and picking depends on the warehouse's characteristics. Simultaneously, Sweden also looks for general methods in terms of automation

of weighing, packaging, dimensioning, sorting, and palletizing of outgoing goods (Kembro and Norrman, 2022).

To illustrate, DB Schenker Sweden successfully implemented AutoStore, which is a goods-to-person system, to enhance the warehouse process for e-commerce customers (Swisslog, 2022). Warehouse robots are used in the automated storage and retrieval system to deliver and retrieve bins for operators. It is powered by smart software that connects to the warehouse management system of DB Schenker (Finn, 2022). AutoStore consists of a mobile rack, mobile robot, and workstation that provide a scalable and flexible solution. It helps Sweden's DB Schenker save time, space, and resources and create an ergonomic working environment (Schenker, 2022). On the other hand, one of the Swedish online shops, "Outl1" sells seasonal products and requires a warehouse that can handle a large number of products while at the same time ensuring the safety of storage. Therefore, pallet shuttles are an appropriate solution to implement to ensure proper storage conditions. Pallet shuttles eliminate the need for forklifts to move in the aisles. It helps to optimise the storage space as well as minimise equipment damage (Jurczak, 2018).

2.5 Challenges of Implementing Warehouse Automation

First and foremost, the prior challenge of implementing warehouse automation is the level of worker acceptance of new technology. Even though automated warehouses are intended to shift workload from humans to machines, they still require human intervention or manpower to optimise the use of or control the platform. Therefore, there will be a gap in knowledge as well as operation in each of the employees. Employees are required to learn how to operate and

commit to the fully automated warehouse in order to increase its efficiency and effectiveness. Moreover, since many system component operations are unfamiliar to employees, this might be tricky for most of them. Thus, several training sessions and lessons related to the automated warehouse operation have to be conducted for the employees. For instance, setting up a standard operating procedure (SOP) while operating the system at the workstation and providing training on machinery wrapping, compressing, and ergonomic practises (Joseph and Sony, 2021).

Furthermore, Joseph and Sony (2021) have carried out a comparative study that changes in an employee's work skills is one of the challenges to be concerned. Once an automated warehouse has been implemented, the employees have to shift most of their practises from handling things manually to handling digital devices. For instance, employees used to manually label the inventories one by one, but after the implementation of an automated warehouse, they had to learn how to operate robotic appliances and mechanical and hydraulic components to perform labelling. Besides, the operator's duties change from manual labour to decision-making or problem-solving (Joseph and Sony, 2021). Employees will need more time and awareness to learn new skills so that they can easily adapt to the new warehouse environment and increase productivity in a warehouse (Agha, Venâncio, and Barlasakli, 2020). Consequently, workers need to advance their skills to maintain or safeguard their employment in the organisation (Syafiq, 2022).

Besides, financial capability is also the confrontation that top management will face in order to realise automated warehouse implementation. The cost and complexity of technology investments may deter businesses,

especially SMEs, from making new technology investments. This is because there are too many technologies needed in a fully automated warehouse, such as AGV, electronic data interchange (EDI), cloud storage, and a driverless future. These technologies are growing rapidly with their advanced functions, increasing the demands on efficiency and throughput (Williams, 2022). With it, the top management has to make the right decision on investing in all these technologies from time to time so that the systems are all up-to-date and getting more mature (KPMG, 2018). According to the Jeralin (2022), a fully automated warehouse costs around $25 million, and more investment is needed for future improvements. To illustrate, Amazon decided to invest $1 billion in warehouse automation solutions such as robots and AI (Newman, 2022).

2.6 Conclusion

To conclude, this chapter has provided an in-depth overview of the literature relevant to the research objectives. The major areas to be explored include the trends in warehouses and the technologies used in warehouse automation. This chapter has included the trend of moving from manual to automated warehouses. While in terms of the technologies used, there are various kinds of technologies have been described in this chapter, along with its purpose, benefit, and importance. In addition, the author has indicated the challenges of implementing an automated warehouse. At the end of the chapter, it has included some overseas automated warehouses as examples.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction

This chapter describes the research methodology of the thesis. Research methodology refers to the approach applied to collect the raw data and information for the research's content. The research design, research method, time horizon, data collection, data processing, data analysis, and ethical considerations were shown in this chapter. This chapter primarily provides an overview of how the research is conducted.

3.1 Research Design

Research design is a vital element of research as it provides a proper framework to collect, measure, and analyse data (Sileyew, 2019). It is required to have a properly planned research design to ensure the researchers are employing the right types of methods that are matched with the research objectives and applying the right type of data analysis. The research questions to be answered throughout this research include the following:

1. What is the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd.?

2. What are the problems resulting from current warehouse operations of PLC5, Schenker Logistics (M) Sdn. Bhd.?

3. How to enhance the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd. by automation?

The subsequent sections will demonstrate how this study is designed to accomplish the research objectives.

3.2 Research Method: Qualitative Research Approach

A qualitative approach has been selected throughout this research as it is the most suitable method to address the research objectives. A qualitative research approach captures individuals' concrete and real-life experiences and then conveys them in their own words. The aim of qualitative research is to answer the questions "what", "why", and "how" under a situation, which is able to support researchers in designing a more creative and flexible study. The respondents are normally questioned about their insight based on their prior knowledge and experience, which could help the researchers explore the topics from different angles and with deeper concepts. The collected data is normally in the "narratives" structure, including comments made during an interview, statements written in text, photographs, and videos (Haven and Grootel, 2019).

In this study, a case study approach, which is one of the qualitative designs, is applied. A case study method is a type of research approach that encompasses going deeper into a specific case, such as an event or a company. In this case, researchers could obtain varied sources of information to gather pertinent information by doing a case study. PLC5, Schenker Logistics (M) Sdn. Bhd. is the organisation regarding which this study will be conducted in order to gain access to its warehouse operation and collect relevant data via interviews.
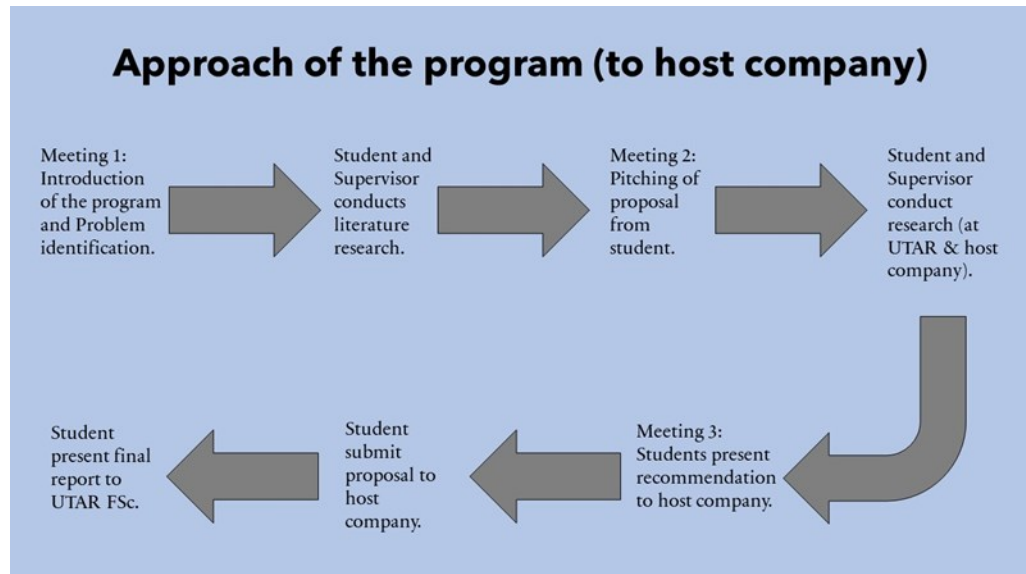
Figure 3.1: Progress Flow of the Research.

The flow chart below indicates the progress of the research. First and foremost, a kick-start meeting with the assistant general manager of PLC5 is held to introduce the research program. The purpose of this meeting is to discover the complications regarding warehouse automation at PLC5, Schenker Logistics (M) Sdn. Bhd. are undergoing. After the meeting, literature research is carried out to ensure the researchers have a proper understanding of the trend of warehouses, the technologies applied in warehouse automation, and the challenges of implementing warehouse automation. Additionally, a second meeting is planned to share the proposal of the research with the assistant general manager of PLC5. Next, the researchers and supervisor make a physical visit to the company. The researchers then hold a third meeting to present their recommendations to PLC5, Schenker Logistics (M) Sdn. Bhd. Lastly, a formal proposal is submitted to the company, and the final report is delivered to UTAR.

3.2.1 Non-probability Sampling

Purposive sampling method will be used in this study, and it is also called judgmental sampling. It is a type of non-probability sampling where there is no known probability among the members of the population. This technique is suitable for small target groups, as the researcher can achieve the desired findings by directly communicating with the target group (Bhardwaj, 2019). Thus, purposive sampling is useful since it gives the researcher access to a wide variety of non-probability sampling approaches. whereby the data collected from the interviewees or respondents is considered primary data, and it is believed that this sampling method requires a shorter time to obtain the result due to some of the pre-defined elements. In addition, the outcomes or data are almost real-time results since members of the sample are professionals, knowledgeable, and familiar with the corresponding topic (Fleetwood, 2018).

3.3 Time Horizon

	Activities	Week 1 13-Jun	Week 2 20-Jun	Week 3 27-Jun	Week 4 3-Aug	Week 5 10-Aug	Week 6 17-Aug	Week 7 24-Aug	Week 8 31-Aug	Week 9 7-Sep	Week 10 14-Sep	Week 11 21-Sep	Week 12 28-Sep	Week 13 5-Oct	Week 14 12-Oct
1	Construct Project Plan	▓	▓												
2	Finalize Scope Meeting						▓								
3	Sign NDA and Contract							▓							
4	Prepare the Proposal								▓						
5	Draft Proposal Presentation										▓				
6	Proposal Amendment											▓			
7	Proposal Finalization												▓		
8	Data Collection													▓	▓
9	Data Analysis														▓

	Activities	Week 1 31-Jan	Week 2 7-Feb	Week 3 14-Feb	Week 4 21-Feb	Week 5 28-Feb	Week 6 7-Mar	Week 7 14-Mar	Week 8 21-Mar	Week 9 28-Mar	Week 10 4-Apr	Week 11 11-Apr	Week 12 18-Apr	Week 13 25-Apr	Week 14 2-May
1	Recommendation														
2	Report Preparation			▓	▓	▓	▓	▓	▓	▓	▓	▓	▓		
3	Draft Report Presentation													▓	
4	Report Amendment														▓
5	Report Finalization														▓

Figure 3.2: Project Schedule.

3.4 Data Collection

Data collection is a vital part of this study, as it can assure the accuracy of the collected data and reduce any unwanted problems or difficulties that may occur during the research process (Kabir, 2016). It is the procedure of investigating, collecting, and evaluating raw data from different types of sources to acquire the required information for the research. Hence, it is used to enable the researchers to obtain accurate and consistent findings that can be used to carry out data analysis and build trustworthy and persuasive answers to the research questions. There are two types of data collected in this research: primary data and secondary data (Sadan, 2017).

3.4.1 Primary Data

Primary data, also known as first-hand data, refers to information gathered directly from sources that do not exist elsewhere. This type of data is typically gathered directly by the researchers through surveys, in-depth interviews, and experiments (Wagh, 2020). In this study, the primary data will be collected through physical interviews with the managers and supervisors of PLC5, Schenker Logistics (M) Sdn. Bhd. In addition, an in-depth virtual interview will be conducted via Microsoft Teams with the Head of Operation System Management, Innovation, Automation, and Digitization of Contract Logistics to understand more about the automation that the company currently has. The questions are prepared beforehand for the interview sessions with eight respondents. The whole interview session is recorded after the researchers obtain approval from the respondents, and the answers from the respondents are noted down for research purposes.

3.4.2 Secondary Data

Secondary data refers to the data that can be acquired from a source that has previously been published on a certain platform (Kabir, 2016). It might be primary data before but turn secondary after it is published by a third party. It is easier to access secondary data as it has ordinarily been published publicly and can be obtained from a diverse range of sources, including scientific journals, newspaper articles, books, and online sites. Secondary data collection may require less time than primary data collection as it is readily available. In this study, the researchers would acquire secondary data through journal articles from Google Scholar, SAGE Journals, JSTOR, and reliable websites. These data would enable researchers to develop a more detailed and in-depth understanding of the related theories.

3.5 Data Processing

Data processing refers to the process where the data is gathered and converted into useful information. Data processing collects raw data and transforms it into a more readable format, providing it with the structure and context needed to be processed by researchers (Duggal, 2023). In this research, the recorded interviews will be converted into a readable form to make it easier for the researchers to refer to them. Every single word spoken by the interviewee will be transcribed into word form and categorised under different themes. This type of data processing is done manually without the aid of any other technological equipment or automation software. The entire process of data gathering, filtering, sorting, and other logical activities is carried out manually.

3.5.1 Data Reliability and Validation

The narrative provided by the respondents will be double-checked to see if it is relevant to the research, sounds logical, and contains any information that is repeated or missing in order to further improve the reliability and validity of the data that has been collected. Besides, any ambiguous or questionable information would be double-checked with the participants via phone and email.

3.6 Data Analysis

Data analysis is a part of qualitative research that most clearly sets it apart from quantitative research techniques (Ravindran, 2019). Qualitative data analysis is known as the process of gathering, organising, and interpreting qualitative data to understand the information. Qualitative data analysis cannot be counted or measured because it defines the data. It refers to the terminology or descriptions applied to specific traits or characteristics. Qualitative research yields most of the unstructured text-based data. These textual data might include diary entries, medical and nursing records, observation notes, or transcripts of interviews. In addition, qualitative research focuses on the evaluation of values, experiences, beliefs, perceptions, meanings, and feelings characteristic of the subject being investigated (Hotjar, 2022). Coding and categorising the data is a major part of the qualitative data analysis process. It basically includes understanding large volumes of data by reducing the volume of raw data, then recognising relevant patterns, finally getting meaning from the data, and subsequently developing a logical chain of evidence (Dye, 2021).

3.6.1 Thematic Analysis

Thematic analysis is one of the qualitative data analysis methods that involves reading a set of data and identifying patterns in the meaning of the data to explore themes. Thematic analysis facilitates the identification, evaluation, and interpretation of patterns in qualitative data, and it is only applicable to qualitative data by focusing on patterns and themes (Maguire and Delahunt, 2017). Thematic analysis is an accessible form of analysis since researchers can easily evaluate significant information from raw data. It is an effective method to process large volumes of data into a concise summary. In other words, thematic analysis is a flexible method that allows researchers to create new insights and concepts derived from data (Kiger and Varpio, 2020). Thematic analysis involves a six-step process: familiarisation, coding, theme generation, theme review, theme definition, theme naming, and writing up. Thematic analysis is an excellent method when researchers want to evaluate the views, opinions, knowledge, experiences, or values of the participants from a set of qualitative data such as social media profiles, interview transcripts, or survey results (Dye, 2021). The purpose of thematic analysis is to identify themes, such as significant or interesting patterns in the data, and then utilise those themes to discuss the research. A great thematic analysis does more than just summarise the data; it explains and clarifies the data instead (Caulfield, 2022).

3.7 Ethical Considerations

Ethical practices must be endorsed to ensure the information provided is strictly utilized for research and academic purposes in order to comply with the Personal Data Protection Act 2010 (PDPA) in Malaysia. The privacy and information of

PLC5, Schenker Logistics (M) Sdn. Bhd., and the interviewees are restricted from being disclosed to any party other than the individuals engaged in this research, as stated in the signed Non-Disclosure Agreement (NDA). The researchers could only record the interview session between the researchers and the interviewees after permission was given by the interviewees. The recorded conversation would be used as the primary data for this study, and neither the recording nor the data obtained would be disclosed to any other parties.

3.8 Conclusion

This chapter offers clear guidance for the research methodology of this study, including the research design, research method, time horizon, data collection, data processing, and data analysis. Ethical consideration is clearly defined at the end of this chapter to ensure the information obtained is private and confidential. The following chapter will focus on an in-depth review of the data analysis.

CHAPTER 4

DATA ANALYSIS

4.0 Introduction

This chapter covered the research design, the interview results of the selected respondents, and the analysis of the interview results. This study applied the qualitative research approach, and the data acquired will be analysed and concluded in this chapter. There are 3 interview sessions with 8 respondents conducted for this research. In addition, there are a total of 19 questions that have to be answered by the respondents. The interview meetings were conducted physically at PLC5 and virtually using Microsoft Teams.

4.1 Research Design

Basically, this study focuses on the Penang region. The number was used to symbolise the eight respondents, whose identities have been rendered purposefully anonymous to comply with the ethical consideration requirements. Each interview session was conducted for around an hour and a half. Below are the details of each respondent for the interview session.

Respondent	Date of Interview	Position of Respondent
1	14/03/2023	Head Of Operation System Management, Innovation, Automation & Digitization of Contract Logistics
2	15/04/2023	Assistant General Manager
3	24/03/2023	Logistics Manager

4	24/03/2023	Program Manager
5	24/03/2023	Assistant Manager (Customer Service)
6	24/03/2023	Senior Executive (Outbound)
7	24/03/2023	Executive (Inbound)
8	24/03/2023	Senior Supervisor (Inventory)

Table 4.1 List of Respondents

4.2 Interviewee Response

4.2.1 – Objective 1: To assess the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd.

Q1(a): May we have a brief introduction about the warehouse operation of PLC5?

i)   Brief Introduction About PLC5

Respondent 3 explained that "Our site is the largest site for Malaysia in Schenker. We have about 320,000 square ft. We have about 4 major customers, one is Dell, second is CISCO, third is TAICO electronics, fourth is the Canon printers. And we have another one is small general bonded which is small companies they can keep here".

ii)   Inbound Operation of PLC5

Respondent 7 mentioned that "Whereby we receive the shipments more with two types, so one is from the oceans, and another is from the air shipments. When the shipment arrives, we will take the shipping document to do the custom clearance before send it out. So, this unloading activities for the truck shipment

is done by drivers, and for the container will be done by Schenker hub operator staff. We will do the inspection on the quantities, part numbers, and after that we will do the four-wall checking. Once we done transact into system, we will have and paste the pallet ID on the box, then go for RF Scanning to capture in WMS system. For the truck shipment, we will receive on average 10 trucks, for the container is 11 container per day." He also stated that "If you say the pallet shipment, there are slip sheet and pallet. For the pallet, a 40ft container will take about 40 minutes for offload. Let say slip sheet, we have to use slip sheet machines to pull the rubber slip sheet, and it takes 3 hours for offload".

Respondent 3 clarified that "For one container we take 3 hours because it is not a normal pallet, the goods will sit on the slip sheet, the type of material like plastic but very thick. So, we have a special machine call a slip sheet, so this machine will pull up, and then the staff will raise and put it on the pallet. That's why one container took 3 hours".

iii)   Outbound Operation of PLC5

Respondent 6 mentioned that "Once we receive the order, the system will allocate based on DO, whatever available we pick, scan, pack, and deliver. So, we will need to scan the packaging IDs, then we have the 8-roll pallet listing, whichever we scan versus with the DO we need to print out the pallet listing, and match back and we can send out with the DO copies. And we have four PV processes, whereby, at PLC5 outbound, the checker needs to check the first point, the second checkpoint will be the driver, the third one will be the security. Once security already check, they will do the sealing, then only load into the truck.

The fourth checking will be at our Dell Interphase Team, they will check the number of cartons versus the DO, and they will hand over to Dell Receiving. Once the system transaction is completed, we will receive an email from Dell, saying that this window has been completely transacted, and we will proceed to ship out, the moment we ship out the next report will be sent to the individual suppliers." Besides, he also explained that "We have two wheeling pulls, six window requests, one window can be for ten truck deliveries. It starts at 10:30 am first window, and our last window is 9:30 pm." In addition, he also clarified that, "It is within 2 hours. We need to pick, pack, and then ship. The next window will be dropped in the next two hours already. It is quite rush, but anyhow, they have the base like this is our line items. The capacity of shipment loading is "Line item is 150, carton is 1120, trips are 10. Whatever above is above capacity".

iv)   Inventory Operation of PLC5

Respondent 8 *highlighted that "For the Log Dell, currently we have the 11,000 plus pallet portion. Then, we have a total 107 stores sorting their product in our warehouse. We are focusing on the monthly count to our supplier, then we have two types of storage area in the Dell department, which is under aircond and non-aircond".*

Respondent 5 *mentioned that "After they put it away, the system already captures what is this pallet ID, they are sitting in which location is right, Dell also can see the inventory received in the system. Dell will start to drop orders to Schenker. This is basically you see the VMI warehouse WMS. Just now he had*

explained during the incoming, we do the four-wall checking, then after that we will transact in the system, so transact in the system, that is the data EDI, we send to Dell, so Dell knows the inventory updated then they will start to pull the order. This is how the system is running. Just now he also said that inbound we have three types of incoming, come by ocean freight, container, offloading is done by Schenker staff, air freight is done by truck driver. Then we also have the cross border which comes by truck, like China, they use land transport to ship from China to Malaysia, Penang. They use trucks, that one is also offloading by hub operators as there is a container". Besides, Respondent 5 mentioned that "Currently we have 4000-part numbers, they are different Dell suppliers. It will take two or three days. During the full count, the operation transaction will be stopped, so we will engage the operation person to support this count activity".

Respondent 4 answered that "Even though it is 4000 SKUs, because we count just the carton only, we are not going to twist them all. So, it is all big cartons. Let's say, now we have a total of 18,000 pallet levels, so in one pallet level maybe we have 2000 pieces, but it is just one carton, so the time taken may be just one second. Based on carton but not even pallet level, we depend on what's the packaging. That's why we can do it in one month. If you go at a piece level, one year also cannot. We also have a full count, which is the PI count. That means every year we have one physical inventory count, stop the operation, and do the count".

Respondent 3 implied that "Cycle count has two methods, one is all to book, or book to all, so normally we do book to all".

v)   Customer Service Operation of PLC5

Respondent 5 highlighted that *"Customer service (CS) is the front line of the operation which is to deal with Dell suppliers and Dell customers. Basically, our CS team here will liars for the inbound and outbound. Inbound mostly is like incoming damage. Then, our customer service will ask the Dell suppliers what the next disposition is. Whether you will ask your engineers to come to Schenker to do the repacking or want to send these damaged cartoons back to your factory or to scrap it. For the outbound side, the operator sometimes will detect a concealment of damage. Because most of the Dell suppliers are not local, not in Malaysia, they are in China, Taiwan, Hong Kong, Singapore, and Thailand as well. Customer service is more on emailing, to follow up with the supplier. We also monitor the supplier's products, whoever is sitting in the warehouse for the long aging. Long aging means more than one year. So, our inventory side will inform our CS. Please ask the supplier what you want to do with these products because long sitting days are here".*

Q1(b): How many workers are required for the current warehouse operation?

Respondent 5 claimed that for inventory operation, *"We have 4 workers for counters, 2 inventory coordinators, then supervisor, and myself. So, the total is eight. 4 counters will be inside the warehouse to do the counting, then our inventory coordinator is mainly like after they get, after the counter completes the count, so the counter will pass to the inventory coordinator, to match back with the system, see whether the physical count, and the system, is it tally or not.*

Respondent 5 stated that *"Currently we have six customer services".*

Q1(c): What is the working schedule for the operation?

      i)   Working Schedule for Inbound Operation of PLC5

Respondent 7 mentioned that *"Inbound will work for 6 days, Sunday is closed, and we have two shifts, 8am – 4pm; 3pm – 11pm, 16 hours, for the locals; for the foreigners, it is 12 hours"*.

      ii)   Working Schedule for Outbound Operation of PLC5

Respondent 5 stated that, *"Outbound is working for 7 days. We have two cruises, 6 days 6 days but operation is still Monday to Sunday, because it takes turns"*.

Respondent 6 claimed that *"Outbound follow Dell work plans, whatever is the work plan given, by that, we will follow"*.

      iii)   Working Schedule for Inventory Operation of PLC5

Respondent 5 mentioned that *"Currently it is like eight to eight, morning to night"*.

      iv)   Working Schedule for Customer Service Operation of PLC5

Respondent 5 clarified that *"Working hours are not in shifts, all of them are normal shift working hours, from 8:30am to 5pm for Monday to Friday. While Saturday is a half day, 8:30am to 12pm"*.

