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Analysis of the Redesign of the Rice Storage Warehouse Layout Using the Shared Storage Method at PT. XYZ

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Abstract. In the manufacturing industry, problems often occur with warehouse layout arrangements. A finished product warehouse that is not arranged based on a good warehouse layout designer will experience difficulties in operating the product entry and exit process and is not based on the capacity of the warehouse itself. Increasingly advanced industry and increasingly fierce business competition encourage. The problems that occurred in the 4C Warehouse of the PT.XYZ Complex were in the storage warehouse and the placement of rice, causing several problems in the process of loading and unloading goods. PT.XYZ uses the Shared Storage method to arrange the warehouse space layout using the FIFO (First In First Out) principle, namely where products that are quickly sent are placed in the storage area closest to the entrance and exit. Data collection was carried out through observation, interviews and literature study. Data is calculated and analyzed by comparing the total distance of the initial layout and the proposed layout. The research results show that the total distance of the proposed layout is smaller than the initial layout with a total distance of 617,7.

Keywords: Layout, Warehouse, Shared Storage,Industry

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1. Introduction

A warehouse is a place for receiving, storing, distributing goods or products. Warehousing is needed in industry as part of the supply chain and distribution of goods, from raw materials, semi-finished products, to finished goods which will later be distributed to maintain the stability and availability of resources, locations and product supplies (Nugraha et al., 2022). In the manufacturing industry, problems often occur with warehouse layout arrangements. A finished product warehouse that is not arranged based on a good warehouse layout design will experience difficulties in operating the product entry and exit process and is not based on the capacity of the warehouse itself (Febriana, 2023). PT.XYZ is a state-owned public company which operates in the food logistics sector. PT.XYZ has rice commodities originating from within the country and abroad . In the case of the PT.XYZ warehousing complex, it is included in the finished goods warehouse type and there are several types of Bulog rice packaging, namely medium rice with 50 kg packaging, BanPang rice (food ingredients) with 10 kg packaging and SPHP rice with packaging 5 kg. The problems that occurred in the 4C Warehouse of the

PT.XYZ Complex were in the storage warehouse and the placement of rice, causing several problems in the process of loading and unloading goods. For example, a warehouse has four doors with the same function so that when transferring rice that is loaded into a truck there is a queue because the available doors are less functional when warehouse activities are very busy and the road is blocked by other goods which will have an impact on the material handling process. Another problem is in the warehouse, namely the placement of rice which does not match the type or is random and has not implemented a placement system according to demand requirements which is placed near the delivery door, where rice is placed in each empty staple only. This 4C warehouse has conditions with a random rice storage system, where this condition will have an impact on the material handling process, namely requiring more time in the process. Based on these problems, it is necessary to revise the layout of the product warehouse to be more organized and effective so as to obtain a better distance between the movement of rice products between doors and the storage area. Therefore, the shared storage method was used to solve the problem of rice storage warehouse layout at the PT.XYZ warehouse.

2. Methods

In this research, it is necessary to identify the research variables. Based on the title of the research, variables related to this research can be identified, namely the dependent variable and the independent variable. The dependent variable is a variable that is influenced or is a result of the independent variable. The dependent variable in this research is improving the layout of the rice storage warehouse. Meanwhile, the independent variable is a variable that influences the dependent variable where the independent variable will be the decision variable that will be sought. The independent variables of this research are warehouse area and layout, number of products, product type and size, product demand. The research framework in this final assignment can be seen in the following flowchart image:

