International Journal of Allied Research in Engineering and Technology (IJARET)
Volume.13, Number 1; January-2022;
ISSN: 2836-5631| Impact Factor: 5.52
https://zapjournals.com/Journals/index.php/ijaret
Published By: Zendo Academic Publishing

REDESIGNING RICE REFINERY WAREHOUSE LAYOUTS THROUGH THE SHARED STORAGE APPROACH

[1]E. Fahrizal, [2]M. Imam, [3]S. Masthura Hassan, and [4]E. Saputra,

Article Info

Keywords: Warehouse layout, finished products, manufacturing industry, shared storage method, FIFO principle, PT. Kilang Padi Mutiara refinery, material handling, inventory management.

Abstract

The rapid development of the industrial world and advancements in technology have fostered significant growth in the manufacturing industry. However, this progress has also led to various challenges, such as warehouse layout issues for finished products. Warehouses serve as critical storage spaces for raw materials, goods in process, and the final products for distribution. The effectiveness of the storage system in the manufacturing industry plays a pivotal role in ensuring product quality and quantity [1] [2] [3]. Unfortunately, poor warehouse layouts have resulted in damaged finished products [4] [5], necessitating the establishment of efficient storage systems.

This study focuses on PT. Kilang Padi Mutiara Refinery, a prominent rice-producing company in Samudra District, Kab. North Aceh. The company operates three production lines for rice, groats, and bran and possesses a single finished product storage warehouse measuring 28 x 21 m2 with a door of 1.95 m2 [8] [9]. Despite its significance, the current warehouse layout at PT. Kilang Padi Mutiara is disorganized and based on inadequate inventory management, leading to mismatches between stored products' type and size. This mismanagement results in limited space within the warehouse and a cluttered environment, causing product build-up and damage to packaging [10] [11].

Another issue that arises due to the current layout is the prolonged material handling distance and time. The chaotic product arrangement necessitates extra efforts for operators to retrieve desired products, especially when obstacles obstruct material handling routes. Consequently, operators must first clear the pathway before accessing the intended products, leading to increased material handling mileage [12] [13].

[1] Department of Industrial Engineering, Faculty of Engineering, Universitas Malikussaleh, Aceh, Indonesia
[2] Department of Industrial Engineering, Faculty of Engineering, Universitas Malikussaleh, Aceh, Indonesia
[3] Department of Industrial Engineering, Faculty of Engineering, Universitas Malikussaleh, Aceh, Indonesia
[4] Department of Industrial Engineering, Faculty of Engineering, Universitas Malikussaleh, Aceh, Indonesia

In response to these challenges, this research proposes the implementation of the shared storage method using the FIFO (First In, First Out) principle to optimize the finished product warehouse layout at PT. Kilang Padi Mutiara. By prioritizing goods that are sent out frequently and placing them closer to the main entrance and exit, the proposed layout aims to improve organization and efficiency in the warehouse [16] [17] [18]. The evaluation of the current layout and the subsequent redesign using the shared storage method will significantly reduce material handling mileage, which is evident from the calculation results indicating a decrease from 719.56 m to 593.33 m [14] [15].
In conclusion, this study endeavors to address the challenges associated with the finished product warehouse layout at PT. Kilang Padi Mutiara refinery. Through the application of the shared storage method and the FIFO principle, the proposed layout seeks to enhance organization, accessibility, and overall efficiency in the warehouse [4] [19] [20] [21]. It is hoped that this research will contribute valuable insights to the optimization of warehouse layouts in the manufacturing industry, thereby improving the storage and handling of finished products.

1. Introduction

The development of the industrial world, which is increasing rapidly and followed by increasingly advanced technological developments, not only makes the manufacturing industry develop well but can also cause several problems. One of the problems we often find in the manufacturing industry is the problem of warehouse layout, especially for finished products [1] [2] [3]. The warehouse is a place for storing goods, raw materials, materials to be processed, to finished products to be distributed. Storage plays an essential role in the manufacturing industry. Many finished products are damaged due to the poor location and layout of the warehouse [4] [5]. This causes the need for a warehouse with a sound storage system for the quality and quantity of a product that will be stored in the warehouse [6] [7].

PT. Kilang Padi Mutiara Refinery is a rice-producing company located in Samudra District, Kab. North Aceh. PT. Kilang Padi Mutiara refinery has three production lines, namely rice, groats, and bran, and has one finished product storage warehouse with an area of 28 x 21 m2 with a door of 1.95 m2 [8] [9].

From the observations made for the placement of finished products PT. Kilang Padi Mutiara refineries such as rice, bran, and groats in the storage warehouse are still not neatly arranged due to the arrangement is not based on a good inventory, so the products in the warehouse do not match the type and size, which results in the warehouse being narrower and seems messy, this also triggers the occurrence of product buildup due to narrow storage locations causing damage to the finished product packaging which often falls due to excessive accumulation [10] [11].