Q1(d): Was the material handling equipment enough for the current warehouse operation? Is there training provided to the floor workers?

Respondent 3 *highlighted that "Yes, it is sufficient, we have a total of 30 machines here. We can multiple, we can cross use, because we are under the same roof. Yes, we provide training to them. We have a dedicated trainer here, who will train and be certified. They will be refreshed yearly".*

Q1(e): Have the current PLC5 warehouse spaces been fully utilized?

Respondent 3 *mentioned that "Maximum already, even though customers come in, we also say sorry we don't have space for this site. Full".*

4.2.2 – Objective 2: To identify the problems resulting from current warehouse operations PLC5, Schenker Logistics (M) Sdn. Bhd.

Q2(a): What is the most common issue that is faced by PLC5 during the operation?

Respondent 3 *stated that "We have the engineering spec. There was class one, two, three kinds of criteria. Class one is the minor one, Dell can accept class one damages; class two that means rebox or FAE damages, class three is totally no. Common issue for inbound: sometimes the document does not tally with the physical, like the wrong part has been sent to us. Sometimes they will ship back the RTV, so that part does not belong to Dell. Sometimes wrong declarations in the customs. So, customs will query, they will come over, then we need to open the inventory in front of them to show things. Because the entire warehouse is a human dependable warehouse. Sometimes we have a lot of that's where our*

leaders are there to try to solve the problem. That's how we try to motivate people all that because human error can happen anywhere".

***Respondent 5** stated that "It is misplaced. Maybe this carton box is supposed to be sitting in this location but sometimes people want to take it, so they put this besides, but forgot to put it back. First count we encounter that there are discrepancies, then we will go to the second count. So usually on the second count we will get the 100% accuracy." Besides, Respondent 5 also claimed that "Currently our customer service is facing the issues because recently customers have guidelines on the incoming shipment. As I said, we need to report to the suppliers on this damage and provide you with all the photos. That is the challenges because all these photos providing to suppliers is by manual pull, which is a very time constraint." In addition, Respondent 5 explained that "I add on for the inventory, because right now we are using the manual count. So now we are actually in the midst of implementing smart count. Smart count means we are using a small device, to do the counting, which can go paperless. Smart count is already implemented in KL side Schenker. But in PLC5 we are the first site to use smart count by using RF scanner".*

***Respondent 7** mentioned that "It is damages. For example, the staff will detect damages whenever this is not for the in damage after we deteriorate as racking, the storage, and the detected damages. For these damages will come to the superior they will update to the superior. So, we talked to the suppliers, this is the damage we found, and the other around we also check the CCTV for how the damage happens because when it comes there is no damage and after storage*

then there is damage. Most of the suppliers sometimes send the FAE to verify if the inner part got damaged or not. Sometimes, there is a prosecutor issue, and then they will ask us to deposit it. So, we will rework the budget list to the inventory that everybody can view".

Respondent 8 *implied that,* **"Yes, we are facing the issues when we do the monthly count right for all the suppliers. Sometimes we will see the issues. Then it is not we can call it as missing, it is a misplaces, so we can check back, and we can find the premise".**

Q2(b): Is PLC5 facing a worker shortage problem or a worker turnover problem currently and during the COVID-19 pandemic?

Respondent 1 *clarified that* *"Because during COVID, government imposed a very strong SOP to our warehouse operation to stop it from expanding. During the COVID-19, I was doing project implementation, that was the busiest 2 years in my life. We have a lot of customers during that period, so the new customer come in, of course we will have the minor problem at the beginning, for example, when we found 1 case in the operation, we need to quarantine the area, and then we need to actually talk to the customer please don't send in so many orders now. So, we basically face this issue. And then it is also we try to split to different locations. Basically, those are the key things that we have done, then of course we have less people so the current worker need to do overnight, so we provide a lot of, something like good things to customer for our existing worker for example the free, the complementary, we give a lot of motivation, we actually give a lot of incentive during that time to make sure they keep the same capacity*

with less people. We have achieved the highest performance for the last 2 to 3 years. Last year was the best in our history for Malaysia".

Respondent 2 *mentioned that "I will reduce local workers. In fact, the price of foreigners will be higher, because we must be responsible for their transportation and accommodation. It is more expensive for me to hire a foreign worker than hire a local. However, when we hire foreign workers, we have a contract for three years. So, I can't send them back rashly, otherwise I will need to bear those costs. Why do we hire foreign workers? One of the reasons is that local people don't want to do warehouse work. It is too manual. Because we have been struggling for almost a year, it is difficult to find people in the market, they will resign or the job statistics are not there, and local people are less likely to commit to work. When we don't take automation, we take foreign workers, because they will be more committed, and they cherish the job and money. However, when automation comes in, I will also reduce the foreign workers".*

Q2(c): Does the warehouse worker often take leave?

Respondent 2 *explained that "Their reason would be too much house stuff, or they will take unpaid leave during the celebration, so it affects our productivity to customers".*

Respondent 3 *stated that "We have challenges especially for locals, I do agree. They will say I got this breakdown; I got that breakdown. But for foreign workers, no excuse, because transport being given from point A to point B, hostel to workplace then workplace to back hotel they only given Sunday to rest and they*

have been given annual leave and they can apply five working days before, unless for emergency is different. Given that they can apply sometimes if they want to go to any festive season like Bangladesh for Raya, and Sri Lanka they are mostly Buddhist and Hindu so they want to celebrate that, they can apply for it, but we have to plan for the resources".

Q2(d): Human error always happens in a conventional warehouse. Have the workers made errors that caused a significant impact to the warehouse?

Respondent 3 *explained that "Depending on the case, some minor and some major. We have cases up to 45,000 dollars, we paid for the supplier. Because the warehouse is in use, the error made by your staff, you have to pay is already stated in contract. So, this is a minor impact for company. It depends on the case but very minor because a lot of leaders will control and monitor the staff".*

Respondent 7 *mentioned that "Human error happens every process, we will make improvements from the mistake. So, we will find out what is the actual problem for the error at first. The root cause. From that we look to correct the action and do prevention".*

Respondent 8 *implied that "Yes, we are facing the issues when we do the monthly count right for all the suppliers. Sometimes we will see the issues. It is a misplaces, so we can check back, and we can find the premise".*

Respondent 1 clarified that *"We have very strong software team can develop different system for different customer. So, I can say system down is not occurring very frequently. Of course, every system will have their maintenance time, this is weekly migration time because for all the jobs we operate we need to migrate it to the global server, it normally will be done during Sunday or not operating hours. Alright, certain operations sometimes will also be operating on Sunday, that is something that we cannot avoid. But talking about the IT downtime, I would say our company is doing very well in keeping that in it".*

Respondent 7 stated that, *"Normally there is no system down, whenever they have any issue, we will trigger our IT to rectify humanity issues. There is a human issue right, we have to receive the same case, cannot go next. We have IT department facilities to help to investigate and they usually respond immediately".*

Q2(f): What is the rate of injuries or fatalities in PLC5?

Respondent 1 explained that *"In fact, my operation is excellent. We are keeping track of lost time injuries. We have a near-miss case, while keeping track of all these incidents. I would say that of course every year we will have some cases, that are incidents that cause the operation to stop. This is the serious injuries we have also keeping safe of those near miss, that means there are minor incidents but didn't cause injuries, it does not cause damage to the assets, so we are keeping track of that. So, I would say in Malaysia cases near-miss about 10 or*

20, so it is not serious. All the warehouses that need to follow all these standards, so they are well tracked, are developing their staff, they are keeping finance and reporting the performance every day".

__Respondent 5__ mentioned that "No injuries as we Schenker is very look into safety, so we also always will tell our staff, safety always first, don't rushing do the job. Safety comes first. Safety precaution is a must. Before they enter the warehouse, everyone, even if a visitor wants to go into the warehouse, a safety vest is a mandatory safety shoe and is also mandatory. If without, anyone is not allowed to enter the warehouse".

4.2.3 – Objective 3: To enhance the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd. by automation.

Q3(a): What is your understanding about automated warehouses?

__Respondent 1__ responded that "I just want to categorize the innovation of automation into 3 categories. First one is very complex. A lot of warehouse operators are requested in the pallet shuttle. Even after this you interview with the PLC5 manager, this pallet shuttle is the one that we are actually in the middle of voting up and propose for dell operation in PLC5. ASRS is a technology that I think was popular 20 years ago. Basically, for those countries that have a small land area, the labour is expensive, so like Singapore they are actually favorable to put ASRS 20 years ago. Auto store is the compact storage system that is very compact. AGV is something like a man-less big-truck or forklift. The AMR that you can take note of is something when you go to the restaurant the robot will serve you by picking the food, something like that. Carousel, A-Frame, Exotic

these are actually the technologies that currently people start to explore about in and try to use it while this is a bit complex and costly. The next category that I categorize as a less complex automation, refers to auto labeling machines. Like you need the manpower to actually paste the label but actually it can be done by using a production line. Another technology I can say dimension and weighing machine. So, all this will actually eliminate the barriers when you imagine your ground floor worker taking dimensioning, they need to write on the paper and pass it to other CS people to key in. Along the way, there will be a lot of chances to make mistakes. Conveyor, carton erector means when you have a warehouse that spend a lot of manpower to erect the carton. Robot arm is a technology that currently is in very high demand in a lot of countries. Ok box building machine this is something like when you might think that this could be the same as a carton erector. So, this box building is a machine when you put your sneaker to the machine, so the machine can actually produce the most suitable carton box according to the size. Auto pack machine is the machine that can help you to simplify your packing, no need so much manpower especially when we have labour storage. I would say this does not 100% cancel all our issues. When we come to automation, if a certain solution can settle about 90% or 80%, then it is good to implement. Alright so when we study the ROI, when we study the visibility of certain innovation, it would need to be considered, we need to take it into consideration. So, another group that I classified is simple, easy to implement their thesis, so I classified it as digitalization which is currently happening in IT technology".

Respondent 3 mentioned that *"For inbound, it's like we can have what you call an auto put away. Auto put away means the moment I finish receiving, make a good palette, okay? For example, this is a palette, you can finish. Then I go to the roller place where I put that and then key in. Okay, this one in the system can show which locations are empty. So, I think this product will go to this location. So, you can move and then there is a like escalator, go to that and do a placement, then they come back. You know that kind of. So, I can reduce the number of machines like manuals"*.

Q3(b): Is there any area where improvement is required in PLC5's current operation?

Respondent 1 also gave the perspective that *"Automation and innovation is playing a vital role to stabilize operations and this department is established to improve in overall warehouse operations and smoothen the working processes"*.

Respondent 2 implied that *"Although racking for simple, double deep or multiple deep does not fall under automation, it is under process enhancement or the improvement area of storage optimization. If we want to go to the middle or complex, we can go to the pallet shuttle, if we want to be more complicated, we need to use ASRS"*.

Respondent 3 clarified that *"There will be the issue. The small issue always occurs, and then we will find the way to solve that. So, there will be a team that will sit together like us, a group do some brainstorming. That's why our*

merchant team has already set a target for us every year because we need to catch up with the customers' orders, suppliers, and each other".

Respondent 5 stated that "Ya, instead of to let our customer service copy and paste manually for the images and photos, so is there any way for our customer service, just upload these photos then we just share the link to the Dell's suppliers, they just click the link then able to see the photo already. Because the file size is already very big, it is better that we share the link, when a customer just clicks the link, it is able to see. This will break out the productivity for the customer side for reporting out the incoming damage".

Respondent 6 mentioned that "We would like to tell you the scenarios, like we found damage or what, we are having scanning activities on delivery basis. When we scan, and we encounter any damage, we will need to record it out, so that we can have better visibility and better communication before taking orders from Dell. We encounter daily issues; we will solve it at that time".

Q3(c): What are the considerations in transferring from a manual warehouse to an automated warehouse?

Respondent 1 clarified that "So far the bosses is very supportive as I mentioned the biggest challenge is the ROI and the technical condition, and also I would say another issue maybe is the system interfacing because the in order for robot to move, it have to link to our system, so our system will know what is the order that come in, tis information need to send to the robot, and tell them they need to go which location to pick the item. Respondent 1 also indicates that "When

we come to automation, if a certain solution can settle about 90% or 80%, then it is actually good to implement. When we study the ROI and the visibility of certain innovation, we need to take it into consideration".

Respondent 3 *stated that "I'm losing people as people got jobless. For example, from receiving, system prospection, and then to the rest. If I go for full automations, maybe from four workers, I may need only one person. While the other three people, I need to lay off, or need to go to another department".*

Q3(d): Do you think that the inventory currently stored in PLC5 is suitable for automation?

Respondent 1 *stated that "Every industry is suitable for automation, of course for Dell, the current key problem is the storage, because we have a good projection for every year that need to increase 1000 location every year, so you need to look into our current capacity and the automation opportunity. So can we actually justify for this, because when we increase the space after the automation, that will be new revenue for storage and handling, not only storage, the storage you can sell any one location RM50, but you remember all this pallet you need people to handle it, so that will be additional revenue for you. When we are doing the pallet shuttle study for dell, we are actually considering the additional space after automation".*

<u>Q3(e): Implementing warehouse automation to acquire a large amount of capital.</u> <u>However, do you think that warehouse automation will assist PLC5 to make</u> <u>profit in the long-term?</u>

Respondent 4 claimed that *"Yes, there's a reason to make a startup. I think in the long term, motivation will be hard for us because of cost, the dependence on the workers because workers can make mistakes. Hopefully the system won't make the same mistake. But long term, yes, it will become profitable. I don't think people will invest time to come up with all these technologies, I mean if nobody wants to buy".*

<u>Q3(f): Adoption of automated warehouses requires knowledgeable workers to</u> <u>monitor and control the technologies. Will the company spend more money to</u> <u>hire a high-educated employee or provide training to existing foreign workers?</u>

Respondent 1 highlighted that *"There will be training given. I can see all these automated technologies do not require much specific technical knowledge to run. Whatever automated it should be easy, and friendly to the user. If you compare to our warehouse system, maybe you think is very complicated, but for our operation, certain level of operation, we do not expect them to operate whole system, when comes to picking, only the picking person need to operate the picking system, so it do not acquire any technical knowledge to run the system, same to the automation system, so most of the time this actually it will be run by their operating system, it will be interpret to our WMS system. Eventually, our people are still doing their normal job. So, this is not a very big deal for an automation system".*

<u>Q3(g): Is automation urgent for PLC5?</u>

Respondent 1 replied that *"I had to said this is urgent, we always find our opportunity, that's why when I show you our department performance in 2022, we receive about 50 requests for innovation, it can be either automation or digitalization, and this we already actually sending our message to all the ground people, and they are very supportive, they are telling us what they want to do, is either the complex automation or some even tell us they want to automate their simple process, so at least the awareness is already there in our operation. I will track all the records to make sure the urgent request has been fulfilled. We are tolerant of requests coming in from customers. Customers are always our priority".*

Respondent 2 mentioned that *"It is not urgent, but is a suitable time to do automation, because now the entire market volume is in the dropping trend. If the whole warehouse is full of shipment and inventory, I need to do automation, I need to move them to another warehouse. When I move to another warehouse, I will affect the productivity of customers and throughput. If we want to make simple changes, the investment is relatively small. So, if customers don't want to invest so much, and same to Schenker, then we can work for simplicity. Although racking for simple, double deep or multiple deep does not fall under automation, it is under process enhancement or the improvement area of storage optimization. If we want to go to the middle or complex, we can go to the pallet shuttle, if we want to be more complicated, we need to use ASRS. For Dell, we are looking forward to the procedures for the pallet shuttle, then the next step is the project team or operation excellent team will do calculations".*

<u>Q3(h): What is the future direction of Schenker Malaysia in 5 years?</u>

Respondent 1 highlighted that *"The future direction will be on complex automation. I have designed a proposal, but eventually we need to calculate whether we are going to get the return in the coming 2 years to 5 years. We want to know whether this technology is the cost we can get the return or not. So that's why we have the challenges, especially for those countries that have very cheap labour. When we talk about ROI, the first thing we will count is the labour cost, when we cut the labour cost, we can justify the investment. The second thing is we will cut the equipment cost. So, all this generates the income to justify the investment. In Japan, they are very easy because their manpower is very expensive. If they want to invest, it is easy to cover, but in Malaysia, we have this problem. Even though we have the labour issue, our labour cost is also one of the lowest in the nation"*.

Respondent 2 indicated that *"The current trend, during Covid the market was in a mess and the price fluctuated every week, so everyone wanted to stock up and find storage space. The storage optimization, referring that we could double up or triple up the storage capacity. In the Post A Dell Inbound Area, we have created a proposal for them, about 600 to 800 pallet positions can be squeezed out, but the setup is almost RM3 million. The second solution is the pallet shuttle. There were originally 5,000 pallet positions, but we will optimize to 8,000, it will cost about RM30 million"*.

4.3 Summary of Findings

Table 4.2: Coding of interviewee data.

Theme	Respondent 1 (Innovation Team)	Respondent 2-8 (Operation Team)
Understanding about PLC5's inbound operation		-Receive shipment (ocean, air, truck) -Unloading activities -Carry inspection on goods -Daily receiving average: 10 trucks, 11 containers
Understanding about PLC5's outbound operation		-Pick, scan, pack and deliver orders -Prepare delivery order -Daily capacity: 150-line item, 1120 cartons, 10 trips
Understanding about PLC5's inventory operation		-Manage on inventory -Focus on monthly count and yearly full count
Understanding about PLC5's customer service operation		-Front line of operation -Deal with Dell customers and suppliers -Notify condition of goods and shipment
Working schedule in PLC5		-Refer to Table 5.1

Current system adopted in PLC5		-WMS -Smart Count (trial) -RF Scanning -Power App
Common issue that is faced by PLC5		-Damages -Human error -Guideline on incoming shipment -Inventory inaccuracy
Rate of injuries or fatalities in PLC5	-Low rate, minor incident, no injuries cause	-No injuries, very look into safety -No
Worker shortage/turnover problem in PLC5 especially during COVID-19 pandemic	-Low rate, take shift during Covid	-Yes, difficult to find person so hired many foreign workers -No, already hired foreign workers to fulfill shortage of people
Understanding about warehouse automation	-3 categories of automation: o simple o not so complex o complex	-Reduce manual, auto put away in inbound
Improvement needed in PLC5	-Use automation and innovation to stabilize, smoothen overall warehouse operations	-Enhance area of storage optimization -Improve customer service lead time while sending damages photo to suppliers -Improve inbound scanning activity to prevent damage -Better visibility and communication with Dell

Top priority to implement warehouse automation		-Inbound
		-Inventory
		-Outbound
Suitability and consideration in transferring from a manual warehouse to an automated warehouse	-Yes, suitable. -ROI	-Yes, suitable -Cut labour force, jobless and laid off
Urgency of warehouse automation in PLC5	-Urgent	-Not urgent
Future direction of PLC5 in years	-Complex automation that ROI in return can cut labour and equipment cost	- Go for middle or complex automation that can achieve storage optimization, productivity like pallet shuttle -Maintain focus on E&E product customer

4.4 Conclusion

This chapter contained the primary data gathered from the eight respondents, which are all the managers and supervisors of PLC5. The three research objectives served as the foundation for the construction of **section 4.2 Interviewee Response**, which includes a short version of the respondent's narratives. The full transcript of the interview sessions is available in **Appendix C: Interview Transcript**. The data analysis gathered from the respondents will be further addressed in the following chapter.

CHAPTER 5

DISCUSSION

5.0 Introduction

This chapter illustrates the discussion of the results obtained through the interview session. It includes the interpretation of interview data regarding the three objectives of the research. The data obtained from the interview session is categorised into a total of 15 themes.

5.1 Interview Data

5.1.1 Theme 1: Understanding about inbound operation of PLC5.

Respondent 7 explained the receiving process in PLC5. The inbound process starts when the supplier will deliver the shipments to PLC5 and then perform the unloading activities. For the truck shipment will be unloaded by drivers, while container shipment will be unloaded by Schenker hub operator staff. Subsequently, detailed inspections will be executed by Schenker staff to check the shipping documents with the shipments. The workers will then prepare the four-wall checking, and the shipment will be transacted into the system. At the same time, the Schenker control pallet ID will be generated and pasted on the physical box. Later, the inbound team will go for RF scanning to capture the data in the Warehouse Management System (WMS) and then perform the put-away activity. Besides, Respondent 7 also clarified that they would receive an average of 10 trucks and 11 containers daily for receiving shipments. There are three types of shipments: truck shipments, container shipments, and containers for loose cartons.

5.1.2 Theme 2: Understanding about outbound operation of PLC5.

Respondent 6 described the shipping process from PLC5 to Dell. Once the outbound team receives the order from Dell, the system will allocate the inventory that needs to be picked based on the delivery order (DO). The team will then perform picking, scanning, packing, and delivering. Besides, there is an 8-roll pallet listing, which the team can scan versus the DO that is required to be printed out for the pallet listing, match back, and send out with the DO copies. There is also a four-parking verification process. To illustrate, the first point will be checked at PLC5 outbound, follow by the driver, and the third check point will be the security. Once security has done the checking, they will do the sealing and the fourth check point will be at Dell Interphase Team. Then, Dell Receiving will perform their system transaction, and send email to PLC5 to inform that the transaction has been successfully completed. Furthermore, Respondent 6 explained that they start their operation at 10:30 a.m. and end the window at 9:30 p.m. They have only 2 hours to perform the processes, and the maximum capacity for them to ship are 150-line items, 1120 cartons, and 10 trips.

5.1.3 Theme 3: Understanding about inventory operation of PLC5.

Respondent 8 highlighted that they are currently having around 11,000 pallet portions and 107 stores in PLC5, Log Dell. The inventory team is focusing on the monthly count for the suppliers, with two types of storage areas, including air conditioning and non-air conditioning. Besides, Respondent 8 mentioned that they have more than 4000 part numbers from different Dell suppliers. They also prepare for monitoring of the products that are long ageing. The warehouse is currently storing 85% fast-moving items and 15% slow-moving items. The fast-

moving items are classified by their product age, which is below 200 days. Besides, the inventory system that is currently used to monitor the PLC5 Log Dell is the Warehouse Management System (WMS). Respondent 4 clarified that the monthly count is based on the carton and the packaging, as it is challenging to finish counting according to pieces. In terms of the physical inventory (PI) count, the inventory department will do it once a year, which will take two to three days with the cooperation of the entire warehouse workforce.

5.1.4 Theme 4: Understanding about customer service operation of PLC5.

Respondent 5 stated that the customer service team is dealing with inbound, outbound, and inventory. For instance, when there is incoming damage during an inbound inspection, the information will be passed to the customer service team, and they will email and notify the Dell supplier. Then, it is required for them to wait for the notice from the suppliers and either do repacking, scrap, verify, or send these damaged cartons back to their factory (RTV). In terms of outbound, problems occur during the picking process. For instance, the operator has detected that there is concealed damage, which means the damage is inside the carton with the strapping bag. This happens when the pallet of cartons is being strapped and the workers can only check the surface without breaking the bulk during inbound inspection. When it comes to picking, the outbound operator is required to break down the shipment into bulk and pick only a few cartons. They found hidden damage that occurred during the installation. Therefore, the outbound team will ask the customer service team to inform the suppliers. As most of the Dell suppliers are not in Malaysia, customer service

relies more on emailing to ask the suppliers for the plan to do with all this damage. Furthermore, in terms of inventory, the customer service team is required to email the supplier for the long-aged products stored in the warehouse. Specifically, the customer service team will focus on the incoming damage that has not been repaired by the suppliers for more than one year.

5.1.5 Theme 5: Working schedule in PLC5.

Table 5.1: Working schedule in PLC5.

Department	Working Day	Working Hour
Inbound	6 days	8am – 4pm 3pm – 11pm
Outbound	7 days	Follow Dell work plan.
Inventory	6 days	8am – 8pm
Customer Service	6 days	8:30am – 5pm (Mon – Fri) 8:30am – 12pm (Sat)

According to the Respondent 5, 6, and 7, working days for inbound operation, inventory department, and customer service department is 6 days. Respondent 6 mentioned that the working hour for outbound operation is required to follow Dell's work plan, which is 7 days. On the other hand, Respondent 7 clarified that the working hour for inbound operations separates into 2 shifts. The local workers need to work for 8 hours with a 1-hour break, while foreign workers need to work for 12 hours with 2 hours break. Similarly, the workers under the inventory department have the same setting as inbound operations. However, Respondent 5 stated that the working hour for the inventory department is only 1 shift which is from 8 am to 8 pm. In addition, the customer service department

has normal working hour which is 8:30 am to 5 pm every Monday to Friday, and half a day on Saturday from 8:30 am to 12 pm, based on Respondent 5.

