Improvement of Medicine and Medical Device Storage Layout in The Pharmacy Warehouse Using The Craft Method

(Case Study:The Nganjuk Regency Health Facility)

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Abstract. As a place for storing and managing medicine and medical tools, the warehouse has responsibility for planning, procurement, storage, and distribution to 20 public health centers. Recently, the warehouse uses a randomized storage system to store and causing unclear placement, especially for fast-moving stock. Moreover, the storage must pay attention to the layout principles and rules of the National Food and Drug Agency. This study aims to determine the optimal layout of the District Pharmacy Installation warehouse and find out how to minimize the travel distance of material handling. The Computerized Relative Allocation of Facilities Technique (CRAFT) method was used with excel add-ins tools and supported by rectilinear measurements to see a comparison of the total distance between the existing and proposed conditions. The results obtained by calculating the layout distance in the initial condition is 508.55 meters and in the layout of the proposed condition are 411.00 meters.

Keywords: Warehouse, CRAFT, Rectilinear distance, Layout, Medicine

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1 Introduction

A warehouse is a building that plays an important role in a company or agency that aims as a storage area and has a function to maximize service to customers to get the requested goods quickly and in good condition [1, 3, 5]. Planning and arranging a good warehouse layout will create an activity that runs in the warehouse such as storing raw materials and finished products or storing all kinds of products or goods with various product sizes ranging from small to large-sized products within a period time set by the company or agency until later products come out to be sent to customers can run smoothly [4,6].

One of the warehouses that have an important role in an agency is the District Pharmacy Installation warehouse owned by the Nganjuk Regency Health Office. The pharmacy warehouse in the District Pharmacy Installation plays an important role in storing medicines and medical devices to avoid damage to drugs and medical devices. Currently, the pharmaceutical warehouse has 196 products stored following the rules of the regulation of the minister of health [2]. The regulation contains related to the requirements for drug storage that must be considered by the warehouse [13].

Based on the observation results of the application of pharmaceutical goods storage in the warehouse of the Nganjuk Regency Pharmaceutical Installation, the warehouse still uses a randomized storage system, where when the goods enter, it will be placed in an empty area or the goods are placed in any location does not consider the type and throughput goods, the accumulation of empty goods packaging in the warehouse storage area can result in disruption of the process of placing and picking up goods, and the placement of goods or storage blocks of certain types of goods that have a high frequency are placed in locations far from the I/O point, causing a greater length of the material handling trajectory. Therefore, there is a need for alternative proposals related to improving the storage layout in pharmaceutical warehouses to minimize the distance of movement of goods and alternative layouts.

One alternative to improving the storage layout is to use the CRAFT method. The results of CRAFT will display alternative layouts that have the most optimal storage layout improvements by exchanging between storage departments in the warehouse. The researcher will propose an improvement in the layout of the storage warehouse based on measuring the retrieval distance of existing goods and after the repair using rectilinear distance. The selection of distance measurements considers the material handling and activities in the warehouse.

1.1 Problem Formulation

Based on the background of the problem, the problems discussed by the authors in this study can be identified as follows:

1. What is the alternative to the proposed layout change using the CRAFT method in the pharmacy warehouse of the Nganjuk District Health Office Pharmacy Installation?
2. What is the efficiency of material handling mileage from alternative proposed layout improvements using *the* CRAFT method?

1.2 Purpose Of Research

Based on the identification of problems that have been described earlier, this study has several objectives, namely as follows:

1. Knowing alternatives to proposed layout changes using the CRAFT method in the pharmacy warehouse of the Pharmacy Installation of the Nganjuk Regency Health Office.
2. Determining the layout that has the best material handling mileage efficiency from the alternative proposed layout improvement using the CRAFT method.

1.3 Limitations of Research

The limitations of this research include:

1. The warehouse that will be used for observation is the main warehouse owned by the Nganjuk Regency Pharmaceutical Installation.
2. The area to be studied is only the storage part of the goods that use pallet storage media.
3. Frequency data is taken from January 2020 – January 2021.

1.4 Problem Assumptions

The assumptions of this study include:

1. The warehouse office department area, expired storage area, and I/O point are fixed point areas.
2. Pallets in the barn have 1 level with 6 stacks of cardboard. Pallet capacity will consider the dimensions of each pharmaceutical goods packaging.
3. The calculation of the CRAFT method and visualization of the layout of storage warehouse conditions are obtained from the data on the stock of goods and the largest throughput of goods from January 2020 – January 2021.
4. Doesn't consider the cost of designing the storage layout of the warehouse

2 Theoretical Foundations

2.1 District Pharmacy Installation (IFK)

The District Pharmacy Installation is part of the Technical Implementation Unit (UPT) of the District Health Office which must should carry out the management of pharmaceutical supplies and medical devices. The purpose of the Regency Pharmacy Installation is in the context of preventing and eradicating diseases, as well as as a health service facility in a district or intermediate city, and has the main function, namely. Carry out tasks related to the receipt, management, storage, and distribution of pharmaceutical goods and medical devices in districts/municipalities.

2.2 Warehouse

A Warehouse is a storage place and place to manage goods before goods reach consumers, and has several functions including [5] :

1. As a temporary storage place for goods before the goods are sent to the final location (customers).
2. As a place to prepare the demand for goods ordered by customers.
3. As a customer service facility provider, namely the liaison between customers and warehouses, including customers can conduct market surveys and customers can exchange orders for damaged goods.
4. Protecting goods because warehouses in general have been equipped with an optimal security and protection system. So that this will prevent goods from being damaged quickly.

2.3 District Pharmacy Warehouse

The pharmacy warehouse is a building devoted to the location of receiving, storing, distributing, and managing goods in the form of medical devices, medicines, and other pharmaceutical supplies that aim to meet the health needs of the district concerned and aims to maintain the quality of pharmaceutical goods, avoid irresponsible use, and facilitate the supervision and search for pharmaceutical goods [2].

2.4 Warehouse Layout

The layout can be said to be optimal or effective when it can help an organization achieve their strategic goals, namely quick handling and the relationship between facilities or processes in an organization running smoothly. The layout of the warehouse will affect the storage of goods, so there is something that need to be considered in designing a warehouse building including the flow of receipts, the selection of methods for storing and managing goods, as well as the flow of warehouse activity processes [3].

