i-RIC 2024

INTERNATIONAL RESEARCH & INNOVATION CONFERENCE

PROCEEDING

"HARMONY IN DIVERsITY: FOsTERING UNITY
SUsTAINABLE REsEARCH AND INNOVATION SOCIETY"

24 & 25 JULY

2024

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PREFACE

It is a great privilege for us to present the proceedings of the International Research and Innovation Conference (i-RIC 2024) to the authors and delegates. We hope that you will find it useful, exciting, and inspiring. The International Research and Innovation Conference (i-RIC 2024) was held online from 24 to 25 July 2024, organized by Politeknik Nilai in collaboration with Universitas Logistik dan Bisnis Internasional (ULBI) with the theme, "Harmony in Diversity: Fostering Unity Sustainable Research and Innovation Society."

i-RIC 2024 aims to gather more researchers, students, government agencies, and private sectors in an event with a larger international impact. The organization of this program also serves as a platform for sharing research findings, ideas, and knowledge among members of polytechnics, community colleges, higher education institutions, public universities, as well as government and private agencies involved. Researchers, academics, and experts from various sectors will have a global stage at i-RIC 2024 to discuss the latest findings and research that support sustainable development goals. The conference aims to generate knowledge to make our world greener and better for us and our future generations.

There were 4 keynote speeches covering different areas of the conference. The first day started with Associate Professor Dr. Ir. Agus Purnomo (ULBI Indonesia) talk on "How to Boost Green Supply Chain Resilience?" and Professor Dr. Mohamed Kchaou (University of Bisha, Saudi Arabia; University of Sfax, Tunisia) on "Latex Based Membrane for Oily Wastewater Treatment Technology Process and Perspectives". The second day featured Professor Dr. Recai Kus (Selcuk University, Turkey) on "Load Optimization of AISI 1040 and AISI 5140 Joint" and Dr. Umawathy a/p Technamurthy (Universiti Kebangsaan Malaysia) with her talk on "Harnessing the Potential of Maker Education in Enhancing Student Learning Outcomes".

A total of 124 presenters participated in the parallel presentation sessions, which ran smoothly over the two-day event supported by 109 i-RIC 2024 organizing committees. This included 16 online presentation moderators, 42 reviewers, 19 judges, and all participants who took the time to attend the online sessions. A total of 124 research papers and 56 innovations were presented in this program across 7 fields, namely:

A. Engineering and Technology
B. Business Management
C. Education, Teaching, and Learning
D. Health and Life Sciences
E. Social Sciences
F. Information Communication Technology
G. Logistics and Supply Chain

Information regarding i-RIC 2024 can be accessed through the Program Book at https://heyzine.com/flip-book/521619ef82.html and overall results can be found at http://iric.polinilai.edu.my/.../confe.../results-innovation.

We would like to express our heartfelt thanks and sincere appreciation to all the authors for their contributions to this publication. We also express our gratitude and appreciation to all of the reviewers for their constructive feedback on the papers. Warmest thanks to the members of the organizing committee for their hard work and dedication in ensuring the success of the event.

Congratulations to everyone involved in making this conference a success.

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LOGISTICS AND SUPPLY CHAIN MANAGEMENT

"HARMONY IN DIVERsITY: FOsTERING UNITY
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The Impact of Dedicated Storage and Class-Based Storage Methods on the Warehouse Layout of KPK PosIND Jakarta Centrum on the Distance and Time of Item Movement

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Abstract

The Directorate of Social Community of the Corruption Eradication Commission (KPK) collaborates with PosIND in the distribution of socialization materials to various regions in Indonesia. These materials are temporarily stored in the KPK PosIND warehouse at Jakarta Centrum before distribution. Observations of the warehouse conditions revealed several issues, including the lack of clear labeling and grouping of items, poor cleanliness, and an unstructured layout, which hinder workflow efficiency. This study aims to analyze the impact of the warehouse layout at KPK PosIND Jakarta Centrum using dedicated storage and class-based storage methods on the distance and time of item movement. The study results indicate that changes in the warehouse layout using dedicated storage and class-based storage methods led to a reduction in item movement distance by up to 59.38% and item movement time by up to 57.2%. Therefore, changes in the warehouse layout significantly reduce the distance and time of item movement.