Another problem factor is the material handling distance becomes longer and takes quite a long time. This is based on a messy product arrangement where the products that go out more often should be close to the entrance and exit, besides that there are obstacles in the road or aisle that are used as material handling roads, causing the operator to first move the product that is blocking the road and then return to the road. material handling to pick up the desired product [12] [13].

Based on the results of observations and measurements, the material handling mileage in the initial layout is 719.56 m, while the material handling mileage in the proposed layout is 593.33 m where with the proposed layout, it can be seen that the distance comparison is quite significant so that the results For these calculations, it is necessary to plan the layout of the proposal using the shared storage method [14] [15].

This underlies the need to evaluate the layout of the finished product warehouse at PT. Kilang Padi Mutiara refinery redesigns the warehouse layout to be more organized and tidy through the shared storage method using the FIFO (First In, First Out) principle, where goods sent more often are placed close to the main door in and out of the warehouse [16] [17] [18].

Based on the problem description, research will be carried out for the proposed improvement of the finished product warehouse layout with the title "Warehouse Layout Planning Using the Shared Storage Method at PT. Kilang Padi Mutiara [4] [19] [20] [21].

2. Literature Review

2.1 Definition of Layout

Layout or layout is a facility design, forming one or more concepts, analyzing and reviewing, and realizing a network system for goods and services. The design is described as a floor layout design, which is an arrangement of facilities such as (land and buildings) to maximize the relationship between officers and implementers as well as the flow of information and the flow of goods, as well as the procedures used to achieve business and company goals safely and effectively economical [22].

The layout notion seen from the production system is the arrangement of production facilities to achieve production efficiency. A good layout can really help companies determine the need for space and the efficient and practical use of space [23].

2.2 Definition of Warehouse

The warehouse is a facility that functions as a place to store a product or goods, both produce results and raw materials or other types of goods where the goods or products will be stored in the warehouse before the distribution of goods or until the request is fulfilled for distribution or delivery of goods to consumers.

A warehouse is a place used to store goods, raw materials that will be processed later to become finished materials or finished goods that are ready to be marketed. While warehousing is a process of suitable activities for storing goods, receiving goods, recording goods, selecting and sorting, and sending goods. While the purpose of the storage is to manage goods so that no damage occurs when storage is carried out in the warehouse before the goods are distributed and reach consumers, before storing goods in the warehouse some things need to be considered when storing in the warehouse as follows, namely as follows:

a. Estimating space requirements and using the entire area of the room as much
as possible. b. Make the most of the tools.
c. Maximization of road access to all storage areas.
d. Maximization of protection for all stored goods.

2.3 Warehouse Storage Method

There are four methods of setting the location of storage of goods, namely:

1. Dedicated storage method

   This method is often referred to as fixed storage because the location of the goods to be stored has been determined. The amount of space to store must be sufficient and by the maximum storage space requirements of the product. Space requirement is a calculation to determine the storage location of certain products. This formula aims to ensure that there is only one product placed on a warehouse shelf storage location. The following is a formula that can be used to calculate the space requirement.

$$\textit{Storage area requirement} = \frac{\textit{Monthly Product Storage Requirement}}{\textit{Monthly Storage Capacity}} \quad (1)$$

2. Randomized storage methods.

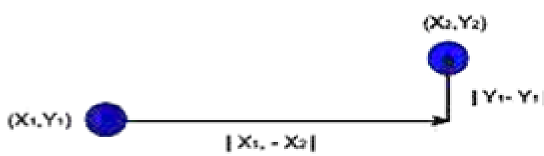
   This method is often referred to as floating lot storage, which is storage that may change locations or areas at a particular time. Goods must pay attention to the closest distance to the storage area using the FIFO (First In, First Out) system.

3. Class-based dedicated storage method
   This method is a combination of randomized storage and dedicated storage methods. With this method, the product is divided into several classes based on the ratio of throughput (T) and storage ratio (S). This method creates location rules which will later be used to design to be more flexible by dividing the storage location into several parts. Each place can be filled randomly with the type and size of goods that have been selected.
4. Shared storage method
   The Warehouse Head or warehouse manager uses various types of dedicated storage methods as a solution to reduce storage space requirements. Different products but suitable storage space, even if one product occupies one place when the slot is filled. This type of storage is also known as shared storage. This method has a difference, the shared storage method is more suitable for use with various types of products and relatively continuous demand. To reduce storage space in dedicated storage, warehouse managers use several types of dedicated storage to place the final product, which is arranged to be more careful. Especially at different times but using the exact same storage space, even though the final product occupies the slot only once. In shared storage considerations, if the pallets that arrive are about a hundred pallets in large quantities, "fast circulation of goods moves" from the product to be stored.

