# A Study on Improving Warehouse Operations of Siamphan Salaya Co., Ltd. Using Simulation Techniques

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## Abstract

This research aims to enhance the efficiency of warehouse management at Siamphan Salaya Co., Ltd. through the application of simulation techniques. Data were collected through interviews with the business owner, and analytical tools including ABC Classification Analysis, Flow Process Chart, and Fishbone Diagram were employed. In addition, the FlexSim program was utilized to simulate warehouse operations. A simulation model was developed based on a random sample of 10 trials to determine the average processing time required for handling one item by a single employee in each process. The results indicated that the existing warehouse layout required an average processing time of 1,695.22 seconds, whereas the redesigned warehouse layout required an average of 1,254.16 seconds. This represents a reduction of 441.06 seconds, or 26.90 percent. Due to the low sales volume of certain products, the company has reduced inventory levels, resulting in increased available warehouse space. This additional space contributes to shorter picking times and improved product accessibility. Moreover, occasional staff absences may cause operational delays when substitute employees experience difficulty locating products, which further affects warehouse efficiency

**Keywords**: Warehouse, Simulation, Techniques

## 1. Introduction

Warehousing is a critical component of logistics and supply chain systems, serving as a storage point for goods prior to their distribution to various destinations. Warehouse costs account for a substantial proportion of total logistics costs (NESDC, 2023). Therefore, effective warehouse management plays a vital role in cost control, operational efficiency enhancement, and responsiveness to customer demand (Richards, 2017).

At present, many organizations continue to face challenges related to inefficient and unsystematic warehouse management, resulting in waste in terms of time, space, and resources. Previous studies have demonstrated that improvements in warehouse layout design, appropriate storage policies, and the application of technologies such as automation and simulation can significantly enhance operational efficiency and reduce warehouse operating costs (Goetschalckx, 2010; Faber et al., 2013).

FlexSim is a simulation software widely recognized for analyzing and designing logistics systems, as it enables the modeling of warehouse operations in a virtual environment. This capability helps reduce costs and risks associated with real-world experimentation. Numerous studies have applied FlexSim in conjunction with ABC Classification Analysis to improve warehouse management practices and have reported reductions in processing time, increased operational flexibility, and more effective decision-making support.

Accordingly, this academic article aims to investigate the enhancement of warehouse management efficiency through simulation modeling using FlexSim combined with the principles of ABC Classification Analysis. A case study of Siamphan Salaya Co., Ltd. is conducted to propose effective approaches for improving warehouse layout design and storage processes

### 1.2 Research Objective

1.2.1 To design and improve the warehouse layout by developing a simulation model of the warehouse

1.2.2 To reduce the order picking time in the warehouse of Siamphan Salaya Co., Ltd.

## 2. Literature review

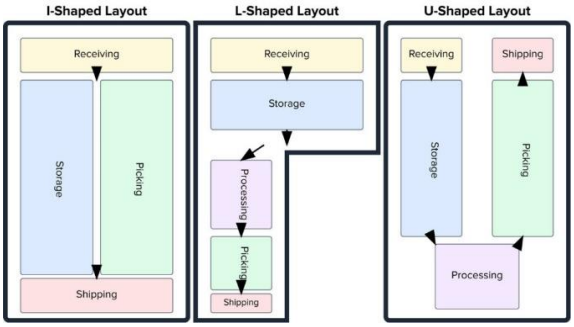
### 1. Warehouse Management Theory

Warehouse management is a crucial process in logistics and supply chain systems. Its primary objective is to control, monitor, and manage the flow of goods, from receiving and storing to moving, picking, and delivering, aiming for maximum efficiency. Richards (2017) states that effective warehouse management focuses on reducing costs, increasing operational speed, and improving product data accuracy, all of which contribute to customer satisfaction and organizational competitiveness.

The principles of warehouse management include warehouse layout design, space utilization, material handling, and order picking. An optimized warehouse layout design reduces distance and time for goods movement, resulting in lower operating costs (Tompkins et al., 2010).

Furthermore, the application of information technology and decision support systems, such as Warehouse Management Systems (WMS) and simulations, in warehouse management allows organizations to analyze problems, test improvement strategies, and evaluate results before actual implementation. To reduce risk and costs from experiments in real-world environments (Banks et al., 2014), warehouse management theory focuses on optimizing internal warehouse processes to align with business goals and market demands.

