ISSN 2962 - 2069
Journal of Industrial System Engineering and Management.

Journal of Industrial Systems Engineering and Management Vol. 4 No. 2, November 2025

Proposed Layout for Goods Storage in RM Supermarket Warehouse Using Dedicated Storage

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ARTICLE INFORMATION

Article history:

Received: 19 November 2025
Revised: 28 November 2025
Accepted: 30 November 2025

Keywords:
Dedicated Storage
Layout
Space Requirement
Throughput Distance Risk

ABSTRACT

The warehouse is one of the most important components of the business. Activities storage covering receipt, storage, arrangement, bookkeeping, maintenance, and disbursement of goods from the storage place. When the warehouse lacks proper management, goods are not arranged by type or classification. Goods are piled up in one place because the warehouse does not have enough space. Therefore, when taking goods, must dismantle and move the appropriate goods. Thus, the process of taking and storing goods takes quite a long time. Planning layout means building and integrating flow components for the product so that operators, equipment, and material transformation processes interact most efficiently from part reception to part delivery, which is also known as the location storage still with the Dedicated Storage method. Research results indicate two proposed storage layout options. The First Alternative produces the total distance of 281.9 meters by subtracting 55.8 meters, or 6.6%, from the current layout. Meanwhile, the alternative second produce distance is 373.9 meters, with a subtraction distance of -36.3 meters, or -10%. Of the two choices, alternative 1 is more efficient than alternative 2.

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INTRODUCTION

Warehousing is a series of activities aimed at supporting continuity. Work each unit at once to support effectiveness, efficiency, and overall organization [1][1]. The warehouse is one of the most important aspects of the company, as it serves as a storage facility for goods. Storage is an activity of receiving, storing, arranging, bookkeeping, and maintaining goods and expenses in a storage [2]place [2]. Apart from being a place of storage, a warehouse also performs functions such as receiving and shipping goods to distributors and consumers, and maintaining products [3].

The warehouse is something place or the building used For hoard, store goods, good in the form of material raw materials, goods half So or goods So [2], [4], warehouse is component important from chain modern supply chain supply involving activity in various stages: sourcing, production, and distribution goods, from handling material raw materials and goods in process until product So [5]. The warehouse can be depicted as part of a logistics system for a functioning company to store products and provide up-to-date, easily accessible information on the status and condition of materials/inventories, ensuring that this information is always up-to-date and easily accessible to anyone concerned [6].

Poor warehouse governance results in goods not being organized by type or classification. Lack of utilization of space in the warehouse causes goods to pile up in one area, so when they are taken, they must be dismantled and moved appropriately. So that needs quite a long time in the storage and delivery process [7]. Layout warehouse is about design placement facilities, analyze, forming a concept, and make it happen in a system reception to delivery goods to customers with minimal total possible costs happen [8]. Design layout is defined as the design and integration of flow components that provide the most effective and efficient interrelation among operators, equipment, and material transformation processes from part reception to part delivery [9]. Design is generally depicted as a floor plan of the facility's physical (equipment, land, buildings, and other facilities) to optimize interactions or connections between officers/implementers, flow of goods, flow of information, and necessary procedures. For achieving the objective in an economical way and safety work [10].

Layout planning in the warehouse is important for adapting to changes in product, demand, safety, operational efficiency, and environmental comfort [11]. One of the usual methods used is Dedicated Storage, also known as location-specific, fixed-slot *storage*, with the use of place-specific storage [8], [12]. Total location storage for a product must be sufficient need room the maximum storage from the product. The required storage space is cumulative from the need for maximum storage for each type of product, if the products will be saved more from one type [12].

Dedicated storage determines the slot or intended location for the product. The number of slots is the same as the storage level maximum in the product [13]. Layout issues warehouse covers determination of location storage in the warehouse. The placement process involves product on the method *dedicated storage* is organized storage areas based on condition, wide floor warehouse, then sorted by closest location to the furthest area from the door, go out, enter, so that placed items are sent quickly to the nearest area and so on [7][7].

