Bulk Warehouse Layout Design Analysis Using the Dedicated Storage Method (Case Study: PT Krakatau Jasa Logistic)

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Abstract

The warehouse is a place to store goods in the form of raw materials, work-in-process goods and finished goods and a place that provides information about the status and condition of goods stored in the warehouse so that information can be easily accessed by interested people. This study aims to identify and analyze PT Krakatau Jasa Logistics' warehouse layout problems, provide cargo storage layout suggestions to maximize capacity using the dedicated storage method, and determine the warehouse layout that produces the largest warehouse utility value. A comparison of the current warehouse layout with the dedicated storage method was carried out to choose a warehouse layout by maximizing the free in the warehouse based on the greatest utilization. The results of the study show that the proposed layout has greater utility compared to the current layout, namely 81% and 19% for forklifts and trucks, where the proposed storage layout only has a little free space or has maximized cargo placement, but in the current warehouse, there is a warehouse utility that is equal to 36% where in the storage layout there is still a lot of empty space in the warehouse.

Keywords
Warehouse, Layout, Dedicated Storage, Utilization, and Cargo

1. Introduction

The warehouse is a place to store goods in the form of raw materials, work in process goods and finished goods and a place that provides information about the status and condition of goods stored in the warehouse so that information can be easily accessed by interested people (Apple 1990, Francis, & White 1992). According to Heizer and Render (2009). The layout is a crucial decision in determining long-term operating efficiency. The layout has many strategic implications for determining a company's competitiveness in terms of capacity, maximizing the use of space in the warehouse, processes, flexibility, minimizing costs, quality of the work environment, customer contact, and corporate image. A practical layout helps a company to achieve a strategy that facilitates differentiation, low costs, or fast response. A layout strategy aims to create an economical layout that meets the competitive needs of the business. A good warehouse layout is by arranging the facilities in the warehouse so that workers can operate it more efficiently and speed up service. Workers no longer waste time looking for goods because they have been placed according to their characteristics. A good layout scheme will improve overall operating efficiency (Zhenyuan et al. 2011).

Technology is growing rapidly, resulting in many advances, especially in the design of developments using engineering drawing software. With increasingly sophisticated technology, it can help speed up the completion of a

job using CAD (Computer Aided Design). CAD is a drawing or design made by a computer, but the software that is often used by CAD is AutoCAD. AutoCAD (Automatic Computer Aided Design) is a program created to help design a drawing, both two-dimensional and three-dimensional, precisely and accurately (Atmajayani 2018).

In this study, researchers will discuss warehouse management and discuss more deeply in the warehouse layout section. Warehouse layout is an important issue in the manufacturing system. In the current era, with limited land conditions, companies must be able to work on a more systematic warehousing system. The company must know the character of the goods that want to be stored in the warehouse, especially goods with an expiration date, the company can arrange the layout of the warehouse, whether rented or owned by the company. In this study, an analysis of the layout of the warehouse at PT Krakatau Jasa Logistik will be carried out using the dedicated storage method. The dedicated storage method is a method that is often referred to as fixed storage because the location of each item has been determined.

After doing practical work, the authors found several problems in the PT Krakatau Jasa Logistik company, namely the layout of the warehouse, which was not neatly organized and did not have partitions for storing cargo which resulted in a lot of empty space to separate cargo from one another so that it did not mix. Companies often lack warehouses to store future cargo, which results in companies having to conduct surveys to find vacant warehouses according to the company's needs and SOP for storing these cargoes, which results in companies having to incur more costs. Companies that still use a manual system make workers have to recap daily reports and recap as a whole at the end of the month, which results in frequent human errors. Judging from the closed warehouse and the lack of air circulation, the cargo stored in the warehouse is still in bulk form, or raw materials that are not packed using sacks can make the cargo moist, and the quality will decrease.