5.1.6 Theme 6: Current system adopted in PLC5.

Respondent 2 highlighted that the current systems adopted in PLC5 are Smart Count, Warehouse Management System (WMS), Power Apps, and RF Scanner. Firstly, smart count is a smart inventory system that will track and count, update the inventory database, and generate reports, which could save time as well as reduce human error risk (Legchekov, 2022). Besides, WMS is a collection of procedures and guidelines designed to streamline operations and organise the work of a warehouse's distribution centre while achieving all of the system's goals (Deng et al., 2018). Power Apps is a collection of apps, services, connectors, and a data platform that offers a quick development environment for creating unique apps for Schenker's requirements. The company can quickly develop unique business apps with Power Apps that connect to data located in the underlying data platform (Vivek, 2023). Lastly, radio frequency scanners normally keep track of every order's detail as well as information about every SKU in the inventory. RF scanners will read the barcodes and then send product details, quantity information, and position data wirelessly into the WMS (Pandey, 2023).

5.1.7 Theme 7: Common issues that are faced by PLC5.

Respondent 7 mentioned that the common issue faced by PLC5 is incoming damages, racking damages, storage damages, and detected damages. The action taken by PLC5 is to bring up the issue with the supplier, and they will check

whether it is incoming damage or after storage damage by checking the CCTV. Most of the suppliers will send the FAE to verify if the inner part is damaged or not. Moreover, Respondent 3 also mentioned that they will determine the damages by using Dell's engineering specification. As shown in literature review, automated vision inspection (AVI) can overcome the challenges of manual inspection. AVI utilises arrays of cameras with image processing software to inspect the product to ensure no damage as the vision software is to differentiate defective goods such as missing components, dirt or scratches, and cracks (Yadav and Kennedy, 2023).

Furthermore, there is also another common issue for inbound goods, which is that the shipping documents do not match the physical goods received. Respondent 3 had explained that sometimes they need to revise the shipping document as there might be issues such as a part number that is different from the actual goods or important details are missing. Thus, they have to ship back the goods for the RTV process, hold them until further communication. Referring to the literature review, WMS is able to streamline the shipping process at FedEx with smart label printing. It helps to print all packing slips, return forms, and carrier labels in advance for each shipment. Besides, automated label rules, batch label printing, and print-on-demand packaging stations can be used to make the process more efficient and faster (Logiwa, 2022).

Moreover, as PLC5 is a human-dependable warehouse, therefore, human error are occurred. For instance, when the workers are facing personal issues, their emotions will be indirectly affected. Hence, this may lead to imperfect performance and losing focus while carrying out the job tasks given. According to literature review, human error can be removed by AI, provide accurate data

on demand. Machine learning employs algorithms to "learn from experience" and generate useful conclusions for the warehouse (Wilson et al., 2021). A study shows that the implementation of the GTP system can effectively save up to 60% of the time required while picking (Winkelhaus et al., 2022). For example, Amazon deployed 4,000 Kiva robots and successfully cut their fulfilment cycle from 90 minutes to 15 minutes (Styleintelligence, 2018).

The inventory department is facing issues that the physical count quantity does not tally with the system count during cycle counts. However, this doesn't mean that the warehouse is missing some parts of the goods; it is just a misplaced inventory issue. The reason for this issue is mainly because some workers forgot to put it back to its original place, causing discrepancies. A second count needs to be conducted to find out where the inventory is located. Generally, the workers manage to get 100% accuracy after the second count. Based on a literature review, FedEx utilises a Management System (WMS) to keep track of every product with robust software. Order management, inventory management, mobile pick and pack, real-time carrier rate shopping, and returns management are all accessible from a single intuitive interface that is simple to learn. Mistakes in picking and shipping can be reduced with the implementation of WMS (FedEx, 2022).

In addition, PLC5 also faced the low productivity in customer service operations as they are manual pull operations. Customer service needs to deal with providing guidelines or information to the suppliers and customers daily. Any problems resulting from each department will be handled by the customer service team, who will access the parties via email and other platforms. The productivity of the customer service team decreases when a huge number of

damages happen. This is because the team need to send the photo evidence one by one to their clients. In short, this manual pull operation consumes plenty of time, and due to the large file size, the team is unable to send all photo evidence in one email.

5.1.8 Theme 8: Rate of injuries or fatalities in PLC5.

Respondent 3 stated that there have been nearly no injuries or fatalities in PLC5, and Respondent 5 claimed that Schenker is putting a high priority on the workers safety issues. There are rules to follow with safety precautions for workers who enter the warehouse areas. For instance, all people, including visitors, have to wear a safety vest, helmet, and boots before entering the warehouse. All of these are mandatory, and anyone without any of these requirements is not allowed to step into the warehouse. The literature review claimed that the application of IoT in warehouse management systems can reduce hazards to people and products as well as avoid workplace accidents by instantly spotting theft, worker negligence, product leakage, and insufficient usage of safety equipment (Nantee and Sureeyatanapas, 2021).

Nevertheless, Respondent 1 claimed that there are minor incidents but didn't cause the injuries, and so the department is keeping track of that. There are some cases that cause the operation to stop every year, but mostly they are minor incidents. Bundles of training and standardisation must be followed by the workers, and there are a lot of pillars to make sure they have a well-developed staff, make sure the workers have stable performance, and prevent injuries and fatalities during the working period.

5.1.9 Theme 9: Worker shortage or turnover problem in PLC5 especially during COVID-19 pandemic.

Respondent 1 explained that the company faced worker shortage issues, especially during the COVID-19 pandemic. There were a lot of customers during that period, and they found quarantine was needed in the operation. As such, they are lacking workers, and they have to split workers into teams to conduct the work by taking shifts, yet working overnight frequently occurs at that time. Anyhow, they successfully achieved the highest performance for the last 2 to 3 years. Whereby, as stated in the literature review, the warehouses in the U.S. are mostly automated because COVID-19 is the aggregate economic consequence and does not consider potential changes in job requirements for specific occupations during the following ten years.

According to Respondent 3, since Schenker falls under the MITI, a movement approval was provided, yet the foreign workers are able to travel from the hostel to the PLC5. Even for the local workers, a supporting letter was provided along with the official company letter to ensure all of them were able to come to work during the restricted implementation of the SOP period. Also, the second batch of foreign workers from Nepal are ready to come in around March. Thus, they are mainly facing a low rate of worker turnover during the COVID-19 pandemic.

On the other hand, Respondent 2 also mentioned that they do face worker shortages or turnover problems in the operations and have been struggling for almost a year to find for workforce. The reason is that most locals dislike warehouse jobs since they are tough and require less commitment. Therefore, PLC5 would prefer to hire foreign workers due to their greater commitment to

the job and money compared to locals. According to the literature review, warehouse automation can reduce the workforce. For example, JD.com launched an automated warehouse in Shanghai that only employs four workers. Although there are only four workers in the warehouse, it is able to handle 200,000 orders a day (Houser, 2018). Therefore, warehouse automation can minimise the labour shortage and turnover problem.

5.1.10 Theme 10: Understanding about warehouse automation.

As stated by Respondent 1, warehouse automation is a fully automated warehouse that needs to operate using systems without manuals and can be categorised into three main classifications: complex, not so complex, and simple. For instance, complex warehouse automation may include pallet shuttles, ASRS, AMR, and carousels that can increase warehouse productivity and space. In terms of not being so complex, warehouses used to have automation such as conveyors, auto-pack machines, robot arms, and auto-labelling machines to aid the warehouse operation. Lastly, simple warehouse automation refers to easy-to-implement and more cost-saving automation like smart picks and counts, IoT, power platforms, and artificial intelligence. Moreover, the automated technologies do not require much specific technical knowledge to run, and they should be easy yet friendly to all of the users. Nevertheless, the warehouse automation in PLC5 is not expected to be very complicated since certain levels of the operation do not require a complex adoption of automation.

Based on a literature review, warehouse automation strives to build a self-sufficient supply chain by automating processes and choices. Non-value-adding repetitive procedures can be turned into automated tasks through

warehouse automation (Gee, 2023). Besides, employees can concentrate on jobs that bring value through automation, such as quality control. Technology can improve operations by eliminating the need for personnel to move between different areas of the warehouse. The productivity of the entire warehouse operation, including order fulfilment, inventory management, and numerous administrative operations, can be increased by automating physical procedures and data processing (Wu et al., 2020). In addition, warehouse automation is categorised into physical automation and digital automation. Digital automation relies on the use of electronics and software to reduce manual operations and increase the number of suppliers and customers (Edmondson, 2022). On the other side, physical automation describes the use of equipment in warehouses to reduce staff work. Physical automation includes things like robotics and automated guided vehicles (Harjono, 2019).

5.1.11 Theme 11: Improvement needed in PLC5.

Respondent 3 stated that there is improvement needed in PLC5 as the entire warehouse is human dependable, and to reduce the occurrence of human error, counselling, motivation, and caring need to be performed for the workers in order to understand their issue and concern. Whereas Respondent 5 proposed that the customer service department needs improvement in boosting productivity with the aid of technologies while reporting incoming damage to their valued customers. In addition, Respondent 7 mentioned that improvement for human error and mistakes is vital, and finding the root cause and planning prevention for it is needed in the PLC5 operations. Respondent 1 also gave the perspective that automation and innovation are playing a vital role in stabilising

operations, so this department was established to improve overall warehouse operations and smooth the working processes.

Based on the literature review, it proves that the improvement needed for PLC5 can be fit into semi-automation. There are various advantages that can be provided by a semi-automated warehouse. First and foremost, it helps reduce errors made by human employees. Repetitive warehouse jobs such as picking and placing tend to cause some kinds of human mistakes. The error rates will be greatly reduced when semi-automation such as pick-to-light and put-to-light is used to assist the workers during order picking and placing (Reining et al., 2018). Besides, using semi-automation methods helps increase the speed of picking. Manual picking times are observed to get slower after employees have done the same job for hours. For instance, a vertical lift module (VLM) tends to raise the average speed of picking as the machine has taken on the responsibility to directly deliver each item to the picker, saving pickers' time and energy because they do not need to walk through aisles to look for every item (Bartkowiak et al., 2019).

5.1.12 Theme 12: Top Priority to implement warehouse automation.

Respondent 3 mentioned that they wish to implement an auto-put-away machine in the inbound operation. For example, a worker will place the goods on the roller, and after keying in the requirements, the machine will automatically deliver the goods to unoccupied areas in the palette. Thus, it can be moved through an escalator to that location and placed there. The machine will then return on its own, and this may reduce the usage of manual machines and human labour. Based on the literature review, DB Schenker Sweden, successfully implemented AutoStore, which is a goods-to-person system to enhance the

warehouse process for e-commerce customers (Swisslog, 2022). Warehouse robots are used in the automated storage and retrieval system to deliver and retrieve bins for operators. It is powered by smart software that connects to the WMS of DB Schenker (Finn, 2022). It helps Sweden's DB Schenker save time, space, and resources and create an ergonomic working environment (Schenker, 2022).

Furthermore, in terms of the outbound process, Respondent 3 expected to adopt auto-wrapping machine. The machine will start to wrap the goods from the bottom all the way up and come back again to complete one wrapping. The only thing to do is place the pallet on the rotating plate, adjust the wrapping strength, and the auto-wrapping machine will then start to operate. Respondent 5 also stated that instead of relying on the workers to wrap the goods one by one and rotate the goods manually, an auto-wrapping machine can help a lot in the operation. Based on a literature review, Chewy invested in box-building machines and auto-pack machines to replace the manual packaging process. It enhances the packing process and reduces packaging materials used per order, which is more environmentally friendly (Quast, 2020). Besides, Alibaba Cainiao also invests in auto-pack machines to properly pack shipments that include items of different shapes, sizes, and weights. According to the company, this method lowers the consumption of packing materials by more than 10% (Faggella, 2022).

In addition, Respondent 3 and 5 stated that smart counting is the easiest and lowest-cost project that can be implemented immediately in the inventory department in order to ease and increase productivity when conducting monthly counts. This technology will replace the manual counting cycle and increase the efficiency of the operations by using device such as an RF scanner and

smartphone. Referring to the literature review, the Warehouse Management System (WMS) is suitable to utilise for cycle counting. It is a database-based computer application system that helps maintain the accuracy of inventory data by recording each transaction in a warehouse (Deng et al., 2018). An inventory management system's primary function is to record when inventory enters and exits the warehouse.

5.1.13 Theme 13: Suitability and consideration in transferring from a manual warehouse to an automated warehouse.

Both Respondent 1 and 3 stated that PLC5 is suitable for transferring from a manual warehouse to an automated warehouse. Anyhow, Respondent 1 has to consider Dell's storage because they have a good projection for every year that they need to increase 1000 locations every year, so he is urged to look into their current capacity and the available automation opportunity to maximise the storage. According to a literature review, DB Schenker in Sweden faced the same issue, which is unlimited storage capacity. To overcome it, they implemented AutoStore to maximise the storage capacity. AutoStore is a goods-to-person system to enhance the warehouse process (Swisslog, 2022). Warehouse robots are used in the automated storage and retrieval system to deliver and retrieve bins for operators (Finn, 2022). It helps Sweden's DB Schenker save time, space, and resources and create an ergonomic working environment (Schenker, 2022). Besides, pallet shuttles are an appropriate solution for the Swedish online shop "Outl1" to ensure proper storage conditions. Pallet shuttles eliminate the need for forklifts to move in the aisles. It helps to

optimise the storage space as well as minimise equipment damage (Jurczak, 2018).

Moreover, the huge amount of investment involved in increasing additional space, cutting down labour costs, and maximising the return on investment in automation are also factors to consider. If automated warehouses are adopted, no more manpower will be needed, and there comes the problem of justifying the spending while computing the ROI. However, the literature review mentioned that there are three considerations: the acceptance level of employees towards new technology, changes in employees work skills, and financial capability. The acceptance level of employees towards new technology refers to their willingness to learn and operate a fully automated warehouse to increase efficiency and effectiveness (Joseph and Sony, 2021). The second challenge is that once an automated warehouse has been implemented, the employees have to shift most of their practises from handling things manually to handling digital devices (Syafiq, 2022). The third consideration, which is financial capability, matches what the informant stated. The main consideration for PLC5 will be the return on investment (ROI). In general, financial capability is one of the challenges that top management will face in order to realise automated warehouse implementation. The cost and complexity of technology investments may deter businesses, especially SMEs, from making new technology investments (Williams, 2022).

On the other hand, Respondent 2 stated that once automation has been adopted, local workers will be reduced first instead of foreign workers, as laying off foreign workers incurs a higher cost to bear compared to local workers. All of the foreign workers in PLC5 are under a 3-year hiring contract, so the

organisation could not violate the clause, and so local workers need to be sacrificed first. However, foreign workers will be reduced as well, but it is just a time consideration.

From another perspective, Respondent 3 is considering on whether his workers will get laid off and become jobless. For example, if the warehouse goes for full automation, the workers needed in receiving system prospection will be reduced. The remaining workers might be laid off or transferred to another department. Similarly, the example given in the literature review mentioned that JD.com launched an automated warehouse in Shanghai that only employs four workers. The warehouse consists of controllers and camera systems that are able to connect with existing robot arms to enhance autonomy and intelligence (Houser, 2018).

5.1.14 Theme 14: Urgency of warehouse automation in PLC5.

Respondent 1 stated that it is urgent. They always find the opportunity to innovate some useful technologies to implement in the warehouses. To elaborate, the department has received around 50 requests for innovation. As such, they have already informed all the ground people on the warehouse automation. Surprisingly, they are very supportive by sharing what they want to do for automation, either in a simple or complex way. So, the awareness of warehouse automation is already there in the operation. The head of department always keeps track of all the records to ensure the urgent request is met.

According to Respondent 2, warehouse automation in PLC5 is not urgent, but currently is a suitable time to implement automation because the entire

market volume is in a dropping trend. However, cost is the heavy commercial topic when it comes to automation. Schenker can choose simple automation if they don't want to invest so much on automation. On the other hand, if Schenker wants to go to the middle or complex automation, they can go for pallet shuttle, or ASRS which is considered as complicated automation. Respondent 2 also mentioned that warehouse automation is not necessary for every product. It needs to depend on what the company wants. For Dell products, a pallet shuttle is enough to meet their productivity and throughput requirements. Respondent 2 stated that it is important to understand customers' expectations because if customers want storage optimization, they may not be able to get the productivity efficiency or throughput. All in all, automation is not able to be implemented right away because it involves a lot of study.

5.1.15 Theme 15: Future direction of PLC5 in 5 years.

Respondent 1 provided that the future direction would be complex automation. To illustrate, automation will be one of the main pillars of the future strategy, as it will eventually come back to return on investment (ROI). As mentioned in the literature review, smart warehousing in China has been completely mechanised and automated (Kamali, 2019). The United States is also one of the leaders in warehouse automation because of its cutting-edge technology and substantial e-commerce sector. Moreover, the literature review also stated that Sweden is moving towards warehouse automation and that Swedish retailers have a high willingness to implement automated warehouses (Kembro and Norrman, 2022). Therefore, Schenker can take these countries as models, as they are in a complex automation phase.

On the other hand, Respondent 1 mentions that he has designed a proposal, but now his team is working to calculate whether the investment can provide a return in the coming 2 to 5 years. If the investment cannot provide a good ROI within 5 years, the plan does not work successfully. It is challenging when the warehouse is implemented with all robots and drones in a short time, as it is too ambitious. Therefore, it is encouraged to make sure that the technology implemented can get a return at a suitable cost. The implementation of auto labelling machine in KL branch able to get back the return within 1 year. Moreover, as stated in literature review, the revenue of Chewy increased by 40% in 2019 after investing in automation technology (Garland, 2021).

Respondent 3 provided that the company has already signed contracts with its current customers, including Dell and CISCO. That is to say, the current layout of the warehouse is now fully occupied. Although other customers want to store their products, it is difficult because the space is allocated. In addition, the existing customers have already paid for the space, so it is not possible for renting the customers' space, only if they want to give away a portion of it due to volume drops. Then, the solution team will need to recalculate the space available, and other customers are welcomed.

5.2 Conclusion

Generally, this chapter includes the interpretation of interview data according to the 15 themes discussed above. It can be concluded that the opinions between the respondents are slightly different from each other. However, they still have similar opinions about the core concept of warehouse automation.

CHAPTER 6

CONCLUSION

6.0 Introduction

This chapter includes a recapitulation of the research, which concludes the content of the entire research, followed by the discussion. Besides, this chapter will also justify the contribution of research and its limitations, as well as provide recommendations to the host company. Finally, the chapter will continue with future research and end with a conclusion.

6.1 Recapitulation of Research

Chapter 1 defined the background of study, the problem statement, the research objectives and questions, the scope of research, the significance of study, and the definition of terms. Next, Chapter 2 explained the academic theory that the researchers applied for the study. The literature review mainly focused on the trend of warehouse automation, the technologies utilized in warehouse automation, as well as the challenges of implementing warehouse automation. Subsequently, Chapter 3 showed the research methodology, which consists of research design, research method, time horizon, data collection, and data analysis. Besides, Chapter 3 also provides recommendations to the company and ethical considerations. In Chapter 4, it covered the profiles of the company managers and supervisors, the findings, and summary of findings. Lastly, Chapter 5 described the interview data while Chapter 6 outlined the recapitulation of research, answering the research question, contribution of

research, limitations of study, recommendations, future research and ended up with a conclusion.

6.2 Answering the Research Question

6.2.1 Research Question 1: What is the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd.?

Table 6.1: Summary of interviewee's comments towards main role and responsibility of each department in PLC5.

Department	Main Role and Responsibility
Inbound	Perform Receiving Process
Outbound	Execute shipping process within 2 hours once receive the order from Dell.
Inventory	Carry out monthly count and monitoring on suppliers' products.
Customer Service	Deal with Dell suppliers and customers daily.

The current warehouse operation of PLC5 includes four main operations: inbound, outbound, inventory, and customer service. Each operation carries its own specific role to maintain stable operation performance, and PLC5 now has automation systems such as WMS, Smart Count, and Power App. The Dell VMI inbound and outbound process flow can be related to **Appendix A - Figure 1.4**. Whereby the inbound will unload goods once the shipments have been delivered from the customs office to the PLC5. The two main types of shipments in PLC5 are airborne and oceanic, but truck shipments are also available. Generally, the

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unloading for container shipments will be done by Schenker hub operator staff, whereas truck shipments will be done by the truck drivers themselves. The detailed procedure of the inbound unloading process in inbound operations included inspection of shipping documents and four-wall checking to ensure the goods condition. An average of 10 trucks and 11 containers will be received daily for the inbound operation and the detailed inbound process can be referred to **Appendix A – Figure 1.5.** The working schedule for inbound operation is 6 days with a total of 16 hours.

Moreover, the outbound operation in PLC5 is responsible for picking, scanning, packing, and delivering the inventory within 2 hours once they receive the order from Dell. The outbound process can be referred to **Appendix A – Figure 1.6.** PLC5 outbound will start receiving orders from 10:30 a.m. to 9:30 p.m. daily, and it is based on two hourly pulls. The team must scan the packaging ID on the carton, and the delivery order needs to be printed out for the pallet listing. The goods will be sealed before moving to the last verification at Dell Interphase Team for checking on the quantity of cartons and delivery order details. Once the four-parking verification has been done, the shipments will be handed over to Dell Receiving for system transactions. The daily capacity of outbound operations to conduct the shipping process is 150-line items, 1120 cartons, and 10 trips. The working schedule for outbound operation is 7 days by following Dell's work plan.

Furthermore, the inventory operation in PLC5 focuses on the monthly count and monitoring on suppliers' products. The usage of wireless RF scanning can be referred to **Appendix A – Figure 1.7**. Recently, the inventory operation has about 11,000 pallet portions and 107 stores in Log Dell, and there are two

types of storage areas: air-conditioned and non-air conditioned. PLC5 inventory includes both fast and slow-moving items, yet a WMS is adopted to monitor the log. Even though there are over 4000 SKUs in the PLC5, they will only count the inventory on a carton basis, and the method used for cycle counting is book to all. Other than a monthly count, PLC5 will also conduct a physical inventory (PI) count on a yearly basis to keep track of their inventory accuracy. The PLC5 operations will be fully stopped while the PI count is carried out, as all of the workers will aid in the operation. The working schedule for inventory operation is 6 days, from 8am to 8pm.

In addition, customer service acts as the front line of the operation in PLC5, as they will deal with Dell suppliers and customers from time to time. For instance, when damages occur in an inbound inspection, they need help from the customer service team to notify the supplier about this issue. If the outbound team finds concealed damage during picking, the customer service team has to inform, send evidence and follow up with the supplier for next action. Meanwhile, customer service needs to contact the supplier when identify there is long-aged product stored in the PLC5. In short, the customer service operation has a close linkage with the other three operations, and mostly their job task is building strong relationships and approaching Dell customers and suppliers. The working schedule for customer service is 5 and ½ days, which is a normal working hour.

6.2.2 Research Question 2: What are the problems resulting from current warehouse operations PLC5, Schenker Logistics (M) Sdn. Bhd.?

One of the problems resulting from the current PLC5 warehouse operation is damage. PLC5 faces not only incoming damages but also deterioration due to racking, storage, and detected damage. The Dell suppliers are not only from Malaysia but also from China, Taiwan, Hong Kong, Singapore, and Thailand. This long journey for the goods to reach PLC5 may incur some damages to the goods themselves, and FAE will be sent to verify whether the inner part of the goods is damaged. According to the Dell engineering specs, there are three classes of damages that can be categorised, and each class of damage requires a different action. PLC5 also faced problems with unmatched shipping document details with the physical goods received and so the receiving process needs to be put on hold and shipped back for the RTV process until further notice.

Moreover, since PLC5 is a human-dependable warehouse, human error might take place and lead to some of the problems. To illustrate, the inventory department is facing problem with inventory inaccuracy. However, these discrepancies are mainly because of misplacement by the labour, as they forgot to put the inventory back to its original place. Hence, second count needs to be conducted, which is a highly time-consuming process due to PLC5 having more than 4000 SKUs in the warehouse. Also, when the labourers are facing personal issues, their emotional condition will be affected, and lead to imperfect working performance and errors in the workplace. Worker shortage is also a problem that arises from the current warehouse operation. Nowadays, the local workforce dislikes warehouse jobs as they are tougher and more tiring.

