# CHAPTER I
# INTRODUCTION

This chapter contains background, problem formulations, research objectives, research scope, and outline of the final project report.

## 1.1 Background

Operational efficiency is one of the crucial aspects in order to achieve success of a company, especially in the manufacturing and distribution sectors. In modern industry, warehouses play an important role to connect some points in supply chain, for example from suppliers to consumers and from suppliers to manufacturing department. Efficient warehouse operations are critical to the success of a supply chain. Efficient operations help reduce costs, improve customer service, and increase the overall efficiency of the supply chain (Richards, 2022). With increasingly fierce global competition, companies must continue to innovate in managing their warehouses to ensure fast and timely delivery.

One of the biggest challenges in warehouse management is layout, as a poorly organized warehouse can significantly increase the time needed to search for goods, extend material handling distances, and lead to inefficient use of space. According to Tompkins et al. (2010), poor warehouse layout management can raise operational costs by up to 20%, ultimately impacting distribution efficiency and overall productivity. In many cases, warehouses also struggle with overcapacity, a condition in which the volume of stored goods exceeds the available space due to factors such as poor inventory planning, fluctuating demand, or limited responsiveness to consumption trends. Overcapacity often results in random placement of goods and creates multiple forms of operational waste, especially from a lean warehousing perspective. These include waste of motion where workers must travel farther to access goods, waste of waiting caused by delays in retrieving items from congested or disorganized areas, and waste of inventory when excessive stock occupies valuable space without immediate utility. Furthermore, the inability to implement a proper first-in-first-out (FIFO) system is another common issue in such environments. The FIFO system is critical for ensuring that older items are issued first to minimize product deterioration and support better inventory turnover (Richards, 2022). However, without a well organized layout and storage logic, the FIFO process becomes difficult and inefficient, further emphasizing the need for effective warehouse design and management (Tompkins et al., 2010)

PT Semen Padang is one of the largest cement manufacturing company in Indonesia. This company has six warehouses for inventory unit, namely administration, packing plant, spare parts, general goods, bulk, and operating supply warehouse. In general, the inventory unit at PT Semen Padang is responsible for the continuity of availability, receipt, storage, and maintenance of all items in the warehouses. The type of operational warehouse at PT Semen Padang is called an operating supply warehouse. Operating supply warehouse is an important facility in the sustainability which is a storage facility used to store operational item needed to support cement production activities.

Operating supply warehouses store consumable materials and auxiliary supplies that support the cement production process but are not included in the cement composition. These materials include cement bags, oil and grease, grinding balls, detonators, castables, and anchors. Operating supply warehouse area consists of six buildings, namely two cement bag warehouses, one oil and lubricant warehouse, one grinding ball warehouse, one detonator warehouse, and one refractory warehouse (which stores firebrick, castable, and anchor). These warehouses are located in separate locations but are still in the same main area of the PT Semen Padang factory in Indarung, Lubuk Kilangan, Padang City.

The operating supply section consists of two sub-sections, namely receiving and storing goods and issuing goods. The work of the inventory unit in the operating supply section is carried out using SAP (System Application and Product in Data Processing) software. Stages of operating supply warehouse goods storage begins with transferring posting (TP) and ends with conducting stock opname with updated stock data. Meanwhile, the operating supply goods issuance process is held when the user makes a purchase transaction. The goods are issued after the user receives the printed goods issue slip, the warehouse displays the document as proof that the user can take the goods from the warehouse.

One of the warehouses is the cement bag warehouse, that stores various types of cement bags. The cement bag warehouse in the operating supply section is different from the cement bag warehouse in the packing plant section. The operating supply section cement bag warehouse stores cement bags that come from purchases from suppliers, while the packing plant warehouse stores cement bags that are produced by PT Semen Padang's own packing plant unit in Bukit Putus. The cement bag of operating supply section warehouse has 2 different buildings namely warehouse I and warehouse II. The size of bag warehouse I has an area of 360 $m^2$ with a building length of 27 m and a width of 13 m. Meanwhile, warehouse II has an area of 684 $m^2$ with a building length of 19 m and a width of 36 m. Items are stored using pallets of the same size for all types of products, namely 1.1 m x 1.1 m. In the current situation, only warehouse I is used to store cement bag.

The types of cement bags stored in the cement bag warehouse area are used for mixed cement types, consisting of Portland Composite Cement (PCC), Portland Pozzolan Cement (PPC), and Oil Well Cement (OWC) with various types of materials and bag sizes with the total 25 types of SKU (Stock Keeping Unit). The production of cement bags uses a make to stock strategy that produces goods based on a certain stock level and stores them in the warehouse ready for distribution. The products stored are bought out items obtained from domestic and foreign suppliers. This warehouse is the busiest warehouse in the operating supply Semen Padang section because of the high frequency of incoming and outgoing goods every month. Depiction of the activity of cement bags entering and leaving the warehouse during 2024 is illustrated in **Figure 1.1** below.