1.1 Objectives

This study aims to analyze the warehouse layout problems at PT Krakatau Jasa Logistik, provide cargo storage layout suggestions to maximize capacity using the dedicated storage method, and determine the warehouse layout that produces the largest warehouse utility value.

2. Literature Reviews

2.1 Layout Types

Layouts have several types that can be applied based on the outgoing and incoming flows of goods, including:

Simple straight-line current

This type of layout is a simple straight-line flow, in which the flow of goods will be in the form of a straight line where the process of entering and leaving goods is relatively faster because the warehouse does not have winding aisles or aisles. At the location of goods storage, the goods to be stored can be differentiated based on the turnover of goods, namely fast-moving and slow-moving. Goods with fast-moving turnover are stored in a location close to the exit. Meanwhile, goods with slow-moving turnover are stored in a location close to the entrance.

"U" Current

The type of “U” flow layout is a "U"-shaped flow of goods where the process of entering and leaving goods is relatively longer because the warehouse has winding aisles or aisles. At the location of goods storage, the goods to be stored can be differentiated based on the turnover of goods, namely fast-moving and slow-moving. Goods with fast-moving turnover are stored in a location close to the exit. Meanwhile, goods with slow-moving turnover are stored in a location close to the entrance.

Current "L"

Type of flow layout “L” is the flow of goods in the form of "L" where the process of entering and leaving goods is relatively faster because the warehouse has aisles or alleys that are not too tortuous. At the location of goods storage, the goods to be stored can be differentiated based on the turnover of goods, namely fast-moving and slow-moving. Goods with fast-moving turnover are stored in a location close to the exit. Meanwhile, goods with slow-moving turnover are stored in a location close to the entrance.

2.2 Warehouse Layout

In determining the location of the warehouse that suits the company, there are several methods to compare the right one for the warehouse at the PT Krakatau Jasa Logistik company. The following are the existing methods in warehousing, among others:

1. Dedicated Storage Method

The dedicated storage method is a method that is often referred to as fixed storage because the location of each item has been determined. The policy is designed in such a way according to the storage area of each item with the maximum inventory level. As storage, that is certain and fixed because the location for each item has been determined. The number of storage locations for a product must be able to meet the maximum storage space requirements of the product. The required storage space is cumulative of the maximum storage requirements of each type of product if more than one type of product is to be stored

The following are the steps for planning a warehouse layout using dedicated storage:

Calculating Throughput (storage activity)

Throughput is a dynamic measure of activity or storage that shows the storage flow. The term throughput is used as a measure of the amount of storage and retrieval activities that occur per period of time (Sule, 2009). The following is the throughput formula, namely:

$$T_j = \left(\frac{Admission\ Average}{The\ number\ of\ transfers\ one\ time}\right) + \left(\frac{Shipping\ Average}{The\ number\ of\ transfers\ one\ time}\right) \quad (1)$$

Calculating Space Requirements

Space requirements themeselves are used for placement in a more specific location, and only one type of product will be placed in that storage location. To be able to calculate space requirements, it takes average storage data for each product in the warehouse as well as a measure of the capacity of each block for each product. The following is the space requirement formula, namely:

$$S_j = \frac{Maximum\ Storage}{Block\ Capacity\ Size} \quad (2)$$

Placement of cargo at the storage location by calculating Tj/Sj to find the order of comparison, namely the largest value will be placed in the area closest to the out point until the smallest value will be placed in the area close to the in point.

2. Random Storage Method

The random storage method is a method of storing goods based on the place closest to the input location of the goods to the farthest. The implication of this policy is that the search time for goods is longer. Random storage requires a good information system. Generally, this method is carried out on an AS/RS (Automated Storage/Retrieval System) system.

3. Class-Based Storage Method

The class-based storage method is a mixed method between the dedicated storage method and the random storage method, in which this method has more flexible storage rules. Dedicated storage rules are used to determine the class location, while random storage rules are used to determine the location within the class. The placement of components or products in class can be seen based on type and size. The class-based storage method is divided into three, four, or five classes based on the ratio of throughput (T) to storage (S) based on the product or component. Products that are fast-moving products are categorized as class 1 products, and then next are class 2 products, then class 3 products, and so on (Zaerpour & de Koster 2017).