*Figure 1: Warehouse Layout and Flow*




*Source: Richards, 2017*

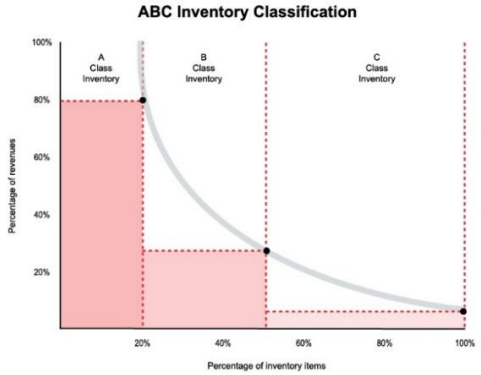
## 2. Inventory Management Theory

Inventory management is the process of planning, controlling, and monitoring the quantity of goods to match market demand. The goal is to avoid shortages or excessive inventory, which affect costs and operational efficiency. Heizer, Render, and Munson (2020) state that effective inventory management reduces an organization's total costs, including purchasing costs, holding costs, and costs associated with shortages.

Inventory management theory encompasses various models and concepts, such as the Economic Order Quantity (EOQ) model, the reorder point model, and ABC classification analysis. The ABC classification method categorizes goods based on their value or importance, where Group A items are high-value and require close monitoring, and Groups B and C items have progressively lower levels of control (Silver, Pyke, & Peterson, 1998).

Applying inventory management theory in conjunction with warehouse management helps organizations allocate storage space efficiently and reduce search and picking times. Furthermore, it improves the accuracy of inventory data. In addition, using simulations allows organizations to test inventory management policies in various scenarios and select the most appropriate approach before implementing them in real-world situations, which improves overall decision-making and management efficiency.

*Figure 2: ABC Inventory Classification*




*Source: Heizer et al., 2020*

## 3. FlexSim Simulation Theory for Warehouse Modeling

Simulation is a crucial tool for analyzing and designing complex systems, especially logistics and warehousing systems, which are difficult to experiment with or modify in real-world environments. FlexSim is a discrete event simulation (DES) software developed to simulate, analyze, and improve processes in manufacturing and logistics systems (Banks et al., 2014). The principle of discrete event simulation is to consider changes in the system's state that occur at the time of significant events, such as receiving, moving, storing, and picking goods. This aligns with the characteristics of warehouse operation. FlexSim uses this concept to create models that systematically represent the sequence of operations, resources used, and the relationships between various activities within a warehouse. FlexSim excels in object-oriented simulation, allowing users to define warehouse components such as receiving, storage, picking, processing/packing, and shipping areas, as well as resources such as personnel, forklifts, and material handling equipment. FlexSim enables warehouse simulation to replicate predefined operating conditions. Furthermore, FlexSim allows for the definition of time, distance, and probability variables to reflect real-world warehouse operations, such as picking time, movement time, and order arrival rates. Simulation results are then used to analyze Key Performance Indicators (KPIs) such as total operating time, employee movement distance, resource utilization, and process congestion, supporting decision-making for improving warehouse layouts and processes. Applying FlexSim to create warehouse models also allows organizations to compare multiple design or system improvement alternatives without actual investment, reducing decision-making risk and increasing planning accuracy. Especially when combined with inventory management theories such as ABC Classification Analysis, it leads to more efficient space allocation and picking. Therefore, FlexSim simulation is a suitable approach for analyzing and improving warehouse systems, providing a comprehensive understanding of system behavior and enabling the simulation results to guide the development of efficient warehouse management that aligns with real-world operating conditions.

## 4. Related Research

Ittithep Panlai and Thitima Wonginta (2024) conducted this research with the aim of improving the inventory management efficiency of a company selling motorcycle spare parts and accessories by classifying product groups based on value and frequency of use. The study used inventory movement data from January to December 2021 and the ABC-FSN Matrix to group products. For the study, the researchers selected product group AN (high-value, low-frequency products) for analysis, consisting of 9 items with a total value of 23,389,749 baht. The Economic Order Quantity (EOQ) theory was then used to determine the economic order quantity and reorder point (ROP).

Kittisak Saenrat et al. (2024) conducted research with the objective of designing and improving warehouse layout by creating a simulation model and enhancing the efficiency of goods sorting based on transfer requests. The research involved collecting data on customer complaints and analyzing the causes using a fishbone diagram. The findings revealed that the problems stemmed from incorrect picking, counting errors, and inefficient storage space

allocation, resulting in wasted time searching for items. Therefore, ABC analysis was used to categorize goods, leading to improved warehouse design. A simulation modeling application using Flexsim software was then used to optimize warehouse management, space management, and storage systems for greater efficiency.

