# PICKING PRODUCTIVITY: A CASE STUDY OF FASHION RETAIL WAREHOUSE

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## ABSTRACT

*This research presents a case study conducted in a fashion retail warehouse, with the primary objective of addressing delays in the picking process to meet order fulfillment timelines. To identify and analyze the underlying reasons for picking inefficiencies, the study employed various tools, including assessing picker skill, evaluating the shelf layout, conducting an ABC analysis of inventory, and utilizing a Fishbone diagram. Data collection for the research encompassed the use of picking forms, direct observations, interviews with personnel, and historical data analysis. As a result of these efforts, the study identified five root causes, as depicted in the causes and effects diagram. To rectify the issue of prolonged picking lead times, the researcher proposed five distinct solutions, accompanied by control strategies aimed at measuring and sustaining the improvements achieved. The company has reaped numerous benefits from implementing these recommendations. In summary, the research findings unequivocally demonstrate a significant enhancement in the productivity of the picking process.*

***Key Words:*** *Seven Wastes, Fishbone Diagram, Layout Design*

**บทคัดย่อ**

งานวิจัยนี้นำเสนอกรณีศึกษาที่ดำเนินการในคลังสินค้าแฟชั่น โดยมีวัตถุประสงค์หลักในการจัดการกับความล่าช้าในกระบวนการหยิบสินค้าเพื่อให้ตรงตามกำหนดเวลาในการดำเนินการตามคำสั่งซื้อ เพื่อระบุและวิเคราะห์สาเหตุในการหยิบสินค้าที่ไม่มีประสิทธิภาพ การศึกษานี้ได้ใช้เครื่องมือต่างๆ รวมถึงการประเมินทักษะของผู้หยิบสินค้า การประเมินผังชั้นวาง การวิเคราะห์จัดกลุ่มด้วยระบบ ABC และแผนภูมิก้างปลา การรวบรวมข้อมูลสำหรับการวิจัยครอบคลุมการใช้แบบฟอร์มการหยิบ การสังเกต การสัมภาษณ์ และการวิเคราะห์ข้อมูลในอดีต ทำให้สามารถระบุสาเหตุ 5 ประการ ดังที่ปรากฏในแผนภูมิก้างปลา เพื่อแก้ไขปัญหาเรื่องระยะเวลาในการหยิบสินค้า ผู้วิจัยได้เสนอแนวทางแก้ไข 5 ประการ ควบคู่ไปกับกลยุทธ์การควบคุมที่มุ่งวัดและรักษาการปรับปรุงที่ทำได้สำเร็จ บริษัทได้รับประโยชน์อย่างมากจากการปฏิบัติตามคำแนะนำเหล่านี้ โดยสรุป ผลการวิจัยแสดงให้เห็นอย่างชัดเจนถึงการเพิ่มประสิทธิภาพของกระบวนการหยิบสินค้า