4. Shared Storage Method

The shared storage method is a storage method based on the condition of the warehouse floor area, which is then sorted from the area closest to the area farthest from the exit and entry (I/O) so that goods that will be sent immediately are placed in the area closest to (I/O) (Sutisna & Irfan 2015)

Technology is growing rapidly, resulting in many advances, especially in the design of developments using engineering drawing software. The increasingly sophisticated technology can help speed up the completion of a job using CAD (Computer Aided Design). CAD is a drawing or design made by a computer, but the software that is often used by CAD is AutoCAD. AutoCAD (Automatic Computer Aided Design) is a program created to help design a drawing, both two-dimensional and three-dimensional, precisely and accurately (Atmajayani 2018).

3. Methods

The research methodology is used to achieve research objectives during practical work, which consists of several stages, namely:

1. Study of Literature

At this stage, the author first looks for references related to the problem to be identified before looking directly at the actual conditions. The author seeks references from journals, books, or other official references related to the case he wants to study. After that, the authors also identify directly with the conditions that exist in the field.

2. Data Collection

The author collects data to complete practical work reports regarding warehouse layout at PT Krakatau Jasa Logistik. Data were obtained through interviews and from recording company document data. The data that the author will collect includes data on the arrival schedule of goods, data on goods stored in the warehouse, data on the schedule of goods leaving the warehouse, data on incoming ships, customer data, data on the characteristics of goods, and data on the storage capacity of goods in the warehouse.

3. Data Processing

After collecting data, the authors perform data processing from the data provided by the company using the dedicated storage method to obtain results that can be studied in the data analysis section. In data processing, the author will evaluate the initial condition of the warehouse, calculate the need for warehouse area, and determine the priority of goods seen from the characteristics of the goods. After processing the data and if it is found that the warehouse is not effective, the researcher will design a proposed warehouse layout. An effective layout is by maximizing the use of space in the warehouse, aisle sizes that match the goods stored and forklifts used, minimizing costs, and placing goods according to characteristics so that goods are easy to find to avoid delays in product or material flow processes (Heizer and Render 2009). To design space requirements must be seen from the storage capacity of goods in the warehouse (Prayoga 2014). According to (Tompkins 2010), the maximum storage in the warehouse is 80%, while the rest is used for aisles that are adjusted from the forklift used by the company.

4. Data analysis

At this stage, the author will analyze the data that has been processed using a predetermined method, namely dedicated storage, to find an effective layout. The results of the analysis that have been obtained by researchers can be used as a solution to a problem that can be recommended and applied to the company to see whether the solution can have a good impact on the problem or not.

5. Conclusions and recommendations

After the authors get the results of data processing and analysis, the authors will present the conclusions and the authors will provide suggestions for the company.

The following are several stages for analyzing a case study, which can be seen in the following Figure 1:

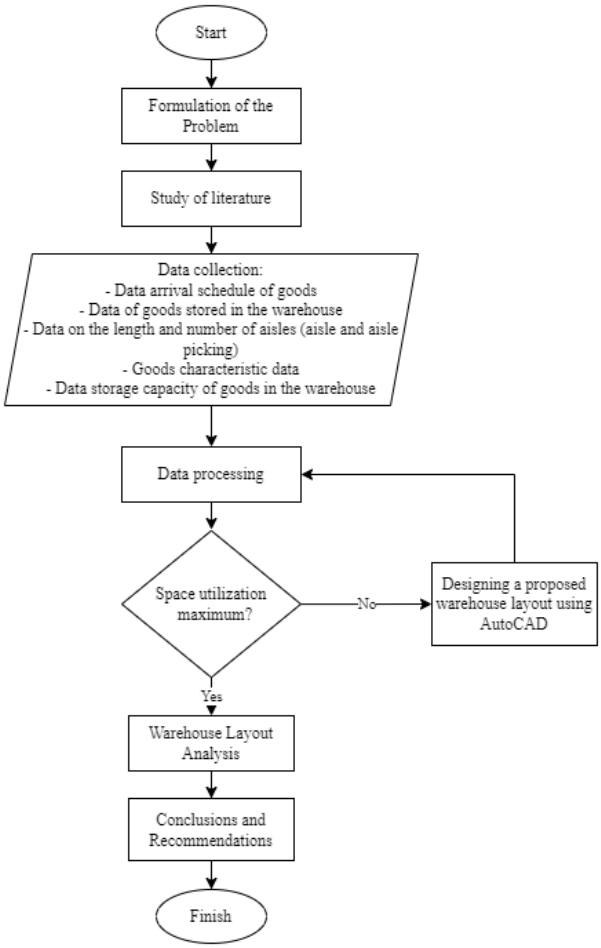

Figure 1. Research Methodology Flowchart

4. Data Collection

Researchers will examine the layout of the warehouse from one of the 10 warehouses available at PT Krakatau Jasa Logistik, namely warehouse D. The data to be collected by researchers include the specifications for the entire warehouse, roads, and warehouses per block. Following are the specifications for warehouse D:

Overall Warehouse Specifications

The following are the overall specifications for Warehouse D, as shown in Table 1.

Table 1. Overall Warehouse Specifications

Location	Length (m)	Width (m)	High (m)
Warehouse D	132	8	6,1

Interface Specifications

Following are the Warehouse D interface specifications, as shown in Table 2.

Table 2. Interface Specifications

Location	Length (m)	Width (m)	High (m)
Warehouse D	132	8	6,1

5. Results and Discussion

Data processing in warehouse D is based on data obtained when carrying out practical work at PT Krakatau Jasa Logistik. The data obtained is from June 2022 to August 2022. Calculation of the total area in Warehouse D to find the maximum capacity in Warehouse D, as shown in Table 3.

Table 1. Calculation of the Overall Area of the Proposed Cargo Warehouse

Length (m)	Width (m)	High (m)	Area (m)	Volume (m)	Cargo Specific Gravity	Capacity (ton)
132	55	6,1	7.260	44.286	0,64	28.343

The following is an example of calculating the total warehouse area:

$A = p \times l$

$= 132 \times 5$

$= 7.260\ m^2$

The following is an example of calculating the overall warehouse volume:

$V = p \times l$

$= 132 \times 55 \times 6{,}1$

$= 44.286\ m^3$

The following is an example of calculating the overall warehouse capacity:

$\text{Capacity} = volume \times \text{cargo specific gravity}$

$= 44.286 \times 0{,}64$

$= 28.343\ \text{ton}$

5.1 Data Processing in Current D Warehouse

In data processing, to find capacity per-block warehouse D then, the size of the area per-block is assumed according to the capacity of cargo that will enter the Warehouse, as shown in Table 4.

Table 2. Calculation of Current Capacity per Block D Warehouse

No	Ship Name	Length (m)	Width (m)	High (m)	Area (m2)	Volume (m3)	Cargo Specific Gravity (ton)	Capacity (ton)
1	Alexandra	25	15	6,1	375	2.287,5	0,64	1.464
2	Yangtz harmony	25	22	6,1	538	3.281,8	0,64	2.100
3	ying shun	27	15	6,1	405	2.470,5	0,64	1.581
4	Alcor	30	18	6,1	540	3.294	0,64	2.108
5	BW osaka	56	13	6,1	728	4.440,8	0,64	2.842
Total					2.586	15.775	-	10.096

The following is an example of calculating the overall warehouse capacity:

$\text{Capacity} = volume \times \text{cargo specific gravity}$

$= 2.287{,}5 \times 0{,}64$

$= 1.464\ \text{ton}$

The following is an example of a warehouse utility calculation:

$$\text{Warehouse Utilization} = \frac{\text{Block Capacity Size}}{\text{Maximum Storage}} \times 100\%$$

$$= \frac{7.260}{2.586} \times 100\%$$

$$= 36\%$$

Based on the utility results in the current layout, which is 36%, there is still a lot of free space in Warehouse D. The company still has not maximized the use of space properly.