Mana Khaown, and Rachata Panich. (2024). stated that after improving the warehouse management process, the average time for picking spare parts decreased from 32.03 minutes to 25.12 minutes, a reduction of 6.91 minutes or 21.57%. This demonstrates a clear improvement in work efficiency, consistent with the concept of using a visual control system to ensure smooth storage and picking of spare parts and reduce operational errors.

## 3. Methodology

### 3.1 Key Informants

Key informants, selected based on their authority and involvement in the warehouse department, include the business owner, executives, warehouse managers, and warehouse staff of Siamphan Salaya Co., Ltd.

### 3.2 Data Analysis

The collected data was analyzed to identify root causes. This involved compiling all the data and using the Fishbone Diagram to identify cause and effect relationships, thereby finding the root cause of the problem. A flow process chart was used to record data, separating the steps of the process. ABC Classification Analysis was used to categorize products and select high-movement, medium-movement, and low-movement sorting methods. Flexsim was used to create a warehouse model, and the four theories were combined to create a new diagram.

### 3.3 Data Collection

Primary data was collected through observation at the actual work site. This included data on warehouse area, time spent storing and retrieving goods, product value, and the frequency of storing and retrieving goods from December 2024 to March 2025. Secondary data was gathered by studying relevant theories, research, articles, and information from the internet to support this research.

## 4. Results

The researchers compared traditional and new inventory management methods. They applied the widely used and highly effective ABC analysis technique, beneficial for improving warehouse management efficiency, to the case study company, along with problem analysis and warehouse layout planning techniques.

### 4.1 Basic Information of Siamphan Salaya Co., Ltd.'s Warehouse

1. Siamphan Salaya Co., Ltd. began its business of selling construction materials wholesale and retail in 1986. Its products include transparent roofing sheets, green roofing

sheets, black wire, barbed wire, screws, and nuts. It is located at 112 Moo 5, Thep Nimit-Lan Tak Fa Road, Salaya Subdistrict, Phutthamonthon District, Nakhon Pathom 73170.

2. The warehouse area is 18 meters wide and 20 meters long.

3. The warehouse uses 7 steel shelving units.

*Figure 3*: *Inside the warehouse.*

Ten samples were randomly selected to collect data on the average time taken to complete each process item. Each employee spent 815.94 seconds completing the task

**Table 1: Working time before improvements**

| sequence | Activity | Average Time Before Improvement (sec) |
|---|---|---|
| 1 | Receive customer order | 40.50 |
| 2 | Check item list / Notify insufficient items | 81.83 |
| 3 | Pick items according to order | 366.71 |
| 4 | Prepare items according to order | 122.48 |
| 5 | Pack items for shipment | 122.17 |
| 6 | Deliver items / Notify incomplete delivery | 82.25 |
| | **Total** | **815.94** |

### 4.2 Solve the problem by categorizing products using ABC Classification Analysis

**Table 2: The results of product grouping using ABC Classification Analysis**

| Item | Unit Cost | Inventory Quantity (Units) | Annual Sales (Units) | Inventory Value | % of Inventory Value | Cumulative Inventory Value (%) | Item Category | Visual Control |
|---|---|---|---|---|---|---|---|---|
| Transparent Roofing Sheet | 3,000 | 1,200 | 8,590 | 25,770,000 | 87.76% | 87.76% | A | Red |
| Screw | 145 | 1,380 | 6,300 | 913,500 | 3.11% | 90.87% | B | Green |
| Barbed Wire | 200 | 800 | 3,700 | 840,000 | 2.86% | 93.73% | B | Green |
| Black Wire | 100 | 1,000 | 4,200 | 750,000 | 2.55% | 96.28% | B | Green |
| Bolt | 2,000 | 40 | 310 | 620,000 | 2.11% | 98.39% | B | Green |
| Green Roofing Sheet | 1,750 | 40 | 270 | 472,500 | 1.61% | 100% | C | Blue |

| Item | Unit Cost | Inventory Quantity (Units) | Annual Sales (Units) | Inventory Value | % of Inventory Value | Cumulative Inventory Value (%) | Item Category | Visual Control |
|---|---|---|---|---|---|---|---|---|
| **Total** | **7,195** | **4,466** | **27,170** | **29,366,000** | **100%** | **100%** | | |

From the table, it can be concluded that product type A is transparent roofing sheets, represented by red.