**คำสำคัญ:** ของเสีย 7 ประการ แผนภูมิก้างปลา การออกแบบผัง

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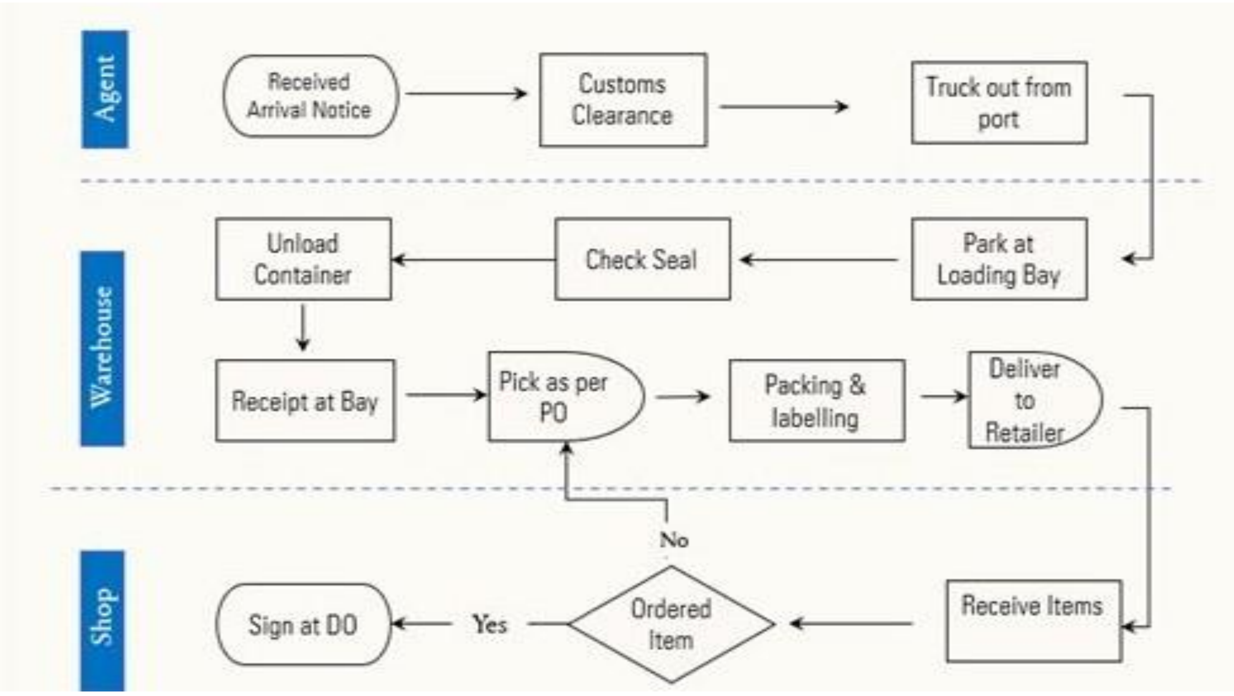
## INTRODUCTION

This research aims to investigate and propose solutions to address the challenges faced by a fashion industry company, specifically Thiri Trading Co., Ltd. (Thiri Trading), in Myanmar, regarding inefficiencies in their picking process. The current process involves receiving orders from merchandisers via email, printing them out, and manually going to the warehouse floor to assign pickers to retrieve the items from the shelves. However, the lack of precise item location information results in pickers spending excessive time searching for items, leading to delays and reduced efficiency in order fulfillment.

**Figure 1: Supply Chain Process of Thiri Trading**




Thiri Trading imports fashion and accessories from China and Korea, selling them in their own retail shop within a shopping mall. The company purchases items from overseas suppliers, which are then shipped via ocean freight. Upon arrival at the Yangon port, the shipping team clears the cargo and forwards it to the warehouse. At the warehouse, the cargo is unloaded and arranged for receipt. Subsequently, items are picked from the receiving bay and prepared for packaging to be delivered to the retail outlets. However, due to inefficiencies in the picking process, orders often experience delays, resulting in late arrivals at the shop. This, in turn, leads to customer dissatisfaction and revenue loss. Integrating solutions to address this picking inefficiency is crucial for improving Thiri Trading's supply chain process.

***Research Objectives***

The objectives of this research were as follows:

1. To determine the root causes of the inefficient order picking productivity at Thiri Trading.
2. To develop a solution for enhancing order picking efficiency, including the implementation of precise item location systems within the warehouse.
3. To measure the impact of the proposed solutions on key performance indicators such as order processing time and overall operational efficiency.

***Scope of the Research***
This study will focus on work design and process improvement to enhance productivity by analyzing the current workflow and task allocation. To optimize the process, the nature, sequence, volumes, and frequency of orders will be identified to improve resource allocation. Data will be collected from warehouse records, processes, and customer feedback to gain insights for improvement actions. Furthermore, warehouse layout and design will be examined to minimize walking distance and reduce picking overlap. Additionally, waste elimination strategies will be implemented using Lean methods to reduce picking lead time.

## LITERATUER REVIEW

***Lean Philosophy (Muda – Seven Wastes)***
The seven types of waste identified in Lean philosophy (Henshall, 2023) are:

1. Excessive Walking or Motion: Unnecessary movement of pickers within the warehouse can waste time and energy, such as long travel distances between pick locations or inefficient routing.
2. Overprocessing: Performing unnecessary steps during the picking process, like excessive inspections or double-checking, leads to wasted time and effort.
3. Waiting Time: Delays and idle time during picking due to inventory unavailability or inefficient order sequencing result in wasted productivity.
4. Overproduction: Picking more items than required leads to excess inventory and storage costs, often occurring when multiple orders are batched together.
5. Inventory Waste: Poor inventory management practices, like excessive safety stock or picking incorrect items, result in wasted space and increased carrying costs.
6. Defects: Picking errors, such as selecting the wrong items or quantities, lead to wasted time and resources, often requiring rework or causing delays.
7. Unnecessary Transportation: Unneeded movement of items during picking, such as unnecessary transfers between pick locations, wastes time and increases the risk of damage.