In addition, PLC5 also faced the problem of low productivity in customer service operations as they are manual pull operations. Customer service needs to deal with providing guidelines to the suppliers and customers of PLC5. Any problems resulting from the main operations will be handled by the customer service team, who will access the parties via email and other platforms. The productivity of the customer service team decreases when a huge number of damages happen. This is because when there are 30 pallets of goods encountering damage, the team has to send the photo evidence one by one to their clients. In short, this manual pull operation consumes a lot of time, and because of the large file size, the team is unable to send all this photo evidence in one email.

6.2.3 Research Question 3: How to enhance the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd. by automation?

Warehouse automation can be categorised into three main categories: complex, not so complex, and simple. Complex warehouse automation includes pallet shuttles, ASRS, AMR, and carousels, while not so complex automation includes conveyors, auto-pack machines, robot arms, and auto-labelling machines. Simple warehouse automation includes smart picks and counts, IoT, a power platform, and artificial intelligence. Warehouse automation in PLC5 is not expected to be very complicated, as certain levels of the operation do not require a complex adoption of automation. In terms of the improvement needed in PLC5, it refers to the motivation and care of workers to enhance their productivity. Additionally, customer service needs improvement to boost productivity when reporting incoming damage. Human error and mistake prevention are also

needed, while automation and innovation are essential to stabilising operations. Therefore, the innovation, automation, and digitalization department were established to improve warehouse operations and smooth working processes.

Furthermore, the top priority for the implementation of warehouse automation in PLC5 is an auto put away machine in the inbound operation, an auto wrapping machine in the outbound process, and a smart count in the inventory department. The auto put away machine will build the goods into a pallet and deliver them to unoccupied areas in the pallet, while the auto wrapping machine will wrap the goods from bottom to top and come back again to complete one wrapping. To illustrate, smart counting is the easiest and cheapest project that can be implemented immediately in the inventory department to ease and increase productivity when conducting monthly counts. PLC5 is suitable for transferring from a manual warehouse to an automated warehouse. Dell has a projection for increasing 1000 locations every year, so it is urged to look into their current capacity and the available automation opportunity to maximise the storage.

In addition, warehouse automation requires a huge amount of investment, and the return on investment in automation is also part of the consideration. However, there is a concern about workers getting laid off and becoming jobless. If the warehouse goes for full automation, the workers needed in receiving system prospection will be reduced to only one instead of four. Referring to the urgency of warehouse automation in PLC5, there is around 50 requests for innovation, automation, and digitalization. The department has meetings daily and weekly to find progress, and the head of department keeps track of all the records to ensure the urgent request is met. As such, it is urgent for the

department to implement warehouse automation. However, for the operation team, warehouse automation is not urgent but is now suitable to be implemented as the entire market volume is in a declining trend. It is cost-effective in the long term, and it is also important to understand customers' expectations. For instance, if customers want storage optimisation, they may not be able to get the productivity efficiency of throughput. Automation is not able to be implemented right away as it involves a lot of study. The future direction of the company is complex automation because it will ultimately come back to return on investment (ROI). A proposal has been designed, and the team is now working to calculate whether the investment can provide a return in the coming 2 to 5 years. Ambition and reality must meet at the same time, as the warehouse is now fully occupied, and the existing customers have already paid for the space. If there is extra space, then other customers are welcome.

6.3 Recommendation

Achieving full automation in PLC5 can be challenging because it involves several considerations, especially financial support. The current operation of PLC5 is in the middle of simple automation, including the usage of WMS, Power App, and Smart Count. Therefore, the researchers integrate all the data collected and provide some suggestions in terms of warehouse automation technologies.

Firstly, PLC5 currently uses a manual worker to inspect the goods while receiving. The inspection process is recorded by CCTV, which is able to zoom in and observe in 360 degrees. However, the worker might miss out on some damaged parts and directly store them in the PLC5 warehouse. Therefore, it is suggested that PLC5 invest in an auto-vision inspection system to automate the

inspection process. An auto-vision inspection system is a cost-effective way to inspect a variety of products in real-time. Inspection systems can identify uncommon product shapes, rapidly measure items, and confirm that items are in the right place. A wide variety of specialty features, including a camera or numerous cameras, barcode scanners, x-ray machines, foreign object detectors, and even video inspection tools, are included with these systems. As products move through the process, computer software integrated into the inspection system will instantly analyse images or data that are recorded and take a certain action depending on that analysis.

Furthermore, PLC5 also faced an issue with packaging. It requires a little manpower and takes time to do the wrapping manually. An auto-pack machine is suggested to automate the packaging process, which can save time and increase productivity. Auto-pack machines can pack the products with high precision, which can help reduce errors and improve the overall quality of the packaging process. It is important to have a consistent and uniform packaging process in order to provide protection for the product. The rate of injuries can also be reduced since auto-pack machines can be equipped with safety features such as sensors and emergency stop buttons, which can help prevent accidents and injuries in the workplace. Auto-pack machines can be cost-effective in the long term since they eliminate the need for manual packaging, which can be time-consuming and expensive.

Consequently, PLC5 can proceed with complex automation in the next 10 years as PLC5 is trying to optimise the warehouse storage. Therefore, pallet shuttle is highly recommended to invest in the future as the storage space can be optimised by allowing deeper racking through remote control by the operator. A

pallet shuttle system can help improve the efficiency of warehouse operations by reducing the time required to load and unload pallets. Besides, pallet shuttles can help improve safety in the warehouse by minimising the need for forklifts or other equipment to enter the racking, reducing the risk of accidents. Hence, PLC5 is suggested to focus on investing a pallet shuttle to improve inventory control by providing real-time tracking of inventory levels and locations, making it easier to manage the inventory and preventing stockouts.

Subsequently, PLC5 is proposed to develop a comprehensive automation plan and implement it based on the timeline. This involves developing and testing automation workflows, integrating automation tools into the existing systems, and training employees on using the new automated systems. Finally, continuous improvement is important to ensure that the automated systems continue to adapt to changes. Thus, it is highly suggested that PLC5 to regularly assess the effectiveness of the automation systems, identify areas for improvement, and make necessary adjustments to optimise performance.

6.4 Contribution of Research

6.4.1 PLC5, Schenker Logistics (M) Sdn. Bhd. Management

Eventually, this study carries a clear picture of the current warehouse operation of PLC5 and the problems resulting from it. The findings of this study can provide a more in-depth understanding of the consequences of warehouse automation and aid in top management decision-making. Furthermore, information collected from the research can help the organization to determine the most relevant and suitable technologies for improving their operations to enhance customer satisfaction. Moreover, the impact of warehouse automation

on the workforce and capital needed in PLC5 may be evaluated as well. To illustrate, skilled and knowledgeable workers are required to operate and maintain automated equipment, as well as measure cost and return on investment (ROI) before implementing warehouse automation. Therefore, this research can provide organizations intending to implement warehouse automation with valuable insights and guidance, allowing them to make informed decisions and maximize the benefits of automation in the warehouse.

6.4.2 Academic

This research has made significant contributions to the readers as the information in the study has provided a clear image of warehouse automation. Academicians or researchers may identify the vital role of efficiency in warehouse operations since automation can streamline the goods movement as well as minimise the time and expenses involved with manual labour in a warehouse. In addition, various technologies of automation have been discussed in the literature review, which can assist in comprehending the potential advantages and suitability of these technologies in a warehouse. The data analysis and literature reviews about the adoption of warehouse automation in PLC5 can also enhance the perception of readers by relating their knowledge to a physical warehouse. Furthermore, this study offered students practical insights into the pros and cons of modern warehouse automation, assisting them in developing a better grasp of supply chain management and logistics. On top of that, this study can be considered a future guide for academicians or researchers who intend to prepare for further research on the technologies of automation in Malaysia's warehousing industry.

6.4.3 Policy Maker

Besides, this study can serve as a guideline for the government to better understand the current warehouse operation. Policymakers are able to evaluate the challenges faced by manual warehouse operations and create supportive regulations. For instance, the government can coordinate with industry experts to develop appropriate guidelines on safety and operational requirements for automated systems. Additionally, policymakers can provide suitable financial incentives, including tax breaks, subsidies, or grants, that could help offset the initial cost associated with automation technology by referring to this research. Furthermore, warehouse automation relies on data collection and connectivity. Policymakers can establish regulations and frameworks to safeguard the security and privacy of data gathered by automated warehouse systems. This involves defining the ownership of data, setting rules for data sharing and usage, and conducting robust cybersecurity measures.

6.5 Limitations of Study

There are certain limitations encountered when achieving this research. One of the boundaries is that it is mainly focused on only one of the branches in Schenker Malaysia (M) Sdn. Bhd., which is PLC5. Although there are a total of 23 warehouses in Schenker Malaysia, the researchers are not able to cover as many branches as the study should be precise. Furthermore, the respondents might not be able to express their opinions in detail due to time limitations. This is because the interview session is mainly conducted for positions at the middle managerial level in PLC5, while the managers and supervisors are occupied with their daily operations. In addition, all the data was gathered from the same

company management, but unfortunately, the data collected from the interviewees is not compatible, as they might have different points of view when in different positions.

6.6 Future Research

As mentioned in the limitation of study, the current findings only focus on PLC5. Therefore, it is suggested to include the study for the entire Schenker Malaysia. Besides, there is plenty of research that can be conducted in the future since warehouse automation is an ongoing trend. Research regarding robotics and autonomous systems will continue to develop as they can provide greater accuracy and efficiency. Besides, future research might look into augmented reality, as it will be increasingly used in the warehouse to improve the accuracy and speed of order picking and inventory management. As such, future research can focus on implementing a new augmented reality system in Schenker Malaysia to improve the productivity of warehouse operations. Lastly, future research can emphasise on improving energy efficiency to minimise the environmental impact and operating costs. Researchers can focus on studying energy-efficient automation technologies and optimising existing systems to minimise energy consumption.

6.7 Conclusion

PLC5, Schenker Logistics (M) Sdn. Bhd. is moving forward into warehouse automation. Warehouse automation has become an increasingly important trend in modern logistics and supply chain management. With the advancement of technology, automated systems such as robots, drones, and autonomous vehicles have been developed to streamline warehouse operations and improve efficiency. These systems have been proven to increase productivity and minimize errors in inventory management. Overall, warehouse automation is likely to continue to grow and transform the industry in the coming years.

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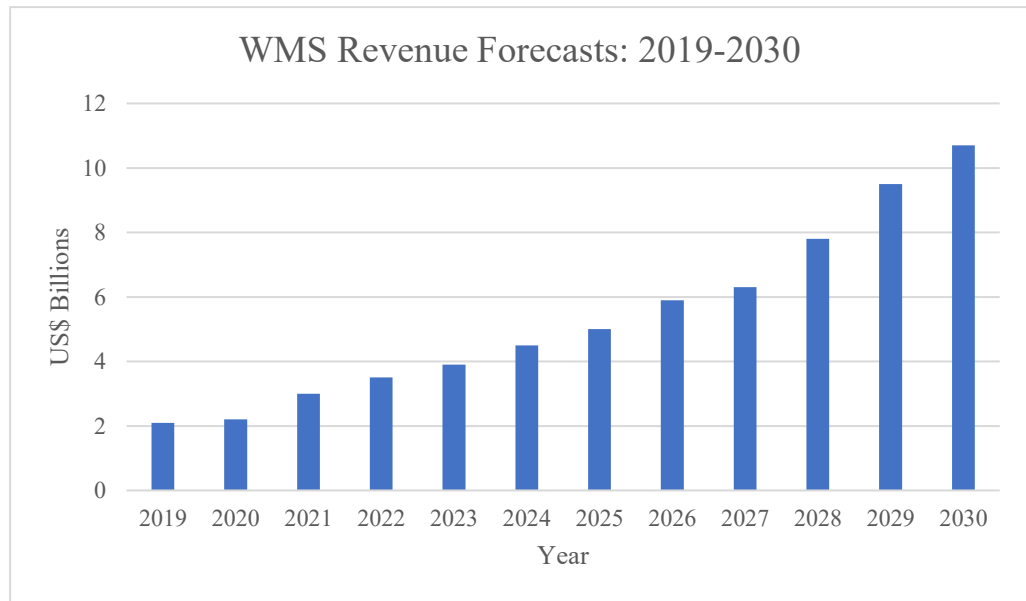
WMS Revenue Forecasts: 2019-2030

Figure 1.1: WMS Revenue Forecasts (2019-2030). Source: (Luitel, 2022)

Technologies Adopted in Worldwide Automated Warehouse
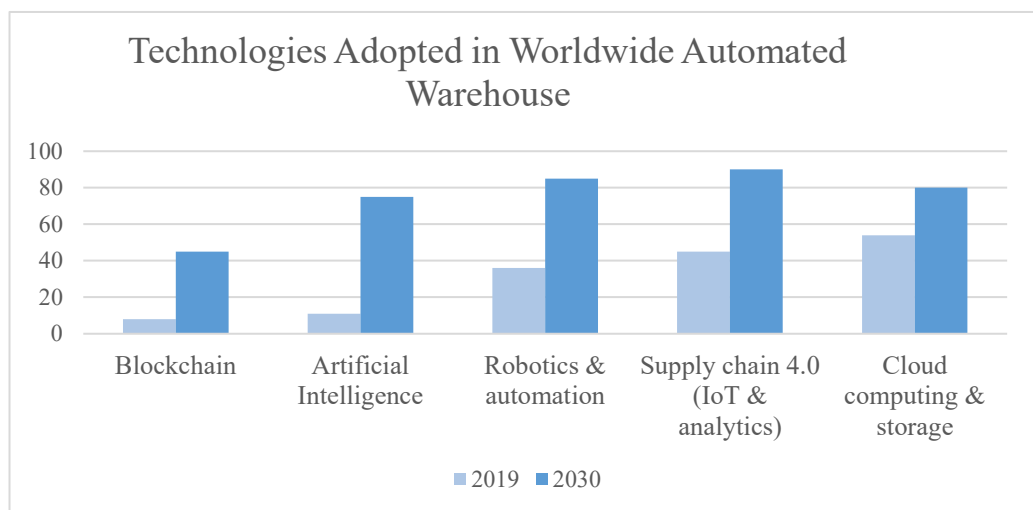
Figure 1.2: Technologies Adopted in Worldwide Automated Warehouse.

Source: (Golosova and Romanovs, 2018)
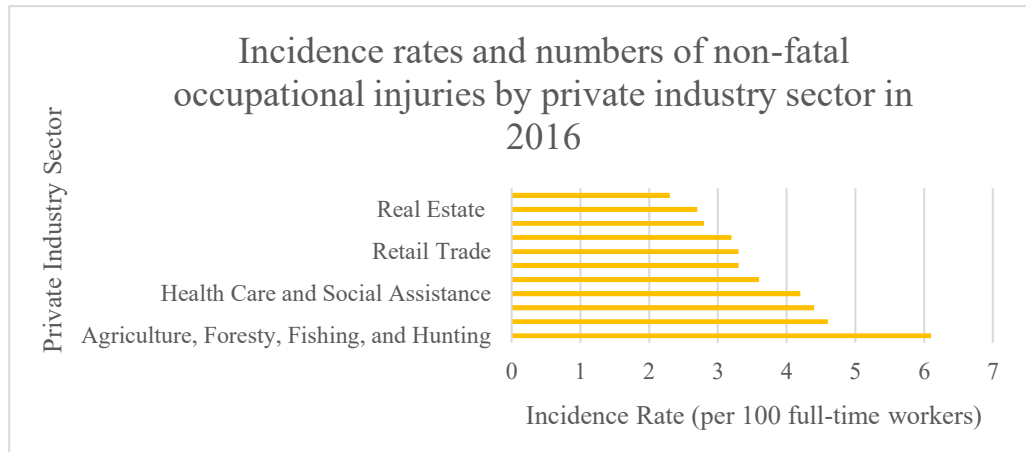
Figure 1.3: Incidence rates and number of non-fatal occupational injuries by

private industry sector in 2016. Source: (Tutterrow, 2018)
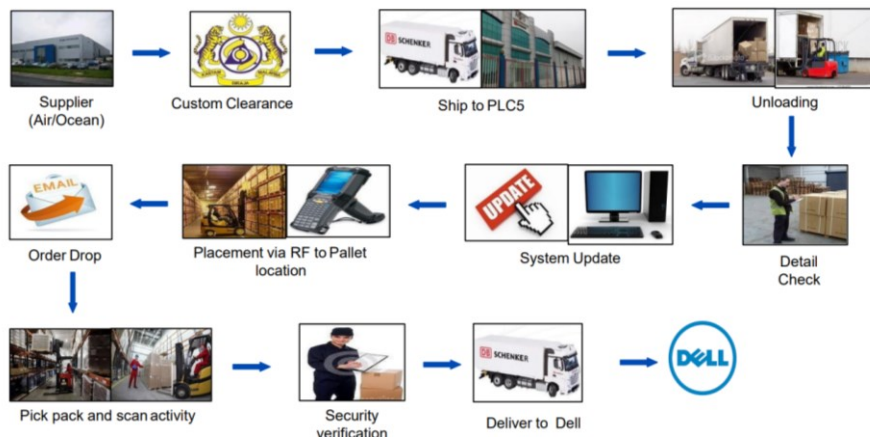
Figure 1.4: Dell VMI inbound and outbound process flow.

Source: PLC5, Schenker Logistics (M) Sdn. Bhd.
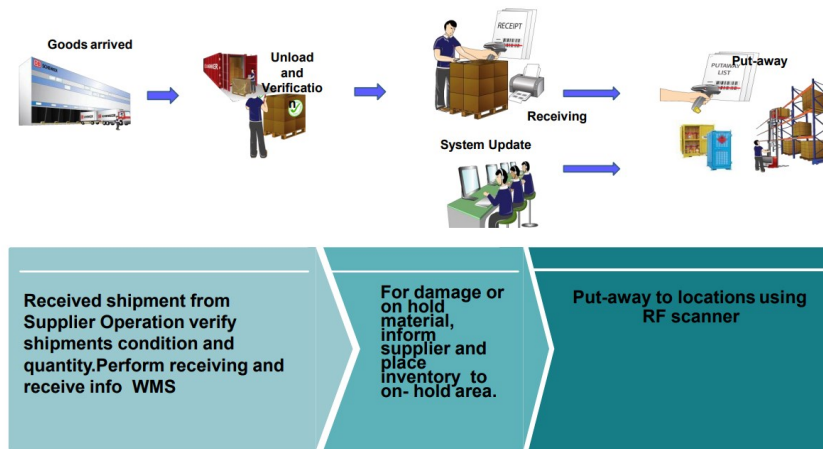
Figure 1.5: Inbound process of PLC5, Log Dell.

Source: PLC5, Schenker Logistics (M) Sdn. Bhd.

Outbound Process
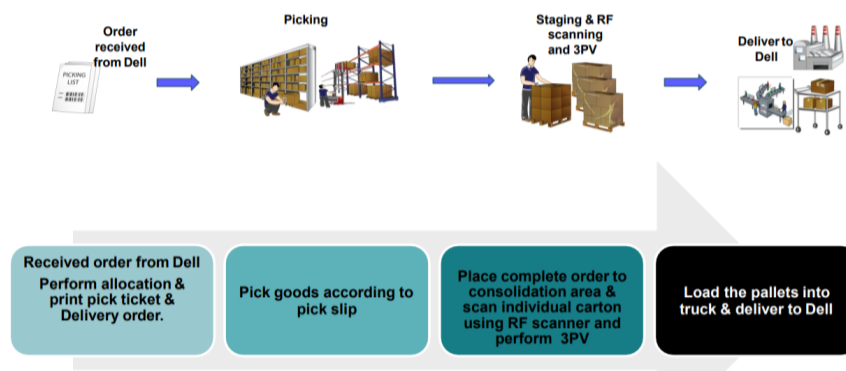
Figure 1.6: Outbound process of PLC5, Log Dell.

Source: PLC5, Schenker Logistics (M) Sdn. Bhd.
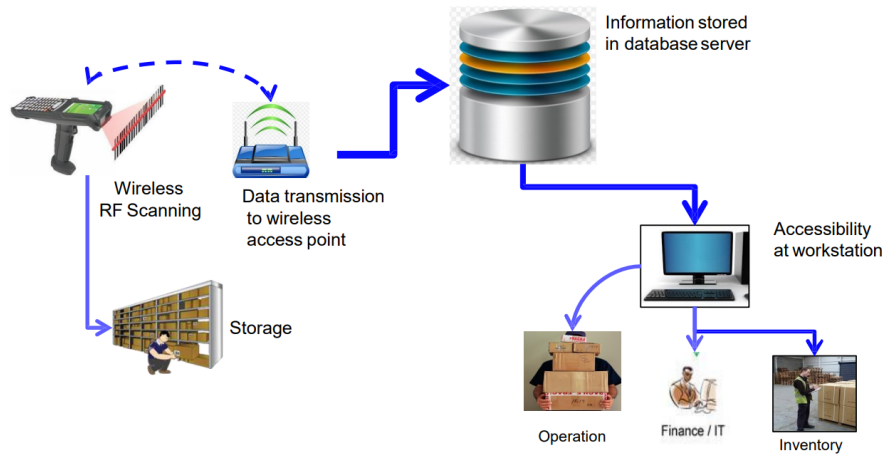
Figure 1.6: Dell VMI Warehouse WMS.

Source: PLC5, Schenker Logistics (M) Sdn. Bhd.

Research Objectives

OBJ 1: To assess the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd.

Questions:

1. May we have a brief introduction about the warehouse operation of PLC5?

2. How many workers are required for the current warehouse operation?

3. What is the working schedule for the operation?

4. Was the material handling equipment enough for the current warehouse operation? Is there training provided to the floor workers?

5. Have the current PLC5 warehouse spaces been fully utilized?

OBJ 2: To identify the problems resulting from current warehouse operations PLC5, Schenker Logistics (M) Sdn. Bhd.

1. What is the most common issue that is faced by PLC5 during the operation?

2. Is PLC5 facing a worker shortage problem or a worker turnover problem currently and during the COVID-19 pandemic?

3. Does the warehouse worker often take leave? If yes, will this impact PLC5 warehouse processes, such as delays?

4. Human error always happens in a conventional warehouse. Have the workers made errors that caused a significant impact to the warehouse?

5. Operation Down could affect the warehouse process. Is there any system down issue in Schenker? If yes, how much of a cost does the company need to bear?

6. What is the rate of injuries or fatalities in PLC5?

OBJ 3: To enhance the current warehouse operation of PLC5, Schenker Logistics (M) Sdn. Bhd by automation.

1. What is your understanding about automated warehouses?

2. Is there any area where improvement is required in PLC5's current operation?

3. What are the considerations in transferring from a manual warehouse to an automated warehouse?

4. Do you think that the inventory currently stored in PLC5 is suitable for automation?

5. Implementing warehouse automation to acquire a large amount of capital. However, do you think that warehouse automation will assist PLC5 to make profit in the long-term?

6. Adoption of automated warehouses requires knowledgeable workers to monitor and control the technologies. Will the company spend more money to hire a high-educated employee or provide training to existing foreign workers?

7. Is automation urgent for PLC5?

8. What is the future direction of PLC5 in 5 years?

Respondent 1 – Head of Operation System Management, Innovation, Automation & Digitization of Contract Logistics

Student A:

May I know your perspective or understanding about automated warehouses?