Rank throughput was carried out to find out the type of product that has the fastest to the slowest movement. One of the influential references in designing cargo storage layouts is the throughput rank, as shown in Table 5.

Table 3. Calculation of Current D Warehouse Throughput

No	Ship Name	Admission Average (ton)	Truck	Shipping Average (ton)	Truck	Tj	Rate
1	Alexandra	1.464	66	1.463	89	38,6	2
2	Yangtze Harmony	2.100	116	2.095	120	35,6	3
3	Ying Shun (Arge)	1.575	77	1.476	72	41	1
4	Alcor	2.100	111	104	73	20,3	5
5	BW Osaka	2.850	144	163	56	22,7	4

The following is an example of calculating throughput:

$$T_j = \left(\frac{Admission\ Average}{The\ number\ of\ transfers\ one\ time}\right) + \left(\frac{Shipping\ Average}{The\ number\ of\ transfers\ one\ time}\right)$$
$$= \left(\frac{1.464}{66} + \frac{1.463}{89}\right)$$
$$= 38{,}6$$

Based on the throughput results at Warehouse D, the largest value is the Ying Shun ship at 41, and the smallest value is the Alcor ship at 20.3. Where the Ying Shun ship has the fastest movement activity, it will be placed in the area closest to the out point, while Alcor has the slowest movement activity, so it will be placed in the area farthest from the out point.

In calculating the space requirement, it is assumed that the size of the block capacity is the capacity according to the cargo that will enter the warehouse, which can be seen in Table 6.

Table 4. Calculation of Space Requirements

No	Ship Name	Maximum Storage (ton)	Sj
1	Alexandra	1.464	1,00
2	Yangtze Harmony	2.100	1,00
3	Ying Shun (Arge)	1.575	1,00
4	Alcor	2.100	1,00
5	BW Osaka	2.850	1,00

The following is an example of space requirement calculation:

$$S_j = \frac{Maximum\ Storage}{Block\ Capacity\ Size}$$
$$= \frac{1.464}{1.464}$$
$$= 1{,}00$$

Based on the results of the Sj (Space Requirement) calculation, a value of 1.00 is obtained. This result is caused by the size of the block capacity, which is assumed to be based on the incoming cargo capacity because the warehouse does not have a partition or barrier between other blocks.

After obtaining the results of the throughput and space requirements, the following is the calculation of the ratio of throughput and space requirements, as shown in Table 7.

Table 5. Calculation of Throughput Ratio and Space Requirement

No	Ship Name	Tj	Sj	Tj/Sj
1	Alexandra	38,6	1,00	38,6
2	Yangtze Harmony	35,6	1,00	35,6
3	Ying Shun (Arge)	41	1,00	41,1
4	Alcor	20,3	1,00	20,4
5	BW Osaka	22,7	1,00	22,6

The following is an example of calculating the ratio of throughput and space requirements:

$$\frac{Tj}{Sj} = \frac{Throughput}{Space\ Requirement}$$
$$= \frac{38,6}{1,00}$$
$$= 38,6$$

Based on the results of calculating the ratio of throughput and space requirements, the smallest value was obtained, namely the Alcor ship of 20,4 and the largest value, the Ying Shun ship, of 41,1.
The calculation of the proposed warehouse layout mileage is prepared based on the largest to smallest Tj/Sj values. Cargo that has the largest Tj/Sj value is placed in the area closest to the output point, and the product with the smallest Tj/Sj is placed farthest from the output point. The calculation of the total mileage for the proposed layout can be seen in Table 8.