A good warehouse layout doesn't have a partition and only has one floor because if the warehouse has two floors, you have to consider how to plan to raise and lower the goods. In addition, there are some factors that must be considered before designing the warehouse layout including the measurement of the alley, the type of storage shelf, and the process of storing and retrieving an item.

2.5 Warehousing Principles

The principle of warehousing is very important in planning the layout of storage in a warehouse. There are principles related to warehousing including [6]:

1. Popularity
   This principle confirms that the goods that are most often used or have a high level of demand then they must be placed close to the exit.

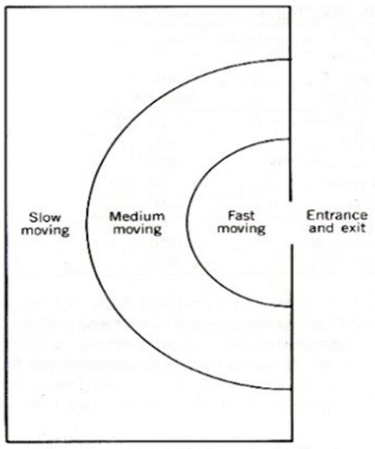


Fig. 1. Storage Popularity

2. Similarity

   This principle applies if by storing an item in a certain storage area, then the retrieval time of an item will be reduced.

3. Size

   This principle applies if the storage is adjusted to the size of the goods. Items that have a small size must be placed in a storage area that has a small place while goods that have a large size are placed in a large place.

4. Characteristics
   This principle applies if storage is carried out based on the characteristics of an item such as perishable materials or hazardous materials.

2.6 Material Handling Equipment

Material handling equipment is a tool used to move heavy loads in the direction of vertical, horizontal, or combination displacement from one department to another. Material handling equipment only distributes materials within a certain distance, for example moving goods from the I / O point to the goods storage block [11].

The selection of material handling equipment considers several factors including the characteristics of the material, the hourly capacity used, the displacement distance, and the period time of use of the tool.

2.7 CRAFT Method

CRAFT is a heuristic algorithm method and aims to improve the layout based on the throughput of goods between departments with the area of block layout used as input. The inputs needed to meet

the design using the CRAFT method include the area of the warehouse department, the flow of goods in the warehouse, the throughput of goods, and the distance of material handling from one department to another. The results of CRAFT processing will produce an estimate of the reduction in the distance of moving goods by looking at the smallest cost. The CRAFT method has the following form of purpose function [15]:

$$Min\ z = \sum_{i=1}^{m}\sum_{j=1}^{m} F_{ij}C_{ij}D_{ij} \quad (1)$$

Where:

Min z = Minimal cost

F_{ij} = Frequency of departments from i to j

C_{ij} = Cost of moving goods between department

D_{ij} = Distance of movement of goods

The transfer fee (C_{ij}) can be assumed to be worth 1 if it is not too significant to the problem at hand or the problem only focuses on the total unit load travel of the facility.

2.8 Rectilinear Distance

Rectilinear calculations are usually also referred to as manhattan distance which is a measurement following a perpendicular path. One of the applications of this measurement is the determination of the distance between cities, the distance between departments where the handling material used only moves perpendicularly. Here's the formula from the rectilinear distance measurement [5].

$$|x_i - x_j| + |y_i - y_j| \quad (2)$$

3 Research Methodology

Improvement of the storage layout using the CRAFT method has methodological stages in the study which include:

1. Problem Identification

   Identification of the problem is obtained from the real problem of observations that occurred in the warehouse of the Nganjuk Regency Pharmaceutical Installation. The problem experienced is the condition of the warehouse which is still not organized and neat, causing damage to goods, waste of placement of goods, and the length of time for

picking up goods due to the long distance of material handling to pick up goods that have a high frequency of demand.

2. Problem Formulation and Research Objectives

   The formulation of the problem to be studied is related to proposing a redesign related to the layout of storage in pharmaceutical *warehouses* using the CRAFT method and rectilinear distance measurement. Meanwhile, the purpose of this study is to answer the formulation of the problem.

3. Defining Problem Limits

   Problem limitations are used to aid the problem research process.

4. Literature Studies

   The literature study used is a continuous study of previous research literature with the design of warehouse storage layouts using the CRAFT method.

5. Data Collection

   Data collection is used as a tool to find the most optimal solution to the problem that occurs. The data needed in this study include primary data and secondary data. Primary data includes the layout of the initial layout of the warehouse, stock data, warehouse area, and data on the entry and exit of goods (*throughput*). In addition, there are secondary data needed including data on the type of *material handling* of goods in pharmaceutical warehouses and the dimensions of goods packaging.

7. Data Processing

   Data processing is carried out after the required data has been collected, including the stock of goods, throughput, and the area of the storage department in the pharmaceutical warehouse. Data processing begins with classifying storage based on the type of goods that correspond to the storage block that has been regulated by the pharmaceutical warehouse of the Health Pharmacy Installation. After knowing the storage location of each item, the next step is to calculate the stock of goods and the throughput of goods from the period January 2020 – January 2021. The calculation of stock and *throughput* takes into account the volume of packaging and the volume of pallets used. Stock and *throughput* of goods are taken from the month that has the highest total stock and *throughput*. Then calculate the material handling displacement distance with the initial layout conditions using rectilinear measurements. Next is to design the layout using the CRAFT method in *excel*, where in the design it is necessary to input the warehouse area, department area, and the frequency of material movement from the I / O point to the storage location. After inputting all the necessary data, it can be known the number of iterations and the location of storage that must be exchanged. It then compares the distance results of the initial layout and the alternative layouts resulting from the CRAFT method.

8. Analysis Result

The results of the research analysis were seen from the comparison of the distance of picking up goods in the warehouse before and after the redesign was carried out. In addition, it is seen from the comparison of the distance and cost of moving material handling the movement of goods before and after the repair of the storage layout. Both comparisons will show how much influence the CRAFT method has.