To reduce Muda waste in the picking process, warehouses can implement various lean practices and strategies. For instance, efficient warehouse layout and organization can minimize travel distances and streamline picking routes. By identifying and eliminating Muda waste in the picking process, warehouses can optimize their operations, improve productivity, reduce costs, and enhance customer satisfaction.

***Layout Design***
In the process of order picking, two layout designs are crucial: the overall facility layout and the internal layout within the order-picking system. The facility layout problem, as described by Tompkins, White, Bozer, & Frazelle (2003) and Meller and Gau (1996), involves determining the optimal arrangement of various functions within the warehouse, such as receiving, picking, storage, sorting, and shipping. However, this paper primarily focuses on the internal layout design or aisle configuration problem. This aspect entails decisions about the number of blocks, as well as determining the number, length, and width of aisles within each block in the picking area. The ultimate objective is to establish a warehouse layout that minimizes the distance traveled during the picking process. By optimizing the internal layout design and aisle configuration, warehouses can reduce the time and effort required for pickers to navigate the picking area, leading to enhanced efficiency and productivity.

***Fishbone Diagram***

The Fishbone diagram, also known as the Ishikawa diagram, is a valuable tool used to pinpoint the root causes of quality issues Juran (1999). It categorizes potential factors into five main branches, commonly referred to as the "4Ms and 1E": Man (people), Material, Machine, Method, and Environment.

- Man: Factors related to individuals involved in the process, such as skill level, training, knowledge, and adherence to procedures.
- Material: Factors concerning the materials used in the process, including quality, specifications, and suitability.
- Machine: Factors associated with equipment and machinery, including maintenance, calibration, reliability, and suitability.
- Method: Factors relating to procedures, instructions, and adherence to standard operating procedures.
- Environment: Factors linked to the physical surroundings, like temperature, humidity, and lighting.

Each main category can be further expanded to identify specific sub-causes or factors. The Fishbone diagram aids in visualizing and analyzing potential causes within each category, facilitating structured analysis and identifying areas for improvement or further investigation. Under each category, specific sub-causes or factors contributing to picking efficiency issues will be explored and identified.

Additionally, Key Performance Indicators (KPIs) such as order fulfillment rate, picking lead time, and average picking time per unit have been defined. These metrics offer a quantifiable means to assess the performance of the picking process.

## RESEARCH METHODLOGY

The research methodology employed to reduce the picking lead time in this study involved a systematic data-driven approach.

***Data Collection***

When collecting data for the picking process, the author utilized several sources and methods. Here are some common approaches for data collection in order to reduce picking lead time:

- **Time Logs**: Time logs have been used to record the start and end times for each picking activity. This data has been collected directly from the manual picking process.

- **Order Details**: The order detail of the picking process typically involves several elements as per below:

Order Information: This includes essential details such as the order number, customer name, delivery address, and any special instructions provided by the merchandiser.

Item Identification: Each item in the order needs to be accurately identified. This can be done using unique identifiers such as SKU (Stock Keeping Unit) numbers, product names, or barcodes.

- **Picking Methods**: There are various picking methods depending on the nature of the products and the order volume. Common methods include batch picking (collecting multiple orders simultaneously), zone picking (assigning specific areas for each picker), or wave picking (picking in predefined intervals).

Picking Tools: Picking tools can include handheld scanners or mobile devices to scan barcodes or RFID tags, pick-to-light systems that provide visual cues for item selection, or voice picking systems that guide pickers through voice commands.

- **Quality Control**: A quality control process is important to ensure accurate picking. This can involve random checks or verification of picked items against the order details to identify any errors or discrepancies.

- **Packaging and Labeling**: Once the items are picked, they need to be properly packaged and labeled for delivery. This includes selecting appropriate packaging materials, applying shop labels, and ensuring the packages are secure.

- **Documentation and Record-Keeping**: Proper documentation is essential for record-keeping and order tracking purposes. This includes updating the inventory system, generating packing slips or invoices, and keeping records of picked orders for reference.

- **Order List Preparation**: At the beginning of this stage, the order was sent by the customer with an email including code, color, quantity details in Excel format. Warehouse senior staff checked the order lists with warehouse inventory stock and prepared the pick lists.