Table 6. Mileage Calculation of Proposed D Warehouse Layout

No	Ship Name	Block Distance to Input	Block Distance to Output	Mileage to Input	Mileage to Output
1	Alexandra	47	47	1.814,91	1.814,91
2	Yangtze Harmony	9	9	320,09	320,09
3	Ying Shun (Arge)	38,5	38,5	1.582,85	1.582,85
4	Alcor	47	47	960,00	960,00
5	BW Osaka	47	47	1.063,65	1.063,65

The following is an example of calculating the distance to the input:

$$\text{Mileage to input} = \frac{\text{Tj}}{\text{Sj}} \text{ x Block distance to input}$$
$$= 38,6\ x\ 47$$
$$= 1.814,91$$

The following is an example of calculating the mileage to the output:

$$\text{Mileage to output} = \frac{\text{Tj}}{\text{Sj}} \text{ x Block distance to output}$$
$$= 38,6\ x\ 47$$
$$= 1.814,91$$

The following is the current Warehouse D layout which still has a lot of free space or has not maximized warehouse space as shown in Figure 2.

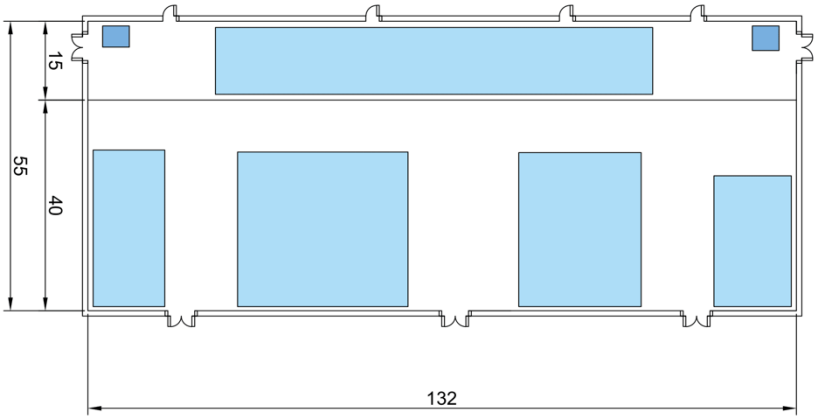

Figure 2. Current D Warehouse Layout

5.2 Data Processing in the Current D Warehouse

Data processing at the proposed D Warehouse is based on data obtained when carrying out practical work at PT Krakatau Jasa Logistik. The data obtained is from June 2022 to August 2022. The calculation of area per block in Warehouse D is a suggestion to find the maximum capacity per block in Warehouse D to maximize free space, as shown in Table 9.

Table 7. Calculation of Cargo Capacity per Block

Length (m)	Width (m)	High (m)	Area (m)	Volume (m)	Cargo Specific Gravity	Capacity (ton)
132	55	6,1	7.260	44.286	0,64	4.568

$$\text{One block long} = \text{total warehouse width} - \text{the width of the road}$$
$$= 55 - 10$$
$$= 45 \text{ m}$$

$$\text{One block wide} = \left(\frac{\text{overall warehouse length} - \text{width of bulkheads}}{5}\right)$$
$$= \left(\frac{132-0,5}{5}\right)$$
$$= 26 \text{ m}$$

The following is an example of a proposed warehouse utility calculation:

$$\text{Warehouse Utilization} = \frac{\text{Block Capacity Size}}{\text{Maximum Storage}} \text{x } 100\%$$
$$= \frac{5.850}{7.260} \text{ x } 100\%$$
$$= 81\%$$

Based on the results of the utility in the proposed layout, it is equal to 81%, where 19% is the road adjusted for the forklifts and trucks used by the company. So the proposed layout has a maximum warehouse capacity compared to the current warehouse layout. The current warehouse layout is 36%, where there is still a lot of unused empty space, or the warehouse capacity is not maximized.