Keywords: Warehouse Layout, Dedicated Storage, Warehouse Efficiency, Warehouse Management

1. Introduction

The Directorate of Social Community of the Corruption Eradication Commission (KPK) or *Komisi Pemberantasan Korupsi (KPK)* is a state institution in Indonesia with the primary duty of supervising, investigating, and following up on corruption crimes. The KPK was established based on Law Number 30 of 2002 concerning the Corruption Eradication Commission. The main goal of the KPK is to enhance the efficiency and effectiveness of corruption eradication efforts in Indonesia and to restore public trust in the government and other institutions (Corruption Eradication Commission, 2023).

The KPK's Directorate of Social Affairs collaborates with PosIND in the distribution of outreach materials to regions throughout Indonesia. These materials will be distributed to various parties in the regions, including local government agencies. Before distribution, the materials are temporarily stored at the KPK PosIND KCU Jakarta Centrum Warehouse. Based on observations at the KPK PosIND Jakarta Centrum Warehouse, several issues have been identified. First, there is no clear labeling and grouping of stored items, making identification and searching difficult. The disorganization of items ultimately creates an untidy environment, resulting in poor warehouse cleanliness. Second, poor warehouse management, coupled with a lack of structured layout, leads to inefficient workflow.

Warehouse layout management is a crucial aspect of operations for a logistics company like PosIND KCU Jakarta Centrum. A poorly organized warehouse can cause various problems, including difficulty in identifying and efficiently locating items by warehouse staff. Additionally, a lack of structure in the layout can impede workflow and reduce overall operational efficiency.

This research aims to analyze the impact of dedicated storage and class-based storage methods on the warehouse layout at PosIND Jakarta Centrum. Focusing on changes in travel distance and item retrieval time by warehouse staff, this study hopes to provide concrete solutions for improving warehouse management efficiency and effectiveness. The results of this research are expected to offer appropriate recommendations for improving the warehouse layout to meet the operational and working environment needs of PosIND Jakarta Centrum.

2. Literature Review

Warehouse

A warehouse is a storage facility used to accommodate materials, including raw materials, semi-finished goods, and finished products ready to be distributed to customers (Rosyada, 2023). Warehouses play a crucial role in inventory management and company logistics. For logistics and courier service companies, warehouses function as distribution centers where packages are received, sorted, temporarily stored, and then dispatched according to predetermined delivery schedules and routes. Warehouses also ensure a smooth and efficient flow of goods, enabling timely delivery to customers.

Warehouse Layout

A warehouse layout is a design aimed at reducing total costs by creating a balance between space utilization and goods management. The layout and design of a warehouse significantly affect a company's operational efficiency. An effective warehouse layout should minimize damage and loss of goods within it. Therefore, one important aspect of warehouse layout is the relationship between the receiving area (where goods are taken in) and the shipping area (where goods are sent out) (Ma'arif & Tanjung, 2006). In the operations of logistics and courier service companies, the warehouse layout is adjusted to the needs of document or goods movement and focuses on the physical arrangement of elements related to the courier service industry. Planning a warehouse layout involves designing or arranging various components, work centers, and equipment that manage the document or goods delivery process (Putro, 2022).

Dedicated Storage Method

In warehouse layout, the dedicated storage method, also known as fixed slot storage, assigns each item a fixed storage location so that when items need to be stored or retrieved, their locations can be easily identified (Purwantinah, 2021). The number of storage locations for an item must be sufficient to accommodate its maximum storage needs. The total storage space required is the combination of the maximum storage needs of each item, especially if more than one type of product is stored (Tompkins et al., 2010). The steps for arranging a warehouse layout using the dedicated storage method are as follows (Kulsum et al., 2020):

1. Calculating Space Requirements
   Space requirements are calculated to place stored items in specific locations. The formula used to calculate space requirements is:

$$Sj = \frac{Average\ receipts\ (inflow)}{Block\ capacity}$$

2. Calculating Throughput
   Throughput relates to the inflow and outflow of an item or product. The formula used to calculate throughput is:

$$Tj = \left(\frac{Average\ inflow}{Max.\ Capacity\ per\ transport}\right) + \left(\frac{Average\ outflow}{Max.\ Capacity\ per\ transport}\right)$$

3. Calculating T/S

T/S is essential as the main reference in determining product placement locations. Products are placed based on the ranking of T/S values from the largest to the smallest. The formula is as follows:

$$\frac{T}{S} = \frac{Throughput}{Space\ Requirement}$$

4. *Calculating I/O*

Calculation of item movement distance.