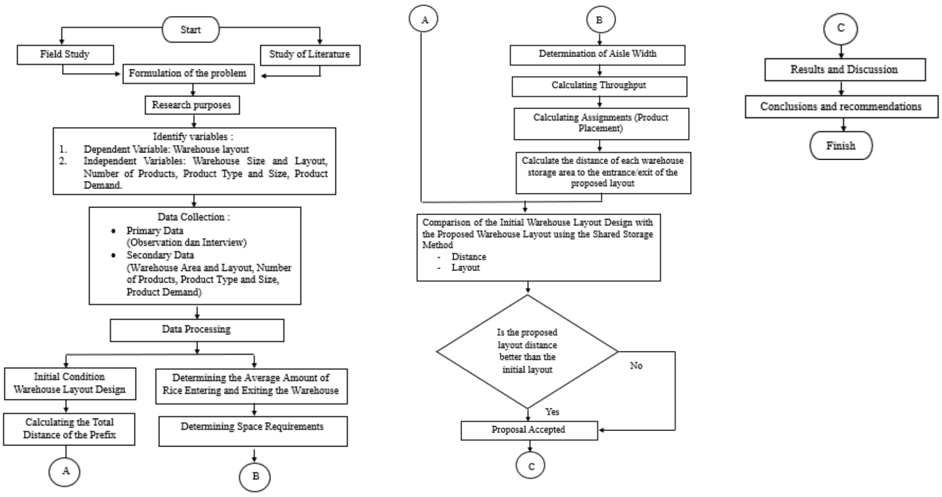

Figure 1. Flowchart

Data Processing, Researchers calculate data and information that has been obtained in the company to solve problems. The following are the steps: Create an initial warehouse layout design, calculate the total distance of the initial layout, calculate the average rice entering and leaving the warehouse, determine space requirements, determine the width of the aisle, calculate throughput, calculate assignment, calculate the distance to each warehouse area. to the entrance/exit of the proposed layout. Then compare the Initial Warehouse Layout Design with the Proposed Warehouse Layout using the Shared Storage Method.

3. Results and Discussion

The data that will be used in the research, the data that will be collected comes from the research location, namely PT.XYZ. The data obtained includes: Data or information obtained includes: Warehouse area and layout, number of products, type and size of products, product demand. Bulog Sidoarjo's 4C warehouse is 48 m long; width 30 m; 8.2 m high, 1,440 m2 wide and has a storage capacity of 452 tons. From the data collection that has been carried out, an initial layout of the warehouse is obtained which is in accordance with the initial conditions. The following is a picture of the initial layout of Warehouse 4C.

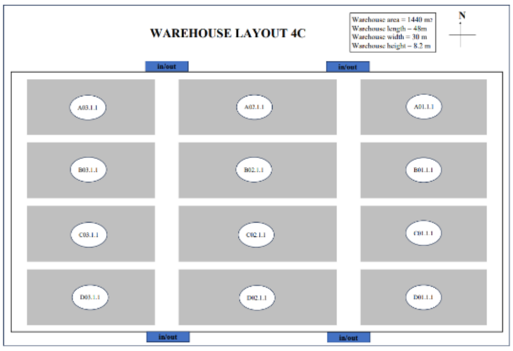

Figure 2. Initial Layout of the 4C Warehouse of PT.XYZ

Furthermore, the data for the width of the aisle between the door and the door is 150 cm, the width between the wall (west and east) and the pallet block A01.1.1; B01.1.1 ; C01.1.1 ; D01.1.1; A03.1.1 ; B03.1.1; C03.1.1 ; D03.1.1 is 100 cm, and the width between block and block is 50 cm. The next data required is the pallet in block A01.1.1; B01.1.1 ; C01.1.1 ; D01.1.1 ; A03.1.1 ; B03.1.1 ; C03.1.1 ; D03.1.1 each consists of 24 pallets and the remainder A02.1.1 ; B02.1.1 ; C02.1.1 ; D02.1.1 consists of 30 pallets each. The pallet size is 200 cm long and 150 cm wide and the number of pallets in the initial layout is a total of 312 pallets. The data in this step is obtained by making direct observations with the help of measuring instruments. The following is the initial layout of Warehouse 4C. The random storage location in question is a product that is mixed with other products in one block and when the product arrives at the warehouse, the product will be stored wherever the block is empty. An example is in block A03.1.1; B03.1.1 and D02.1.1 which contain different products, but are mixed and stored on pallets randomly in empty blocks. The reason the company carries out random storage is so that it is faster to store.

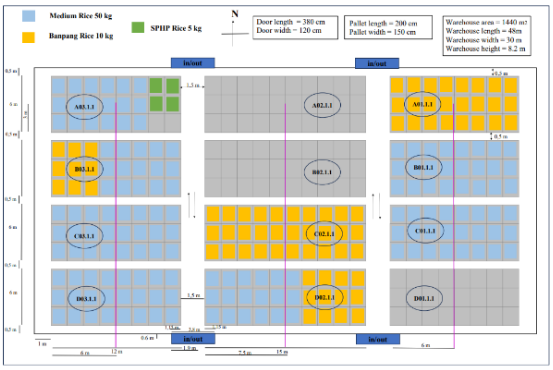

Figure 3. Layout Distance Calculation Layout

Calculation of the Entrance-Exit Distance to the Storage Area

Table 1. Calculation of the Entrance-Exit Distance to the Storage Area

		Dock	Block				
Block	Dock	X1	Y1	X2	Y2	Distance (m)	Total Distance (m)