***Analyzing***

When analyzing the picking process, the author used the following approaches to gain insights and improve efficiency.

**- Inventory Analysis**

Assessed the impact of inventory and layout on picking efficiency. Analyzed the inventory for Assessed the impact of inventory and layout on picking efficiency. Analyzed the inventory for the proximity of frequently picked items, their categorization, and the ease of picker access. Various methods were used such as ABC analysis, past history, and visual management techniques to lead to improvements in order picking.

**- ABC Analysis**

The research utilized the ABC analysis technique to classify the inventory items based on their product demand. The author categorized the items into three distinct categories:

A. High Demand: These items experience continuous movement, with units entering and exiting the warehouse on a regular basis. They are characterized by high demand and are in constant motion.

B. Medium Demand: Items in this category have a moderate level of movement, with units entering and exiting the warehouse in smaller volumes compared to the high moving category. They exhibit a relatively lower level of demand.

C. Low Demand: This category consists of items that spend a significant amount of time in the warehouse, with limited movement and low demand. These items have a slower rotation compared to the high and medium moving categories.

By segregating the groups, inventory can be seen with a clear view and optimal placement. Moreover, positioning high-volume and high-demand items closer to the picking area or in easily accessible locations helps reduce unnecessary movement. Arrange the items in a logical sequence, following the order in which they are typically picked, as shown in Table 1.

**Table 1: Inventory Analysis**

| Category | Brand | Average Monthly Volume (pieces) |
|---|---|---|
| A | Apparels | 16,205 |
| B | Accessories | 6,337 |
| C | Cosmetics | 2,597 |

***Historical Records***
Analyzing historical picking data, including past order volumes, picking times, and any known issues or challenges, can provide valuable insights into trends, seasonality, and potential patterns affecting picking lead time.

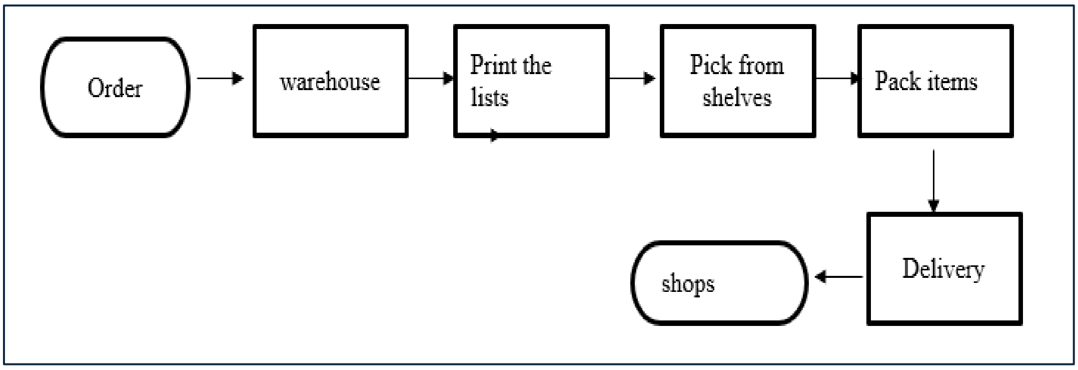
***Warehouse Layout***
The author revealed that the distance traveled by pickers has a significant impact on the efficiency of the order picking process. When pickers are required to cover long distances to retrieve items for an order, it results in increased travel time, leading to reduced picking speed and overall lower productivity levels within the warehouse.

In response, the author investigated the current warehouse layout to identify opportunities for improvement. One approach involved grouping frequently picked items closer to the packing or shipping area, thereby minimizing the distance that pickers need to travel. This strategic placement of high-demand items aimed to streamline the picking process and reduce travel time.

Additionally, the author employed data analysis or simulations to optimize the placement of products for efficient picking routes. By analyzing historical data or using simulation tools, the author identified the most optimal arrangement of products within the warehouse. This optimization aimed to minimize the overall travel distance for pickers, thereby increasing efficiency and productivity. Overall, the author's investigation into the impact of travel distance on the order picking process led to the implementation of strategies such as rearranging frequently picked items and utilizing data analysis or simulations to optimize the placement of products. These efforts were undertaken to improve picking efficiency, reduce travel time, and enhance overall warehouse productivity.