5. *Items with the highest T/S are placed in areas with the shortest travel distance.*

The predetermined distance is applied to place products according to the T/S ranking, ensuring smooth production and avoiding the accumulation of items in the process.

Class-based Storage Method

The Class-Based Storage method is a combination of the dedicated storage and randomized storage methods. In this method, products are grouped based on certain types or characteristics and placed in specific locations within the warehouse. These groups of items are based on similarities in the type of items or similarities in the consumer order list (Purwantinah, 2021). In class-based storage, products or components are divided into three, four, or five classes based on the comparison of throughput (T) and storage (S). Fast-moving products are categorized as class 1, followed by class 2, class 3, and so on, with placement adjusted according to their type or size (Johan & Suhada, 2018).

3. Research Method

In this study, data collection was conducted through observational approach involving direct observation of the research object, and through literature review encompassing examination and analysis of various relevant written sources. The methods used were dedicated storage and class-based storage methods involving calculations of space requirements, throughput, and T/S calculation and ranking, leading to recommendations for warehouse layout based on these methods. Each layout then influences changes in travel distance and picking time by warehouse personnel. The research flow is depicted in diagram form as follow:

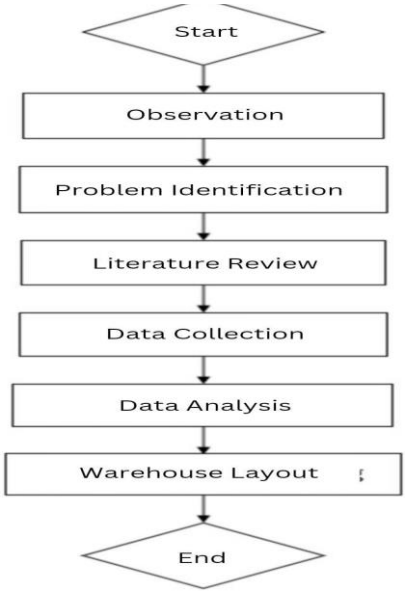

Figure 1: Research flow

4. Result and Discussion

Data on Types, Receipt, and Shipment of Goods

Activities at the KPK warehouse at PosIND KCU Jakarta Centrum include receiving, storing, and dispatching/shipping goods for the socialization activities of the Directorate of Social Community of the Corruption Eradication Commission (KPK) to various regions in Indonesia. Goods are received an average of twice a week, while shipments to the regions are also conducted an average of twice a week. The types of goods stored at the KPK warehouse at PosIND KCU Jakarta Centrum are presented in the following table:

Table 1. List of Names, Quantities of Receipt, and Shipment of Goods

No	Code	Types of Goods	Inflow	Outflow
1	2323	Card Holder BYB	1.000	0
2	2322	Mug Stainless BYB	1.000	0
3	2321	Umbrella BYB	1.000	77
4	2318	Tumbler Vacuum BYB	1.050	1
5	1856	Pencil Case BYB	1.000	990
6	1855	Piggybank BYB	1.000	980
7	1854	T-Shirr BYB	3.000	1.117
8	1852	Pouch BYB	5.000	3.143
9	1851	Totebag BYB	16.000	1.192
10	1850	Blocknotes BYB	4.060	2.958
11	1849	Tumbler BYB	6.000	3.015
12	1525	Boardgame PDKT	1.700	1.661
13	1512	Pocket Book on Understanding Corruption	2.500	2.495
14	1420	Spunbound Bag	40.000	32.202
15	1508	Wooden Plaque	350	250

Warehouse Information

The KPK warehouse at PosIND KCU Jakarta Centrum has an area of approximately 135 m². Inside the warehouse, there are 23 racks, each measuring 120 cm x 150 cm x 60 cm, and each rack has 3 slots/levels with a distance of 10 cm between them. Currently, the storage is still disorganized, and there is no naming or numbering on each rack. Some items are placed on the warehouse floor, even though there are still parts of the racks that are not filled. Among the total of 23 racks in the warehouse, only 6 racks are fully filled. Many items are stacked in the farthest part of the warehouse from the entrance, while the racks closest to the entrance still have a lot of empty space. The layout of the KPK warehouse at PosIND Jakarta Centrum can be illustrated as follows:

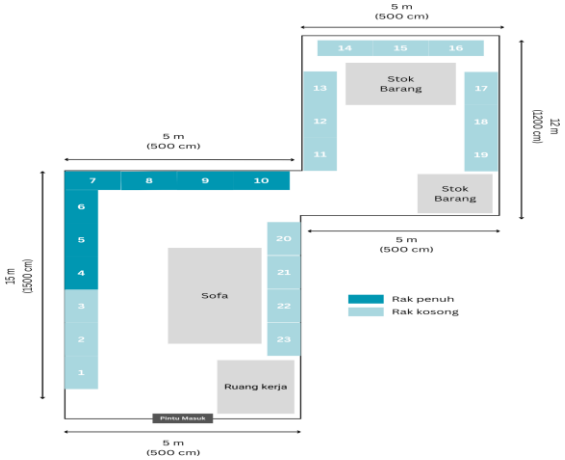

Figure 2. Warehouse Layout

Space Requirement, *Throughput*, and Activities

Socialization materials from the Directorate of Social Community of the KPK are placed on storage racks, each with 3 slots/levels. Each rack can accommodate between 240 to 43,000 items, depending on the type and size of the items. The flow of goods from receipt to shipment is manually handled by 2 warehouse staff members, each capable of carrying up to 200 items in one trip. The unit used for measuring both incoming and outgoing goods is "item". Furthermore, the placement of socialization materials can be ordered from the highest T/S value to the lowest. Items with the highest T/S value are placed on racks closest to the entrance, and items with the lowest T/S value are placed on racks farthest from the entrance.

Table 2: Throughput, Space Requirements, Activities, And Sequence of Item Activities

No	Code	Inflow	Outflow	Carrying Capacity	Throughput	Space Requirement			Activities (T/S)	Rank
						Slot/Rack Capacity	Theroretical SR	Actual SR		
1	2323	1.000	0	400	3	25.600	0,04	1	3	9
2	2322	1.000	0	400	3	396	2,5	3	1	12
3	2321	1.000	77	400	3	360	2,8	3	1	13
4	2318	1.050	1	400	3	540	1,9	2	1	14
5	1856	1.000	990	400	5	12.000	0,1	1	5	8
6	1855	1.000	980	400	5	240	4,2	5	1	15
7	1854	3.000	1.117	400	10	11.400	0,3	1	10	5
8	1852	5.000	3.143	400	20	6.000	0,8	1	20	2
9	1851	16.000	1.192	400	43	2.400	6,7	7	6	6
10	1850	4.060	2.958	400	18	7.200	0,6	1	18	3
11	1849	6.000	3.015	400	23	540	11,1	12	2	10
12	1525	1.700	1.661	400	8	43.200	0,04	1	8	6
13	1512	2.500	2.495	400	12	36.000	0,1	1	12	4
14	1420	40.000	32.202	400	181	34.200	1,2	2	90	1
15	1508	350	250	400	2	1.200	0,3	1	2	11

Classification of Goods

Using the class-based storage method, promotional items are grouped into 3 classes: Class A, Class B, and Class C. The classification is based on the durability of the materials of the promotional items stored in the warehouse.

Class A (green) = the most perishable materials, such as paper and fabric.
Class B (yellow) = moderately durable materials, such as wood and leather.
Class C (orange) = non-perishable materials, such as metal.

Calculation of Item Movement Distance in the Existing Warehouse

The following table presents the distance and time of item movement from each shelf in the KPK PosIND Jakarta Centrum Warehouse:

Table 5. Distance and Time of Item Transfer from Each Shelf

Rack	Distance (cm)	Time (s)	Rack	Distance (cm)	Time (s)
1	910	11,375	***13**	-	-
2	1040	13	***14**	-	-
3	1170	14,625	***15**	-	-
4	1300	16,25	***16**	-	-
5	1430	17,875	***17**	-	-
6	1560	19,5	**18**	2560	32
7	1582	19,775	**19**	2430	30,375
8	1530	19,125	**20**	1610	20,125
9	1660	20,75	***21**	-	-
10	1790	22,375	***22**	-	-
11	2430	30,375	***23**	-	-
12	2560	32			

**The shelf is not accessible because it is blocked by a sofa and a stack of stock items.*

Based on the table above, it is found that shelves 13, 14, 15, 16, 17, 21, 22, and 23 cannot be used because they are obstructed by a sofa and a stack of stock items placed on the floor. Among all shelves, only shelves 4, 5, 6, 7, 8, 9, and 10 are fully occupied. Some stock items are stored in the farthest part of the warehouse, requiring longer distances and more time for item transfers.