Respondent 1:

I prepared some slides. A short introduction about DB Schenker, we are a German company, so DB itself named it DB in Germany, DB is something like "kereta api" in Malaysia KTM. So, it is owned by a German company, and is hundred percent owned by the government. So, DB bought over Schenker, so it actually became DB Schenker. Ok so er in Germany their post office is something like DHL, DHL is their post office. So, DB is their KTM in Malaysia. I hope you can understand a little bit the wording of why DB is a KTM. So, we have in Malaysia itself we have about 2400 employees, we established in 1979, and we are operating an about 2.5 million square feet. So, Mr Claus Kuhnert is our contract logistics director. If you still remember, the contract log is warehousing. So, in Malaysia we have 4 divisions, air freight, sea freight, contract log and also transportation. So, the contract log is actually handled by Mr Claus. So talking about the warehouse we have 23 warehouses in Malaysia you can see here Penang have PLC 1, 2, 5, 5A, 6, and 7. We have the airport warehouse, followed by Ipoh, Kulim, and then we have Tanjung Malim, so Penang and Kulim fall under the north. Ipoh, Tanjung Malim, Shah Alam, Bukit Jelutong, Port Klang, and Melaka all fall under central region. And then in the south we have PTP, we have the biggest warehouse in JLC6, JLC7 and we also have an in-plant operation, we have LLC5 in Nusajaya. Basically, this simply makes up the southern region. KLIA, Kemamman, Seremban all actually belong to other divisions. We are actually ISO certified 2004, and we are actually halal certified 2400, we are actually halal hub, one of the sides actually certified as

halal hub, and also ISO-13486, which refers to medical devices, they have a high standard about their warehousing. We have 21 Schenker on Klang, and 300 over all trucks for our trucking operation. So basically, this is the background of Schenker Malaysia.

Basically, I just want to categorize the innovation of automation into 3 categories. First one is very complex, after this you can find the details of these technologies. Pallet shuttle is in very high demand at this moment. A lot of warehouse operators are requested in the pallet shuttle. Even after this you interview with the PLC5 manager, so this pallet shuttle is the one that we are actually in the middle of voting up and propose for dell operation in PLC5. ASRS is a technology that I think was popular 20 years ago. Basically, for those countries that have a small land area, the labour is expensive, so like Singapore they are actually favorable to put ASRS 20 years ago. At this moment, I can see people still using ASRS. Autostore, AGV, autostore is the compact storage system that is very compact, and normally it is actually used to store the boxes. Pallet shuttle is used to store the pallet. An Autostore actually stores the carton in the compact way, and then it will be put away and received, retrieved by using the robot. Ok, AGV is something like a man-less big-truck or forklift. You imagine a big truck is actually run by itself, by the system without the human-being. Autonomous mobile robot, and ACR is something like a small robot. The AMR that you can take note of is something when you go to the restaurant the robot will serve you by picking the food, something like that. Alright, the details I will show you the video after this. Carousal, A-Frame, Exotic are these are actually the technologies that currently people start to explore about in and try to use it while this is a bit complex and costly. The next category that I, myself categorize as a less complex automation, refers to auto labelling machines. Like you need the manpower to actually paste the label but actually it can be done by using a production line. Alright so you just put your box there and when they go through a certain process, the labelling can be done. In fact, there will be some QC check for the quality itself also. Alright, so another technology I can say dimension and weighing machine, alright, at this moment the worker needs to actually make sure the box and then need to check the weight. So, what we are going to do with this dimension and weighing machine, alright when the parcel goes through this

machine, so it will auto capture the dimension and the weight, and then the system will show in the dimension system, to record it in our system. The information will eventually be used when you try to ship out your cargo to customers, you will be needed for documentation purposes. So, all this will actually eliminate the barriers when you imagine your ground floor worker taking dimensioning, they need to write on the paper and pass it to other CS people to key in. So, along the way, there will be a lot of chances to make mistakes. Ok so when we have all this automated machine, all this can be eliminated, and customers will be very happy.

Conveyor, carton erector means when you have a warehouse that spend a lot of manpower to erect the carton, because when we pick the small item from the shelf, we put to the packing station then we need to erect the bigger carton actually store the big item into it, and then it will only send it to customer. Most of the time the customer not only buys one item, they will be buying a lot of items. So, we need to erect a big carton, and put all the small items into it and then ship it out. So, this actually involves a lot of labour jobs, a lot of foreign workers or local workers need to deploy to erect the carton. So, we actually use a carton erector. Alright, it can be done by machine or using the robot arm to erect the carton. Ok robot arm is a technology that currently is in very high demand in a lot of countries actually. If you go to any exhibition you can find a lot of robots who are doing human jobs, they are taking raw materials to the production line, they are doing some easy job, or a standard job. Robots are still robots, they only can do simple jobs, if you need a lot of complex steps in a certain process, then it is not so suitable to use a robot. Alright, the robot arm can do the repeating job and also the simple step to actually help the warehouse operations.

This has become very famous and popular now in our industry. Box building machine this is something like when you might think that this could be the same as a carton erector. Box building machine is something like for example this is what actually happen in the warehousing, so for sneaker or sport shoes have many sizes from small to big, if let you say you need to prepare empty box to put all the sport shoes, so you will need to keep a lot of sizes of the box. So, this

box building is actually, it is a machine when you put your sneaker to the machine, so the machine can actually produce the most suitable carton box according to the size. It can actually eliminate a lot of storage or empty boxes. This will actually eliminate your carton boxes.

Auto pack machine is the machine that can actually help you to actually simplify your packing, no need so much manpower especially when we have labour storage. A lot of warehouses, you still remember Malaysia foreign worker policy keep changing, so sometimes we are not allowed to bring in, sometimes they, the government will not actually approve their application, we have a lot of manpower issues. So, this auto pack machine can actually help when the. I would say this does not 100% cancel all our issues. When we come to automation, if a certain solution can settle about 90% or 80%, then it is actually good to implement. Why I say that is because sometimes when you come to the packing rack, sometimes it could be oversize, so our machines have certain limits or certain sizes. Alright so when we study the ROI, when we study the visibility of certain innovation, it would need to be considered, we need to take it into consideration. So, another group that I classified is simple, easy to implement their thesis, so I classified it as digitalization which is currently happening in IT technology.

A lot of technology happened that can assist our daily job. For example, we have a smart series developed in our regional office. I will explain to you later the smart pick, smart count, all these are using handphone devices to assist the manual operation to actually perform certain activities in the warehouse for example taking, for example when they do inventory count. Alright all of these are actually newly available in our company. And also, we are actually developing a TV dashboard, at this moment, for example, when you go to Sunway shopping mall, you will like to see how many parking lots are available. Before you enter the car park, you can see already. Even when you enter the shopping mall nowadays, you do not need to take the ticket, so people will have the camera to scan your car plate and before you exit just go to the machine to pay parking fees. All these are simple technologies to actually assist our operation. Alright the common one power platform, power PI, power automate,

power app, all these currently we are using to smooth our warehouse job. Customers want to see their last week performance, and to see their last month performance, alright we use power PI to display the performance based on customer requirement. Alright customers want to see their damaged cargoes when we are doing the inbound or outbound sometimes that could cause some incidents to happen. They want us to be recorded in this moment we actually need to take the camera, we take photo, we keep the share folders, we record down the incident, report, so all these can be done by using our power app, so we just take the handphone then snap, using the power app so all these information immediate record and job router will automatically store in the cloud shareholder, it actually eliminate a lot of manual job. RPA, this is the automation tool to actually automate a lot of repetitive jobs. For example, you always receive emails from customers about their order drop. We can actually use the RPA to actually automate the process. Our cs no need to go into the EPL and open the job. So, this robot can do it, it can take the report that is sent by the customer and actually store it in the shareholder and make it into a summary like that. So, this is the RPA technology that is currently being used.

Other than that, there are other technologies like E-scan, or we can actually, for example, when there is an approval that needs to have approval from many departments, so this technology can actually help to keep track and can actually follow up from A to Z from the process and keep the approval. Also, this technology to connect straight-line IoT, this is actually keeping track of the cargo from A point to B point. For example, it will help to ship out from Penang to Europe, so we have the device to actually be used for pallet tracking. All these technologies are actually helping our operation to make their life easier. Actually this is so simple and easily to install, and actually, our job here we try assist our warehouse operation throughout Malaysia to make them familiar with these technologies, and we will also not split spoon-feed there, it would actually develop for them, we will train them, to make sure when there is any new request from customer in future, all our warehouse key person know how to do.

So basically, these are the 3 categories, the first one is complex, it will take a lot of time, it will take a lot of money to implement it, and the return could be low,

8 years, or 5 years. The intermediate one, I think it is easier to understand, sometimes the impact is very huge, when you implement this, the cost is not so high, but the impact save a lot of manpower, so we actually even though we focus on this 3, but we will think the intermediate, the simple one, that the things that we can easily grow up. Ok, the next question is why we actually need automation and digitization. I think this is a very important question that can answer your question why we need automation. So, the first one you can see, the most direct impact is the cost, the manpower cost is getting higher in all the countries in these 1 or 2 years especially. If you don't have the manpower, it will have inconsistent productivity, I would say manpower cost, process cost, the space cost, the space rental is getting higher, so we need to actually do some automation to actually compact, to actually make the operation smaller, to generate more mobility.

All these are actually contributed into the cost. Other automation, of course the evolution in industry 4.0, so maybe you can know from industrial 4.0, so there is an evolution in manufacturing. A lot of technologies can be implemented, can be used in manufacturing. Same contract logistics we can actually try to take, we will try to use the same technology to manage the warehouse activities. Alright, other reasons like branding, environmental, the customer request, security, and globalization, so I do not want to explain in more detail. But I would like to say cost and customer request is currently the main contributor and triggered us in automation. A lot of customers such as Dell request automation, a lot of customers like SKF, our major customers actually request us about automation because they know automation, the benefits of automation, they know how important innovation can actually save costs, and improve their productivity. Alright, and also to eliminate errors, when customers receive their cargo happily, they will be happy also. Alright, so digitization. This is the smart tool that I just now already touched. These are the digitalization. Initially we have smart count, smart pick, smart loading, power app, and then we are in the midst of developing other technology to support our operation. For example, in one pallet there are many many boxes, so we can use a certain method to actually scan, and immediately we can identify which carton that actually wants to be shipped out. So, we already have this kind of technology. Smart loading helps to put the cargo

into the truck, or to the container. Smart pass is to manage the truck driver when they enter the facilities. Inbound Tally System, so all these are the future technologies that we hope to work on.

This is the detailed explanation about the smart matrix. Smart matrix is actually to show the dashboard performance of company performance. Smart count, instead of manual they are taking manual paper to do the counting, using this method where we can use the handphone to perform the simplest step on the item that we are going to count. Smart picking, power app, search and find. Ok, this is digitalization.

Now I bring you to automation. These are the common warehouse automation for pallet storage. Automated pallet shuttle, ASRS, A-Frame, Automated Dispensing system, carousel, AGV, autostore, mini load, this is just the introduction, the details if we have time, maybe we can go through some details. This is for carton or unit storage. Let's look at the pallet handling and storage technology. Ok this is the automated pallet shuttle. So, as I mentioned just now. This is the storage system, there will be no arc, there is no walking space, so all the pallets are put in the white area, and all the put away retrieves will use this shuttle. So this is the benefit of using automated pallet shuttle in terms of productivity, in terms of space, quality, and cost. High means this is very expensive, it is actually very expensive, you imagine one pallet shuttle cost about RM1200. So, if you have about 1000 locations then you need to convert into this kind of technology, imagine how many million you need to take.

Ok, just now the pallet shuttle. Now is ASRS, so this is similar to pallet shuttle, but you will have the walking space here, but the is only allow MHE to move, so all the instruction, put away, picking, instruction will be sent to the vehicle, and the vehicle will move to the specific location to retrieve or put away the pallet. This ASRS is a hundred percent robot or machine operation. Ok, so next automation is talking about the unit or case handling storage to store smaller items. A-Frame is highly utilized for boxes, for the item that is actually common use in Schenker. So, this is the benefit. So, this is the Automated dispensing system that is highly used for the hospital. The robot will actually pick the item from the shelf. AGV this is the new trend in warehousing. So, this is the manless

automated guided vehicle in short form AGV. So, this equipment actually can operate without the manpower. All these are benefits. So AGV in our warehouse refers to this kind of operation, the forklift, the V-truck, ok all these are actually automated. So, they will be moving, following the robot system, and actually controlling all these vehicles. So, the auto store is just now briefly explaining. So, this is the compact storage system. Alright the robot is moving, the put away, and key in will be done by these small robots. This is highly used by especially E-Commerce companies. Mini load is something like ASRS, a small version. This is a multi-shuttle. This multi-shuttle is a small version of pallet shuttle, but actually is to manage the carton. This is a carousel, and I think this is commonly used in our warehousing. This is a vertical carousel, this is actually most suitable for less, I mean slow moving items. Alright because you see in the design itself the picking, put away activities does not be fast. For vertical carousel especially you imagine this is to put all the small bulk, for the automation industry. This is the benefit. Vertical Lift module, this is to actually occupy space, so it is especially for small items. Normally if we use the normal shelving, it is less than 2 meters, not very big. But this system is actually needed to cater the new space. So, this is less common in our industry, I would not explain in more detail. AMR is highly demanded in our industry nowadays. So, especially we have very fast-moving items, so this technology has been commonly used, so AMR means autonomous mobile robot, as I mentioned it can bring the goods for you. U just pick, or u just put away, it will go to the location. So, this is the technology automation technology that is highly demanded.

Just now AMR, this is ACR Autonomous case-handling robot, the differences between AMR and ACR, just now AMR the robot moving from the whole racking to the picking station, for us to pick or put -away, but this ACR is something like the racking is actually higher, the racking is actually not thick. The robot will bring down the item, the box to the lower level, and then it will be transferred by using the AMR to the racking station. So, this is the ACR, so there are pros and cons, so we need to look at the operation requirement to decide whether we can deploy ACR or AMR.

So, that is all about digitization and automation. So next I will just show you what my department has done for DB Schenker Malaysia last year. So, we actually open, and we brief all the operations about our new debt, what we can do for them, and what they want us to do. Eventually we connected 49 requests for all the operations. So, we actually have a started most of our request, as you can see the status here, one haven't start, we are doing pre-screening, screening, development, UAT, go-live, some are actually after we do the screening, we felt that this is not possible, or sometime customers exceed, or sometime we need to on hold for a certain things due to some technology issues, or some operation issues, so basically we received 49 request from warehouse operation, from Schenker Malaysia. Ok so we have categorized all this automation into different categories, and different categories we need to work with different people. For last year itself, we went live with 10 projects, so the total cost saving per year for these 10 projects is estimated at RM680.68K. So, this is the brief project status. Ok some important go-live work for 2022 last year. First one, an auto labeling machine, we have one customer, medical customer PTP, JLC7, so we have about 26 labourers to actually do the pasting of the label every time. So, their main job is the pasting of labels, we have 3 types of labels, different labels, some require 2 labels, some require 3 labels, we have about 26 manpower to do it and we have a mix storage just to store the printed label. So, we actually automate this manual process, the machine itself is actually spent about half-million, and is actually designed and developed. With this type of saving after the machine was in place, we actually cut down 11 staff, because we still had a certain requirement that could not be managed by machine. So, within 1 year we get back the return already, the ROI, so this is a very successful project. Power BPI is the coordination for Schenker, so we actually organize the trending, we receive the customer request they want to see the two weeks number to appear. We actually develop Power BI for them. So, until now this year we have already adopted a few more machines to fulfill customers. Power apps for consumables that are for this power app can actually know the inventory level. Consumable means when we do the packing, we need to have the carton box, we need to have the certain cover or plastic that we need to have. All these are actually under the consumable category. Sometimes we need to put the product label, so we need to print it, need to repeat the label, and all this is considered a consumable force.

The empty pallet is also considered consumable, if we did not manage all these consumables, so u will find what they affect the operation, so for these consumables can be forced to stop the operation. Alright, so this power app, we keep the inventory visible, so the operation supervisor, manager know their consumer level. Alright, so a lot of operation also that require us to take photo if for example when outbound when empty box need to take photo when u already uploaded 30%, you need to take another photo, when 100% the container need to take the photo, or something like that, so all this can manage by power app. Including the damage just now, the order damage recording, so we can actually use the power app to store it. This is the avatour, this is grown up by our global, alright so customers can actually not need to visit our warehouse, we can use the 360 cameras to live in our warehouse, the customer can actually view 360 degrees of their warehouse condition. This is an award giving project by our HQ. Malaysia was one of the pioneers that started this avatour case. At that time, I was very happy. Ok this is the real time dashboard. We published the real time performance for example when we receive the goods whether we have the receive system or not, whether we are putting-away the pallet on time or not, alright, and for outbound we need to know whether we allocate the picking, packing, shipping, on time or not. This is very important especially for us to manage the operation, we do not look at the past record and manage, this is to show the status, and manage the current manpower. We have also implemented this smart count especially, we still have a few slides that running this operation, smart pick, smart count, are helpful to convert the info into the system.

Student C:

What are the considerations in transferring from a manual warehouse to an automated warehouse?

Respondent 1:

So far the bosses is very supportive as I mentioned the biggest challenge is the ROI and the technical condition, and also I would say another issue maybe is the system interfacing because the in order for robot to move right, it have to link to our system, so our system will know what is the order that come in, this

information need to send to the robot, and tell them they need to go which location to pick the item, for example if the system interfacing with the robot is actually the at this moment is one of the challenges, because the cost is very high.

Student A:

Is the inventory currently stored in the PLC5 suitable for automation?

Respondent 1:

Every industry is suitable for automation, so you need to find out, of course for Dell case right, talking about for Dell case, the current key problem is the storage, because we have a good projection for every year that need to increase 1000 location every year right, so you need to look into our current capacity, you need to look into the automation opportunity, how you can maximize the storage and from there you need to look at the investment that you going to throw in to increase the additional space, so can we actually justify for this, because when we increase the space after the automation, that will be new revenue for storage and handling, not only storage, the storage you can sell any one location RM50, but you remember all this pallet you need people to handle it, so that will be additional revenue for you, alright so when we are doing the pallet shuttle study for dell, so we are actually considering the additional space after automation.

Student C:

If the adoption of automated warehouses will require knowledgeable workers to monitor and control the technology, would you spend money to hire highly educated employees or provide training to the existing workers?

Respondent 1:

Of course, there will be training given. I can see all these automated technologies right, actually do not require much specific technical knowledge to run. Whatever automated it should be easy, and friendly to the user. So I not see very, very different from, if you compare to our warehouse system right, warehouse system maybe you think is very complicated, but for our operation, certain level of operation, we do not expect them to operate whole system, when comes to

picking, only the picking person need to operate the picking system, so it do not acquire any technical knowledge to run the system, same to the automation system, so most of the time this actually it will be run by their operating system, it will be interpret to our WMS system. Eventually, our people are still doing their normal job. So, this is not a very big deal for an automation system.

Student C:

Is warehouse automation urgent for PLC5?

Respondent 1:

For me it is urgent. As the department head I had to said this is urgent, we always find our opportunity, that's why when I show you our department performance in 2022 right, we receive about 50 requests for in we so call innovation, it can be either automation or digitalization, and this we already actually sending our message to all the ground people, and they are very supportive, they are telling us what they want to do, what they want to automate their warehouse, is either the complex automation or some even tell us they want to automate their simple process this and that, so at least the awareness is already there in our operation, and we are actually every day, every week meeting my staff, find the progress, even all the request is putting the hedging to see already how long pass, still under what project status, so I will track all the record to make sure the urgent request is being been fulfil. Alright, and of course, we are tolerant of requests coming in from customers. Customers are always our priority.

Student A:

Why is Schenker Malaysia not ready to implement automated warehouses?

Respondent 1:

I would say the for all the warehouse in Malaysia are half automation, so we only can start from those warehouses who are having a lot of manpower, they are actually because we cannot start from the small one, they only have one or two headcounts to run the job right, cannot justify our effort right. So that's why we actually started the survey for a certain warehouse. Singapore automation

that is called red lion. I visited there last year, so they have a robot arm to do the packing, to do some DAS jobs. DAS, they have a pallet shuttle, they have an AGV, they have an online transferable who actually, they have online customers for e-commerce, they have the AGV to equip the racking to a bigger grouping we so-called person, they have a lot of automation opportunities. So, as I mentioned, different sites have different limitations. For example, let say if I want to start AGV for my SKS, then it is very hard because in order for AGV to move at the area, it needs the space, it needs about 3.5m, but after set up, we have for SKS is only 3.3m, which the machine cannot move, so I need to give up the idea already. But Singapore red lion is actually build from the scrap, thy actually scrap the whole operation at there, when they design and build, they already consider the automation, what happened to Malaysia limitation, we already have all the ready racking, all the ready and shelving position, alright so if I want to implement AGV to the location, first I would have a problem, because they do the shelving, small item at the bottom already, most of the racking if you go to the warehouse, you will have the pallet at the top, and the shelving at the bottom rack. So, in this case we have to split the two things already, the racking and shelving small box cannot be together, because we cannot allow the AGV, and the AMR move under the same area. But in Singapore when they design this operation is already consider AMR, that need to be at this area, the AGV at another area, so they don't have the inter-cross, so the design itself, the current existing operation if you want to convert to automation area, it will subject to a lot of limitations or condition that you need to follow. As I mentioned to you just now, the arc itself is 3.3m but the robot moving condition is 3.5, so it is too narrow for a robot. So dialog also cannot already, and we come to the pallet location right, the pallet itself the position of the pallet and the bin itself it has to have 200mm, because when the robot go in and take the pallet sometimes it will be shaking a little bit, so it need to be allowance, but our current operation is only 40mm, it is not actually not build to automation environment, the current operation. So, when I study automation, I need to go through this kind of study in order for me to propose automation, so I will have this kind of limitation. It hasn't come to the cost right. As I mentioned Malaysian labour cost is low, the proposal that I proposed for SKF, AGV spend about 15 million, and now itself I can split one new location just for the AMR to

propose, no problem because they have enough space, but it takes another 3 million, so I need to spend about 15 million, it need to take another 3 million, so I need to spend about 18 million, plus by the system cost, IT cost, IT system facing with the vendor system, another 1million, about 19 million, it can takes me more than 10 years to recover, so do you think as a boss, you want to see a good fancy automation in your warehouse, but it takes more than 10 years to recover, but after10 years you don't know whether the customers will stay to u or not, so are u going to give money to invest? No right. I did not propose to my boss, until my boss we forgot about this, the cost is wide, and after that we have the technical issue, the design itself is not automation trendy, so when we study on this automation opportunity, talk about the condition, we need to actually consider.

Student B:

What is the future direction of Schenker Malaysia in 5 years?

Respondent 1:

The future direction will be on complex automation. The category that you can see like, our focus will be on complex automation. Automation will be one of the main pillars in our future strategy. Yup so of course this is the strategy that eventually it will come back to ROI, I have actually design proposal, but eventually we need to calculate whether the investment that we going to invest, are we going to get the return in coming 2 years, coming 5 years, more than 5 years no need to think already. So, we have ambition, but as I mentioned just now, we need to be realistic. Ok we cannot say we want all this automation; we want all this robot in our warehouse including all the drones, do the stock count, this is very ambitious, but we want to know whether this technology is the cost we can actually get the return or not. Otherwise, no. So that's why we have the challenges especially for those countries that have very cheap labour. Eventually, when we talk about ROI, the first thing we will count is the labour cost, when we cut the labour cost, we can justify the investment. Second things we will cut the equipment cost, if no manpower, then all this we need to cut down. We can cut. So, all this actually generates the income to justify the investment. So, this

is the reality. In Japan they are very easy because their manpower is very expensive. If they want to invest, it is easy to cover, but in Malaysia, we have this problem. Even though we have the labour issue, our labour cost is also one of the lowest in the nation. When I try to calculate ROI, there is a problem to justify the spending.

Student B:

What is the planning done by Schenker to overcome labour shortage issues currently and during Covid-19 pandemic?

Respondent 1:

Because during Covid government imposed a very strong SOP, alright very strong SOP to our warehouse operation to stop it from expanding. Ya and then after that it was during the covid-19, at that time I was doing project implementation, that was the busiest 2 years in my life. We have a lot of customers during that period, so the new customer come in I of course we will have the minor problem at the beginning for exp when we found 1 case in the operation, so we need to actually quarantine the area, and then we need to actually talk to the customer please don't send in so many orders now. So, we basically face this issue. And then it is also we try to split to different locations. We make 2 teams, 3 teams, so ya. Basically, those are the key things that we have done, then of course we have less people so the current worker need to do overnight, so we provide a lot of, something like good things to customer for our existing worker for example the free, the complementary, we give a lot of motivation, we actually give a lot of incentive during that time to make sure they keep the same capacity with less people. This is how we actually went through the covid period. We have achieved the highest performance for the last 2 to 3 years. Last year was the best in our history for Malaysia.

Student B:

Operation Down could affect the warehouse process. Is there any system down issue in Schenker?