2.4 Material Transfer

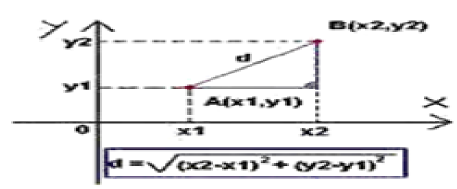
Materials are moved manually or using automated methods, materials can be moved more than once. Materials can be placed in a fixed or random area. If there are two workstations, namely stations A and B, with coordinate points (x, y) and (a, b), then to calculate the distance between the two midpoints at B, several methods can be used, namely as follows:

1. Rectilinear Distance
   Calculation of distance by measuring the length of the path with a perpendicular line. An example is a material moving along an aisle or aisle in a warehouse.



$$d_{ij} = |x-a| + |y-b| \quad (2)$$

2. Euclidean Distance
   Measurement Fixed distance is measured by the length of a straight line path between two points. The Euclidean distance can be described by a straight conveyor cutting two workstations.



$$d_{ij} = \sqrt{[(x2-x1)^2 + (y2-y1)^2} \quad (3)$$

3. Squared Euclidean Distance
   With this method the measurement of distance is also measured based on the actual length of the path that passes between two points. For example, in a guided vehicle system, the vehicle on its journey must follow the directions that have been determined on the controlled track network. Therefore, the flow path distance can be longer than that of rectilinear or Euclidean.

$$d_{ij} = (x-a)^2 + (y-b)^2 \quad (4)$$

2.5 Types of Warehouse Layout

According to Apple (1990), in determining the layout of the warehouse in addition to the size of the room, the cargo capacity area of the warehouse must also be determined by arranging the layout of the goods stored.

Warehouses with messy storage areas are certainly less effective and efficient and don't look neat. There is a part that really needs to be considered carefully, namely the type of material that will be stored later in order to know the process of movement of the product, including the following:

1. Fast moving, is goods with fast circulation.
2. Slow-moving, is an item with slow circulation.

Based on the flow and entry and exit of goods, several forms of layout can be applied in the warehouse, namely:

1. Simple straight-line current
   By using a simple straight-line flow layout, the flow of goods will look straight, and the process of entering and leaving the product is not hindered by aisles or aisles and bulkheads so the process is relatively better and faster. The location of the goods storage area is distinguished between fast-moving and slow-moving goods. Goods with fast circulation will be stored near the exit and vice versa, if the goods are slow, will be placed near the entrance. A simple straight-line current is like the following picture:

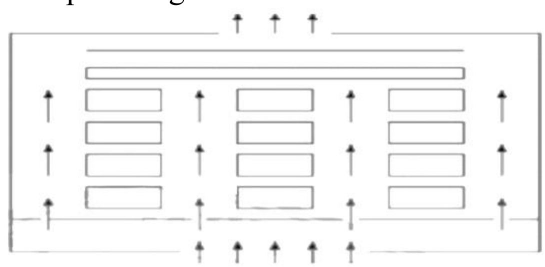


Fig 1: Straight Line Flow Layout
Source: Binus Library

2. Layout "U"
   It is a process of entering and leaving an item through the hallway so that the taking and storing of goods is relatively longer. The warehouse layout with "U" flow can be seen as shown below

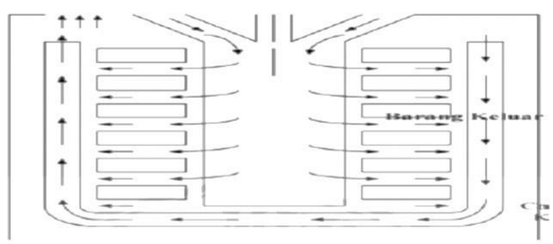


Fig 2: Flow Layout "U"
Source: Binus Library

3. Layout "L"
   It is an L-shaped flow where the goods will go through the process of entering and leaving through the aisle but not experiencing too many winding currents due to the aisle or aisle so as to facilitate the retrieval and storage process and make the process relatively fast. The warehouse layout with flow "L" can be seen as follows:

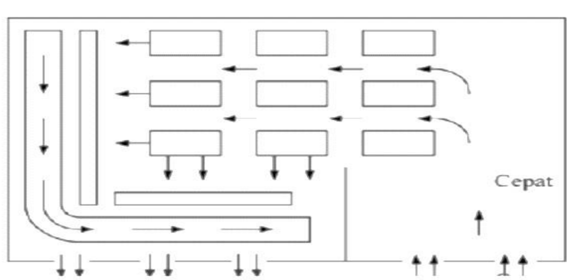


Fig 3: Flow Layout "L"
Source: Binus Library

3. Method

3.1 Stages of Research Implementation

This research was conducted at PT. Kilang Padi Mutiara, which is located in Samudra District, Kab. North Aceh. The overall time of research was carried out starting from April 2022 to September 2022. In this study, the research object is the warehouse where the finished product is stored at PT. Kilang Padi Mutiara.

3.2 Data Collection Techniques

Based on its nature, this research is classified as descriptive research, which seeks to explain problem-solving to an existing problem systematically and factually and data. So this research includes collecting, presenting, and processing data and problem-solving analysis. In this study, the author uses two types of data as research material, namely primary data and secondary data.