***Process Mapping***
The picking process was carefully mapped to understand the workflow. When orders are sent by email from the shop, warehouse staff print the lists and move to the warehouse floor to locate the items among the shelves (refer to Figure 2). Once the items are found, they are retrieved from the shelves and placed into a trolley basket. Subsequently, the items are packed and prepared for delivery, then handed over to the delivery personnel for transportation to the shop. A critical aspect of this process is navigating the warehouse to locate the items. While staff are familiar with the shelves and their locations, they rely on their experience to pick the items. However, the author discovered that this movement results in unnecessary travel and time wastage during the picking process.

**Figure 2: Current Stage of Picking**

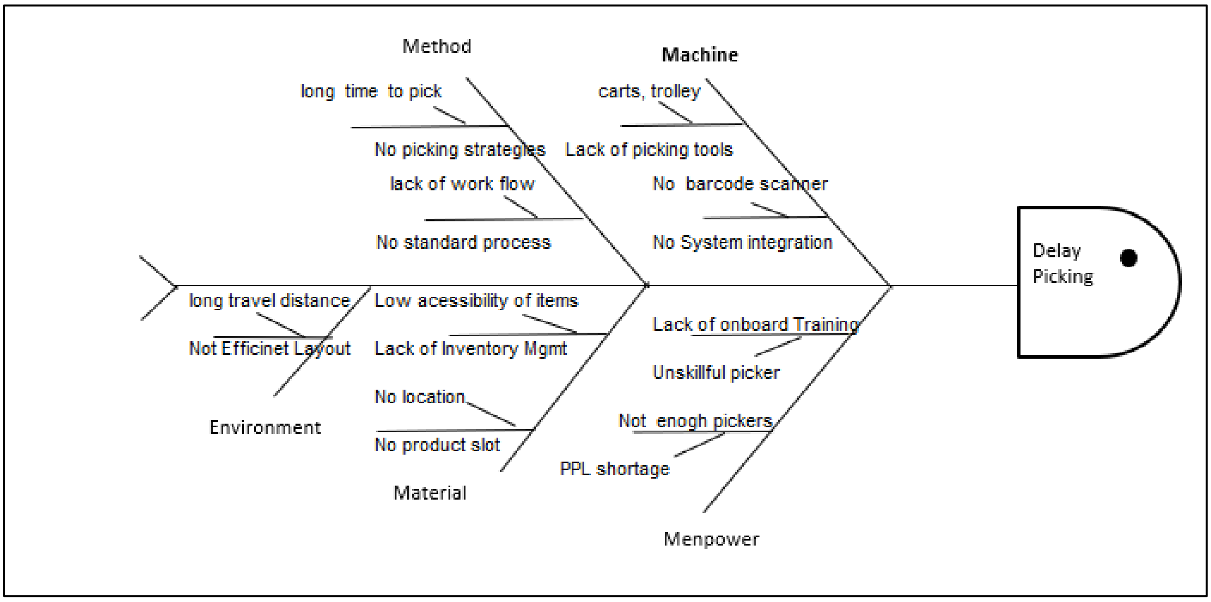



The author studied customer demand and requirements for picking, such as order volume, order frequency, and specific timelines, to establish the new process. By analyzing each step in the picking process and categorizing them as activities directly benefiting picking or as activities that are necessary due to inefficiencies or other constraints but do not directly contribute to picking, the author identified areas of waste. These included unnecessary movement, waiting times, excessive inventory, and over-processing.

***Root Cause Analysis***

Fishbone diagrams were used to identify the root causes contributing to the excessive picking lead time. The author followed a structured approach of using the Fishbone Diagram to identify the various categories and subcategories of potential causes that contributed to the picking delay problem. The author aimed to understand the complex relationships between Men, Material, Machine, and Method, which can affect a specific outcome.

**Figure 3: Fishbone Diagram**




**Man (People)**

The author discovered that warehouse staff, except for supervisors, did not know how to pick efficiently; they simply picked items according to lists. As a result, they kept moving around the floor to find items, leading to excessive motion during orders. Repetitive picking often occurred from the same place and the same carton.

**Material**
While doing the picking, staff have no equipment such as a trolley or scanner to place the items. They have to carry the items along the shelves to the floor before putting them into the delivery box. Hence, additional travel occurs for order collection and piling.

**Method**
Staff started work whenever they received orders, resulting in extra processing, especially when there were many revision orders. This was due to a lack of workflow and order cutoff times. Additionally, staff had not been specifically assigned as picking leaders and followers. When inexperienced or new staff were assigned to pick, it took more time to find the items and sometimes they were unable to pick as well. This led to delays in picking and failure to finish within the timelines.