Respondent 1:

Schenker is a German company, so the difference between European companies and local companies is they are very specific, so the reason they can survive 150 years is that they have very good strength. For example, I am actually specifying in the project, I would only manage the project issue, so of course this happened to IT, we have very strong IT team from global, from regional, from our Malaysia, who are actually taking care of GI, we called hardware, we have very strong software team actually can develop different system for different customer. So, I can say system down is not occurring very frequently. Of course, every system will have their maintenance time, so this is weekly migration time because for all the jobs we operate we need to migrate it to the global server, so it normally will be done during Sunday or not operating hours. Alright, certain operations sometimes will also be operating on Sunday, that is something that we cannot avoid. But talking about the IT downtime, I would say our company is doing very well in keeping that in it.

Student C:

Just now sir you mentioned that you can lower the labour cost right, but on the other side, the unemployment rate can be increased, so what do you think about this?

Respondent 1:

Basically, for our warehouse operation, for those level that above supervisor, or supervisor and above, we don't have the issue, but the, because we are contract log, we are warehousing, most of the physical job is carry out by low level worker, so, it is not so easy to get those unemployed people to work in our warehouse. Of course, we have tried in Kuantan. We try to follow government regulations, we try not to use foreign workers, we use local workers, and what happens, every month I think after gaji month they will disappear. So sometimes we have a big problem, because most of the time customers will drop their order during the night, so we have a lot of occasions where people don't want to do OT, our local worker, means Malaysian workers they don't prefer to do OT. So, we have this kind of problem, internally we feel that if we use foreign workers,

we need to replace local workers, so this is actually high cost and inconsistent in terms of their attendance, their quality. Foreign workers are mainly there to make money, they work for OT, they find ways to make more money, they are affordable, right so I think most of the Malaysia warehouse operators are facing the same problem. In the warehouse industry, all this low-level job normally we prefer to carry out by foreign workers.

Student C:

Since most of the operation still is operating manually, may I know the injuries or fatalities frequently occur in Schenker Malaysia's warehouse?

Respondent 1:

In fact, my operation is excellent. We are keeping track of, we call lost time injuries. We have a near-miss case, while keeping track of all these incidents. I would say that of course every year we will have some cases, most of the injuries, that are incidents that cause the operation to stop. This is the serious injuries we have also keeping safe of those near miss, that means they are minor incidents, there are minor incidents but didn't cause injuries, it does not cause damage to the assets, so we are keeping track of that. So, I would say in Malaysia cases near-miss about 10 or 20, so it is not serious. Because I would say we have our system to train our staff when it comes to auto, we have the proper training, we will have the trainer that always, we have a lot of pillars to make sure there is standardization in our warehouse. All the warehouses that need to follow all these standards, alright so they are well tracked, are developing their staff, they are keeping finance, they are reporting the performance every day, so we have a standard that needs to actually follow for our daily operation.

Supervisor:

Do all the operations are basically run or exactly all the systems already run in all the warehouses?

Respondent 1:

We are trying because all the operation are suitable for all kind of automation of course our approach is actually pull approach so we will actually explain to all the operation and the, we tell them what are available technology, and they need to view urgency, because if let say we impose to them, we might have minimum support from them, they cannot feel. So our approach is pull approach, so at this moment is about, I think this moment we have about 45 requests from all the warehouses of course we cannot fulfill all request because all the automation project it will take time, it need to go through the screening, pre-screening, we need to develop, and we need to do the testing, so for last year itself it manage to deploy about the initiative, so our plan is actually to roll out to all the warehouses that actually need automation.

Respondent 2 – Assistant General Manager of PLC5

Student A:

Automation 对 PLC5 来说 urgent 吗？

Is automation urgent for PLC5?

Respondent 2:

Urgent 是不 urgent， 但是一个 suitable time to 做 automation，如果我们说现在的情势来看，因为现在整个 market volume 是在 dropping trend。就是因为他 drop 了，我才有机会做 automation，因为我需要 space 来做 automation。如果当整个 warehouse 满跟 shipment 和 inventory 的时候，我要做 automation，我需要 space，我就需要把他们搬去另一个 warehouse。当我搬去另一个 warehouse 的时候，我就会影响到 customer 的 productivity 和 throughput。如果我们要做 simple 的，就是 investment 比较少，因为讲到 investment，cost 是每一个公司的 heavy 的 commercial topic，so 如果说

顾客他不想 invest 那么多，Schenker 也不想 invest 那么多，那我们就可以 work for simple。Double deep 或 multiple deep 的 racking 虽然不是 fall under automation，but 是 for under process enhancement 还是 storage optimization 的 improvement area。如果我们讲要去到 middle or complex 的话，我们可以去到 pallet shuttle，如果要 more complicated 就是要用 ASRS 了。因为最近 Malaysia 和 Singapore 是属于一个 cluster，我们两个国家会合起来互相交流，我们知道那边有很多 robotics 的东西。如果我们要做 automation，我们要看是什么 product，不是说每一个 product 都适合做 automation。我们也要 expect productivity 是怎样的，如果有好像 automation up to robotic system 帮他们，包括 pick 货，装货，和包装起来，包括 listing label，这样的算是很 complex 的 automation 了。

Again，我们要看我们要的是什么，如果说那个 productivity，他们要的是说，by man people 来做，customer 一天的 output 是 1000 到 2000，如果我要达到 2000 可能我要拿更多的人来做。But 有一种 product 是当 hot sales，好像双 11 的时候，他们的 volume 可以去到 10,000，然后我们要怎么去 meet 到那个 10,000 的 productivity 呢？然后有一种顾客他们是属于 luxury product，他们每一到两个月都会去做 hot sales，他们知道他们的 selling 会去到哪一种的 productivity 然后他们要收货，so 我们就 divided 出来一天的 productivity 要多少，如果 by man 的话我们一直 pump 人进去来做，就是算起来不会很划算，then automation 就会 come into the picture 了。

Dell electronic 的 product，其实是要看 commodity，只是那个 chassis 会比较贵一点。And then 目前他们会需要用到很 complex 的 automation 的东西吗？目前位置不是很需要，因为他们要的 pallet in，even though carton in 我不需要开那个 product 里面来看。So 其实 pallet shuttle 是已经能够满足他们的 productivity 和 throughput 的要求了。So for Dell 我们是 looking forward for pallet shuttle 的手续给他们，which is 我们有跟他们交流了，then 接下来的 next step 是一些的 project team or operation excellent team 他们会进来做 calculation。因为其实 cost 和 ROI 都是可以谈，space 我们也 propose 给他们了。As I say that 现在是最漂亮的时机来做，因为我的

volume 是 drop 了，我有 space 来做 set up 给他们，因为一个 set up 他们需要用到 6 到 10 个月，然后 customer throughput 是不可以受影响的，那个 bottom-line。那个 pallet shuttle 我们要做 calculation，我们要放什么 commodity 进去啊，然后 volume of commodity 现在是多少，including inbound and outbound，全部我们要做 calculation 的。然后我们要去问那些 origin 的人这个 space 要不要换啊，这个也是个 question 来的。

So 当这些东西出来了，我们就知道这个 commodity 还是这个 customer product 是不是和做 pallet shuttle，目前为止大家看是可以，每一个人都要，but 我们要 detail study 了我们才知道适不适合，可能一些东西，两个 party 要做一些 adjustment，maybe throughput 给不到这么大，but 他们 looking forward 的是 storage optimization，你要 storage optimization 可能就拿不到 throughput 的 productivity efficiency 了。So 每一次我们都要问顾客，你要的是什么，what is your expectation，因为现在 storage optimization 是每一个人 looking forward 的，每一个人现在都在找 warehouse，我们就需要更多的资金去周转，maybe delivery 的时候就花了一些时间。However，如果 customer 只想在同一间 facility 不想把东西放在别的地方，我们就 mind 这个 space，throughput 那边就做一些调整，maybe two hourly pull become two and a half hourly pull, or three hourly pull，他们的整个 production 都要去做调整。So 这个不是我们要做，我们想做，就能马上做，是还有很多 study 要做的。

It is not urgent, but now is a suitable time to do automation, if we look at the current situation, because now the entire market volume is in the dropping trend. As such, I have the opportunity to do automation, because I need space to do automation. If the whole warehouse is full of shipment and inventory, I need to do automation, I need space, I need to move them to another warehouse. When I move to another warehouse, I will affect the productivity of customers and throughput. If we want to do simple changes, the investment is relatively small, because when it comes to investment, cost is the heavy commercial topic of every company, so if customers don't want to invest so much, and same to Schenker, then we can work for simplicity. Although racking for simple, double deep or

multiple deep does not fall under automation, it is under process enhancement or the improvement area of storage optimization. If we want to go to the middle or complex, we can go to the pallet shuttle, if we want to be more complicated, we need to use ASRS. Due to Malaysia and Singapore belonging to a cluster recently, we will come together to communicate with each other, and we know that there are many robotics things there. If we want to do automation, we need to see what kind of product it is, as not every product is suitable for automation. We also need to predict what kind of productivity it is. If there is automation up to robotic systems to help them, including picking, loading, and packaging, including listing labels, this is a very complex automation.

Again, we need to see what we want. If we talk about productivity, what they want is to do it by many people. The output of a customer is 1000 to 2000 a day. If I want to reach 2000, I may have to get more people. do it. But there is a product that has a volume of 10,000 when it is a hot sale, like Double 11. How do we meet that 10,000 productivity? Then there is a kind of customer who belongs to luxury products, they will do hot sales every one to two months, they know what kind of productivity their selling will go to and then they want to receive the goods, so we will divide the productivity of one day How much does it cost? If it is by man, we will always pump people in to do it, but it will not be very cost-effective, and then automation will come into the picture. The product of Dell electronics actually depends on the commodity, but the chassis will be more expensive. Do they need to use very complex automation at this moment? The current position is not very necessary, because they want the pallet in, even though the carton is in, I don't need to open the product to see it. In fact, the pallet shuttle can already meet their productivity and throughput requirements. For Dell, we are looking forward to the procedures for the pallet shuttle, which is that we have communicated with them, then the next step is the project team or operation excellent team will do calculations. Both cost and ROI can be discussed, and we also propose to them for space. As I say, now is the most suitable moment to do it, because the volume of shipment has dropped, and I have space to set up for them, a setup requires 6 to 10 months, and customer throughput cannot be affected, especially the bottom-line. For the pallet shuttle, we need to do calculations, what kind of commodity do we need to put into it,

and what is the volume of commodity now, including inbound and outbound, all of which we need to do calculations. Then, we have to ask those originating people whether they want to change this space, this is also a question.

So, we will know whether this commodity or this product is suitable for making a pallet shuttle. So far, everyone thinks it is possible, everyone wants it, but we will know whether it is suitable for us after we need a detailed study. The two parties have to make some adjustments, for example, the throughput can't be so big, but what they are looking forward to is storage optimization. If you want storage optimization, you may not be able to get the productivity efficiency of throughput. So, every time we have to ask customers, what is your expectation, as now everyone is looking for storage optimization, everyone is looking for a warehouse now, we need more funds for turnover, and it takes some time for delivery. However, if the customer only wants to be in the same facility and does not want to put things elsewhere, we will mind this space and make some adjustments on the throughput, maybe two hourly pulls become two and a half hourly pull, or three hourly pulls, their entire production needs to be adjusted. So, this is not what we want to do, we cannot do it right away if we want to do it, because there is still a lot of study to do.

Student A:

如果 adopt pallet shuttle 会影响到在 warehouse 做工的员工吗？

Will it affect the employees working in the warehouse if they adopt a pallet shuttle?

Respondent 2:

当然是会 impact 的，因为我就不怎么需要 manual manpower 了。However，我就需要 technician，manpower 是一定会 affect 的，会 reduce floor workers，会 cut down 50% or more than 50%。

Of course, it will have an impact, because I don't need much manual manpower. However, I need a technician, manpower will be affected, such as reducing floor workers, and will cut down 50% or more than 50% of manual labourers.

Student A:

如果要裁员，会先裁员 local 还是 foreigner?

If you want to lay off staff, will you lay off locals or foreigners first?

Respondent 2:

会裁 local。其实 foreigner 价钱会比较高 (如果我们算 per package) ，因为我们要负责他们的 transportation 和 accommodation，salary package 我们必须要给一摸一样，就好像一个 local OA 我们给他们 RM1500，但是我们不负责他们的 transportation 和 accommodation。 Then for foreign worker 呢，你给他 RM1500，还要包住，然后 hostel 也有 external party 来 audit 的，还有一些 basic needs 和 criteria 我们一定要 comply，算起来我请 foreign worker 是比较贵过请 local。However，我们请 foreign worker 的时候我们有一个 contract for 三年。So 三年 contract 我不能贸然把他们 send 回去，不然那些 cost 我就需要 bear，这样是亏的，我拿不回也不能 charge 他。为什么我们会请 foreign worker? 其中一个原因，本地人不想做 warehouse 工作，对他们来讲 warehouse 工作就像 guli 的 工作，too manual，他们就不想做，So 我们就请不到人，that's why 我们才会引进 foreign worker。

因为我们已经 struggle 了差不多一年，在市场真的是很难找人，找了人进来了做了几天就辞职，不然就是 job statistics 不在那边，local 的人比较不 commit to work，有时候太多的家事，有时候 celebration 的时候他们会拿 unpaid leave，so 其实是影响到我们的 productivity 给 customer。So 当我们没有拿 automation 的时候，我们就拿 foreign worker，因为他们会比较 committed，他们会比较珍惜那份工作和钱，compare to local worker。当 automation 进来了，foreign worker 我也会 reduce 了。

I will reduce local workers. In fact, the price of foreigners will be higher (if we count per package), because we must be responsible for their transportation and accommodation, we must give them the same salary package, just like a local OA we give them RM1500, but we are not responsible for their transportation and accommodation. Then, for foreign workers, you give him RM1500, and you must cover it, and then the hostel also has an external party to audit, and there are some basic needs and criteria that we must comply with. It is more expensive for me to hire a foreign worker than to hire a local. However, when we hire foreign workers, we have a contract for three years. So, I can't send them back rashly, otherwise I will need to bear those costs, which is a loss, and I can't get it back and I can't charge him. Why do we hire foreign workers? One of the reasons is that local people don't want to do warehouse work. For them, warehouse work is like "guli" work. It is too manual, so they don't want to do it, and we can't hire people, that's why foreign workers will be hired.

Because we have been struggling for almost a year, it is difficult to find people in the market. For example, if someone comes in and works for a few days, then they will resign or the job statistics are not there, and local people are less likely to commit to work. Their reason would be too much house stuff, or they will take unpaid leave during the celebration, so it affects our productivity to customers. When we don't take automation, we take foreign workers, because they will be more committed, and they will cherish the job and money, compared to local workers. However, when automation comes in, I will also reduce the foreign workers.

Student A:

PLC5 五年里的目标是什么？

What is the future direction of PLC5 in 5 years?

Respondent 2:

目前的 trend，两年前跟现在，就是说总共 4 年里面，history 已经发生了，每个人看到了两年前发生什么事情，and then 他们现在会觉得说，接下来的 next 两年他们要怎么去 overcome 前两年发生的事情。Storage optimization，因为两年前 covid，大家的货有进不能出，而他们要出的时候就有 shortage of commodity，然后大家就囤货了，就是把那个货囤起来，为了等到另一个 part 进来，然后才能够把其他的货出去，当时的市场，product 是乱七八糟，从 RM1 卖到 RM5，甚至是 RM10，然后那个价钱每个星期好像股票那样 fluctuate，so 变成大家都要囤货，大家都要找 storage 的 space，storage optimization，在同样的 facility，如果同样的，我们可以把那个 storage 的 capacity，double up triple up 是最漂亮的。然后 productivity 就变成是 secondary，这个是我本身看到的 trend。所以我们和顾客商讨的是，因为他们的 volume 在 drop，是不是有需要去 optimize 你的 storage space，当我 optimize storage space 了你就必须要付钱了，然后他们是不是要 hold 着那个 space，目前为止我们是看不到有 volume 进来，so 我们是在 internally 跟他们商讨 trend 会是怎样。有一个顾客他 hold 着很大的 space for 半年都没有货进来，但是他们还是付钱，因为担心当 volume 进来的时候找不到位置来收货。

So 他们宁愿付钱 hold 到明年，也就是我们看在 second half year 的时候，market 的 trend 会是怎样。然后如果 Dell 他们看不到，他们也不敢放手。虽然那个 volume 正在 dropping，大概有 70%，5000 个 pallet 是空的，but 他们是付钱的，他们不让我卖给人家。So，现在的 trend 就是 storage optimization，所以我们给他的 solution 是，我们去 invest double deep/multiple deep。在 Post A Dell Inbound Area，我们已经 create proposal 给他们了，大概可以挤 600 到 800 pallet position 出来，不多，但 set up 有一点 costly，差不多要用 RM3 million。这样的话，ROI 多久？整个 MHE 我要换过，因为他的 aisle become narrow 了，so 人不会增加，machine 要换过。而且如果我增加人，我就要增加 machine 了。So 如果我加了 600 – 800 个 pallet position 出来，值吗？So 我们把这个 question pass 回去给顾

客，你要什么？第二个 solution，就是 pallet shuttle，在 Post B Dell connect to Post A CISCO area，就是那个前面，包括 CISCO 和 TAICO area，整片我们要做 pallet shuttle，本来有 5000 个 pallet position，我们 optimize 到 8000 个 pallet position，也就是多出了 3000 个 pallet position 给他。如果 to Dell 是增加了 6000 个 pallet position 给他，差不多要花 RM30 million。

So again，值不值得花？6000 pallet position 除 RM30 million，值得花吗？ROI 多久？Malaysia 的 material cost 不便宜，labour cost 我们看到的是会继续上升，现在 RM1500 minimum wages，以后可能会去到 RM1800 到 RM2000。The thing is 我们买 racking 的那些 material cost，一直在增长，今年我说 RM30million，明年会不会去到 RM32 million 呢？所以我们不只是在讲着 labour cost，我们也在讲着 material cost，那个 set up cost。Material cost 已经是很 heavy 的 cost，谁要去付？Eventhough 我和顾客除一半一半，我也要算我的 ROI 多久，uncontrollable 的 cost 就是 material cost，接下来如果 automation 进来，maintenance cost 呢？我砍了我的人，我 save 了我的人，我的 maintenance cost 呢？Racking 不怎么需要 maintenance，每一年都有叫 SME 进来帮我们做 racking inspection，大概 charge 我 RM2000，可能有一些 racking 我需要做 realignment 一些些，那个总共 RM10000 一年。没有事情的话我只是花了个 inspection fee，RM2000 – RM3000，如果我们的人很会保养。But 如果 automation 进来了，我不可以随便叫 SME 进来了，我就必须要 continue with 我们 engage 的 vendor，然后只有他说没有我们说，因为那个东西是他们的不是我们的。老实说，这种技术还不是很成熟，还不是 commonly to be used。Racking 我可以 modify，但 automation 我不能。So, 后续的 maintenance 也是一个 cost，所以我砍了人有 save 钱吗？未必。

The current trend, two years ago and now, that is to say, in a total of 4 years, the history has already happened. Everyone saw what happened two years ago, and then they will now feel that what can they do to overcome or prevent the same issue from happening. Due to the Covid-19 pandemic that happened two years ago, everyone's goods could not be exported, but when they wanted to export, they had a shortage of commodities, and then everyone held the goods

until another part came in, only then can other goods be sold. At that time, the market was in a mess, selling from RM1 to RM5, or even RM10, and the price fluctuated like a stock every week, so everyone wanted to stock up and find storage space. The storage optimization, referring that we could double up or triple up the storage capacity. Then, productivity becomes secondary, which is the trend I see myself. So, what we discuss with customers is, because their volume is dropping, is it necessary to optimize your storage space? When I optimize the storage space, you have to pay, and then they should hold that space. So far we have not seen any volume coming in, so we are internally discussing with them what the trend will be. There is a customer who holds a large space for, and no goods come in for half a year, but they still pay because they are worried that they will not find a place to receive the goods when the volume comes in.

So, they would rather pay to hold until next year, that is, we will see what the market trend will be in the second half year. And if Dell can't see it, they dare not let it go. Although the volume is dropping, about 70%, 5000 pallets are empty, but they are paying, and they won't let me sell to others. So, the current trend is storage optimization, and the solution we gave our customer is that we invest in double deep/multiple deep. In the Post A Dell Inbound Area, we have created a proposal for them, about 600 to 800 pallet positions can be squeezed out, not much, but the setup is a bit costly, almost RM3 million. In this case, how long is the ROI? I must replace the entire MHE, because the aisle has become narrow. The number of manpower will not increase, but the machine has to be replaced. If I increase the number of people, I will increase the machine. So, if I add 600 - 800 pallet positions, is it worth it? We send this question pass back to the customer, what do you want? The second solution is the pallet shuttle, which is in front of Post B Dell connected to the Post A CISCO area, including the CISCO and TAICO area. We will make a pallet shuttle for the entire film. There were originally 5,000 pallet positions, but we will optimize to 8,000. Pallet position, that is, there are 3000 more pallet positions for him. If Dell is to add 6000 pallet positions, it will cost about RM30 million.

So again, is it worth spending? 6000 pallet positions for RM30 million, is it worth spending? How long is the ROI? The material cost in Malaysia is not

cheap. We see that the labour cost will continue to rise. The minimum wages are now RM1500 and may go to RM1800 to RM2000 in the future. Also, the material cost we buy for racking has been increasing. This year I said RM30 million, will it go to RM32 million next year? We are not just talking about labour cost, we are also talking about material cost, the set-up cost. Material cost is already a very heavy cost, who is going to pay? Even though I divide half and half with the customer, I have to calculate how long my ROI is. The uncontrollable cost is the material cost. Next, if automation comes in, what about the maintenance cost? I cut off my people, what about my maintenance cost? The racking doesn't need maintenance very much. SMEs come in to help us do racking inspections every year. They charge me about RM2000, and maybe I need to do some realignment for some racking. That's a total of RM10000 a year. If there is nothing to change, I just spent an inspection fee, around RM2000 to RM3000, provided that our people are good at maintenance. But if automation comes in, I can't just call SME in, I have to continue with our engaged vendor, and then we can follow only what he says, because that thing is theirs and not ours. To be honest, this technology is not very mature yet and not commonly used. Racking I can modify, but automation I can't. So, the follow-up maintenance is also a cost, so if I cut off the manual labourers due to automation can it lead to saving money? not necessarily.

Student A:

你会倾向于 moving toward to automation 还是维持现状？

Do you tend to move toward automation or maintain the status quo?

Respondent 2:

我会要 automation，but 我要看适不适合，值不值得，然后我们才能够做 investment。我们会每一个 programme 都去 try，哪一个 operation 比较适合，怎样做才是最好？所以 Dell 我给他一个 small space 我没有把整个 warehouse 跟他换去 automation。So 我们 start with the small，然后我们

monitor 他的 output 和 investment cost，maintenance cost，是不是真正能达到一个 everyone expects 的 result，我们才能 expand 比较大的 skill 给他。

I will want to do automation, but I want to see if it is suitable and worth it, and then we can make investment. We will try every program, which operation is more suitable, and what is the best way to do it? So, for Dell, I gave him a small space, I didn't exchange the whole warehouse with him for automation. We start with the small, and then we monitor the output, investment cost, and maintenance cost to see if it can really achieve a result that everyone expects, so that we can expand a relatively large skill to them.

Student A:

Dell 和 PLC5 的共识是什么？

What is the consensus between Dell and PLC5?

Respondent 2:

Double deep and multiple deep （不算是 automative，是 fall under operation improvement or operation excellent）Pallet shuttle 是 looking for，还没达成共识，现在有新加坡的一个 team，会 investigate 这个东西，那我们很快就会知道适不适合这样做，能不能够 move forward 了。不是说我们不要，but 适不适合，能不能达到 result 才是最重要。因为我们必须跟三方面谈，Dell，我们自己，和 Dell suppliers。So 其实是要他们都 agree，我们才能 move forward。这些东西不是一天两天，或一两个月能够做好的，所以现在要和 supplier 开始谈，weekly call 也好，alternate call 也好，这些东西要等他们 return 回来也至少要半天的时间。

Double deep and multiple deep (not fall under automation but fall under operation improvement or operation excellent). Pallet shuttle is what we are looking for, but still no consensus has been reached. Now there is a team in Singapore who will investigate this thing, and we will soon know what is suitable

to move forward? It's not that we don't want it, but whether it's suitable or not, and whether it can achieve the result is the most important thing.