1. Primary Data
   Is data obtained directly from the object of research? The primary data needed for this research are product number data, product demand data, warehouse floor area data, product type data, material handling type, displacement distance, the process of taking goods in the warehouse, and the layout of goods in the warehouse.
2. Secondary data
   Secondary data is data obtained by studying literature related to research and company documents. The secondary data needed in this research is the incoming and outgoing data of products in the warehouse in 2021.

3.3 Data Processing

Design for improved warehouse layout with shared storage for three alternative proposals. Space requirements for the proposed finished product warehouse, Product placement (assignments), Throughput (T) and stack (S) (T/S) calculations, Travel distance calculation between each storage stack, and I/O points Results and Discussion.

3.4 Processing Diagram

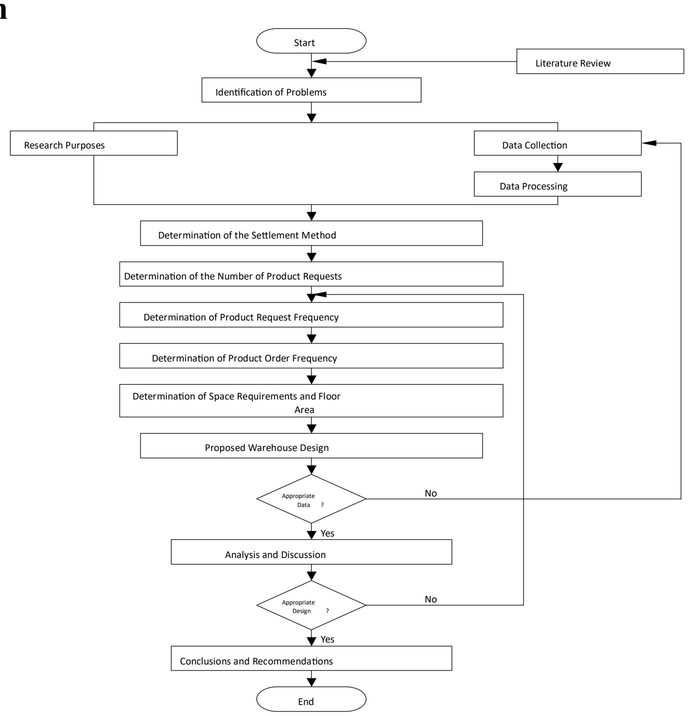


Fig 4: Processing Diagram

Source: Processing Data

4. Result and Discussion

4.1 Determining the Average Number of Product Requests per Month

To obtain the average number of requests for each product per month is by the formula:

$$\text{Product demand per month} = \frac{\Sigma \text{ Product demand per month}}{6}$$

Table 1: Recapitulation of Average Number of Requests per Month

No	Product Type	Number of Product Requests Monthly	Average Number of Requests Per Month
1	Special Ramos Rice 5 KG	3050	508
2	Balam Nail Rice 5 KG	2797	466
3	White IR Rice 5 KG	3496	582
4	Rice HSC 5 KG	1141	190
5	Special Ramos Rice 10 KG	1564	260
6	Balam Nail Rice 10 KG	1181	196
7	White IR Rice 10 KG	1487	247
8	Rice HSC 10 KG	2048	341
9	Local Rice SG 30 KG	1747	291
10	Rice IR SG 25 KG	994	165
11	Rice SG 10 KG	2226	371
12	Bran 30 KG	1391	231
13	Coarse Groats 25 KG	707	117
	Total	**23829**	**3965**

Source: Data Processing

4.2 Average Ordering Frequency of Each Type of Product Per Month

Viewed from Table 1, it can be determined how many orders for each product in one month. Then the average frequency of requests per month is determined, which can be seen in table 2 below:

Table 2: Frequency of Number of Requests Per Month

Product	Frequency Number of Requests Per month						Average
	Des	**Jan**	**Feb**	**Mar**	**Apr**	**Mei**	
Special Ramos Rice 5 KG	2	4	2	2	4	2	2
Balam Nail Rice 5 KG	2	2	3	2	3	4	2
White IR Rice 5 KG	3	2	5	2	2	4	2

Rice HSC 5 KG	1	1	1	2	1	2	1
Special Ramos Rice 10 KG	2	1	2	2	2	2	2
Balam Nail Rice 10 KG	2	2	2	1	2	1	2
White IR Rice 10 KG	1	1	2	2	1	1	1
Rice HSC 10 KG	3	1	1	1	1	1	1
Local Rice SG 30 KG	1	1	1	2	2	1	1
Rice IR SG 25 KG	1	1	1	3	1	1	1
Rice SG 10 KG	1	4	1	1	1	2	1
Bran 30 KG	2	4	2	1	3	2	2
Coarse Groats 25 KG	1	2	1	1	1	2	1