9. Conclusions and Suggestions

Conclusions and suggestions were drawn after observation and analysis of research in the pharmacy warehouse of the Nganjuk Regency Pharmaceutical Installation.

Fig. 2. Stages of Research

4 Results And Discussion

4.1 Data Collection

This data collection aims to help solve problems in this study.

1. Material Handling Tools

   The pharmaceutical warehouse has a material handling tool in the form of a hand pallet jack. This material handling tool is still operated manually and has dimensions of 1.15 m x 0.68 m x 1.10 m. A hand Pallet jack used has a capacity of 2500 kg.

Fig. 3. Hand Pallet Jack

   As a medium used to help hand pallet jacks move goods, pharmaceutical warehouses have plastic pallets. Plastic pallets were chosen as the storage medium for pharmaceutical warehouses because pharmaceutical warehouses have a storage area with cold temperatures and plastic materials are chosen because these materials are not easily damaged and are more durable than wooden pallets. Pharmaceutical warehouse pallets have dimensions of 1.1 m x 1 m.

Fig. 4. Blue Plastic Pallets

2. Data of Goods in warehouses

   The pharmaceutical warehouse of the Pharmaceutical Installation of the Nganjuk Regency Health Office has an area of 16.5 m x 22.5 m. The goods stored in the warehouse are divided

into several types including AIDS PMS, BHP, BMHP, Obat, TB-Non Oat, TB-Oat, Gugus Tugas, and Covid. Determining the layout of drug storage requires the packaging dimensions of each product stored because the packaging of each product in the warehouse has different dimensions. The dimensions of the packaging are obtained from the results of observations and literature studies obtained from websites such as Alibaba and e-catalogue. After knowing the dimensions of the product, you can determine the volume of packaging in the form of cardboard which will later be used as a variable for calculating pallet capacity in the warehouse. Data were taken from January 2020 – January 2021.

Table 1. Data Of Goods In The Warehouse

Name Of Goods	Unit	Kemasan Primer (m)			Kemasan Sekunder (m)			Weight (gr)	Content
		P	L	T	P	L	T		
AIDS PMS									
Dengue Duo	Tes	0.17	0.11	0.07	0.3	0.25	0.25	600	250
Masker Bedah (HIV)	Pcs	0.17	0.09	0.09	0.3	0.25	0.25	15600	2000
BHP									
ADS 0,5 ml	Pcs	-	-	-	0.2	0.11	0.11	700	10000
Alat suntik 5 ml	Pcs	-	-	-	0.42	0.195	0.115	1000	1000
Blood lancet	Pcs	-	-	-	0.49	0.35	0.35	14000	10000
Blood Tranfusion set	Pcs	-	-	-	0.5	0.4	0.38	14000	400
Catgut Chromic	Pcs	-	-	-	0.3	0.25	0.25	300	24
Catgut Plain	Pcs	-	-	-	0.3	0.25	0.25	300	24
Foley Cateter no.16	Pcs	-	-	-	0.52	0.38	0.36	13000	500
Foley Cateter no.18	Pcs	-	-	-	0.52	0.38	0.36	13000	500
I.V. Cateter no.18	Pcs	-	-	-	0.49	0.42	0.32	8000	1000
I.V. Cateter no.20	Pcs	-	-	-	0.49	0.42	0.32	8000	1000
I.V. Cateter no.22	Pcs	-	-	-	0.49	0.42	0.32	8000	1000
Infus Set anak	Buah	-	-	-	0.45	0.3	0.35	12000	100
Infus Set dewasa	Buah	-	-	-	0.45	0.3	0.35	12000	100
Kapas Adsorb. 250 g	Roll	-	-	-	0.41	0.41	0.41	13000	50
Kassa pembalut 4mx15cm	Roll	-	-	-	0.41	0.41	0.41	13000	1000
Plester	Roll	-	-	-	0.41	0.41	0.41	13000	50
Kassa steril 16 x 16	box	-	-	-	0.5	0.7	0.3	5000	100
Plastik Klip Baru	Pcs	-	-	-	0.49	0.42	0.32	8000	1000
Plester Bulat	Lembar	-	-	-	0.48	0.48	0.48	22000	1000
Softa-Man 500 ml	botol	-	-	-	0.43	0.2	0.21	11000	18
Stik Asam Urat (Easy Touch)	Tes	-	-	-	0.41	0.37	0.45	550	100
Stik Glukose (Easy Touch)	Tes	-	-	-	0.41	0.37	0.45	550	100
Stik kolesterol (Easy Touch)	Tes	-	-	-	0.41	0.37	0.45	550	100
Underpad	Pcs	-	-	-	0.605	0.295	0.465	13000	150
Urine Bag	Pcs	-	-	-	0.4	0.32	0.4		250
Vaginal Speculum Disposible	Buah	-	-	-	0.48	0.38	0.33	6000	100
Alat suntik 3 ml	Pcs	-	-	-	0.42	0.195	0.115	800	1000

The next step is to determine the volume of pallets and cartons to find out the capacity of the goods per pack in one pallet.