Robinson Supermarket PT. Ramayana Lestari Sentosa Tbk is a supermarket that operates multiple warehouses. One of the warehouses is the warehouse equipment House stairs. The warehouse, located on the second floor, stores equipment. The house inadequate governance ladder in the warehouse. The causes goods to be not arranged in accordance with type or classification. Lack of utilization space in the warehouse causes goods to pile up in one area only, so that at the time of taking goods, they must be dismantled and moved appropriately. So, that need quite a long time in the process storage and taking related goods with problems said, then done study was done using a dedicated storage method. The results obtained are proposal layout improvements for storage goods in the company's warehouse.

RESEARCH METHODS

Data collection was carried out through three methods: observation, communication, and documentation. Observation done directly with with observe activity work in the warehouse, spare parts, toys and equipment at Robinson Supermarket stairs PT. Ramayana Lestari Sentosa Tbk. Observed activities covering receiving, storing, and issuing materials to the supermarket area, as well as stocktake activities.

Data processing begins with the collection of data on materials stored in the warehouse. This data covers quantity, size, dimensions, capacity stack, and capacity rack for each material type. Information used to determine storage capacity per slot.
Next steps are to calculate the average material receipts and expenditures per month. This data is used to count the space requirement and material activity (throughput). Space requirement calculated based on the comparison between the average material acceptance and the storage capacity per slot. The calculation of the distance between slots and the I/O point is performed using the Euclidean and rectilinear distance formulas [9].

To calculate the Throughput for know activity average material storage and output per month. The throughput value is used in the T/S (throughput/space) calculation, namely the ratio of the maximum storage required for each product to the storage capacity per slot. Material with high T/S value placed near door in/out warehouse, while the low one placed more Far [2], [9].

Material placement is carried out using two alternatives. The first alternative is based on the order total T/S value (combined income and expenditure), whereas the second alternative is based on the difference in T/S value between receipts and expenses. If the T/S value of acceptance more large, material is placed near the door enter; if the expenditure more large, placed near door out. Steps calculation use Dedicated Storage method, namely as follows [2], [8], [9]:

1. Space requirement calculation obtained from comparison of average material acceptance with the size material capacity per row/slot for one material. So that only There is One *materials* placed in place storage with the formula as follows:

$$dij = (xi - xj)^2 + (yi - yj)^2 \quad (1)$$

2. Calculation *Throughput* aims For know mark activity acceptance/collection average product per month with the formula as follows:

$$Tj = \frac{Rata{-}rata\ penerimaan{+}rata{-}rata\ pengiriman\ komponen}{jumlah\ komponen\ per\ unit\ penanganan} \quad (2)$$

3. An assembly product based on comparison *throughput* (*T*) with *storage* (S), ranking products by aim. To know the products that have the highest level of interest from existing products. Products with the level of importance tall can be known from mark high T/S ratio with the formula as follows:

$$Tj = \frac{kebutuhan\ penyimpanan\ maksimum\ tiap\ produk}{kapasitas\ penyimpanan\ produk/slot} \quad (3)$$

4. Measure the distance from the door in / out to each row/slot. Measurement done manually using a ruler. And then the calculate the rectilinear distance method to know the distance from I/O points to each row or slot, with the formula as follows:

$$dij = |xi - xj| + |yi - yj| \quad (4)$$

The recommendation for the layout improvements is to place materials from the second alternative using the existing layout. Comparison done to determine the percentage decline distance material travels, so that the chosen alternative can be the one with the highest efficiency.

The final step is to compile the conclusions and suggestions based on the results of data processing and analysis material placement. The goal is to improve the recommendation layout in the warehouse to be more efficient, safer, and better aligned with the company's operational needs. This approach is expected to increase the effectiveness of storage and distribution of materials in the warehouse as well as support smoothness Operation of Robinson Supermarket PT. Ramayana Lestari Sentosa Tbk.