Source: Data Processing

4.3 Number of Products Per Order Each Type of Product Per Month

By knowing the average frequency of requests per month it can be determined the number of products per order for each product. It can be seen in table 3 below:

Table 3: Number of Requests Per Order

No	Product	Amount of Average Demand Per Month (Product) (1)	Request Frequency Per Month (2)	Number of Requests Per Order (1:2)
1	Special Ramos Rice 5 KG	508	2	254
2	Balam Nail Rice 5 KG	466	2	233
3	White IR Rice 5 KG	582	2	291
4	Rice HSC 5 KG	190	1	190
5	Special Ramos Rice 10 KG	260	2	130
6	Balam Nail Rice 10 KG	196	2	98
7	White IR Rice 10 KG	247	1	247
8	Rice HSC 10 KG	341	1	341
9	Local Rice SG 30 KG	291	1	291
10	Rice IR SG 25 KG	165	1	165
11	Rice SG 10 KG	371	1	371
12	Bran 30 KG	231	2	115
13	Coarse Groats 25 KG	117	1	117
	Total	**3965**		

Source: Data Processing

4.4 Laying Storage Area

After knowing the space requirements will be able to determine the number of areas that can be obtained. The area of the warehouse is 28 m x 21 m = 588 m2.

Then it can be arranged in such a way that the placement of the storage area in the warehouse is based on space requirements data (warehouse width and storage area). The location of the area can be seen in the following figure 5:

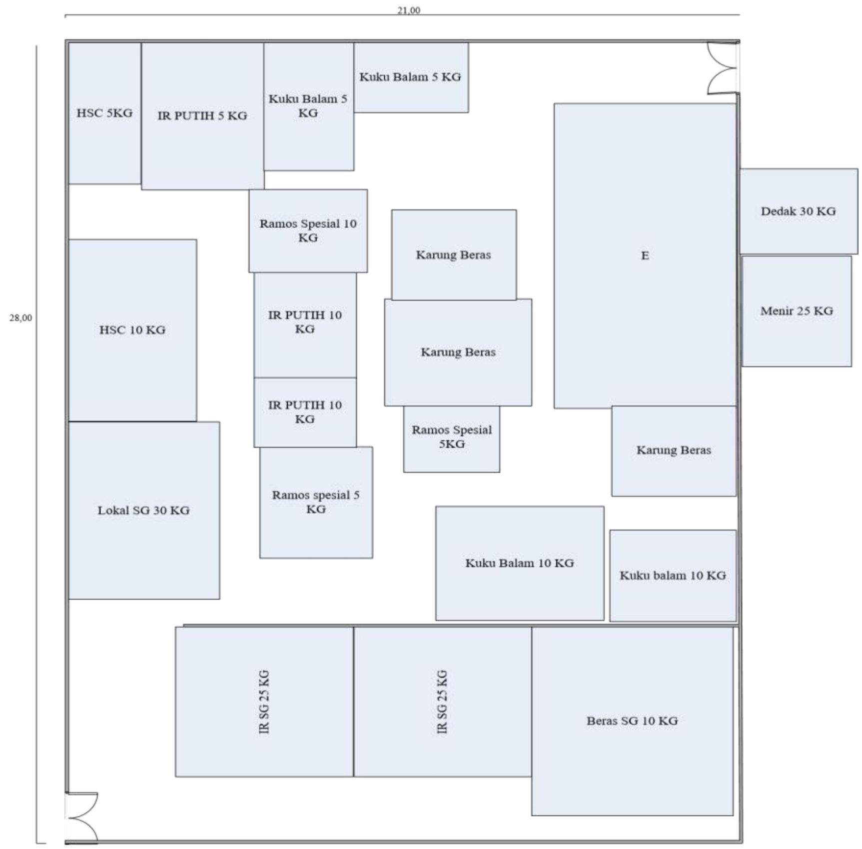


Fig 5: Initial Warehouse Layout

Source: PT. Kilang Padi Mutiara

In the shared storage method, filling the storage area is done by sorting the products sent faster to those closest to the entrance and exit. To make it easier to place, coding is done. The determination of the area from closest to farthest can be seen in table 4 as follows:

Table 4: Coding and Distance Between Doors to Storage Area

Area	Area Code	Distance (m)
Special Ramos Rice 5 KG	A1,A1	12,5
Balam Nail Rice 5 KG	A2,A2	16,6
White IR Rice 5 KG	A3,A3	17,5
Rice HSC 5 KG	A4,A4	17,56
Special Ramos Rice 10 KG	B1	19,1
Balam Nail Rice 10 KG	B3	19,5
White IR Rice 10 KG	B3	20,59
Rice HSC 10 KG	B4	21,66
Local Rice SG 30 KG	B5	23,41
Rice IR SG 25 KG	C1	23,41
Rice SG 10 KG	C2	23,41
Bran 30 KG	D1	39,00

Coarse Groats 25 KG	D2	39,00

Source: Data Processing

After laying the area, measuring the distance, and coding based on the closest distance to the door, the proposed warehouse layout has been completed.