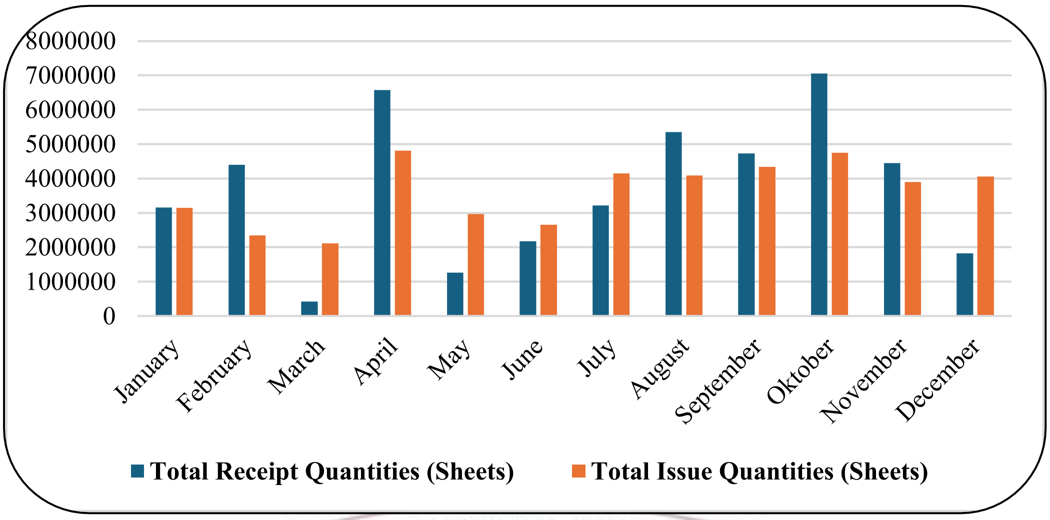


**Figure 1.1** Number of Receipt and Issue of Cement Bag per Month in 2024

This warehouse uses a storage type in the form of block stacking with unit load. Block stacking is a method of storing single SKU that are packaged in unit loads and stacked on the floor using pallets to a safe maximum height (Richards, 2022). An unit load (UL) is a package or collection of items that are combined to facilitate efficient handling. The unit load (UL) can manifest in various forms such as barrels, bales, crates, sacks, boxes, pallets, skids, tote pans, and containers, depending on the specific industry and application. Although the concept of a UL is simple enough, it is crucial for numerous operations, including transportation, storage, packaging, and distribution especially in a warehouse (Al-Hourani, 2022). Unit-load warehouses is one of those widely used in large distribution centers or raw materials warehouse and finished products warehouse in a manufacturing company. Unit-load warehouses often store goods in large load units, such as pallets, which allows the use of material handling equipment such as forklifts.

The use of unit loads in this warehouse is based on the size of the packaging of goods which has quite large dimensions of 1,1 m x 1,1 m x 1,3 m . The process of handling incoming and outgoing materials in this warehouse is carried out using a forklift due to the massive size of the unit load. Meanwhile, the pallets used for all goods are the same size, 1,1 m x 1,1 m. . In warehouse I, there are 17 slots, each measuring 4 m by 3 m. Each slot can store 24 pallets with an arrangement of 3 long pallets, 2 wide pallets, and stacked 4 pallets.  Meanwhile in warehouse II, there are

17 slost available, each measuring 4 m by 7 m. Each slot can store 72 pallets with an arrangement of 3 long pallets, 6 wide pallets, and stacked 4 pallets.   Each slot in the warehouse  is designated for a single type of cement bag and serves as the product storage area. Cement bags can be stacked up to 4 pallets based on interviews with inventory staff. Each slot can store 24 pallets with an arrangement of 3 long pallets, 2 wide pallets, and stacked 4 pallets.  Current condition of cement bag warehouse I and II can be seen in **Figure 1.2** and **Figure 1.3**  below.

**Figure 1.2** Current Condition of Cement Bag Warehouse I

**Figure 1.3** Current Condition of Cement Bag Warehouse II

Preliminary assesment were made at the warehouses by considering the criteria for good warehouse layout. Richards (2022) explains that an efficient warehouse layout is a layout that can reduce the number of trips and labor touch points. In addition, it must also be able to avoid congestion and traffic intersections and ensure that movement within the warehouse takes place in a logical sequence. Based on the characteristics of a good warehouse layout, there are also criteria that must be met by a warehouse. The criteria used refer to Richards (2022) who assesses various aspects of warehouse layout can be seen in **Table 1.1** below.