Product type B is screws, barbed wire, black wire, and nuts, represented by green.

Product type C is green roofing sheets, represented by blue

### 4.3 Creating a warehouse model

This research utilized Flexsim, a 3D modeling software with real-time 3D rendering capabilities. It can simulate and design warehouse systems, perform input/output analysis of goods receiving and dispatching, and provide simulations for material control planning

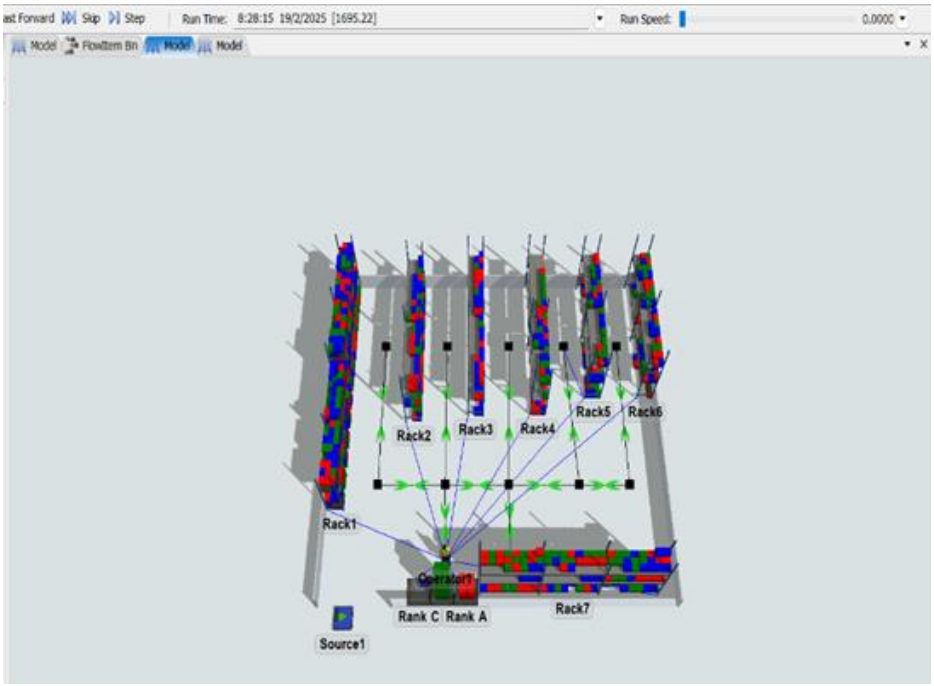
Table 1 shows that the average time employees spend searching for products varies depending on the quantity. To simplify data input into the simulation program, the researchers assigned three colors to the materials based on the quantity searched, each representing a different product type.

**Table 3: Information on product quantities, operator working hours, and raw material color specifications.**

| Material | Quantity (pcs) | Color | ABC Class | Avg. Time Before Improvement (sec) | Avg. Time After Improvement (sec) | Time Reduction (sec) |
|---|---|---|---|---|---|---|
| Clear roofing sheet | 24 | Red | A | 1,695.22 | 1,254.16 | 441.06 |
| Screws | 17 | Green | B | | | |
| Barbed wire | 12 | Green | B | | | |
| Black wire | 21 | Green | B | | | |
| Nuts | 1 | Green | B | | | |
| Green roofing sheet | 1 | Blue | C | | | |