Warehouse Layout Changes

The arrangement of shelves in the KPK PosIND Jakarta Centrum warehouse remains unchanged. However, there is a need to reorganize the placement of stock items that are not properly arranged. Additionally, the sofa needs to be removed to prevent blocking available shelves and hindering the flow of item movement.

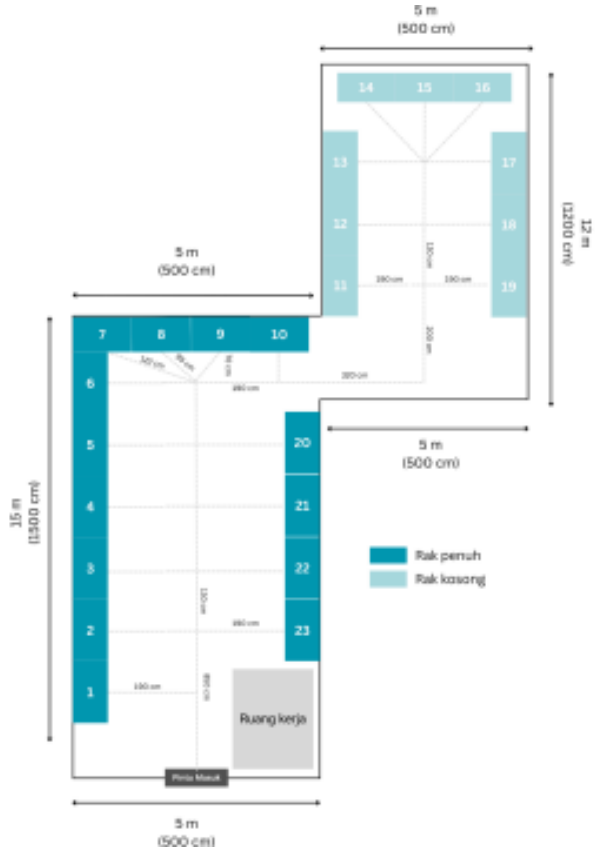

Figure 3. Warehouse Layout

Table 6: item Placement Based on Activity Sequende

No	Code	Placement
1	1420	Rack 1 Slot 1-2
2	1852	Rack 1 Slot 3
3	1850	Rack 2 Slot 1
4	1512	Rack 2 Slot 2
5	1854	Rack 2 Slot 3
6	1525	Rack 23 Slot 1
7	1851	Rack 23 Slot 2-3
		Rack 22 Slot 1-3
		Rack 3 Slot 1-2
8	1856	Rack 3 Slot 3
9	2323	Rack 4 Slot 1
10	1849	Rack 4 Slot 2-3
		Rack 21 Slot 1-3
		Rack 5 Slot 1-3
		Rack 20 Slot 1-3
		Rack 8 Slot 1
11	1508	Rack 8 Slot 2
12	2322	Rack 8 Slot 3
		Rack 9 Slot 1-2
13	2321	Rack 9 Slot 3
		Rack 7 Slot 1-2
14	2318	Rack 7 Slot 3
		Rack 6 Slot 1
15	1855	Rack 6 Slot 2-3
		Rack 10 Slot 1-3

Next, the warehouse layout changes based on the material durability classification can be described as follows:

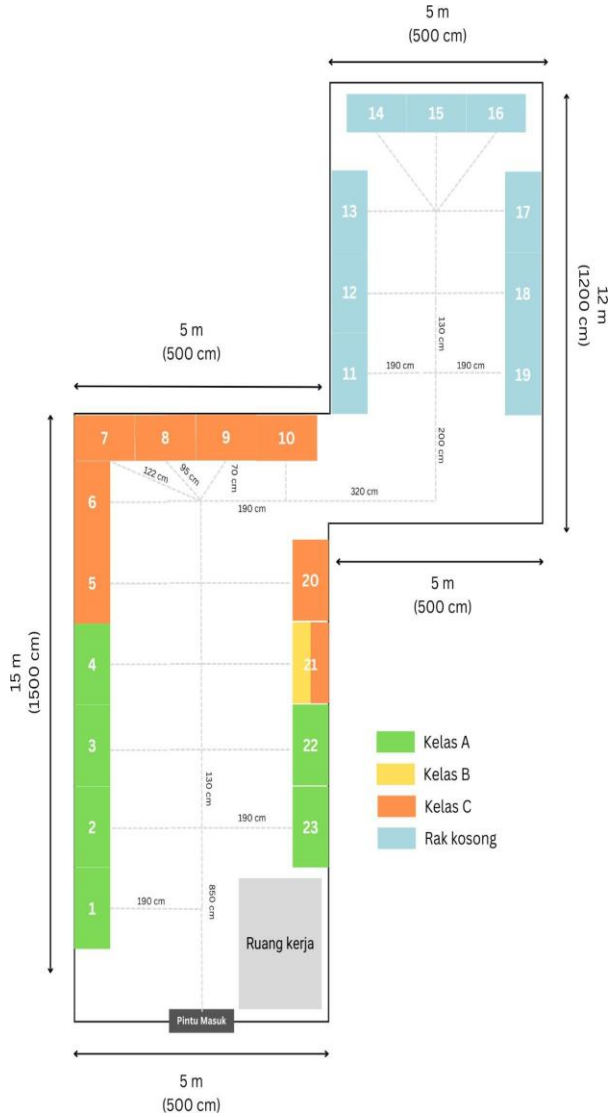

Figure 4. Warehouse Layout

Table 7. Item Placement Based on Classification

Classification	Code	Placement
Class A	2321	Rack 1 Slot 1-3
	1856	Rack 2 Slot 1
	1854	Rack 2 Slot 2
	1852	Rack 2 Slot 3
	1851	Rack 23 Slot 1-3
		Rack 3 Slot 1-3
		Rack 22 Slot 1
	1850	Rack 22 Slot 2
	1525	Rack 22 Slot 3
	1512	Rack 4 Slot 1
	1420	Rack 4 Slot 2-3

Classification	Code	Placement
Class B	2323	Rack 21 Slot 1
	1508	Rack 21 Slot 2
Class C	2322	Rack 21 Slot 3
		Rack 5 Slot 1-2
	2318	Rack 5 Slot 3
		Rack 20 Slot 1
	1855	Rack 8 Slot 1-3
		Rack 9 Slot 1-2
	1849	Rack 9 Slot 3
		Rack 7 Slot 1-3
		Rack 6 Slot 1-3
		Rack 10 Slot 1-3

Comparing Distance and Time of Item Transfer between Existing and New Layout

Changes in the warehouse layout, whether using the dedicated storage method or the class-based storage method, impact the distance and time of item transfers with the following details:

Table 8. Change in Distance and Time of Item Transfers

Rack	Existing Distance (cm)	Changed Distance (cm)	Percentage (%)	Existing Time (s)	Changed Time (s)	Percentage (%)
1	910	910	0	11,375	11,375	0
2	1040	1040	0	13	13	0
3	1170	1170	0	14,625	14,625	0
4	1300	1300	0	16,25	16,25	0
5	1430	1430	0	17,875	17,875	0
6	1560	1560	0	19,5	19,5	0
7	1582	1492	5.69	19,775	18,65	5.69
8	1530	1465	4.25	19,125	18,31	4.25
9	1660	1465	11.75	20,75	18,31	11.75
10	1790	1630	8.94	22,375	20,38	8.94
20	1610	1430	11.18	20,125	17,875	11.18

By removing the sofa, items that should be placed on shelves 11, 19, and 12 can be placed on shelves closer to the entrance, namely shelves 21, 22, and 23. This affects the change in distance and time of item transfers. The comparison is shown in the following table.

Table 10. Change in Distance and Time of Item Transfers

Rack	Existing Distance (cm)	Rack	Changed Distance (cm)	Percentage (%)
11	2430	**21**	1300	46,5
19	2430	**22**	1170	51,85
12	2560	**23**	1040	59,38

Rack	Existing Time (cm)	Rack	Changed Time (cm)	Percentage (%)
11	30,375	**21**	16,25	46,5
19	32	**22**	14,625	54,3
12	30,375	**23**	13	57,2

From the table above, it can be concluded that the percentage change in item transfer distance between the existing warehouse and the new layout ranges from 4.25% to 59.38%. The change in item transfer time ranges from 4.24% to 57.2%.

5. Conclusion

From this research, it can be concluded that the changes in the warehouse layout of KPK PosIND Jakarta Centrum using dedicated storage and class-based storage methods have influenced the distance and time of movement for promotional items. The transfer distances have become shorter and the transfer times have become quicker after the warehouse layout changes. Therefore, it is expected that the goals of improving work efficiency and cleanliness in the KPK PosIND Jakarta Centrum warehouse will be achieved.

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