**Machine**
The implementation of software or a system, in terms of machinery, would facilitate real-time inventory data and order status checks. However, since the system was unavailable, staff had to manually check and input the shelf locations. This preparation took several hours, during which pickers were left idle. This resulted in wasted time for both pickers and order administrators due to the lack of a software system. By using a Fishbone diagram, the author visualized the root causes of the problem and fostered a structured approach to resolving the issues, as shown in Figure 3.

## PRESENTATION AND CRITICAL DISCUSSION OF RESULTS

***Improvement***
This phase focuses on developing the most effective methods and action plans as corrective measures to eliminate or reduce the root causes identified during the Analyze phase. To address these root causes, the improvement action plan will target four significant factors and variables contributing to picking delays: People, Process, Pathway, and Equipment. These factors and variables will be the focus of improvement efforts to enhance warehouse operations and overall efficiency. After thoroughly assessing the previous process, the author identified the strengths and weaknesses as follows.

**- Strength**
Familiarity: Staff members are familiar with the current picking process, reducing the learning curve for new employees.

Established Workflow: The current process has a defined workflow that has been in place for a significant period.

Flexibility: The current process allows for adjustments based on order volume and urgency.

**- Weakness**
Inefficiencies in Travel Path: The current layout leads to excessive travel distances and time spent searching for items.

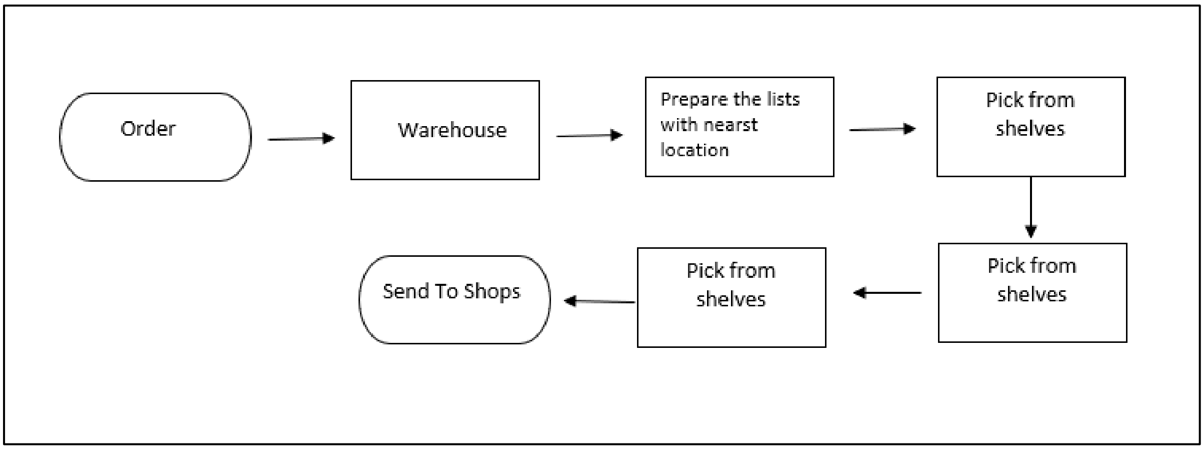
Lack of Technology Integration: Manual data entry and paper-based processes can result in errors and delays.

Limited Scalability: The current process may not be scalable enough to handle increased order volumes or business growth.

After drawing conclusions, the author proceeded to map out the proposed process (Figure 4), which included shelf layout and product slotting. Product slotting was arranged based on the ABC analysis discussed in the previous chapter. It was recognized that product slotting in a warehouse can deteriorate if not regularly maintained, as SKUs may change, be added, or deleted.

During peak periods, workers may misplace items, resulting in increased picking time when searching for them. Historical data revealed that, on average, around 50 percent of SKUs in a warehouse were incorrectly placed, leading to a potential penalty of up to 20 percent on order picking productivity. Emphasizing the importance of consistently following proper procedures, rather than taking shortcuts, is crucial to achieving a shortened lead time for the order picking process.