Because we have to communicate with three parties, Dell, ourselves, and Dell suppliers. So, we need them all to agree before we can move forward. These things cannot be done in a short while, so we need to start talking with the supplier now, whether it is a weekly call or an alternate call, it will take at least half a day for these things to wait for their return.

Student A:

PLC5 现在有什么 system？

What system does PLC5 have currently?

Respondent 2:

Smart count，WMS，Power App 和 RF Scanning。以后他们会是很 commonly to use，他们不算是 system，就类似 word 和 excel。现在还不算 common。

Smart count, WMS, Power App and RF Scanning. In the future, they will be very commonly used. They are not considered a system, but similar to word and excel. But now it is not yet common.

Student A:

如果真的可以 implement automation，cost 是怎么分配呢？

If it is possible to implement automation, how is the cost allocated?

Respondent 2:

会有三种情形。第一个是 对半分，50% 50%，customer bear 一半，Schenker bear 一半，然后 Schenker 会 ask for contract fixed term，好像我们

现在的 pricing contract 是每三年 renew，okay 我现在可能要 increase 5% on pricing 因为我要 cover on 我的 ROI，然后我们也要 list 给 Dell 我们给他们什么 benefit。然后第二种呢，either Schenker take all，contract 要 10 年，因为我的 ROI 要 10 年，然后每一年的 line incremental 我要 20%，不然我 cover 不回，depreciation occurs every year，市场的 material cost 和 labour cost 是 increase 的，so maybe 我们原本是 5% or 10%，但现在是 20%。第三种就是顾客全权拿起来，可能会跟我们有一个 clause，因为 set up 是他们出钱的，就 belong to 他们了，这个要看 Schenker 的 business trend 要的是怎样的，可能有一天他们讲最大的是 Dell，他们拿去我也不需要这个 business，可能这个 business 不赚钱，Schenker 就不要了。其实他们有一个 commercial team，我们叫 operation team，所以要看他们谈了公司的 direction。

There are three situations. The first one is half-and-half, customer bear half, Schenker bear half, and then Schenker will ask for a contract fixed term, it seems that our current pricing contract is renewed every three years. For example, I may increase 5% on the current pricing because I want to cover my ROI, and then we have to list to Dell what benefits we give them. For the second one, Schenker will bear the entire cost, but the contract will take 10 years as my ROI will take for 10 years. Besides, I need 20% of the line increment every year, otherwise I will not return the cover. Depreciation occurs every year, the material cost of the market and labour cost are increased, so maybe we were originally 5% or 10%, but now it is 20%. The third is that the customer has full rights to pick it up, and there may be a clause with us, because they pay for the set up, so they belong to them. This depends on what Schenker's business trend wants. Maybe one day they will say the biggest one is Dell, I don't need this business if they take it, as maybe this business doesn't make money, so Schenker doesn't want it. In fact, they have a commercial team, which we call the operation team, so it depends on what they say about the company's direction.

Respondent 3 to 8 – Managers and supervisors of PLC5

Student A:

May we have a brief introduction about the warehouse operation of PLC5?

Respondent 4:

This is mainly what is our support to Dell. For me, I am doing the program for Log Dell, so whatever format that Dell uses in their production will be stored in our warehouse. Ya then so you can see that we handle VMI suppliers, that means all Dell vendors keep their product, or raw materials or some finished product in our warehouse. Then, every two hours Dell will issue us a pro-request, the pass that they are going to use in their production, or even for their 3PL. So, based on the pro request, we will pick back and then send them every two hours. So, per day we have 7 windows starting from 10:30am until the last window will be 11:30pm. Of course, we will also provide all the inventory cycle reports to all the Dell VMI suppliers on a monthly basis. Other than that, we also have value added service, whereby we offer for the vendor process, rework, reboxing for any damage carton, or any rework support that the Dell VMI suppliers will do. Based on their requirement, then we support them la. Basically that is the service that we are providing to Dell. Currently we have 120 headcount, white collar 20, blue collar 100, and the repack warehouse capacities is 18, 981 square meters. Our current warehouse is actually under LMW, that means we are operating under Dell license, Dell LMW license. So in a way that the product kept in our warehouse belongs to Dell.

Respondent 3:

Our site is the largest site for Malaysia in Schenker. We have about 320,000 sq ft. We have about 4 major customers, which is one is err Dell, second is CISCO, third is err TAICO electronics, fourth is the Canon printers. And we have another one is small general bonded which is like small companies they can keep here.

Respondent 4:

Another thing is that PLC5 falls under TAPA certification, it stands for Technology Asset Protection and Association, from the US. One of the requirements from Dell is that we need to have this TAPA before they can put their product here, so that is all the requirement la. Ermm, we need to say that their product is secure, they have CCTV coverage, they have security within 24 hours and all that is under this TAPA law. And they have been here for 2 years already.

Student C:

May we have a brief introduction about the inbound operation of PLC5?

Respondent 7:

This is the inbound process, whereby we receive the shipments more with two types, so one is from the oceans, and another is from the air shipments. Okay, so when the shipment arrives, there is a custom clearance, then we will take the shipping document to do the custom clearance first, before they send it out, okay. For the third then they will ship to up la, PLC5 or up, so this unloading activities for the truck shipment is done by drivers, and for the container will be our staff, Schenker hub operator staff. So we will do the inspections, whenever we can see the shipment, we will check the related shipping document with the goods, is it tally or not. So we will do the inspection on the quantities, part numbers, and after that we will do the four wall checking. We check the product conditions, are there any damage when we receive the shipments, all done, we will transact the shipment to the system, with the quantities, and uhh part numbers, we will transact into the system. Once we done transact into system, we will have and paste the pallet ID, which means Schenker control pallet ID, so we will paste the pallet ID, to the physicals on the box, then we will go for RF Scanning to capture in the WMS system, whereby we already receive this shipment, and we already transact to this system. Okay, once we done transact the system, err we will perform the put away activity. Whenever we perform the put away activity, we will do this scan again, okay, location and the pallet ID, which means we need to know, when the physical we receive, and when it is in the storage, which location we storage, so we will scan the pallet ID, and the location bar code.

Respondent 5:

So after they put it away, the system already captures what is this pallet ID, they are sitting in which location is right, so at the same time, Dell also can see the inventory received in the system. So, Dell will start to drop orders to Schenker.

Student C:

I will first focus on the inbound process. First of all, what is the working schedule for the inbound operation?

Respondent 7:

We work for 6 days, Sunday is closed, and we have two shifts, 8am – 4pm; 3pm – 11pm, 16 hours, for the locals; for the foreigners, it is 12 hours.

Respondent 3:

We have foreigners from Sri Lankas, Bangladesh, and Nepal. And Locals, as usual, our Malaysians, their working hours are like what he said just now, different working hours, but the contract with the foreign workers is 12 hours, but we give them a 2 hour break.

Student C:

For inbound, how many shipments does PLC5 receive every day?

Respondent 7:

For the truck shipment, we will receive on average 10 trucks, for the container is 11 container per day we receive.

Supervisor:

Is it the container, I mean the lorries belong to Schenker or?

Respondent 3:

No, some we have from airport, they will engage our Schenker transport, but err most of them they own truckers. They appoint their own workers.

Student C:

So, when the truck comes in, they need to unload the shipment, so how long for the unloading process?

Respondent 7:

If you say the pallet shipment, there are three types of shipment, slip sheet and pallet. For the pallet, a 40ft container will take about 40 minutes for offload, okay. And let say you say slip sheet, so we have to use the special machines, slip sheet machines, and then they have no pallet, they only have the covered slip sheet, okay, we have to pull the rubber slip sheet, so this is the 40ft container, that we take 3 hours for offload.

Respondent 3:

For one container we take 3 hours because it is not a normal pallet, the goods will sit on the slip sheet, the type of material like plastic but very thick. So, we have a special machine right, we call it a slip sheet, so this machine will pull up, and then the staff will raise the pallet, and put it on the pallet. So that's why one container took 3 hours.

Student C:

Since you mentioned that PLC5 is the largest site in Malaysia right, I saw that just now the automation machine is only like a forklift, power pallet truck, and the slip sheet machines, but still these machines still need to be manually controlled right?

Respondent 3:

Yes, correct.

Student C:

May I know whether PLC5 is considered to go for full automation?

Respondent 3:

Okay, there is innovation and automation set in Schenker, alright. They will come and do some analyzing, and do some proposals, right? So, in the process, it will take some time, because it is a huge amount, so must get up to German

level approval. Maybe in 2, 3 years, if you get a chance to come in, you can see all the automations, but still in the need of discussion onwards.

Respondent 4:

You can google pallet shuttle or ASR. These are the two things that we are looking into but the cost is in million. We cannot tackle that much.

Student C:

Do you think that the material handling equipment for now is sufficient for the operation? Is there any MHE training provided to the workers?

Respondent 3:

Yes, it is sufficient, we have many, we have a total of 30 machines here. We can multiple, we can cross use, because we are under the same roof right, so we can rotate. Yes, of course, we provide training to them. We have a dedicated trainer here, who will train and be certified. They will be refreshed yearly.

Student C:

Have the current PLC5 warehouse spaces been fully utilized?

Respondent 3:

Maximum already, even though customers come in, we also say sorry we don't have space for this site. Full.

Student C:

Is there any area where improvement is required in PLC5's current operation?

Respondent 3:

In warehouse operations, there will be the issue, here and there alright, the small small issue always occurs, and then we have to solve it immediately, and then we will find the way to solve that, and also how to prevent that. So, there will be a team that will sit together like us, a group do some brainstorming. This is what are the things that we are going to improve here. From time to time, we are going to do that, because we need to catch up with the customers' orders, suppliers,

and each other. On top of that, we think about what we can do better. There is a team to do that.

Student C:

What is the most common issue that is faced by PLC5 during the operation for inbound?

Respondent 3:

Common issue for inbound. Sometimes the document does not tally with the physical, okay, like the wrong part has been sent to us, and then we need to hold it until we communicate here and there, ding dong ding dong, then they say okay, revise the document. You know, sometimes the wrong part is coming, but if the document is different, then they will send another document. Sometimes they will ship back the RTV, so that part does not belong to Dell but unfortunately may be other customers, they wrongly delivered. So these are the things that commonly happen in any inbound. Sometimes wrong declarations in the customs. So customs will query, they will come over, then we need to, you know, open up the inventory in front of them to show things like that.

Student A:

May we have a brief introduction about the outbound operation of PLC5?

Respondent 6:

We will receive the order from the AX system, meaning to our portal. Once we receive the order, the system will allocate based on DO, whatever available we pick, scan, pack, and deliver. So our scanning process is packaging ID, each carton has their own packaging IDs. So we will need to scan the packaging IDs, individual IDs, then we have the 8 roll pallet listing, whichever we scan versus with the DO we need to print out the pallet listing, and match back and we can send out with the DO copies. And we have four PV process, four parking verification, whereby, at PLC5 outbound, the checker need to check first point, the second checkpoint will be the driver, the third one will be the security, once security already check, complete they will do the seal that is being verified, then only you can load into the truck. The fourth checking will be at our Dell Interphase Team, they will check the number of cartons versus the DO, and they

will hand over to Dell Receiving. Everything complete, Dell Receiving will perform their system transaction. Once the system transaction is completed, we will receive an email from Dell, saying that this window, the particular window, has been completely transacted, and we will proceed to ship out, the moment we ship out the next report will be sent to the individual suppliers. So that is an outbound process.

Respondent 5:

This is basically you see the VMI warehouse WMS. Just now he had explained during the incoming, we do the four-wall checking, then after that we will transact in the system, so transact in the system, arr that is the data EDI ah, we send to Dell, so Dell know the inventory updated then they will start to pull the order. So this is how the system is running, okay. Just now he also said that inbound we have three types of incoming, come by ocean freight, container, offloading is done by Schenker staff, air freight is done by truck driver. Then we also have the cross border which comes by truck, like err China, they use the so called land transport to ship from China to Malaysia, Penang. So they use trucks, that one is also offloading by hub operators as there is a container.

Student C:

Is the number of workers the same as inbound?

Respondent 6:

Yes.

Student C:

Will it use the same worker or is it separated from inbound?

Respondent 6:

No, they have their different batch, we have our own different batch.

Student C:

What is the working schedule for outbound operation?

Respondent 6:

We follow Dell work plans, whatever is the work plan given, by that, we will follow.

Respondent 5:

So that means that outbound is working for 7 days. We have two cruises, 6 days 6 days but operation is still Monday to Sunday, because it takes turns.

Student C:

Is there any area where improvement is required in PLC5's current outbound operation?

Respondent 6:

Improvement daily, yes. We like to tell you the scenarios, so what we can do, like we found damages or what, we are having scanning activities on delivery basis. So when we do scan, and we encounter any damages, we will need to record it out, so that we can have better visibility and better communication before taking orders from Dell. We encounter daily issues; we will solve it at that particular time.

Student C:

May I know how many shipments will ship out every day in outbound?

Respondent 6:

We have two wheeling pull, six window requests, we own sufficient, permanent, this is our delivery, one window can be for ten truck deliveries, which means the next window can be two truck deliveries, so at the end of the day we will need to complete the six windows. It starts in the morning at 10:30 am first window, and our last window is 9:30pm.

Student C:

How long does the shipping process take to load the shipment?

Respondent 6:

We won't have sufficient time; it is within 2 hours. We need to pick, pack, and then ship. The next window will be dropped in the next two hours already. It is two hourly pulls. It is quite rush, but anyhow, they have the base like this is our line items, this is our number of cartons that our capacity they can fulfill.

Student C:

Is it like a worker shortage so I need more time or?

Respondent 5:

There is no shortage of workers. Because we already set the capacity in example, like per window how many line items, but suddenly Dell drops over the capacity, so the hand over ah, the shipment to Dell might be delayed. So that means that we can justify to Dell, we are not purposely to delay, because if you already send us the order is over the capacity already, so we need more time to process the order.

Student A:

So normally what's the capacity for this?

Respondent 6:

Line item is 150, carton is 1120, trips are 10. Whatever above is above capacity.

Student A:

Was the material handling equipment enough for the current outbound operation?

Respondent 6:

Yes, it is currently enough.

Student C:

What is the most common issue that is faced by PLC5 during the outbound operation?

Respondent 6:

We have different types of issues usually accounted for. Like when we pick, we found any damages, so it will be another issue, it cannot fulfill the orders, so you

need to hold this part and trace the location or request a new order. Or sometimes it will be the last unit in inventories, whereby if we could not fulfill, we need to find a solution, immediately solutions for them. So, what can we do in order to fulfill this order? We need to engage like the suppliers FAEs, or communicate through emails, to verify this part, in order not to jeopardize their production.

Student A:

Is PLC5 facing a worker shortage problem or a worker turnover problem currently and during the COVID-19 pandemic?

Respondent 6:

We will do a planning for leave; let's say annual leave you already know how many staff are on annual leave, we will need to plan off for the annual leave in order not to jeopardize the operation. Yes, MCs, absence is a reason in a sudden, so we need to think what we can do. Maybe now, we have a second shift coming in at 3pm, we need to engage them early at 11am, earlier. So, we are not sitting on the issues that say we are in shortage of manpower, and we cannot fulfill, so we need to work out something to make it happen.

Student C:

May I have a brief introduction about the PLC5 inventory management process?

Respondent 8:

For the Log Dell, currently we have the 11,000 plus pallet portion, okay then we have a total 107 stores sorting their product in our warehouse. We are focusing on the monthly count to our supplier, then we have two types of storage area in the Dell department, which is under aircond and non-aircond. I think that's all.

Student C:

May I know how many workers are needed for the inventory department?

Respondent 5:

We have 4 workers for counters, 2 inventory coordinators, then supervisor, and myself. So, the total is eight. 4 counters will be inside the warehouse to do the counting, then our inventory coordinator is mainly like after they get, after the

counter completes the count, so the counter will pass to the inventory coordinator, to match back with the system, see whether the physical count, and the system, is it tally or not. Like just now you ask, is it possible there is a system to capture this quantity but in physical it is not there. So, it does not mean that it is missing, it is misplaced. So maybe this carton box is supposed to be sitting in this location but sometimes people want to take it, so they put this beside, but forgot to put it back. So this one, after that we have to reject it, we call it the second count. First count they go to count, then we encounter that there are discrepancies, then we will go to the second count to find out where this carton is located. So usually on the second count we will get the 100% accuracy. Pass back to another one.

Student C:

What is the working schedule for the inventory operation?

Respondent 5:

Currently it is like eight to eight, morning to night.

Student C:

Human error always happens in a conventional warehouse. Have the workers made errors that caused a significant impact to the warehouse?

Respondent 8:

Yes, we are facing the issues when we do the monthly count right for all the suppliers. Sometimes we will see the issues. Then it is not we can call it as missing, it is a misplaces, so we can check back and we can find the premise.

Student C:

So the process is manually done to check one by one, or use the system?

Respondent 8:

It is the manual process, based on the system, we have a current location in our system right, then based on that location, then we can find out the premises.

Student C:

Is the warehouse currently storing fast-moving items or slow-moving items?

Respondent 5:

Both. We have the product aging days which is below 200 days, currently we have 85%, I mean the item storing in our warehouse below 200 days, so after the 200 days, you can calculate, it is about 15%, which is long aging days.

Student C:

So besides that WMS just now mentioned, are there other kinds of systems that are used in the inventory warehouse process?

Respondent 3:

Yes. Normally cycle count has two methods, one is all to book, or book to all, so normally we do book to all.

Student B:

Roughly we have how many inventory parts/part numbers in the warehouse?

Respondent 5:

Currently we have 4000 part numbers, they are different Dell suppliers.

Respondent 4:

Even though it is 4000 SKUs, because when we count, we count just the carton only, we are not going to twist them all. So it is all big cartons, let's say, now we have a total of 18,000 pallet levels, so in one pallet level maybe we have 2000 pieces, but it is just one carton, so the time taken may be just one second.

Respondent 3:

It is counted on cartons, based on cartons, not the inner quantity, based on cartons.

Respondent 4:

Based on carton but not even pallet level, we depend on what's the packaging. So that's why we can do it in one month. If you go at a piece level, one year also cannot. We also have a full count, which is the PI count. That means every year we have one physical inventory count, stop the operation and do the count.

Student A:

How many days is required for the full count?

Respondent 5 & 8:

It will take two or three days. During the full count, the operation transaction will be stopped, so we will engage the operation person to support this count activity.

Respondent 3:

It's normal practice even in a production line, they also do the same thing. Just cut one week they maximize the entire workforce to do counting. We have the stock picker to go up. There is a one pallet or multiple carton la, for example one pallet of 90 cartons, we used the stock picker to go up and then count. Let's say one pallet or one carton is considered one already so fast, complete.

Student C:

Are there any injuries that occurred when using the stock picker?

Respondent 3:

No, because our stock picker, you can see that I think she knows that it's got a basket at the back, right? And they fully wear the harness. On top of that, that particular machine we have a four type of locking system, four type safety locking system, right. So, the moment they rebuild the handle, the site handle machine will auto stop the moment they move the leg from below the leg. It's one more locker. Let's say my foot on that because I moved a leg also stopped. And we have a basket below for locking some more, locking. So all these have four types of locking. On top of that, the driver and driver need to wear a harness and only allow one person to drive. So it is fully secure. Only thing you must do is dare to go up. Some people have acrophobia, so we will identify these people during the training.

Supervisor:

Any potential I mean possibly the MHEs to "rosak" ke?

Respondent 3:

We have a dedicated technician from the supplier. They come every day, we will station here, and we have preventive maintenance and any repairing or service team. Yes, we do have. All our MHEs are controlled by infolding systems. So only authorized people, they put their batch then only you can start, no key. Secure. Even if you go and hit something, a wall or pallet or anything, the machine will stop immediately until the supervisor has to go and release the machine. Then come out. Then we know already, this thing happens. So, we can take what you call necessary action so we have that kind of system.

Respondent 4:

We can say all of us go for training, you will get the access card la, to operate the machine.

Student C:

May I have a brief introduction about the customer service of PLC5?

Respondent 5:

Customer service (CS) is actually the front line of the operation which is to deal with Dell suppliers and also Dell customers, right? Dell suppliers were storing their items in channel warehouses. So, Dell can pull the items on a two-hour basis. So basically, our customer service team here internally were liars for the inbound and outbound. Inbound mostly is like in coming damage, so in coming damage is when inbound doing the checking right, receiving the shipment right, they encounter for example one container consisting of maybe 48 pallets. So, 48 pallets may have found two pallets that are not in good condition. So, this information they will pass to the CS team. CS will email the Dell supplier to notify them. Knowing that today we have two we would like to let you know we have two pallets of increased condition during the offering from the container. Then, our customer service will ask them to ask the Dell suppliers what is the next disposition? Whether you will ask your engineers to come to Schenker to do the repacking or verification or you want to send these damaged cartoons back to the so called RTV back to your factory or maybe you want to scrap it, we don't know. So, we need customer service to email the suppliers to ask what

their next disposition is. So, until the things to be closed can be released to, for outbound to fulfill the order. This is for the inbound side. For the outbound side, the operator sometimes will detect that it is a concealment of damage. Why say that conceal damage is because during the inbound, we perform the wall checking without break-bulking. Four wall checking means that the pallet is being string wrapped, there is the strapping bag. So, they just check for the forward and also the top surface. If let's say there is no damage, then we will store it. But order drops time is not the whole pallet. Sometimes they will ask for the carton, carton pick. So that's why we have to break, break and then pick according to the example we want five cartons. But in this pallet, we have a total of 20 cartons. When they pick these five cartons, they encounter eh, there is a hidden damage. Hidden damage which is during incoming we are not able to detect. So that outbound will email to inform. Then customer service will tell the supplier what you want to do with this damage and conceal the damaged carton. Rebox? Verification? RTV? So basically, customer service is more on the emailing to deal with the supplier. Because most of the Dell suppliers are not local, not in Malaysia, they are in China, Taiwan, Hong Kong, Singapore and Thailand as well. So, customer service is more on the emailing to follow up with the supplier, what do you want to do with all this damage? And just now the inventory also mentioned we not only do the monthly count, but we also do the so-called we will monitor the suppliers products, whoever is sitting in the warehouse for the long aging. Long aging means more than one year. Their products come in just sitting there, one year, no transaction. Yes, there is no transaction. So, our inventory side will inform our CS. Please ask the supplier what you want to do with these products because long sitting days are here, right? So especially we will focus on those like in coming damage. Because one year ago, CS already reported to you. Of course, we follow up then after that, if the communication breaks down because our headcounts turnover right, then maybe the suppliers also their headcounts previously are dealing with you but suddenly these people already resigned, then no more already. So, our inventory will inform customer service, please check with suppliers, what you want to do with this long aging incoming damage in the carton, right? What's the disposition, so this is for the aging. Let's see, customer service is basically dealing with the Dell supplier. Not only for the damages but also aging then RTV is also handled by

the customer service team. So, the supplier will send the email to notify the customer service team saying that we have long aging items in your warehouse already. So, we plan to send these to another's warehouse. So, our customer service will be processed accordingly. Of course, this will be related to the operation because of the right, then customer service just informs the forwarder, appointed forwarder, "BERJAYA" shipment is ready, you can come and pick it up.

Student C:

Who will bear the cost if damage is found?

Respondent 3:

There are two categories. Damage in warehouse in-used damage is surely under Schenker's liabilities. Warehouse in-used or people make the damage, then we have responsibility. For incoming, we go back to supplier those for incoming right inbound incoming, found damage, we go like what you communicate with the CS to inform the photo evidence and documents to show that incoming documents and during our POD, we will do a what to call remarks said how many cartons get there or wet? Sometimes this monsoon season when they offer from the aircraft you know, it is raining sometimes and what you said hidden hidden there's no clean document but found the agent they tell us there was I mean another issue that we need to explain to somebody else there. Warehouse in-used only we pay, that means our firm makes the damage.

Student C:

So, if you didn't realize that the incoming shipment was actually damaged but the worker careless didn't find the mistake after they saw that only found then Schenker will bear?

Respondent 3:

No,we don't do that. Because we have CCTV to cover. We have all the latest CCTV that can zoom up to even my boys. One of my boys was playing with his phone right. You can zoom until you see what game is playing. So, like you say hidden, the moment you bring down something like is there any damage, then you can see from the CCTV, ya so we have the latest TAPA for that.