Table 2. Packaging And Pallet Volume

Name of Goods	Unit	Pallet Size (m)			Volume (m3)	
		P	L	T	Carton	Palet
AIDS PMS						
Dengue Duo	Tes	1.1	1.0	1.65	0.0188	1.82
Masker Bedah (HIV)	Pcs	1.1	1.0	1.65	0.0188	1.82
BHP						
ADS 0,5 ml	Pcs	1.1	1.0	0.81	0.0024	0.89
Alat suntik 5 ml	Pcs	1.1	1.0	0.84	0.0094	0.92
Blood lancet	Pcs	1.1	1.0	2.25	0.0600	2.48
Blood Tranfusion set	Pcs	1.1	1.0	2.43	0.0760	2.67
Catgut Chromic	Pcs	1.1	1.0	1.65	0.0188	1.82
Catgut Plain	Pcs	1.1	1.0	1.65	0.0188	1.82
Foley Cateter no.16	Pcs	1.1	1.0	2.31	0.0711	2.54
Foley Cateter no.18	Pcs	1.1	1.0	2.31	0.0711	2.54
I.V. Cateter no.18	Pcs	1.1	1.0	2.07	0.0659	2.28
I.V. Cateter no.20	Pcs	1.1	1.0	2.07	0.0659	2.28
I.V. Cateter no.22	Pcs	1.1	1.0	2.07	0.0659	2.28
Infus Set anak	Buah	1.1	1.0	2.25	0.0473	2.48
Infus Set dewasa	Buah	1.1	1.0	2.25	0.0473	2.48
Kapas Adsorb. 250 g	Roll	1.1	1.0	2.61	0.0689	2.87
Kassa pembalut 4mx15cm	Roll	1.1	1.0	2.61	0.0689	2.87
Plester	Roll	1.1	1.0	2.61	0.0689	2.87
Kassa steril 16 x 16	box	1.1	1.0	1.95	0.1050	2.15
Plastik Klip Baru	Pcs	1.1	1.0	2.07	0.0659	2.28
Plester Bulat	Lembar	1.1	1.0	3.03	0.1106	3.33
Softa-Man 500 ml	botol	1.1	1.0	1.41	0.0181	1.55
Stik Asam Urat (Easy Touch)	Tes	1.1	1.0	2.85	0.0683	3.14
Stik Glukose (Easy Touch)	Tes	1.1	1.0	2.85	0.0683	3.14
Stik kolesterol (Easy Touch)	Tes	1.1	1.0	2.85	0.0683	3.14
Underpad	Pcs	1.1	1.0	2.94	0.0830	3.23
Urine Bag	Pcs	1.1	1.0	2.55	0.0512	2.81
Vaginal Speculum Disposible	Buah	1.1	1.0	2.13	0.0602	2.34
Alat suntik 3 ml	Pcs	1.1	1.0	0.84	0.0094	0.92

The pallets used have a length of 1.1 meters and a width of 1 meter, then the volume calculation stage is carried out by multiplication of the length, width, and height of the cartons and pallets. The height of the pallet considers the height of the carton and the stack of cartons in one pallet, which is 1 level containing 6 cartons. The results of the volume of cardboard can help determine the area of each storage block in the warehouse, find out the total capacity in one pallet, and the total pallets in the warehouse.

3. Stock Data

The stock data in the warehouse of the pharmaceutical installation is divided into initial stock data and final stock every month obtained from the warehouse database owned by the Pharmaceutical Installation of the Nganjuk Regency Health Office. The total stock of goods from each type of goods ranging from AIDS PMS, BHP, BMHP, medicines, TB-Non Oat, TB-Oat, task force, and covid per month is taken from the final stock every month after the goods enter and exit in the range of months taken.

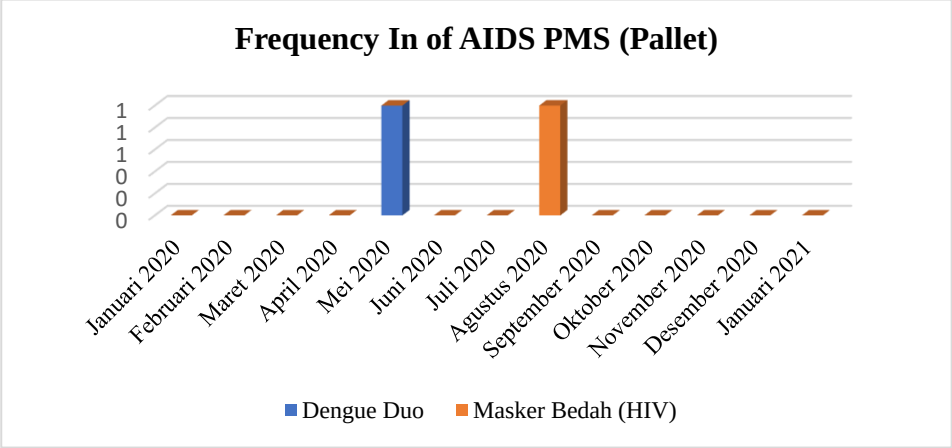
Table 3. Stock Data

Jenis Barang	2020 (Palet)												2021 (Palet)
	Januari	Februari	Maret	April	Mei	Juni	Juli	Agustus	September	Oktober	November	Desember	Januari
AIDS PMS	0	0	0	0	1	1	1	1	1	1	1	1	1
BHP	24	23	23	22	22	25	20	29	29	29	29	30	31
BMHP	0	0	0	0	0	2	2	2	2	2	2	2	2
OBAT	85	86	88	88	88	94	99	103	104	105	116	99	97
TB-NON OAT	2	2	2	4	4	4	4	4	4	4	4	4	4
TB-OAT	4	4	4	4	4	4	4	4	2	2	2	4	4
GUGUS TUGAS	0	0	0	9	14	15	15	15	15	15	15	15	15
COVID	9	9	23	52	57	73	67	55	53	53	64	66	67
Total	124	124	140	179	190	218	212	213	210	211	233	221	221

Based on the table above, it is found that the month that has the highest stock of goods is November with a total of 233 pallets. The total stock of goods in one pallet is obtained from the total of each item in the warehouse.

4. Data In and Out of Goods in warehouses

Data on the in and out of goods in the pharmaceutical warehouse comes from the official warehouse database owned by the Nganjuk Regency Health Agency, where each product is divided into several types including AIDS PMS, BHP, BMHP, drugs, TB-Non Oat, TB-Oat, task force, and covid.