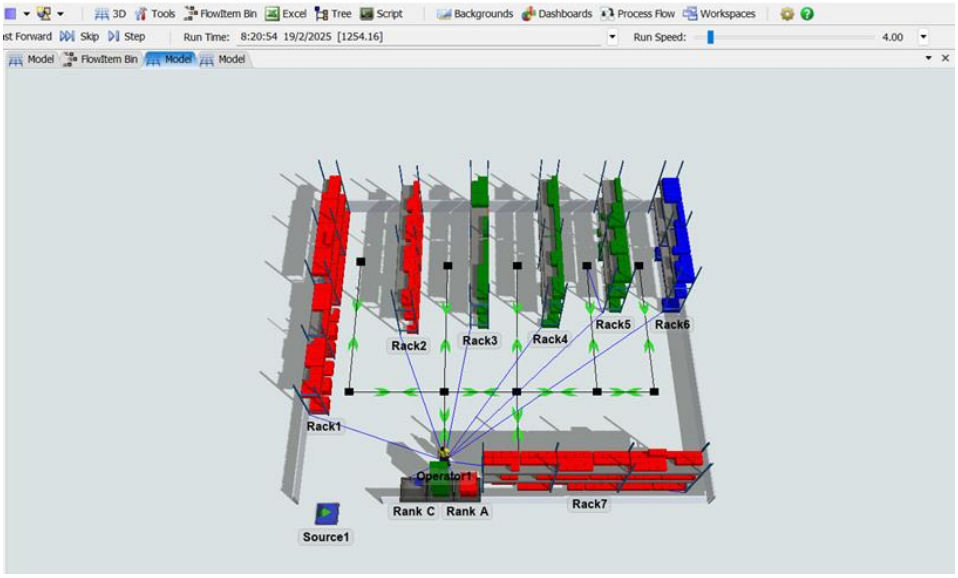
Create a warehouse model based on basic data consisting of racks and operators, and input product quantity data into an object named Source to simulate a realistic scenario, including picking and dispensing, transporting personnel to receiving and sending points or queues, as shown in Figure 4

*Figure 4: Model Plan A*




Model B, or Plan B, represents all shelves or racks. The researchers categorized the products using the ABC Classification Analysis theory, employing color coding: Group A, for example, transparent roofing sheets, represented by red; Group B, for screws, barbed wire, black wire, and nuts, represented by green; and Group C, for green roofing sheets, represented by blue.

*Figure 4: Model Plan B*




Model A took 1695.22 seconds, or 28.25 minutes, to execute because the inventory in the warehouse had not yet been reorganized, causing delays in item retrieval.

Model B took 1254.16 seconds, or 20.90 minutes, to complete because the items in the warehouse were categorized by color according to ABC Classification Analysis.

Based on the simulation and calculation of work time efficiency, the researchers have prepared a comparison table to clearly show the differences, as shown in Table 4

**Table 3: Comparison of time and performance of each model.**

| Medel Neme | Working time (seconds) | Time reduced (seconds) | Performance % |
|---|---|---|---|
| Model Plan A | 1,695.22 | 441.06 | 26.03 |
| Model Plan B | 1,254.16 | | |

From the table, it can be seen that Model B takes 441.06 seconds less time than Model A, thus demonstrating an increase in performance.

## 5. Conclusion

The optimization of warehouse management at Siamphan Salaya Co., Ltd. using simulation techniques in Flexsim resulted in a new warehouse layout. The old warehouse layout sometimes resulted in staff absences, leading to difficulties for substitute staff in locating items and causing delays in order fulfillment. The new warehouse layout simulation reduced picking time by 441.06 seconds, significantly speeding up the picking process. This aligns with the research by Susimol Matchada and Wissawa Aunyawong (2024) who stated that purchasing strategies have a positive influence on operational efficiency and inventory management, while inventory management positively impacts operational efficiency, and purchasing strategies indirectly influence operational efficiency through inventory management. This is consistent with the research by Thamanee Sukhsai (2019) which compared warehouse optimization using Flexsim, showing a reduction in picking time from 55 minutes to 45 minutes per item before and after improvement. Furthermore, it reduced picking costs and increased process reliability, with the number of customers waiting for goods at the warehouse increasing from 89% to 92% after the optimization. In line with Chayut Banthongjit (2018) who stated that a new product layout model was developed using ABC analysis to reduce the time taken to move goods out of the warehouse, the design of the new layout system used warehouse layout simulation with Flexsim software. Comparing the simulations of the old and new warehouse layouts, the results of the new warehouse simulation showed a 27.27% reduction in product movement time. Nantawan Somsri and Supharit Lekdee (2020) stated that inventory and inventory management are as follows: Inventory refers to goods stored in a warehouse for future use or resale, while inventory management is the planning and control of inventory at an optimal level. The goal is to reach the reorder point to meet customer demand in a timely manner while minimizing inventory-related costs. Kritsana Chuga and Naiyaporn Ketwiriyakul (2017) stated that inventory management is the management of the quantity or value of inventory at each period to create a balance between the demand and supply of each inventory item. This ensures that there is sufficient and timely supply of goods and services to customers, thereby generating sales, maintaining market share, and minimizing inventory investment to the lowest possible

level, thereby reducing production costs. Four commonly used methods are ABC Analysis, Cycle Counting, Record Accuracy, and Control of Services Inventories.

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