RESULTS AND DISCUSSION

The company's warehouse layout own wide not enough more than 468.94 m2 with a length of 16 meters, a width of 8 meters, a height of 3.7 meters. This warehouse has 18 shelves of storage on equipment House ladder with a follow line 60 cm x 100 cm x 300 cm side shelf and straight with total of 5 slots per shelf, you can seen in Figure 1 below.

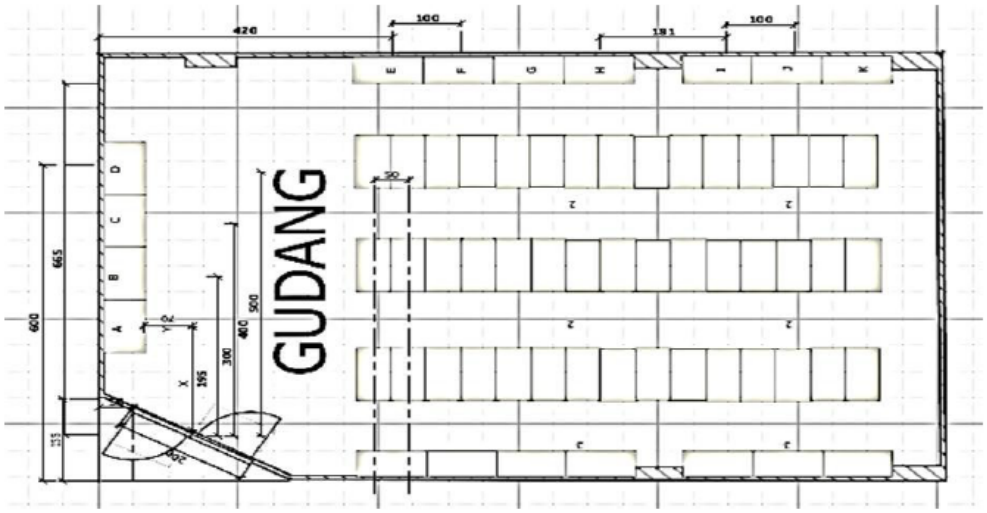

Figure 1. Company Warehouse Layout

Storage area equipment House ladder consists of from rack line up sideways and straight, with a slot measuring 60 × 100 × 60 cm for accommodate product sized big and small . Every type product own configuration storage different , like bowl glass (2 rows, 60 × 30 × 30 cm), teapot LS glass (3 rows, 27 × 33 × 20 cm), medium mug (3 rows, 22 × 47 × 43 cm), plain LS plate (2 rows, 40 × 60 × 60 cm), and others . The acceptance process started with a quantitative inspection by officers of security, based on DO and PO. After according to product stored on the shelf without system grouping, but rather based on empty slots. At the time of disbursement, staff must search and verify physique product manually. System storage efficiency is not yet optimal because classification-structured products have not yet been implemented. Data type product can seen in table 1.

Table 1. Product types and the activities

SKU No.	Types of goods	Amount Product (carton)	Slot Capacity	Average Product Incoming (Carton)	Average Product What Comes Out (Carton)
393557081	Bowl glass	10	7	24	10
393557083	LS glass teapot set	5	21	25	25
393558081	Medium coffee mug	6	9	27	26
393557084	Plain square ls plate	6	3	26	25
393557086	glass glass clear	7	7	29	25
393557183	Premium teapot	5	3	29	24
393557185	cup premium zinc	6	6	26	22
393557087	LS motif cup	5	8	25	17
393557182	Bowl premium buffet	3	4	24	23
393557184	Premium motif LS plate	5	4	28	27
393557082	Plain square ls plate	2	3	26	22

Amount of product received to in warehouse in form *ball* or cardboard arranged on shelves consisting of 5 slots. The expenditure data product is the number of cartons issued or supplied to *the supermarket* area. Here is the result of data processing for average income and average expenditure for the months of January to February 2023.