**Table 1.1** Criteria for Good Warehouse Layout According to Richards (2022)

| No. | Criteria | Evaluation | | | |
|---|---|---|---|---|---|
| | | None | Not Enough | Good | Perfect |
| 1 | All exits are clear | | | | √ |
| 2 | Are the floor surfaces in good condition (clean and dry)? | | | √ | |
| 3 | Doors are sufficient for the volume of traffic entering and exiting the warehouse | | | | √ |
| 4 | Warehouse is clean and tidy | | √ | | |
| 5 | Sufficient space between the end of the storage area and the outer wall | √ | | | |
| 6 | Are storage areas regularly inspected? | | √ | | |
| 7 | Are there any damaged or collapsed pallets? | | √ | | |
| 8 | The aisles are wide enough for MHE | | | √ | |
| 9 | Barrier-free for the aisles | | √ | | |
| 10 | Enough space for empty pallets | √ | | | |
| 11 | FIFO stock rotation is followed correctly | √ | | | |
| 12 | Best-before-date stock (with expiration date) is managed | √ | | | |
| 13 | Location ID is clearly marked | | √ | | |
| 14 | Is slot assignment used effectively? | √ | | | |
| 15 | Random location system is used | | | √ | |
| 16 | Is the volume utilization at the location efficient? | √ | | | |
| 17 | Is the location utilization already at 80%-90%? | √ | | | |
| 18 | Product search is easy to do | √ | | | |
| 19 | Have damaged goods been correctly identified and handled appropriately? | | √ | | |
| 20 | Are items stored in the correct location? | | √ | | |
| 21 | Fast moving goods are placed in the most accessible locations | √ | | | |
| 22 | Items with the same properties are placed close together | √ | | | |

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The observations were carried out by comparing the criteria for good warehouse layout with the actual warehouse conditions. Based on the **Table 1.1** above, it can be seen that the cement bag warehouse of PT. Semen Padang does not meet several criteria, especially in the storage and retrieval of items activity. Items are often stored in empty areas without considering movement patterns or frequency of use, which causes difficulties when implementing the FIFO system.

This also causes piles of item that are not organized and difficult to access, making it difficult to issue items. Operators also have difficulty finding items to be removed. Often there is also stock of items with a fairly long storage period because taking items is only done on goods that are easily accessible. Apart from that, there is also dead stock of 11 types of SKUs that are no longer used. Failure to meet these criteria causes problems especially in the operational part of the operating supply cement bag warehouse, especially when there is increasing demand for several types of cement bags that made this warehouse is experiencing overcapacity and difficulty in managing storage space.

These conditions indicate the existence of waste in the form of unnecessary motion, overstocking, waiting time, and inefficient transportation. These issues affect workflow and mobility within the warehouse. From a lean warehousing standpoint, poor layout leads to fragmented processes that do not create value for the customer and instead increase lead time, operational cost, and the risk of inventory obsolescence. This has an impact on cost and operational inefficiency and ultimately affects the quality of service.

In terms of the costs of the 6 operating supply warehouse section, the cement bag warehouse is the warehouse with the highest operational costs, reaching 60% of the total costs of all operating supply warehouses. So that the increase in material handling activity and movement also contributes to the high operational costs of the operating supply warehouse section. These unnecessary movements are a form of waste that must be reduced through layout optimization, standard work procedures, and better flow management.

This study adopts a lean warehousing approach, focusing on the identification and elimination of waste in warehouse operations to explore and provide solutions to warehouse management problems faced by cement bag warehouse of PT Semen Padang. The main focus of this study is the optimization of the warehouse layout to eliminate waste with the aim of improving operational efficiency. It is hoped that with the improvisation, the cement bag warehouse can reduce the time to search for goods, increase storage capacity, and maximize the utilization of available space.

## 1.2 Problem Formulation

The formulation of the problem in this research is how to apply lean warehousing principles in PT Semen Padang's Cement Bag Warehouse to identify and eliminate operational waste in order to reduce inefficiencies and improve warehouse performance.

## 1.3 Research Objectives

The objectives of the research are as follows.

1. Identifying waste and applying the lean warehousing approach as a complementary solution to enhance warehouse system improvements.
2. Design a more efficient warehouse layout based on the pattern of items movement and storage space requirements with the criteria of material handling cost for each storage location in the warehouse.

### 1.4 Research Scope

The scope of the research are as follows.

1. The study conducted at the cement bag warehouse which is part of the operating supply warehouse section of PT Semen Padang.
2. The data used includes historical data on the frequency of items in and out for the last 1 year.
3. The type of items analyzed are cement bags that are stored on pallets.
4. This study considered only the operational cost affected by material handling movement and travel distance, namely cost of consumable items.

### 1.5 Outline of Report

The outline of this report that consists of six chapters as follows.

**CHAPTER I INTRODUCTION**

This chapter includes background, problem formulations, research objectives, research scope, and outline of proposal.

**CHAPTER II LITERATURE REVIEW**

This chapter includes is about literature review and theory related to the research.

**CHAPTER III RESEARCH METHODOLOGY**

This chapter includes preliminary study, problem identification, method selection, warehouse layout redesign stages, analysis, and flowchart of the research.

**CHAPTER IV LEAN WAREHOUSING IMPROVEMENT PROCESS**

This chapter includes problem and waste identification, mathematical formulation, visualization of new warehouse layout, travel distance evaluation, and 5S.

**CHAPTER V ANALYSIS**

This chapter includes analysis of the result of lean warehousing improvement process.

**CHAPTER VI CONCLUSION AND RECOMMENDATION**

This chapter includes conclusion of this study and recommendations for further study.

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