Respondent 5:

So basically, I would say customer service is not dealing with the customers, Dell suppliers. Internally, Customer service deals with the inventory thing ; customer service deals with outbound things ; customer service also deals with the inbound thing.

Student C:

How many workers are required for customer service?

Respondent 5:

Currently we have six customer services.

Student C:

What is the working schedule for customer service?

Respondent 5:

Their working hours are not in shifts, all of them are normal shift working hours, from 8:30am to 5pm for Monday to Friday. While Saturday is a half day, 8:30am to 12pm.

Student C:

What is the most common issue that is faced by PLC5 for customer service?

Respondent 5:

Currently our customer service is facing the issues because recently customers have so called guidelines on the incoming shipment. As I said, we need to report to the suppliers on this damage and provide you with all the photos right. Like previously it's only one shipment they need to bet us but now we can say that almost like 30 pallets encounter the damage. So 30 pallets, you need to provide all the photos you know, so that is the challenges because all this photos providing to suppliers is by manual pol, manual pol by the customer service, which is a very time constraint, this is the because of Dell they change in guideline, now we need to going through the information, boost the productivity of customer service for this portion. I add on for the inventory also as well, because right now we are using the manual count. Manual count is that we need

to walk, so all by paper so now we are actually in the midst of implementing smart count. Smart count means we are using a small device, to do the counting, which can go paperless. So now in the testing mode. Actually, smart count is already implemented in Schenker which is on the KL side. So, the device they are using is like a smartphone. But in PLC5 we are the first side to use smart count by using RF scanner. We are like geneticists to test using the RF scanner to perform the smart count. Not using the smartphone but using the RF scanner.

Student C:

Is there any area where improvement is required in PLC5's current customer service operation?

Respondent 5:

Yaa, instead of to let our customer service copy and paste manually for the images and photos, so is there any a way for our customer service, just upload this photos then we just share the link to the suppliers, Dell's suppliers right, they just click the link then able to see the photo already instead of my customer service go and copy and paste the photo one by one. We can say that there are a total of 200 pieces of the photo, tak kan I copy one by one 200 but the email couldn't be sent out. Because the file size is already very big right, so it is better that we share the link, when a customer just clicks the link, it is able to see, which picture you want to see, up to you right. This will break out the productivity for the customer side for reporting out the incoming damage. Same as the conceal damages.

Student B:

What is the most common issue that is faced by PLC5 during the operation?

Respondent 7:

It is damages. For example, the staff will detect damages whenever this is not for the in damage after we deteriorate as racking, the storage, and the detected damages. For these damages will come to the superior they will update to the superior. So, what we do, we take up to the suppliers, this is the damages we found, and the other around we also check the CCTV for how the damages happen because when it comes there is no damages and after storage then there

is damages. So, we will, and we want to understand where the damages come from and once, they say we found the damages are used by our staff then we will go to the corporation what we want to do and at the same time we will take out the issues with the supplier, this is the damages. So, most of the suppliers sometimes send the FAE to verify if the inner part got damaged or not? Sometimes, there is a prosecutor issue, and then they will ask us to deposit it. So, we will rework the budget list to the inventory that everybody can view.

Respondent 3:

On top of what he says now for damages, we have the engineering spec. So, the spec is given by Dell. If let's say, about 5cm scratches on top are still acceptable. There was class one, two, three, right? They have this kind of criteria. Our team is trained to follow the spec. So, ten damages can be detected, this is the class one or two. Class one will immediately go back to lobby for action. That's how we train on spec and even our other customer also has a spec.

Student A:

Sir, is class one the most serious or the minor one?

Respondent 3:

Class one is the minor one, Dell can accept class one damages; class two that means rebox or FAE damages, class three is totally no.

Student B:

Other than damages, what are the other common issues you face during the inbound process?

Respondent 7:

Mostly we face the shipping documents. The shipping of documents is a part of it. Sometimes that is incomplete. Incomplete documents so I cannot complete transactions because the document is not telling, insufficient. Sometimes there is no part number in the shipping document like in inbounds. But the other details are correct, just no part number.

Respondent 3:

Of course, customer will say supplier will say yes, I do send the document along the way the transit time a lot of hand be changed like broker, transporter. So, one or two papers must be switched. When it comes here, then we have to go to the CS to get a full document. They send another full document to match where that will take some time. That's why I say sometimes these are the challenges where I'm going to put this on hold, I cannot immediately transact because there are not enough documents. So, I need to find a place to stay temporarily until the documents come in. Then I will take it out and do system transactions, then we need to go and put it back and went back to the location. So, these are the challenges we have.

Student A:

Is PLC5 inbound facing a worker shortage problem or a worker turnover problem currently and during the COVID-19 pandemic?

Respondent 3:

Workers issue everywhere. Even Malaysia also has a worker's issue, right? So that's the result. We went to Nepal and then we hired about 300 people to supply the entire Schenker Malaysia. So, in January we already deployed 20 staff and next week we have another 23 staff coming in. So that means we are fulfilling the shortage of people. Because we fall under MITI, we have a movement. We can move our people here from hostels back to here, even our locals. We also give a letter, like an official letter with our company letter and the MITI letter as well for any roadblocks so they can show later and they can come to work, no issue.

Student B:

Does the warehouse worker often take leave? If yes, will this impact PLC5 warehouse processes, such as delays?

Respondent 3:

We have challenges especially for locals, I do agree right that… simply don't come. They will say I got this breakdown; I got that breakdown. But for foreign

workers, no excuse, because transport being given from point A to point B, hostel to workplace then workplace to back hotel they only given Sunday to rest and they have been given annually because they are under Schenker payroll to be given annual leave and they can apply five days five working days before for annual unless for emergency is different, the emergency must be just a supportive letter as usual that's normal practice anywhere. So annually, given that they can apply even sometimes if they want to go to any festive season like Bangladesh, Raya right and Sri Lankan they are mostly Buddhist and Hindu so they want to celebrate that, they can apply for it but we have to plan for the resources.

Student B:

Human error always happens in a conventional warehouse. Have the workers made errors that caused a significant impact to the warehouse?

Respondent 7:

Human error happens every process, we will make improvements from the mistake. So, we will find out what is the actual problem for the error at first? The root cause. From that we look to correct the action and do prevention. But you ask me, is it daily, is it not daily.

Respondent 3:

So many things here and there will happen. Because the warehouse, the entire warehouse is a human dependable warehouse. Today we might be very happy to come to work. For example, I didn't do work today, I was perfect, happy. Cheers. Let's say tomorrow we had a quarrel with our boyfriend, and suddenly no mood… so I mean that this keeps the process. So, it is human dependable. So, we cannot say 100% fine. So sometimes we have a lot of that's where our leaders are there to try to solve the problem. And then sometimes we used to have these kinds of people who have face to face, come means he had some family issues on that, and I say, okay, fine, I listen to your problem. But what do you want me to do for you? He said I need some days, how many days do you need? He said 2 to 3 days, I said No, I give you one week, you go settle the entire thing, then you come back, fresh, I don't want any errors. Because I depend on him, for

example he rides machines, suddenly he goes and hits somebody, one example is because he is in tension and stress about family problems, so there is no focus in work. So, that's why he needs some time to sit and do some counseling. Sometimes we have everyday machines meeting, you know right? So that's how we try to motivate people all that because human error can happen anywhere.

Student A:

So, will the error impact the company very minor or very major?

Respondent 3:

Depending on the case, some minor and some major. We have cases up to 45,000 dollars, we paid for the supplier. Because the warehouse is in use, so the error made by your staff, you have to pay is already stated in contract, the clauses so you have to pay. So, this is a minor impact for company right. So, it depends on the case. But very minor because a lot of leaders will control, monitoring the staff, we have supervisors, down there we have supervisors and leaders.

Student B:

So, during the receive process right after the inspection, we will key in the information into the system right, so what if the system goes down happens, will it affect anything? Like the WMS system down, so what will be the problems or any alternative solution to solve this?

Respondent 7:

Actually, whenever there is a system down, normally there is no system down I mean, whenever they have any issue, we will trigger our IT to ratify humanity issues. So, there is a human issue right, we have to receive the same case, cannot go next. We have IT department facilities to help to investigate and they usually respond immediately.

Student B:

What is the rate of injuries or fatalities during the inbound process?

Respondent 8:

No!

Student B:

Okay, so I think that's all for the inbound. What is the most common issue that is faced by PLC5 outbound during the operation?

Respondent 6:

Mostly damages here occur because the physical we have our own team, which is they are making it 100% so the only problem during outbound now what they are facing is damages. So, we need to find a solution, to make it less damaged during outbound. Other than that, we have encountered everything.

Student C:

Maybe like in terms of drivers? Driver's license or like driver's qualities?

Respondent 6:

We have only experienced drivers… so all have been trained and only a specific person is allowed to use the vehicles. Like this truck, you have your own license, you have trained, and you have your own license only you are allowed to use these vehicles you cannot go and, you go and experience and you can go and use it. All have been trained and this will be trained on six one basis.

Student B:

During the outbound, the packaging you all will do the packaging, rebox activities?

Respondent 6:

No, during outbound, there are no reboxing activities done on a touch and go basis. I pick, I check, I scan, I wrap and send.

Student B:

Thank you, sir. I will now move on to the inventory part. What is the rate of injuries or fatalities in PLC5 regarding the inventory process?

Respondent 5:

No, no injuries as we Schenker is very so-called look into safety seriously, so we also always will tell our staff, safety always first, don't rushing do the job. Safety

comes first. I don't want to say I want to catch the time right, cepat cepat, then anything hitting? So, you hit the customer products right. If we are able to repair, consider our luck, if we cannot repair, then the company has to bear the claims. You have to pay. What if any person's injury is too serious already, so no injuries happen so far.

Student B:

Are there any safety precautions that will be given to the employees when entering the warehouse area, they will be wearing safety helmets, boots, everything?

Respondent 5:

Yaya, of course, is a must. Before they enter the warehouse, everyone, even if a visitor, let say like yourself, wants to go into the warehouse, a safety vest is a mandatory safety shoe and is also mandatory. If without anyone you are not allowed to enter the warehouse. Like the customer service team, they are actually working in the office, right? But the problem is the office is inside a warehouse, they will also require wearing the safety vest and shoes then only can enter.

Student A:

I would like to ask for the inbound department. What is your understanding about automation?

Respondent 3:

For inbound right, it's like we can have what you call an auto put away. Auto put away means the moment I finish receiving, make a good palette, okay? For example, this is a palette, you can finish. Then I go to the roller place where I put that and then key in. Okay, this one in the system can show which locations are empty. So, I think this product will go to this location. So, you can move and then there is a like escalator, go to that and do a placement, then they come back. You know that kind of. So, I can reduce the number of machines like manuals.

Respondent 3:

Okay another one is like we can say that auto wrapping. Now it's manual. Auto means there's a machine. Okay, you're going to put the palette on the rotating

plate okay to give the motor. Just put that and then you press the button there. Also, we can control the wrap, I mean the wrapping strength and everything. What is the other thing? Just set everything, just press the button, and it can wrap, then the machine can go up. For example, the height of this pallet starts from bottom, goes up, and then it comes back again. So complete one wrapping.

Respondent 5:

Instead of the person going to wrap, go one by one, go down and down and down, now it's by using the machine. They rotate the palette, then they wrap up and then down.

Student A:

What are the considerations in transferring from a manual warehouse to an automated warehouse?

Respondent 3:

I'm losing people la, people got jobless la. For example, from receiving, system prospection, and then to the rest. If I go for full automations, maybe from four workers, I may need only one person. While the other three people, I need to lay off, or need to go to another department.

Student A:

Do you think that the inventory currently stored in PLC5 is suitable for automation?

Respondent 3:

Yes.

Student A:

Implementing warehouse automation to acquire a large amount of capital. However, do you think that warehouse automation will assist PLC5 to make profit in the long-term?

Respondent 4:

Yes, of course, there's a reason to make a startup okay. Like you said, you want to invest as a university student, so you need to know how much equity you will get. After that, maybe it will become profitable again. I think in the short term, the automation will be hard for us because of cost, the dependence on the workers because workers can make mistakes. Hopefully the system won't make the same mistake. But long term, yes, it will become profitable. Definitely for people because of them, I don't think people will invest time to come up with all these technologies, I mean if nobody wants to buy.

Student A:

Are there any advantages if PLC5 is switching to warehouse automation?

Respondent 4:

Advantage because our customers also push us.

Respondent 3:

Anywhere automation is more advanced for us. I mean the advantage to simplify our job right. We need to program. We program and the things will do. You just press the button, and you just continue the process A, B, C, D. Like people, it's difficult. So sometimes they follow, sometimes don't follow. Like just now I said, like I made a change in a good mood, then tomorrow it got not good, not good. This will happen to a human... human beings. But when it comes to systems and robotics, something in the automation, it's all in like…follow the sequence A, B, C, D like that you know, so there is no between stops. It is good in Dell.

Student A:

May we know the future direction of PLC5 in 5 years?

Respondent 3:

At the moment, as current customers have signed the contract right. Dell signed a contract; CISCO signed a contract for 3 years. Meaning to say, our warehouse just now, you saw the layout just now, it's now fully occupied right. So, even other customers want to come in under the product of the E&E right. It's a bit difficult because that's allocated. That means that the customer is already paid for the space. For example, I give you one example. You rent the house with the

three rooms and three of you sitting in the rooms, three rooms each room. If I want to bring one more person or even go inside the room, can I? You are paying for the room, right? This is under business ethics, so we cannot do that. Unless you have the volume... you said I don't want to… Unless you say, my room is too big, I can, you can put a partition, you can rent to another person. Okay, fine. Same goes for customers. So, if they say, this is too big, my volume drops, I want to give away a portion of it, release the things. Then, our solution team will come back and then they will recalculate as we have the space, we can sell to another customer. That's how it works.

Supervisor:

Currently the warehouse layout itself is something flexible. Does it receive any kind of item?

Respondent 3:

No, we have two entities here. One is for Dell and the other is LMW. So LMW is an extended Dell LMW. So, we're using their license to operate their goods over here right. For bonded, it's more tedious because we need to go with the Royal Commission Customs. We need to do any adjustment of the layout under the bonded, we have to go back to Royal Commission Customs with the new layout before and after and must get out of the one or else you can't do that. Partially do, part by part. For example, smart counting, right that's one of the easier ways, the lowest project that we can implement immediately right to ease out the inventory team with the antegrade real type inventory you know, the moment I scan mean "park" the system… pop out, then it will tell you tally or not tally you know. That will be the easiest or fastest way, as huge amounts will take some time, and impact the space for how long the project is going on and we might have lost the revenue to our space.

Student B:

Can baby boomers accept automation?

Respondent 3:

We all are baby boomers and open minded. We are welcoming of the technologies, it's really helpful because we see some places where those in

manufacturing you know what you call, is more logical to have automation. Last time I worked in manufacturing, where I am taking care of auto packing, you know the computer hard disk… anything with that manufacturing… and I, I was the senior technician of that time, I was talking about 19… I think you are all not born yet la, okay… maybe. So, my engineer and my staff are specialized in auto, auto packing. At that moment we already have automation. So, the product will come from the conveyor from production straight away to the… the stock picking area. Then from there all pick up slots into the plastic bag and wrap, and then put the seal and then put in the carton, the carton will be sealed. All that's automation. Yes, under that kind of the product is like picking unless we want to make it a loose, loose picking which has like mean, mean level. It's brought down and then brought to the workstation and then we take how many we want and then after that press the button back, back to location, it will go back to the location, this kind of automation. Yes, it can be done. Because I think some of the company in the Europe they already have that, I see some clips shared by my friend, in Europe they already have that kind of automation whereby, urgh even the UPS also they have the segregation of the goods, make the, the parcels ah by vision, like continental you know straight away in one area then from there one or two people only just alleging inside the what you call the skip inside then you push to the background. So, they have…even anything all living just the scanner only ma is not to the bucker determines this product I mean this parcel goes to which country. Okay, that kind of it. It can but a huge amount of investment.

Student A:

Okay, that's all from us. Thank you for the information and your time.

Appendix D

Photography of Visitation to PLC5, Schenker Logistics (M) Sdn. Bhd.

The discussion in PLC5's conference room.

Security Check Point (In).

Security Check Point (Out).

Warehouse Racking.

Receiving Area (Inbound Post A).

Receiving Area (Inbound Post B).

Shipping Area (Outbound).

MHE Charging Area.

Power Pallet Truck.

Slip Sheet Machine.

Forklift.

Group Photo Session with the Managers and Supervisors of PLC5.

Selfie of Supervisor and Researchers.

Introduction of DB Schenker Malaysia.

Current Innovation, Automation, and Digitalization of Schenker Malaysia.
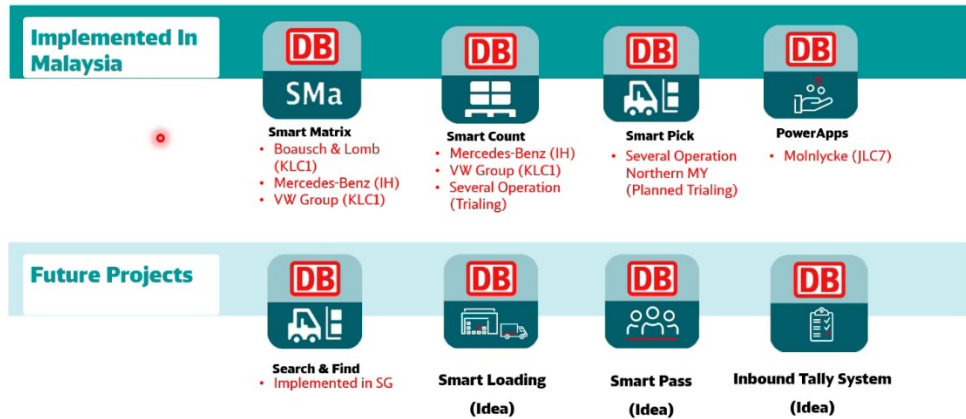
Current and Future Plans of Schenker Malaysia.

Introduction of Smart Matrix and Smart Count.
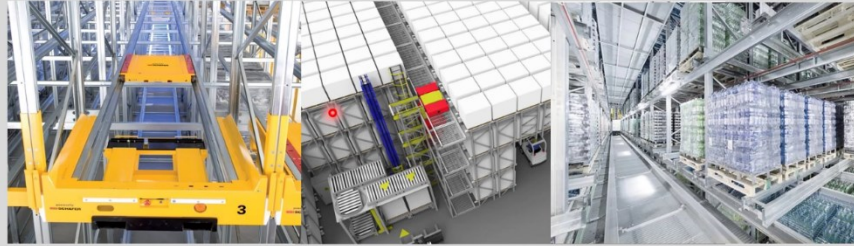
Introduction of Automated Pallet Shuttle.
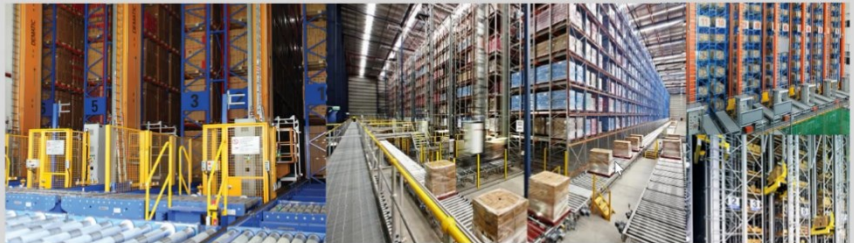
Introduction of Pallet ASRS.

Introduction of AutoStore.

Introduction of AGV.

Group Photo Session with The Head of Operation System Management, Innovation, Automation & Digitization of Contract Logistics.

<u>NON-DISCLOSURE AGREEMENT</u>

Schenker Logistics (Malaysia) Sdn. Bhd. (147186-D), a company incorporated in Malaysia with its principal place of business at Lot 1 & 3, Persiaran Pasak Bumi, Bukit Jelutong Industrial Park, Seksyen U8, 40150 Shah Alam, Selangor Darul Ehsan, Malaysia (hereinafter referred to as "Providing Party"), and Universiti Tunku Abdul Rahman (Kampar Campus), Faculty of Science, a company incorporated in Malaysia with its principal place of business at Jalan Universiti, Bandar Barat, 31900 Kampar, Perak (hereinafter referred to as "Receiving Party"), desire to hereby agree as follows:

1. "Information" shall mean any information, data, knowledge or know-how relating to the business, services, products or employees of Providing Party, including but not limited to any research, developments, inventions, processes, techniques, designs, components, parts, documents, drawings, electronic files, sketches, plans, programs, specifications, software, engineering, marketing, financial, merchandising, sales, pricing, costing, employee, salary and/or any other information (hereinafter collectively referred to as "Information") which is disclosed by Providing Party or on its behalf, before or after the date hereof, to Receiving Party or its employees or agents, whether directly or indirectly, and whether in writing, orally, electronically, or by way of inspection.

2. "Information" shall not include any information, data, knowledge or know-how which is: (i) published or otherwise available in the public domain, other than by reason of any breach of this Agreement or any other obligation(s) of confidentiality owed to Providing Party; (ii) rightfully received from a third party without any obligation(s) of confidentiality; (iii) independently developed by Receiving Party without any access to the Information of Providing Party; (iv) known to Receiving Party at the time of disclosure by Providing Party, without any obligation(s) of confidentiality; and/or (v) produced in compliance with any applicable laws or regulations, or pursuant to any court order or direction, provided that Receiving Party shall give Providing Party reasonable prior written notice of such production, and reasonable opportunity to oppose and/or limit such production.

3. Receiving Party shall hold in the strictest confidence, and not disclose to any others, by any means, any and all Information. Information may be used by Receiving Party only for the purpose of providing services to Providing Party, and in compliance with all

applicable laws and regulations, including but not limited to data protection and/or privacy laws and regulations.

4. Receiving Party shall disclose Information received under this Agreement to its employees who have a need to know such information, and who are bound in writing to protect the confidentiality of such Information. Receiving Party further agrees it shall take the same measures, but no less than such reasonable measures, and use the same degree of care, but no less than a reasonable degree of care, to preserve and protect the confidentiality of, and to avoid any unauthorised disclosure or use of, such Information, as it uses in relation to its own confidential information.

5. Title to all Information received by Receiving Party from Providing Party shall remain at all times with Providing Party, and this Agreement shall not be construed as granting to Receiving Party any licenses or similar rights (including any intellectual property rights) to such Information.

6. Receiving Party shall, upon request of Providing Party: (i) return to Providing Party all Information, and any copies or reproductions thereof, received by Receiving Party under this Agreement; and (ii) certify in writing to Providing Party that all such Information has been returned.

7. Receiving Party's obligations under this Agreement shall expire seven (7) years after the expiration or termination of the relationship between the parties to this Agreement, whichever is later.

8. The parties further agree to the following terms and conditions:

    a. Any breach by Receiving Party of its obligations under this Agreement shall result in irreparable damage to Providing Party for which damages and other legal remedies shall be inadequate, and in seeking enforcement of any of such obligations, Providing Party shall be entitled (in addition to other remedies) to preliminary and permanent injunctive and other equitable relief. The costs and expenses (including but not limited to legal fees and charges) of enforcing such obligations shall be borne by the Receiving Party, an indemnity basis.

    b. If any provision of this Agreement is invalid or unenforceable, then such provision shall be construed and limited to the extent necessary, or severed if necessary, in order to eliminate such invalidity or unenforceability, and all other provisions of this Agreement shall not be affected thereby.

c. No delay or omission by providing party in exercising any right or remedy under this Agreement shall operate as a waiver of such right or remedy. Any waiver or consent given by Providing Party on any one occasion shall be effective only on such occasion, and shall not be construed as a bar to or waiver of any right or remedy on any other occasion.

d. This Agreement shall be binding upon and will inure to the benefit of the parties, and their respective successors and assigns.

e. This Agreement may not be amended except by an agreement in writing signed by both parties that specifically refers to this Agreement.

f. This Agreement shall be governed by, and construed in accordance with, the laws of Malaysia, and the parties irrevocably submit to the jurisdiction of the courts of Malaysia.

Schenker Logistics (Malaysia) Sdn Bhd

Universiti Tunku Abdul Rahman (Kampar Campus) Faculty of Science

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Name: Tey Tai Soon

Title: Head Of Innovation & System

Date: 06/03/2023

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Name: Ts. Khairul Rizuan Bin Suliman

Title: Academic Staff/Lecturer

Date: 07/03/2023

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Name: Chuah Yu Ru

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