A01.1.1	I	13,75	27,1	37	23	27,35	73
	O	13,75	0,6	37	23	45,65	
A02.1.1	I	13,75	27,1	22	23	12,35	43
	O	13,75	0,6	22	23	30,65	
A03.1.1	I	13,75	27,1	7	23	10,85	40
	O	13,75	0,6	7	23	29,15	
B01.1.1	I	13,75	27,1	37	16,5	33,85	73
	O	13,75	0,6	37	16,5	39,15	
B02.1.1	I	13,75	27,1	22	16,5	18,85	43
	O	13,75	0,6	22	16,5	24,15	
B03.1.1	I	13,75	27,1	7	16,5	17,35	40
	O	13,75	0,6	7	16,5	22,65	
C01.1.1	I	13,75	27,1	37	10	40,35	73
	O	13,75	0,6	37	10	32,65	
C02.1.1	I	13,75	27,1	22	10	25,35	43
	O	13,75	0,6	22	10	17,65	
C03.1.1	I	13,75	27,1	7	10	23,85	40
	O	13,75	0,6	7	10	16,15	
D01.1.1	I	13,75	27,1	37	3,5	46,85	73
	O	13,75	0,6	37	3,5	26,15	
D02.1.1	I	13,75	27,1	22	3,5	31,85	43
	O	13,75	0,6	22	3,5	11,15	
D03.1.1	I	13,75	27,1	7	3,5	30,35	40
	O	13,75	0,6	7	3,5	9,65	
			Total				624

Based on Table 1, it can be seen that the distance between each block and each code. This calculation is carried out using the rectilinear distance formula, namely using coordinates (X,Y) with the back end of the bottom left corner of the warehouse as the point (0.0). The calculation results for the total material handling distance were 624 meters. The following is an example of a calculation using the rectilinear distance formula.

Calculation of the proposed layout for material handling improvements in the warehouse using the shared storage method

The data required is the total monthly sales data for each rice product with sizes of 50 kg, 10 kg, 5 kg along with the monthly average for the period January - March 2024. This data was obtained from the Sidoarjo Bulog Warehouse Office.

Sales Data for the Period January - March 2024 $= \sum \frac{Pengeluaran\ barang\ perbulan\ n_1,n_2,n_3}{n_n} = \frac{315.666}{3} = 105.222$ colly

Income Data for the Period January - March 2024 $= \sum \frac{Pemasukan\ barang\ perbulan\ n_1,n_2,n_3}{n_n} = \frac{355.379}{3} = 188.160$ colly

Space Requirement

The following is the calculation of Space Requirements:
Space Requirement= (Average Storage)/(Products accommodated)
Medium Rice 50 kg= 118,160/2400=50
Banpang Rice 10 kg= 118.160/12690=10
SPHP Rice 5 kg= 118.160/2880=42

Determination of Aisle Width

Because this warehouse still uses human power for the material handling process, diagonals are used for rice products with the largest size, namely 50 kg rice. The length of 50 kg rice is 90 cm and the width is 50 cm. This aisle calculation is only intended for door aisles between doors. The following is the calculation to determine the width of the aisle:

$$\text{Diagonal} = \sqrt{(Long)^2 + (Wide)^2} = \sqrt{(90)^2 + (50)^2} = 1{,}02 \text{ m}^2$$

Determination of Throughput

Throughput (T) is a measurement of activity or storage that is variable in nature. This activity shows the frequent movement of goods or materials, both outgoing and incoming goods. The data required is the number of incoming and outgoing products and the number of packages in 1 pallet.

Average rice products coming in per month = 118,160

Average monthly rice products output = 105,222

T= (Average incoming products)/(Number of packages in 1 pallet)+(Average products out)/(number of packages in 1 pallet)

Throughput of 50 kg rice = 118,160/100+ 105,222/100 = 2237

Throughput of 10 kg rice = 118,160/100+ 105,222/100 = 528

Throughput of 5 kg rice = 118,160/423+ 105,222/423 = 311

Calculation of Assignment (Product Placement)

Product placement is a placement that is carried out so that we can find out the priority of placing goods according to the area, seen from the number of existing activities and compared to space requirements. Sorted from largest to smallest.

Following are the steps for calculating assignments.

Assignment = Throughput/(Space Requirement)

Assignment of 50 kg rice = 2237/50 = 45

Assignment of 10 kg rice = 528/10 = 53

Assignment 5 kg rice = 311/42 = 8

Distance from Entrance to Storage Area in Proposed Layout

The data required are the results of aisle width calculations, assignment calculation results and initial layout conditions. Then, in determining the distance from the proposed layout, we also use the rectilinear distance formula.