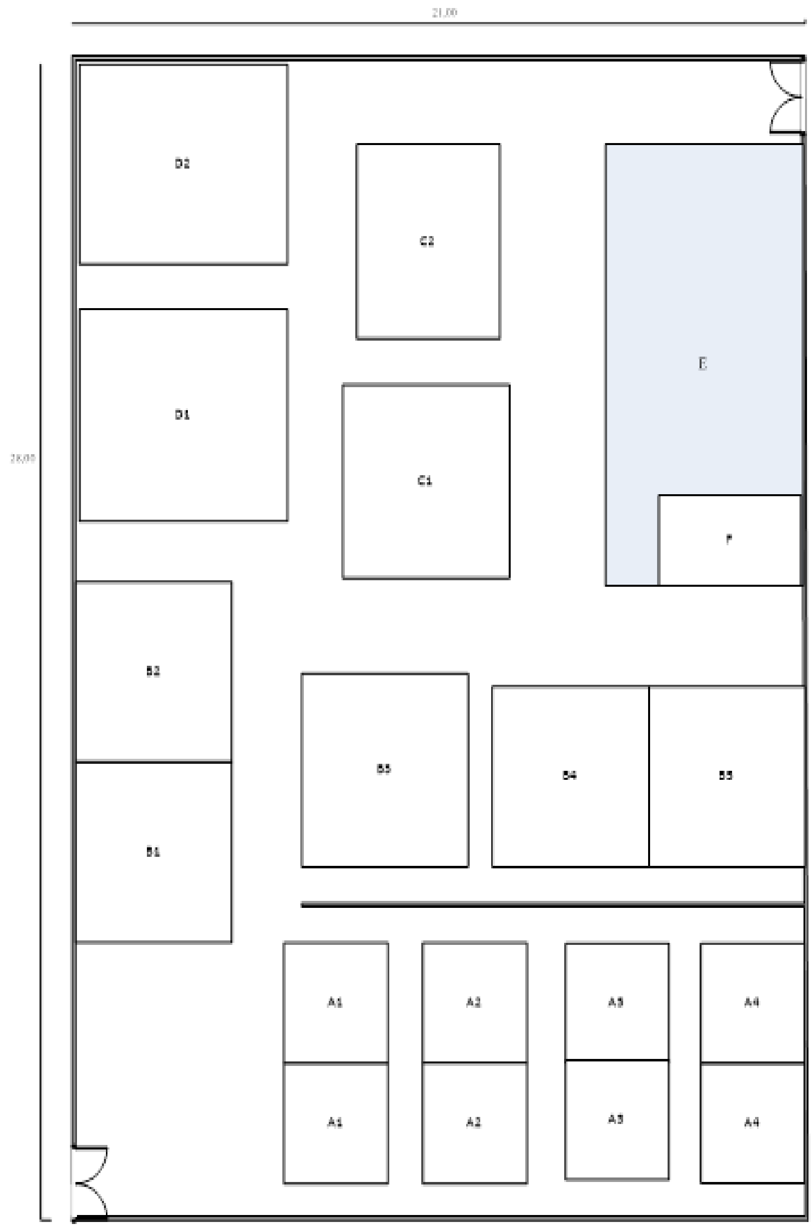


Fig 6: Proposed Warehouse Layout
Source: PT. Kilang Padi Mutiara

4.5 Average Monthly Material Handling Mileage Using Previous Warehouse Layout

Mileage on material handling can be obtained by calculating the distance traveled during delivery multiplied by two, the calculation of the material handling mileage can be seen in table 5 as follows:

Table 5: Average Material Handling Mileage Initial Layout

No	Product	Mileage During Delivery	Total Mileage
1	Special Ramos Rice 5 KG	22,81	45,62
2	Balam Nail Rice 5 KG	28,66	57,32
3	White IR Rice 5 KG	28,66	57,32
4	Rice HSC 5 KG	28,66	57,32
5	Special Ramos Rice 10 KG	25,84	51,68
6	Balam Nail Rice 10 KG	21,58	43,16
7	White IR Rice 10 KG	22,75	45,05
8	Rice HSC 10 KG	26,91	53,82
9	Local Rice SG 30 KG	24,35	48,7
10	Rice IR SG 25 KG	44,25	88,05
11	Rice SG 10 KG	24,75	49,05
12	Bran 30 KG	17,75	35,05
13	Coarse Groats 25 KG	44,25	88,05
	Total		**719,56**

Source: Data Processing

Average Monthly Material Handling Mileage Using Proposed Warehouse Layout

Based on the procedures and layouts in the previous warehouse layout to determine the distance to the material handling layout of the proposed warehouse layout, the same calculation is carried out using the rectilinear distance method. Calculation of material handling mileage in the proposed warehouse layout can be seen in table 6 as follows:

Table 6: Average Material Handling Mileage Proposed Layout

No	Product	Mileage During Delivery	Total Mileage
1	Special Ramos Rice 5 KG	16,03	32,06
2	Balam Nail Rice 5 KG	19,87	39,87
3	White IR Rice 5 KG	22,93	45,86
4	Rice HSC 5 KG	25,73	51,46
5	Special Ramos Rice 10 KG	17,07	34,14
7	Balam Nail Rice 10 KG	18,03	36,06
7	White IR Rice 10 KG	18,03	36,06
8	Rice HSC 10 KG	25,28	50,56
9	Local Rice SG 30 KG	28,83	57,66
10	Rice IR SG 25 KG	23,04	46,08
11	Rice SG 10 KG	27,82	55,64
12	Bran 30 KG	24,21	48,42
13	Coarse Groats 25 KG	27,39	54,78

Total	**593,33**

Source: Data Processing

Comparison of the proposed warehouse layout with the previous warehouse layout

1. The average material handling distance per month for the initial warehouse layout is 719.56 m; after calculating and placing it according to the shared storage method using the first in, first out principle, better results are obtained for material handling mileage.
   for the proposed warehouse layout of 593.33 m.
2. By setting the proposed warehouse layout, it will be easier to place the product due to the placement of one product in one area.
3. Analysis of the results on the layout of the proposed product placement shows better than the previous placement method. This can be seen from the effectiveness of the distance between the doors to the storage area, namely from the product placement process system where the products stored in each area are organized so that when the loading and unloading process no longer results in queues during product storage or delivery.

5. Conclusion

1. Determining the layout in the warehouse so that product transportation is easier and more efficient can be done using the shared storage method, which starts by calculating the product demand where the results obtained will determine which products are placed near the entrance and exit area in accordance with a shared storage method that uses the first in first out principle, in this case the demand for rice products with a size of 5 kg becomes the product with the highest demand or the product with the most frequent delivery activities, then based on the first in first out principle, rice products are placed in the area close to the entrance and exit, then the warehouse layout in the product area with a size of 10 kg based on the calculation of rice products with a size of 10 kg has moderate activity and demand is not too high or low so this product area is placed in the middle area but still close to the entrance to the warehouse,
   for the p . area IR SG 25 kg rice products, 30 kg bran and 25 kg groats are placed at the end area of the warehouse layout because the activities are not too high but they are still given road or aisle access that can be passed by material handling for easy product retrieval.
2. Mileage on material handling can be obtained by calculating the mileage during delivery starting from the material handling location traversed by the entrance and exit to the product area to be transported and sent then, the total mileage is obtained by multiplying the previous distance by two. warehouse layout PT. Kilang Padi Mutiara refinery obtained material handling distance in the initial layout of 719.56 meters after rearranging the product area in the warehouse layout of PT. Kilang Padi Mutiara refinery resulted in a material handling mileage of 593.33, this indicates that there is a distance reduction in the proposed layout which can help regulate the product area so that the distance traveled is not too far and can reduce operational costs and be more efficient.

Acknowledgment

Thank you to LPPM Unimal for providing Research grants through PNBP funds which will be implemented in 2022.

References

O. Faruk, A. K. Bledzki, H. P. Fink, and M. Sain, "Biocomposites reinforced with natural fibers: 2000-2010," *Prog. Polym. Sci.*, vol. 37, no. 11, pp. 1552–1596, 2012, doi: 10.1016/j.progpolymsci.2012.04.003.

D. T. Liputra, S. Santoso, and N. A. Susanto, "Pengukuran Kinerja Rantai Pasok Dengan Model Supply Chain Operations

Reference (SCOR) dan Metode Perbandingan Berpasangan," *J. Rekayasa Sist. Ind.*, vol. 7, no. 2, 2018, doi: 10.26593/jrsi.v7i2.3033.119-125.

A. M. Dewi and N. B. Puspitasari, “Analisis Pengendalian Kualitas Menggunakan Metode Six Sigma pada Produk AMDK 240 Ml PT. Tirta Investama Klaten,” *Ind. Eng. Online J.*, vol. 7, no. 4, 2021.

M. S. Sofyan and A. S. Cahyana, “RELAYOUT GUDANG BARANG JADI UNTUK MEMAKSIMALKAN KAPASITAS

PRODUK JADI DENGAN MENGGUNAKAN METODE ACTIVITY RELATION CHART DAN SHARED STORAGE,” *SPEKTRUM Ind.*, vol. 15, no. 2, 2017, doi: 10.12928/si.v15i2.7552.

I. A. Marie, C. Claudia, and A. Adianto, “Optimasi Persediaan Bahan Baku Berdasarkan Pengali Lagrange serta Rancangan Tata Letak Gudang Menggunakan Metode Shared Storage,” *J. Tek. Ind.*, vol. 10, no. 2, 2020, doi: 10.25105/jti.v10i2.8394.