**Figure 4: Proposed Process Map**



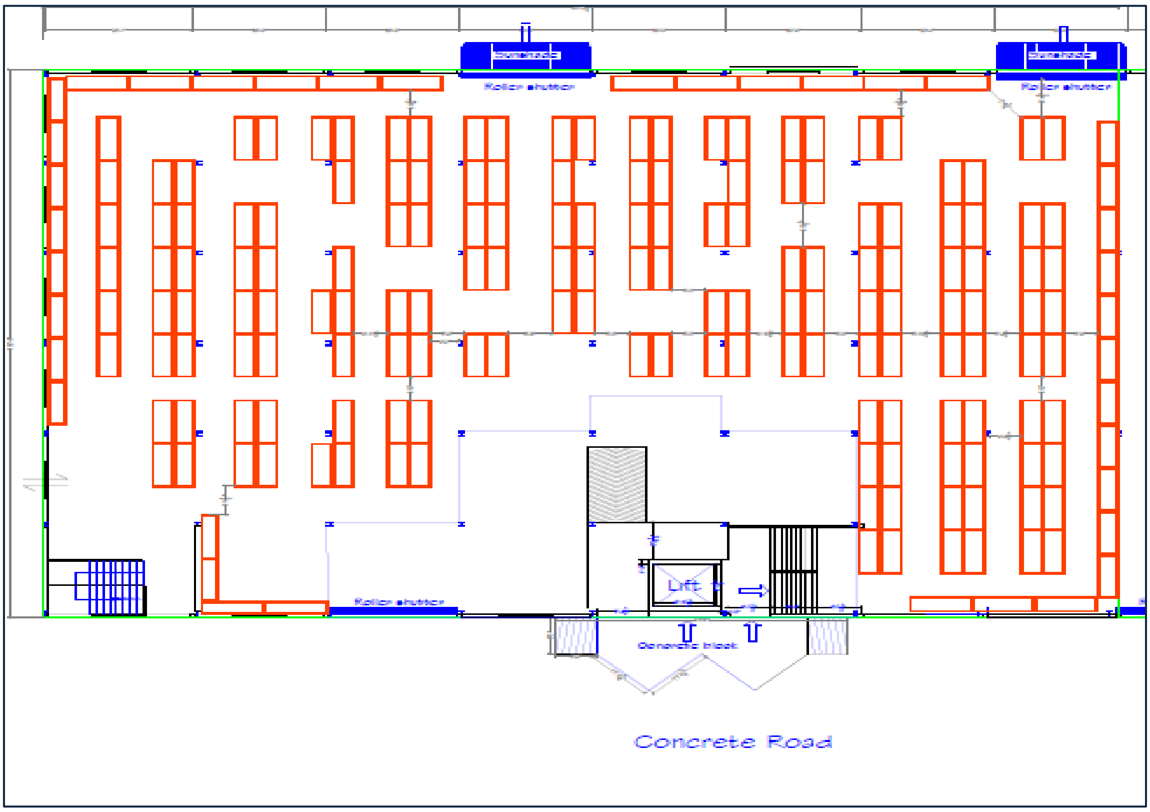

To enhance efficiency and accuracy, visual management methods were implemented. Clear labeling was applied to each shelf, carton, and signage for different item categories within the storage locations. Additionally, the order administrator assigned product slots on the pick list based on the nearest location, aiming to reduce picker travel time.

Furthermore, the optimal placement of shelves in a warehouse has a significant impact on picking efficiency. As a result, the author proposed a new shelf layout design (Figure 5) to enhance operations. The modifications included:

Implementing Tall Shelves: The current shelves were replaced with taller shelves to maximize vertical space utilization and increase storage capacity.

Efficient Order Picking Routes: Careful consideration was given to selecting the most efficient routes for order picking and replenishment activities, minimizing travel time and optimizing the overall picking process.

**Figure 5: Proposed Shelf Layout**




Clear Pathways: Clear pathways, also known as cross aisles, were established between shelves to ensure smooth movement of personnel, equipment, and stock. This enhanced accessibility and reduced congestion within the warehouse.

Accessible Placement of Frequently Picked Items: Frequently picked items were strategically positioned in easily accessible areas, such as at eye level or within arm's reach. This minimized the time and effort required to retrieve these high-demand products.

Flexibility in Layout: The shelf layout design was designed to be flexible, accommodating changes in inventory volume and product sizes. Adjustable shelving systems will be utilized, allowing for easy reconfiguration as needed.

Effective Labeling: Each shelf was clearly labeled to indicate the product category, item details, or any specific instructions. This improved organization and expedited the picking process by providing clear identification of stored items.