Table 8. Calculation of Proposed D Warehouse Throughput

No	Ship Name	Admission Average (ton)	Truck	Shipping Average (ton)	Truck	Tj	Rate
1	Alexandra	1.464	66	1.463	89	38,6	2
2	Yangtze Harmony	2.100	116	2.095	120	35,6	3
3	Ying Shun (Arge)	1.575	77	1.476	72	41	1
4	Alcor	2.100	111	104	73	20,3	5
5	BW Osaka	2.850	144	163	56	22,7	4

The following is an example of calculating throughput:

$$T_j = \left(\frac{Admission\ Average}{The\ number\ of\ transfers\ one\ time}\right) + \left(\frac{Shipping\ Average}{The\ number\ of\ transfers\ one\ time}\right)$$
$$= \left(\frac{1.464}{66} + \frac{1.463}{89}\right)$$
$$= 38,6$$

Table 9. Warehouse D Space Requirement Calculation Proposal

No	Ship Name	Maximum Storage (ton)	Sj
1	Alexandra	1.464	0,32
2	Yangtze Harmony	2.100	0,46
3	Ying Shun (Arge)	1.575	0,34
4	Alcor	2.100	0,46
5	BW Osaka	2.850	0,62

The following is an example of space requirement calculation:

$$S_j = \frac{Maximum\ Storage}{Block\ Capacity\ Size}$$
$$= \frac{1.464}{4.568}$$
$$= 0{,}32$$

After obtaining the results of the throughput and space requirements, the following is the calculation of the ratio of throughput and space requirements for the proposed warehouse, as shown in Table 12.

Table 10. Calculation of Proposed D Warehouse Throughput Ratio and Space Requirements

No	Ship Name	Tj	Sj	Tj/Sj
1	Alexandra	38,6	0,32	120,5
2	Yangtze Harmony	35,6	0,46	77,3
3	Ying Shun (Arge)	41	0,34	118,8
4	Alcor	20,3	0,46	44,3
5	BW Osaka	22,7	0,62	36,4

Based on the results of calculating the ratio of throughput and space requirements, the smallest value was obtained, namely the BW Osaka ship of 36,4 and the largest value, the Alexandra ship, was 120.5.

The calculation of the proposed warehouse layout mileage is prepared based on the largest to smallest Tj/Sj value. Cargo that has the largest Tj/Sj value is placed in the area closest to the output point, and the product with the smallest Tj/Sj is placed farthest from the output point. The calculation of the total mileage for the proposed layout can be seen in Table 13.

Table 11. Mileage Calculation of Proposed D Warehouse Layout

No	Ship Name	Block Distance to Input	Block Distance to Output	Mileage to Input	Mileage to Output
1	Alexandra	108,5	47,5	13.072,89	5.723,16
2	Yangtze Harmony	135	21	10.442,19	1.624,34
3	Ying Shun (Arge)	29	127	3.444,60	15.084,95
4	Alcor	55,5	100,5	2.456,35	4.447,98
5	BW Osaka	82	74	2.982,62	2.691,63

The following is an example of calculating the distance to the input:

$$\text{Mileage to input} = \frac{Tj}{Sj} \text{ x Block distance to input}$$
$$= 120{,}5\ x\ 108{,}5$$
$$= 13.072{,}89$$

The following is an example of calculating the mileage to the output:

$$\text{Mileage to output} = \frac{\text{Tj}}{\text{Sj}} \text{ x Block distance to output}$$
$$= 120{,}5\ x\ 47{,}5$$
$$= 5.723{,}16$$

Based on the results of calculating the distance to the input, the current layout has a value of 1,814.91m, while the proposed layout has a distance of 13,072.89m. After making a comparison, the shortest distance to the input is obtained, namely in the current layout, because the current layout has (I/O) in several places, but after analysis, the warehouse activity is not effective because it can hinder one truck from another, which is carrying out unloading cargo.