1. Calculation need room
   Dedicated storage method of calculating need room for determine capacity storage each type of material, so that one slot only load One type goods. The slot size is set at 60 × 100 × 60 cm to accommodate the product's various sizes and facilitate easy storage. Size this is also customized with dimensions shelves 60 × 100 × 300 cm, so each rack accommodates five slots. Approach This ensure efficiency and order in management room warehouse Space requirements for each type of goods are determined from the maximum and average capacities of acceptance. For example, a bowl-average glass received 24 cartons, with a maximum capacity of 34 cartons per shelf (cardboard size 28 × 30 × 30 cm; slot 60 × 100 × 60 cm), so it requires 3 slots. To Calculation, ensure each slot loads only one type of goods. Moving goods daily or seasonal, based on capacity, maximum and average revenue, to determine the number of slots required.
2. Throughput measures activity storage and disbursement product in period certain in the warehouse. Calculation done based on average income and expenses, shared capacity, and maximum trolley for each type of goods. For example, a bowl, LS glass, and teapot: maximum 2 cartons/trolley; 5 premium mugs; 8 glasses; 5 premium teapots; cups, zinc 6; motif cup 4; bowl buffet 4; patterned plates 4; and plates 3 cardboard squares. Activity only using a trolley as material handling equipment.
3. Throughput/Space Calculation
   T/S value used to determine the location of storage; the more prominent its value, the closer it is to his position when entering or leaving the warehouse; can be seen in table 2.

Table 2. T/S Calculation

Product name	**Slot Yang Needed *(Space)***	**Amount Activity Transport *(Throughput)* Incoming**	**Amount Activity Transport *(Throughput)* Out**	**Activity Transport *(Throughput /Space)* Enter**	**Activity Transport *(Throughput /Space)* Go out**	***Throughput /Space* Total**
Bowl glass	3	11.9	5.2	3.98	1.73	5.71
LS glass teapot set	1	12.4	12.7	6.19	6.34	12.53
Medium coffee mug	3	13.7	12.9	4.56	4.29	8.85
Plain ls plate	8	5.1	5.1	0.64	0.63	1.28
glass glass clear	4	14.7	12.5	3.67	3.13	6.80
Premium teapot	9	9.5	7.8	1.06	0.87	1.93
cup premium zinc	4	5.1	4.4	1.28	1.09	2.36
LS motif cup	3	12.4	8.4	4.15	2.81	6.96
Bowl buffet premium	5	4.7	4.5	0.95	0.91	1.85
Premium motif LS plate	6	5.5	5.5	0.92	0.91	1.83
Plain square ls plate	8	5.2	4.4	0.64	0.55	1.19

The calculation comparison between *throughput* and *space requirement* (T/S) is based on reject measurements for each product storage location type. Highest T/S value placed near with door enter or go out warehouse , while the lowest T/S value placed Far with door enter or go out warehouse . Table 5 shows that the highest T/S value is 12.53. Meanwhile, the lowest T/S value, 1.19, is for activities per slot.

4. Throughput/Space Ranking

Storage based on the T/S value, where the product with the highest T/S placed near door in / out warehouse, and lowest T/S placed the furthest away. Because the warehouse has only one door, determine the location using two alternatives based on the order T/S values of receipts and expenditures. Following These are the alternatives that can be given based on ranking.

4.1 Alternative 1

The first alternative that is storage product based on the total T/S value. The highest total T/S value prioritizes storage near the warehouse door entrance or exit. Here is the order of T/S values from highest to lowest, shown in table 3. The table shows that the product 1s glass teapot set is the highest, and 1s plain square plate is the lowest.