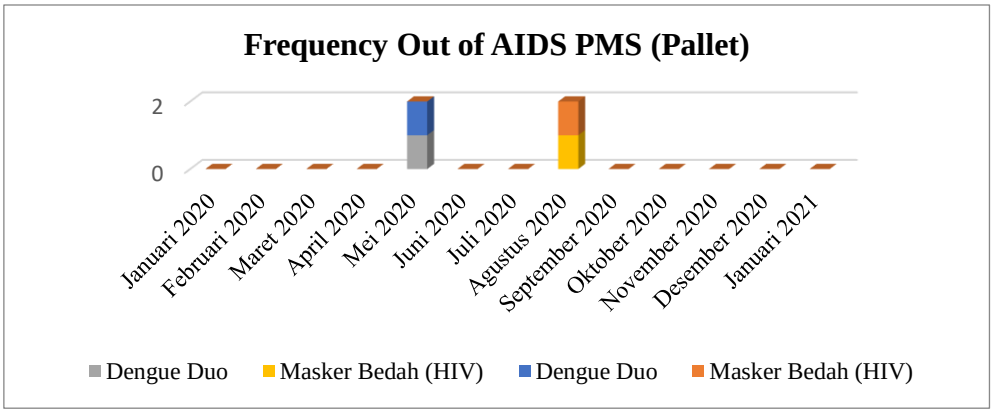


Fig. 5. Data Graph of In and Out AIDS PMS

As can be seen from the chart from January 2020 - January 2021, there was a movement of goods into the warehouse in May 2020 for goods with the dengue duo then in August 2020, there was a movement of surgical mask (HIV) goods into the storage block for PMS AIDS type goods. Meanwhile, the movement of goods out by denguo duo goods in May 2020 and August 2020 was 2 pallets and in May and September, there was a movement of surgical masks (HIV) out of the warehouse as many as 2 pallets.

4.2 Data Processing

Data processing uses several types of data on goods in the warehouse ranging from AIDS PMS, BHP, BMHP, medicine, TB-Non Oat, TB-Oat, task force, and covid. The purpose of this study is to obtain a storage layout that has the minimum range of goods movement.

1. Calculation of the Frequency of Moving Goods

   There are two frequency calculations carried out by researchers, namely the frequency of entry (Fk-in) and the frequency of exit (Fk-out). The first stage in the frequency calculation is to find out the total Fk-in and Fk-out pallets of goods from each month, the total frequency will be used to search for Fk-max.

Table 4. Maximum Frequency Of Goods

Goods	Fk-Maksimal (Palet)	
	Fk-*In*	Fk-*Out*
Penyimpanan AIDS PMS	1	1
Penyimpanan BHP	16	12
Penyimpanan BMHP	2	2
Penyimpanan TB-NON OAT	2	1
Penyimpanan TB-OAT	3	3
Penyimpanan GUGUS TUGAS	12	5
Penyimpanan COVID 1	33	19
Penyimpanan COVID 2	36	29
Penyimpanan OBAT 1	14	33
Penyimpanan OBAT 2	6	3
Penyimpanan OBAT 3	6	4
Penyimpanan OBAT 4	13	6
Penyimpanan OBAT 5	3	2
Penyimpanan OBAT 6	6	5

The use of Fk-In and Fk-Out will serve as data processing inputs in CRAFT.

2. Calculation of Stock Space Needs

The need for pharmaceutical warehouse space is taken from the data on the stock of goods stored from January 2020 – January 2021, then taken from the month that has the highest stock of goods in the warehouse.

Table 5. Maximum Stock Of Goods

Jenis Barang	2020 (Palet)												2021 (Palet)
	Januari	Februari	Maret	April	Mei	Juni	Juli	Agustus	September	Oktober	November	Desember	Januari
AIDS PMS	0	0	0	0	1	1	1	1	1	1	1	1	1
BHP	24	23	23	22	22	25	20	29	29	29	29	30	31
BMHP	0	0	0	0	0	2	2	2	2	2	2	2	2
OBAT	85	86	88	88	88	94	99	103	104	105	116	99	97
TB-NON OAT	2	2	2	4	4	4	4	4	4	4	4	4	4
TB-OAT	4	4	4	4	4	4	4	4	2	2	2	4	4
GUGUS TUGAS	0	0	0	9	14	15	15	15	15	15	15	15	15
COVID	9	9	23	52	57	73	67	55	53	53	64	66	67
Total	124	124	140	179	190	218	212	213	210	211	233	221	221

Based on the table, the month that has the most or highest stock of goods is in November at 233 pallets, so a pallet capacity of approximately 240 pallets requires space requirements for 233 pallets.

3. Warehouse Area

The warehouse area owned by the pharmaceutical warehouse owned by the Nganjuk Regency Pharmaceutical Installation is 371.3 square meters with a length of 16.5 meters and

a width of 22.5 meters, while the aisle length for material handling and inter-each storage block traffic is 1.5 meters.

Table 6. Warehouse Area

Department	Area (m)		Pallet Area (m)		Area (m2)
	p	l	p	l	
I/O Point	3.75	1.00	-	-	3.75
kantor gudang	3.75	2.50	-	-	9.38
Penyimpanan AIDS PMS	1.10	1.00	1.10	1.0	1.10
Penyimpanan BHP	2.25	15.00	1.10	1.0	33.75
Penyimpanan BMHP	1.10	2.00	1.10	1.0	2.20
Penyimpanan TB-NON OAT	2.20	2.00	1.10	1.0	4.40
Penyimpanan TB-OAT	1.10	2.00	1.10	1.0	2.20
Penyimpanan GUGUS TUGAS	5.50	3.00	1.10	1.0	16.50
Penyimpanan COVID 1	2.20	14.00	1.10	1.0	30.80
Penyimpanan COVID 2	2.20	18.00	1.10	1.0	39.60
Penyimpanan OBAT 1	5.50	10.00	1.10	1.0	55.00
Penyimpanan OBAT 2	5.50	4.00	1.10	1.0	22.00
Penyimpanan OBAT 3	2.20	7.00	1.10	1.0	15.40
Penyimpanan OBAT 4	2.20	4.00	1.10	1.0	8.80
Penyimpanan OBAT 5	2.20	3.00	1.10	1.0	6.60
Penyimpanan OBAT 6	1.10	21.00	1.10	1.0	23.10
Penyimpanan Obat Kadaluarsa	4.50	2.50	-	-	11.25

The calculation of the area of the storage block begins with knowing the total pallets in each storage block, then calculating the times between the pallet area and the area in the warehouse.

4. Input Data

   The parts needed in inputting CRAFT method design in excel add-ins are data layout, facility information, and department of information. In the data layout section, what is needed is the number of departments needed, the departments in the pharmacy warehouse are 17 departments. Next is the facility information section, where the length and width of the warehouse are needed, which then gets a grid layout size of 17 x 22 cells. After completing the information facility, the next step is to fill in the department information section by including the frequency of movement and the distance of material handling from the I/O point to the storage block and vice versa. The cost matrix is assumed to be worth one because in this study it is not too significant to use.