The following is the proposed Warehouse D layout which has a warehouse storage utility of 81% and utilities for forklifts and trucks running by 19%, which still has a lot of free space or still has not maximized warehouse space, as shown in Figure 3.

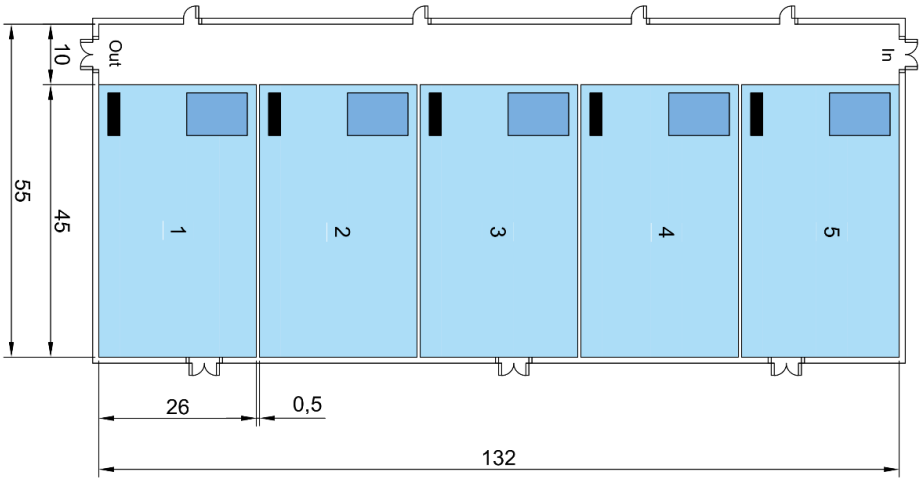

Figure 3. Warehouse Proposed Layout D

6. Conclusion

Based on the results of the research that has been done, namely analyzing the layout of the warehouse at PT Krakatau Jasa Logistik. Based on the results of calculations and data analysis

After doing practical work, the authors found several problems in the PT Krakatau Jasa Logistik company, namely the layout of the warehouse, which was not neatly organized and did not have partitions for storing cargo which resulted in a lot of empty space to separate cargo from one another so that it did not mix. Companies often lack warehouses to store future cargo and this result in companies having to conduct surveys to find vacant warehouses according to the company's needs and SOPs for storing these cargoes, which results in companies having to incur more costs. Companies that still use a manual system make workers have to recap daily reports and recap as a whole at the end of the month, which results in frequent human errors. Judging from the closed warehouse and the lack of air circulation, the cargo stored in the warehouse is still in bulk form, or raw materials that are not packed using sacks can make the cargo moist, and the quality will decrease.

To maximize cargo storage in the warehouse, partitions per block are made to maximize unused empty space and minimize the mixing of cargo with one another. Using the dedicated storage method, it will make it easier for companies to store cargo, inspect warehouses, and look for cargo in warehouses because warehouses have been

grouped by family. For example, such as Warehouse D is only for feed and food cargo, then Warehouse A is for chemical cargo.

Based on the results of warehouse utility calculations, it shows that the proposed layout has a greater value than the current layout value, namely 81% and 19% for forklift and truck running, where the proposed storage layout only has a little free space or has maximized cargo placement, but in the current warehouse, there is a warehouse utility that is equal to 36% where in the storage layout there is still a lot of empty space in the warehouse.

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Biography

Helshy Azzahra NEI is a logistics engineering student at the Faculty of Industrial Technology at Pertamina University. She is a 7th semester student. She has been and is participating in organizations on her campus, she is chairman of the Forces Representative Council (DPA), she is also a member of the disciplinary commission. She has also taken several extracurricular activities to fill her free time, including boxing, entrepreneurship and modern art. In the early semester she once sold food to raise business funds with her entrepreneurial members. During the pandemic she also participated as a delegate at the International Model United Nations (IMUN) for scientific papers. During the semester break she had done an internship at PT Krakatau Jasa Logistik and was placed in the international division.