Table 3. T/S Alternative 1 and Alternative 2

Name of goods	Activity Transport In Throughput / Space (time)	Activity Transport Go out Throughput / Space (time)	Total Activity Transport Throughput /Space (time)	Ranking Throughput /Space T/S
		Alternative 1		
LS glass teapot set	6.19	6.34	12.53	1
Medium coffee mug	4.56	4.29	8.85	2
LS motif cup	4.15	2.81	6.96	3
glass glass clear	3.67	3.13	6.80	4
Bowl glass	3.98	1.73	5.71	5
cup premium zinc	1.28	1.09	2.36	6
Premium teapot	0.95	0.91	1.85	7
Bowl premium buffet	0.92	0.91	1.83	8
Premium motif LS plate	1.06	0.87	1.93	9
Plain ls plate	0.64	0.63	1.28	10
Plain square ls plate	0.64	0.55	1.19	11
		Alternative 2		
Bowl glass	3.98	1.73	5.71	2.25
LS motif cup	4.15	2.81	6.96	1.33
Plain square ls plate	3.67	3.13	6.80	0.55
LS glass teapot set	6.19	6.34	12.53	0.16
Medium coffee mug	4.56	4.29	8.85	0.27
premium motif LS plate	1.28	1.09	2.36	0.19
Cup premium zinc	1.06	0.87	1.93	0.19
Plain ls plate	0.64	0.55	1.19	0.10
Glass cup clear	0.95	0.91	1.85	0.04
Bowl premium buffet	0.64	0.63	1.28	0.01
Premium teapot	0.92	0.91	1.83	0.01
Bowl glass	3.98	1.73	5.71	2.25
LS motif cup	4.15	2.81	6.96	1.33
Plain square ls plate	3.67	3.13	6.80	0.55

4.2 Alternative 2

The second Alternative is a storage product based on the difference between the T/S value entered and the T/S value that comes out. Difference highest will prioritized or moreover formerly prioritized storage near with door enter or go out warehouse . Here, the T/S difference in incoming with T/S value comes out T/S from the highest to the lowest, as shown in table 4.

5. Calculation placement product moment This

Placement in the area at the time This saved based on empty slots and storage nature random or *random*. Here This is calculation placement products in the warehouse moment:

Table 4. Calculation Placement Product Existing Warehouse Currently

Rack	Product name	Slot Requirements	T/S Login	T/S Out	In	Out	Distance
A	bowl glass	3	3.98	1.73	1.15	1.15	6.56
B	LS glass teapot set	1	6.19	6.34	2.2	2.2	27.6
C	Medium coffee mug	3	4.56	4.29	3.2	3.2	28.33
D	plain ls plate	8	0.64	0.63	4.2	4.2	5.36
E	Glass cup clear	4	3.67	3.13	9.35	9.35	63.55
F	Premium teapot	9	1.06	0.87	10.35	10.35	19.93
G	Premium single cup	4	1.28	1.09	11.35	11.35	26.81
H	LS motif cup	3	4.15	2.81	12.35	12.35	85.94
I	Bowl Premium Buffet	5	0.95	0.91	14.25	14.25	26.36
J	ls motif plate	6	0.92	0.91	15.25	15.25	27.83
K	Square ls plate	8	0.64	0.55	16.25	16.25	19.35
		Total					337.6

Table 8 shows the placement product in condition moment, along with total distance and distance traveled. The distance *in* and *out* for each row, obtained from the table listing the distances for each product. Here are the following: This is example calculation :

Product distance bowl glass on shelf A = (3.98 × 1.15) + (1.73 × 1.15) = 6.56 meters

The calculation above shows that bowl glass requires 3 storage slots, so the total distance to the storage moment is 6.56 meters. Based on table 8, the total distance for overall condition storage moment for the warehouse *supermarket* is 337.6 meters. Based on the calculation, the following proposals were made for each alternative. Calculation of distance on the proposal repair: the first alternative is a storage product based on the total T/S value.Total highest T/S value prioritized, or prioritized storage near the door entrance or exit from the warehouse. The total value of T/S is the sum of the T/S value received and the T/S sent. T/S value received highest will placed moreover Formerly near with door enter warehouse , while T/S value send highest will placed moreover Formerly near with door out of the warehouse. Next This proposal For alternative 1, shown in table 5, and the proposed For alternative 2, which shows 10.