5. Layout Improvements Using CRAFT

   After inputting the data, it will bring up the appearance of the storage warehouse layout with the modification of the addition of an aisle.

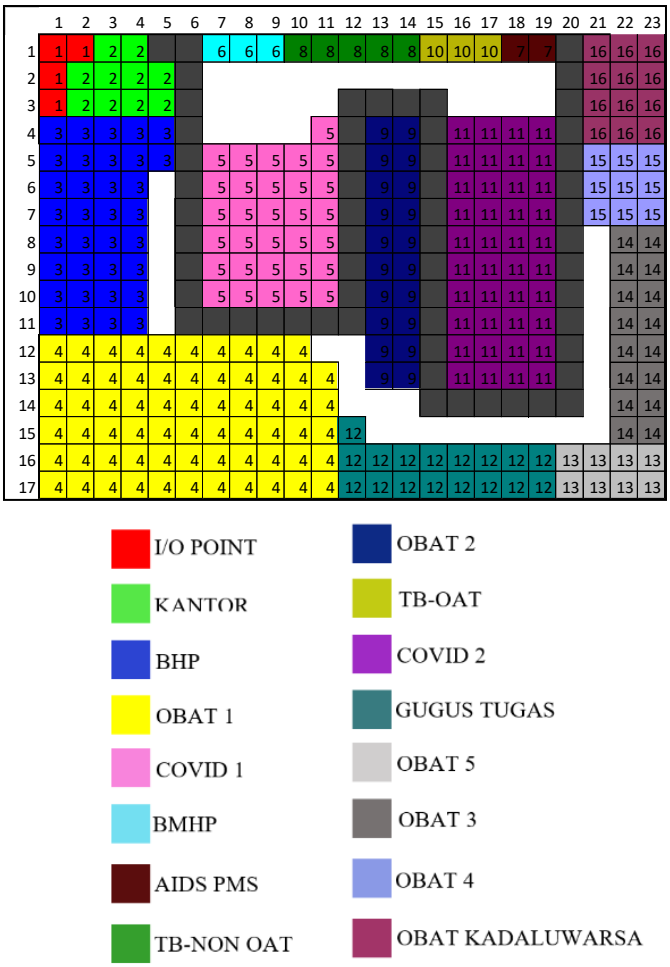


Fig. 6. Initial State Layout

After knowing the layout of the initial condition of the warehouse, the next step is to determine the centroid of each department.

Table 7. Centroid Warehouse Initial Condition

Name	x (m)	y (m)
I/O Point	0.50	1.50
kantor gudang	3.00	1.50
Penyimpanan BHP	2.50	7.00
Penyimpanan OBAT 1	5.50	14.00
Penyimpanan COVID 1	8.50	10.00
Penyimpanan BMHP	7.50	0.50
Penyimpanan AIDS PMS	18.00	0.50
Penyimpanan TB-NON OAT	11.50	0.50
Penyimpanan OBAT 2	13.00	8.00
Penyimpanan TB-OAT	15.50	0.50
Penyimpanan COVID 2	17.00	8.00
Penyimpanan GUGUS TUGAS	15.00	15.50
Penyimpanan OBAT 5	21.00	16.00
Penyimpanan OBAT 3	22.00	11.00
Penyimpanan OBAT 4	21.50	5.50
Penyimpanan Obat Kadaluwarsa	21.50	2.00

Then after knowing the centroid of each department in the warehouse, the next step is to calculate the total mileage of material handling.

Table 8. Total Distance of Movement Of The Initial Goods

Area	Displacement Frequency	Distance (m)
I/O Point - AIDS PMS	1	16.50
I/O Point - BHP	16	7.50
I/O Point - BMHP	2	6.00
I/O Point - TB-NON OAT	2	10.00
I/O Point - TB-OAT	3	14.00
I/O Point - GUGUS TUGAS	12	28.50
I/O Point - COVID 1	33	16.50
I/O Point - COVID 2	36	23.00
I/O Point - OBAT 1	14	17.50
I/O Point - OBAT 2	6	19.00
I/O Point - OBAT 3	6	31.00
I/O Point - OBAT 4	13	25.00
I/O Point - OBAT 5	3	35.00
AIDS PMS - I/O Point	1	16.73
BHP - I/O Point	12	10.15
BMHP - I/O Point	2	18.48
TB-NON OAT - I/O Point	1	18.78
TB-OAT - I/O Point	3	20.23
GUGUS TUGAS - I/O Point	5	22.73
COVID 1 - I/O Point	19	13.98
COVID 2 - I/O Point	29	20.33
OBAT 1 - I/O Point	33	10.73
OBAT 2 - I/O Point	3	18.88
OBAT 3 - I/O Point	4	29.48
OBAT 4 - I/O Point	6	33.83
OBAT 5 - I/O Point	2	24.78
Total Mileage of Goods		508.61

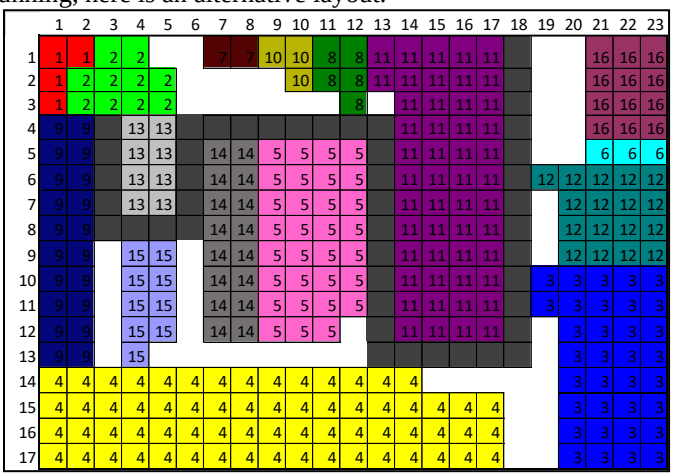
Based on the table above, the total mileage of material handling is obtained from the total distance of each product movement activity that occurs in the warehouse. Then after calculating the total mileage of the goods, after the running results are obtained in the form of the number of iterations obtained to the storage layout with CRAFT producing the lowest cost value to get the shortest total distance of moving goods.