Utilization of Signage: Signage was strategically placed throughout the warehouse to guide personnel and improve overall navigation. This facilitated smoother operations and reduced the likelihood of delays.

If the proposed shelf layout is implemented, travel distance will be reduced by 20%, enhancing picking productivity (Table 2).

**Table 2: Proposed Shelf Layout Travel Distance**

| | Travel Distance (m) | |
|---|---|---|
| | Within Aisle | Within Cross Aisle |
| Current layout | 106 | 65 |
| Proposed Layout with Cross Aisle | 83 | 65 |

***Control***

To monitor and maintain the desired level of efficiency in picking operations, the researcher implemented a control process for picking efficiency. The following steps were taken:

Key Performance Indicators (KPIs): Specific metrics such as order fulfillment rate, picking lead time, and average picking time per unit were defined as key performance indicators (KPIs). These metrics provided a quantifiable way to assess the performance of the picking process.

**Table 3: Proposed Picking Productivity KPIs**

| KPIs | Current Result | Proposed Result | Method | Description |
|---|---|---|---|---|
| Order Lead Time | 3-4 days | 2-3 days | Total time taken for picking and packing orders | Measures the time taken from order placement to order completion, providing an overall measure of the speed and efficiency of fulfillment. |
| Units Picked Per Hour | 50 pcs per hour | 80 pcs per hour | Number of units picked/Total hours worked | Measures the number of units or items picked within an hour, providing insights into the productivity of the picking process. |
| Order Fill Rate | 80-85% fulfillment | 90-98% fulfillment | (Number of complete orders/ Total number of orders) x 100 | Measures the percentage of complete orders fulfilled without any missing items. |

Continuous Improvement: A culture of continuous improvement was fostered by encouraging feedback from warehouse staff and implementing their suggestions. The control process was regularly reviewed and updated based on new insights or changing operational needs.

Performance Feedback and Recognition: Warehouse staff received feedback and recognition regarding their performance in picking operations, reinforcing positive behaviors and motivating employees to maintain and improve efficiency.

Regular Performance Monitoring and Data Analysis: Picking performance was continuously monitored and analyzed against established KPIs. Data analysis identified patterns, trends, and areas for improvement, with regular reports generated to highlight key performance indicators and provide insights into the efficiency of the picking process.

## CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the research successfully identified factors contributing to delays and reduced efficiency in order picking through detailed analysis and data collection. Secondly, implementing precise item location systems within the warehouse was suggested to optimize product organization, streamline picking processes, and reduce cycle time. These findings can serve as a valuable reference for organizations seeking to improve warehouse operations and productivity.

To achieve these improvements, managers must prioritize certain actions. First, optimizing shelf layout involves arranging products logically and efficiently based on sales data and customer preferences. Second, streamlining workflows is essential for minimizing unnecessary steps and eliminating bottlenecks. This may involve reorganizing workflow, adjusting tasks, or utilizing tools.

Third, implementing visual management methods, such as signage and color coding, can greatly improve operational efficiency by providing clear instructions and feedback. Additionally, providing comprehensive training programs and creating a positive work environment can enhance employee skills, motivation, and productivity.

### *Limitations and Recommendations for Future Research*

Despite its valuable insights, this research paper has certain limitations that warrant acknowledgment. Firstly, the study focuses on a specific fashion industry company in Myanmar, limiting the generalizability of the findings to other industries or countries. Therefore, caution should be exercised when applying the results to different organizational contexts.

Secondly, the ideal adoption of technologies such as Warehouse Management Systems (WMS), ERP/SAP, RFID, pick-to-light systems, and voice picking systems may be constrained by budget limitations. While these technologies could enhance pick rate and accuracy, their implementation may not always be feasible due to financial constraints.

Moreover, while the proposed solutions offer a foundation for enhancing picking efficiency, each organization may have unique requirements and constraints. Further customization and adaptation of the solutions may be necessary to align with the specific needs and circumstances of different companies.

Lastly, the research does not delve into potential barriers or challenges that organizations may encounter during the implementation of the proposed solutions. Real-world implementation often involves obstacles such as resource limitations, resistance to change, or technological constraints. Future research could focus on identifying and addressing these potential barriers to provide a more comprehensive understanding of the practical implementation process.

Considering these limitations, organizations should carefully evaluate and tailor the proposed solutions to suit their specific industry, country, and organizational context. Additionally, anticipating and addressing potential challenges during the implementation phase is crucial for ensuring successful outcomes.

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