Table 5. Proposal Alternative T/S Fix 1 and Alternative T/S Fix 2

Rack	Product name	Slot Requirements	T/S Login	T/S Out	In	Out	Distance
		Alternative 1					
A	LS glass teapot set	1	6.19	6.34	2.2	2.2	27.6
A	Medium coffee mug	3	4.56	4.29	2.2	2.2	19.48
AB	LS motif cup	3	4.15	2.81	3.2	3.2	22.27
BC	glass glass clear	4	3.67	3.13	4.2	4.2	28.55
C	Bowl glass	3	3.98	1.73	9.35	9.35	53.37
CD	cup premium zinc	4	1.28	1.09	10.35	10.35	24.45
DEF	Premium teapot	9	1.06	0.87	11.35	11.35	21.86
FG	Bowl premium buffet	5	0.95	0.9	12.35	12.35	22.85
GH	Premium motif LS plate	6	0.92	0.91	12.35	12.35	22.54
HIJ	Plain square ls plate	8	0.64	0.55	15.25	15.25	18.16
JK	Plain ls plate	8	0.64	0.63	16.25	16.25	20.72
		Total					281.8
		Alternative 2					
A	Bowl glass	3	3.98	1.73	1.15	1.15	6.56
AB	LS motif cup	3	4.15	2.81	2.2	2.2	15.31
BC	Plain square ls plate	8	0.64	0.55	3.2	3.2	3.81
C	LS glass teapot set	1	6.19	6.34	4.2	4.2	52.6
D	*Medium coffee* mug	3	4.56	4.29	9.35	9.35	82.79
DE	premium motif LS plate	6	0.92	0.91	10.35	10.35	18.89
EF	Cup Premium zinc	4	1.06	0.87	11.35	11.35	21.86
FGH	Plain ls plate	8	0.64	0.63	12.35	12.35	15.76
H	Glass cup clear	4	3.67	3.13	14.25	14.25	96.86
I	Bowl premium buffet	5	0.95	0.91	15.25	15.25	28.21
JK	Premium teapot	9	1.06	0.87	16.25	16.25	31.30
		Total					373.9

The following is a proposal for layout improvements for a storage warehouse, with alternative 1 and alternative 2.