Iterations: 10

Iter.	Type	Action	Cost
1	Switch:	13 and 3	2643
2	Switch:	9 and 13	2859
3	Switch:	12 and 5	2596
4	Switch:	15 and 6	2447
5	Switch:	13 and 7	2417
6	Switch:	14 and 12	2405
7	Switch:	14 and 4	2380
8	Switch:	10 and 7	2362
9	Switch:	13 and 14	2360
10	Switch:	15 and 4	2359

Fig. 7. CRAFT Iteration Results

Based on these iterations, 10 iterations were obtained, which is the most optimal alternative solution to the proposal. Therefore, from the exchange of departments resulting from the results of running, here is an alternative layout.



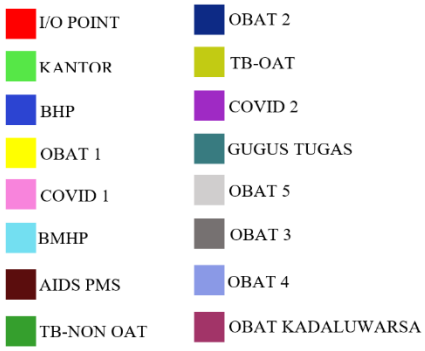


Fig. 8. Warehouse Layout Alternative

The results shown above are the most optimal results obtained after exchanging departments in the warehouse, including in the first iteration there was an exchange of the drug storage block 5 departments with the BHP storage department, but then the optimum results were not obtained, so continuous iteration was carried out until they got the most optimal results. After obtaining the proposed alternative layout, the next step is to recalculate the total mileage of the material handling.

Table 9. Centroid Warehouse Condition Alternative

Name	x (m)	y (m)
I/O Point	0.50	1.50
kantor gudang	3.00	1.50
Penyimpanan BHP	20.50	13.00
Penyimpanan OBAT 1	8.50	15.00
Penyimpanan COVID 1	10.00	12.00
Penyimpanan BMHP	21.50	4.50
Penyimpanan AIDS PMS	7.00	0.50
Penyimpanan TB-NON OAT	11.00	1.50
Penyimpanan OBAT 2	1.00	8.00
Penyimpanan TB-OAT	9.00	1.00
Penyimpanan COVID 2	14.50	6.00
Penyimpanan GUGUS TUGAS	20.50	7.00
Penyimpanan OBAT 5	4.00	5.00
Penyimpanan OBAT 3	7.00	8.00
Penyimpanan OBAT 4	5.00	10.50
Penyimpanan Obat Kadaluwarsa	21.50	2.00

Based on the centroid obtained after conducting a departmental exchange of the results proposed by CRAFT, then calculate the total mileage of material handling based on the proposed layout.

Table 10. Total Distance of Movement of Proposed Goods

Area	Displacement Frequency	Distance (m)
I/O Point - AIDS PMS	1	5.50
I/O Point - BHP	16	31.50
I/O Point - BMHP	2	24.00
I/O Point - TB-NON OAT	2	10.50
I/O Point - TB-OAT	3	8.00
I/O Point - GUGUS TUGAS	12	25.50
I/O Point - COVID 1	33	20.00
I/O Point - COVID 2	36	18.50
I/O Point - OBAT 1	14	21.50
I/O Point - OBAT 2	6	7.00
I/O Point - OBAT 3	6	13.00
I/O Point - OBAT 4	13	13.50
I/O Point - OBAT 5	3	7.00
AIDS PMS - I/O Point	1	5.50
BHP - I/O Point	12	31.50
BMHP - I/O Point	2	24.00
TB-NON OAT - I/O Point	1	10.50
TB-OAT - I/O Point	3	8.00
GUGUS TUGAS - I/O Point	5	25.50
COVID 1 - I/O Point	19	20.00
COVID 2 - I/O Point	29	18.50
OBAT 1 - I/O Point	33	21.50
OBAT 2 - I/O Point	3	7.00
OBAT 3 - I/O Point	4	13.00
OBAT 4 - I/O Point	6	13.50
OBAT 5 - I/O Point	2	7.00
Total Mileage of Goods		411

The results above show the total distance of movement of goods measured using the rectilinear distance measurement model. There is a difference in the distance of moving goods that is smaller than the distance of the displacement of the initial conditions.

6. Comparison Of Initial Layout And Proposals

Based on the results of layout design using the help of excel add-ins of the CRAFT method which then obtained optimal results by looking at the reduction in material handling mileage.

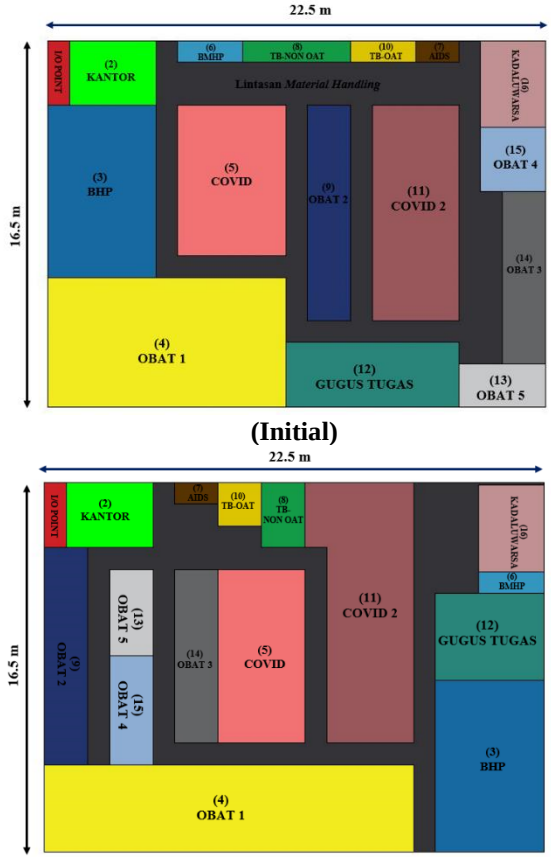


Fig. 9. Comparison of Initial and Alternative Layout

Based on the results of running using the help of excel add-ins obtained the results of the most optimal storage layout of goods with ten iterations. The layout change occurred in the exchange of storage block departments and the distance of moving goods changed to be smaller than the initial conditions.