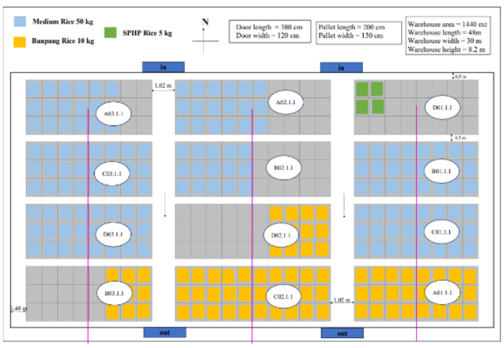

Figure 4. Layout Before Adding Pallets Using the Shared Storage Method

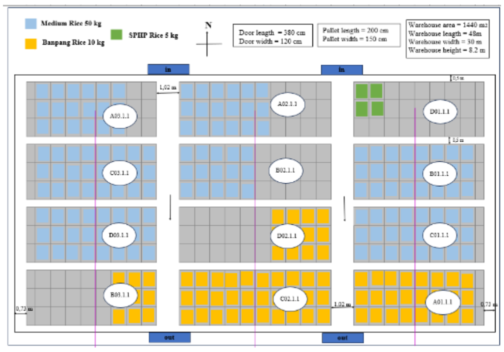

Figure 5. Layout Before Adding Pallets Using the Shared Storage Method

The Shared Storage method uses the FIFO (first in, first out) principle. This is related to the proposed layout regarding product expiry dates. The proposed layout remains as it is, but the first products to arrive are stored near the exit. The following are the results of calculating the total distance on the proposed layout of PT.XYZ Warehouse 4C.

Table 2. Calculation Results of Material Handling Distances in the Proposed Layout

Block	Dock	Dock X1	Block Y1	X2	Y2	Distance (m)	Total Distance (m)
A01.1.1	I	13,99	27,1	36,895	4,5	45,505	91,01
	O	13,99	27,1	36,895	4,5	45,505	
A02.1.1	I	13,99	27,1	22	23,6	11,51	23,02
	O	13,99	27,1	22	23,6	11,51	
A03.1.1	I	13,99	27,1	7,105	23,6	10,385	20,77
	O	13,99	27,1	7,105	23,6	10,385	
B01.1.1	I	13,99	27,1	36,895	17,15	32,855	65,71
	O	13,99	27,1	36,895	17,15	32,855	
B02.1.1	I	13,99	27,1	22	17,15	17,96	35,92
	O	13,99	27,1	22	17,15	17,96	
B03.1.1	I	13,99	27,1	7,105	4,5	29,485	58,97
	O	13,99	27,1	7,105	4,5	29,485	
C01.1.1	I	13,99	27,1	36,895	10,6	39,405	78,81
	O	13,99	27,1	36,895	10,6	39,405	
C02.1.1	I	13,99	27,1	22	4,5	30,61	61,22
	O	13,99	27,1	22	4,5	30,61	
C03.1.1	I	13,99	27,1	7,105	17,15	16,835	33,67
	O	13,99	27,1	7,105	17,15	16,835	
D01.1.1	I	13,99	27,1	36,895	23,6	26,405	52,81
	O	13,99	27,1	36,895	23,6	26,405	
D02.1.1	I	13,99	27,1	22	10,6	24,51	49,02
	O	13,99	27,1	22	10,6	24,51	
D03.1.1	I	13,99	27,1	7,105	10,6	23,385	46,77
	O	13,99	27,1	7,105	10,6	23,385	
				Total			617,7

Based on Table 2, it can be seen that the total distance calculation results are in accordance with the proposed layout. This gives a total distance of 617.7 meters. The next step is to compare the material handling distance in the original warehouse layout and the material handling distance in the proposed warehouse layout. The comparison results are shown as follows.

Table 3. Comparison of Total Material Handling Distance

Layout	Total Distance	Difference
Beginning	624 m	
Proposal	617,7 m	6,3 m

Based on Table 3, it can be seen that the comparison of the total material handling distance in the initial and proposed layouts is that the total material handling distance in the proposed layout is smaller than the initial layout.

Conclusion

Based on the calculation of material handling distance in the initial layout of Warehouse 4C in the Perum Bolug Sidoarjo Warehouse Complex. This calculation was carried out to find out the total distance using rectilinear distance and obtained a total distance of 624 meters.Based on calculations using the shared storage method, it can be used to provide recommendations for warehouse layout with a minimized total distance. Because the results of these calculations show that there is a comparison of the total material handling distance in the initial layout with the proposed layout. The total material handling distance in the proposed layout is 617.7 meters.

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