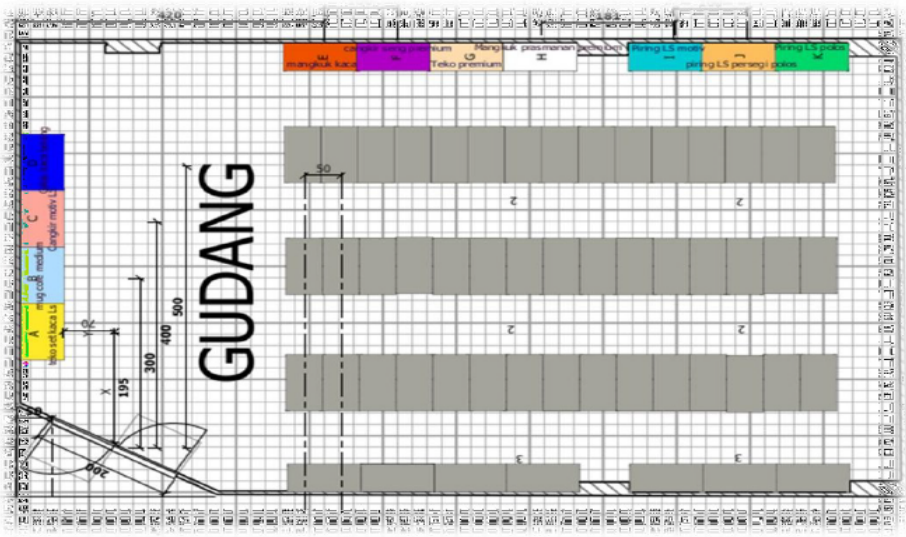

Figure 2. Proposed Warehouse Layout with Alternative 1

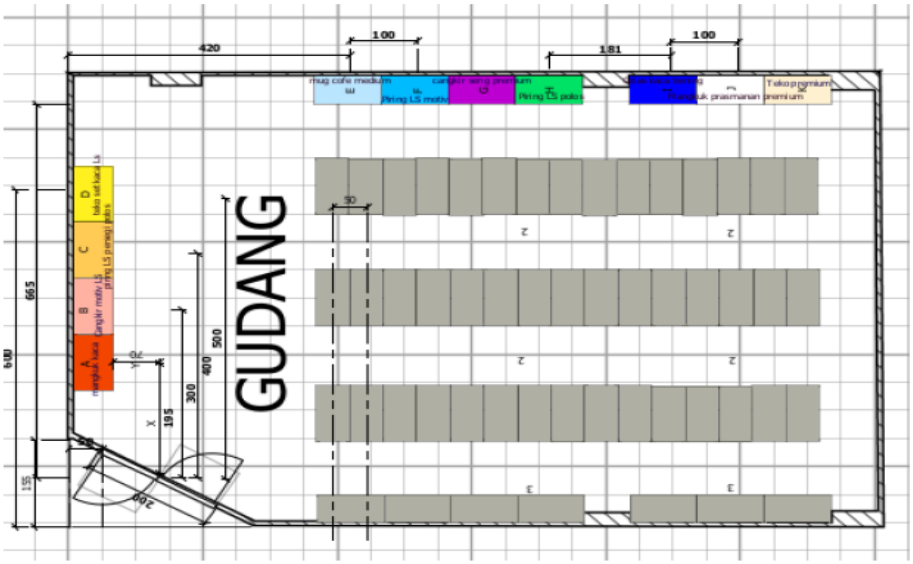

Figure 3. Proposed Warehouse Layout with Alternative 2

6. Comparison of Travel Distance

Comparison of existing layouts with alternatives 1 and 2 is carried out for known percentage decline distance and travel for each product. This result serves as the basis for selecting the optimal layout based on minimum travel distance. The existing layout has a total distance covered of 337.6 meters, while alternative 1 is more efficient at 281.8 meters with the different distance of 55.8 meters and the percentage declined distance 6.6%. Alternative 2 actually has a higher height, namely 373.9 meters wuth the different distance -36.3 and the percentage decline distance -10%. So, alternative 1 becomes the best choice based on efficiency traveled.

CONCLUSION

Based on Data analysis and comparison of storage layouts in the M67 warehouse of Robinson Supermarket, alternative 1 proved to be the most efficient. Travel distance storage was reduced from 337.6 meters to 281.8 meters, making it easier to handle goods displacement and monitoring, and reducing risk differences during stocktaking. Suggestion repair use dedicated storage method with consider activity income and expenses goods. Alternative 1 produces a subtraction distance of 55.8 meters (6.6%), while alternative 2 instead increases the distance traveled to 373.9 meters, or 10% more

than the existing layout. With greater efficiency, alternative 1 is selected as the optimal layout for the packaging material area.

The company should consider implementing a dedicated storage system for packaging materials in the storage area. This method makes it easier to store and distribute activities because every type of material is placed in a special slot, reducing the risk of mixing. However, the weakness lies in the bottom utility room: only one slot for one type of material, and not yet considering seasonal materials that impact needs and capacity. Therefore, that is necessary: an advanced study for validation, accuracy calculation, and capacity. In addition, the placement of materials should be customized based on the intensity of the activity: material with a high frequency of reception tall placed near the door enter, while material with a high frequency of expenditure tall placed near the door out. This approach can increase channel logistics efficiency and minimize time and energy in the warehouse operational process.

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