The results of distance measurements in the warehouse layout are calculated using a rectilinear distance model by considering the results of data processing using the CRAFT method. In the initial condition layout, the total mileage for the movement of goods is 508.55 meters, while for the layout of the proposed condition, it is 411 meters. Therefore, from the comparison of the two layouts, it was found that the minimum mileage of moving goods was 19.2% which resulted in an optimal solution in minimizing the distance of moving goods.

7. Advantages and Disadvantages of CRAFT

The advantage obtained is that the CRAFT method is very flexible in the form of departments and can cover all forms of departments in the warehouse. Then the use of the CRAFT method design is to be able to set fixed positions for some departments that cannot be changed their location in the warehouse. CRAFT also has advantages in the running process in Excel so it takes a short time to solve problems in the warehouse. However, the application of the CRAFT method has the disadvantage that it cannot directly enter the aisle into the grid in Excel, so it must be done manually. In addition, the resulting layout cannot be 100% the same as the results of the initial condition of the warehouse, so the author needs to adjust the layout to the initial conditions of the warehouse. The application of the CRAFT method is also limited, which is only able to input 40 departments.

5 Conclusions And Suggestions

5.1 Conclusion

Based on research that has been carried out by researchers to achieve the goal of minimizing the distance of material handling from the I / O point to the goods storage block or from the storage block to the I / O point using the CRAFT method, it can be concluded as follows:

1. The exchange of storage block departments was obtained from the results of running using the help of CRAFT in excel add-ins and obtained the results of iterations ten times, then an exchange was obtained between the department of drug storage block 4 containing the drug ondansentron 4mg with the drug storage block consisting of tablets and capsules so that an alternative layout proposal was obtained in the tenth iteration.
2. The result of the calculation of the layout distance in the initial condition is 508.55 meters and in the layout of the proposed condition assisted by excel add-ins are 411.00 meters so with the application of the CRAFT method, it can minimize the mileage of moving goods by 19.2%.

5.2 Suggestion

Based on the research that has been carried out, there are suggestions given to the observation site during the study including the following.

1. The Pharmaceutical Installation of the Nganjuk Regency Health Office should consider implementing the use of a storage warehouse layout designed using the CRAFT method. The application of this method can minimize the mileage of moving goods with a difference of 19.2%. However, this decision is left to the party who played a role in deciding for further consideration.
2. The Pharmaceutical Installation Of the Nganjuk Regency Health Office also needs to pay attention to things such as neater placement of goods, more detailed data on the movement of goods, and other supporting aspects related to pharmaceutical warehouses.

3. For further research, material handling cost factors can be added to better know the results of more optimal improvements.
4. For further research, processing can be carried out using the CRAFT method with tools other than excel add-ins so that it can compare the best layout results.
5. For further research, material handling simulations can be carried out after processing layout improvement data using the CRAFT method.

References

[1] Riswanda, J. I. (2018). Evaluasi Tata Letak Dengan Menggunakan Metode Craft Untuk Meningkatkan Efisiensi (Studi Kasus Di Gudang Obat 1 Depo Farmasi Rsud Dr. Saiful Anwa.

[2] Permenkes. (2016). Peraturan Menteri Kesehatan Republik Indonesia Nomor 72 Tahun 2016 Tentang Standar Pelayanan kefarmasian di Rumah sakit. Jakarta: Kementrian Kesehatan Republik Indonesia.

[3] Heizer Jaydan Render, B. (2017). Manajemen Operasi (edisi 11). Jakarta : Salemba Empat.

[4] Padhil, A. P. (2021). Perancangan Ulang Tata Letak Fasilitas Produksi Menggunakan Metode Algoritma CRAFT Pada Pt. Sermani Steel Makassar.

[5] Heragu, S. S. (2016). Facilities Design (4th edition). US : CRC Press Taylor & Francis Group.

[6] Tompkins, J. A., et al. (2003). Facilities Planning (3rd ed). New Jersey: John Wiley & Sons, Inc.

[7] Tahir, S. S. (2015). Usulan Perbaikan Tata Letak Fasilitas dengan Menggunakan Algoritma CRAFT.

[8] Stephens, M. P., & Meyers, F. E. (2013). Manufacturing facilities design and material handling. Purdue University Press.

[9] Nur, H. M. (2018). Perencanaan Tata Letak Gudang Menggunakan Metode Class-Based Storage-CRAFT Pada Distributor Computer & Office Equipment.

[10] Yuliana, L. F. (2017). Usulan Perbaikan Tata Letak Gudang dengan Menggunakan Metode CRAFT (Studi Kasus di Gudang K-Store, Krakatau Junction).

[11] Hermawan, F. &. (2019). Perbaikan Tata Letak Fasilitas Dengan Algoritma Craft Guna Meminimasi Ongkos Material Handling (Studi Kasus: CV, Surabaya Trading & Co).

[12] Tahir, S. S. (2015). Usulan Perbaikan Tata Letak Fasilitas dengan Menggunakan Algoritma CRAFT.

[13] BPOM. (2018). Peraturan Badan Pengawas Obatdan Makanan RI Nomor 4 Tahun 2018 tentang Pengawasan, Pengelolaan Obat, Bahan Obat, Narkotika, Psikotropika, dan Prekursor Farmasi di Fasilitas Pelayanan Kefarmasian, BPOM, Jakarta.

[14] Maheswari, H. &. (2015). Evaluasi Tata Letak Fasilitas Produksi Untuk Meningkatkan Efisiensi Kerja Pada PT. Nusa Multilaksana.

[15] Ristyanadi, B., & Orchidiawati, N. (2019). Perancangan Tata Letak di PT. Aerowisata Catering Service dengan Menggunakan Metode CRAFT (Computerized Relative Allocation Of Facilities Techniques).