C. Candrianto, W. Amalia, and H. S. Ramadhan, “Analisis Penyimpanan Produk Menggunakan Metode Shared Storage (Studi Kasus di PT. X),” *Invent. Ind. Vocat. E-Journal Agroindustry*, vol. 1, no. 2, 2020, doi: 10.52759/inventory.v1i2.24.

J. Febiyanti, “Finished Product Warehouse Layout Design Using Shared Storage Method,” *J. Mekintek J. Mek. Energi, Ind. Dan Teknol.*, vol. 11, no. 1, 2020, doi: 10.35335/mekintek.v11i1.8.

A. Dewi, Z. Azhar, and R. Fauziah, “Analisis Komoditas Padi Pascapanen Berbasis E-SCM Studi Kasus Kilang Padi Sumber Rezeki,” *J-Com (Journal Comput.*, vol. 1, no. 1, 2021, doi: 10.33330/j-com.v1i1.1087.

R. A. Sirait, , V. N., and L. R. B. Ginting, “HUBUNGAN PENGGUNAAN ALAT PELINDUNG DIRI (APD) DENGAN KEJADIAN INFEKSI SALURAN PERNAPASAN AKUT (ISPA) PADA PEKERJA KILANG PADI,” *J. KESMAS DAN GIZI*, vol. 2, no. 2, 2020, doi: 10.35451/jkg.v2i2.417.

Z. Naini and D. Andriyani, “PENGARUH KEBERADAAN KILANG PADI KELILING TERHADAP PENDAPATAN KILANG PADI MENETAP DI KABUPATEN ACEH UTARA,” *J. Ekon. Reg. Unimal*, vol. 1, no. 2, 2018, doi: 10.29103/jeru.v1i2.561.

R. Octavariny, W. W. Siregar, S. M. br Bangun, and D. Sartika, “Hubungan Kebisingan Dan Beban Kerja Dengan Stres Kerja Pada Pekerja Bagian Kilang Padi,” *J. Kesehat. Masy. dan Lingkung. Hidup*, vol. 5, no. 2, 2020.

M. Siska and D. A. N. Henriadi, “Perancangan Fasilitas Pabrik Tahu Untuk,” *UIN Sultan Syarif Kasim Riau, Pekanbaru*, vol. 03, 2009.

M. A. Apriliyani, “Analisa Keterlambatan Berbasis Manajemen Risiko Pada Proyek Warehouse Lazada Tahap 2,” *Rekayasa Sipil*, vol. 8, no. 2, 2020, doi: 10.22441//jrs.2019.v08.i2.02.

M. Z. Mistarihi, “A data set on anthropometric measurements and degree of discomfort of physically disabled workers for ergonomic requirements in work space design,” *Data Br.*, vol. 30, 2020, doi: 10.1016/j.dib.2020.105420.

I. Pratiwi, E. Muslimah, and L. Belakang, “Di Industri Tahu Menggunakan Blocplan,” *J. Ilm. Tek. Ind.*, 2012.

M. Townsend, “Meet the Investors Willing to Bet $300 Million on Dov Charney - american apparel,” *Bloomberg Business*, 2016. .

T. Coelli, “A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program,” 2016.

P. D. Bates *et al.*, “Combined Modeling of US Fluvial, Pluvial, and Coastal Flood Hazard Under Current and Future Climates,” *Water Resour. Res.*, vol. 57, no. 2, 2021, doi: 10.1029/2020WR028673.

I. Noor, “Peningkatan Kapasitas Gudang Dengan Redesign Layout Menggunakan Metode Shared Storage,” *J. JIEOM*, vol. 1, no. 1, 2018.

Y. Muharni, A. Irman S M, and Y. Noviansyah, “Perancangan Tata Letak Gudang Barang Jadi Menggunakan Kebijakan ClassBased Storage dan Particle Swarm Optimization Di PT XYZ,” *J. Tek. Ind.*, vol. 10, no. 3, 2020, doi: 10.25105/jti.v10i3.8405.

K. Kusnadi, A. E. Nugraha, and W. Wahyudin, “ANALISA PENERAPAN LEAN WAREHOUSE DAN 5S+SAFETY DI

GUDANG PT. NICHIRIN INDONESIA,” *J. Media Tek. dan Sist. Ind.*, vol. 2, no. 1, 2018, doi: 10.35194/jmtsi.v2i1.270.

F. Jehlaeh, H. Darjanto, and H. Sutowijoyo, “The Study Deformation Of Bore Pile Foundation Caused by Horizontal Load In Soft Clay,” *Int. J. Eng. Sci. Inf. Technol.*, vol. 1, no. 1, 2021, doi: 10.52088/ijesty.v1i1.59.

E. Fahrizal, M. Imam, S. Masthura Hassan, and E. Saputra, “A Study of the Influence of Interior on Comfort in Outpatient Unit Waiting Room at Hospitals in Lhokseumawe,” *Int. J. Eng. Sci. Inf. Technol.*, vol. 1, no. 4, 2021, doi: 10.52088/ijesty.v1i4.171.