

Storage Allocation In Finished Goods Warehouse (Case Study Of Sock Industry In Bandung)

Nitta Fitria Anggraeni, Dilla Ayu Maharani, Kristina Sihombing, Gustian Adhitya Prayogi, Verani Hartati

Abstract – Warehouse is a temporary storage of goods, such as raw materials, work in progress or finished goods. The warehouse has a different cycle time for each item stored. All the problem that arises in warehouse such as stacking of goods, improper allocation of storage, and time for picker to collect goods. PT SCN is a company that engaged in the production and distribution of fashion products. The high level of production in this company has resulted in the unorganized storage of warehouse storage. Allocation storage of goods in warehouses must be considered carefully so as not to reduce the quality of the goods stored. Based on these problems, the purpose of this research is to be a problem solving of storage allocation. These problems can be solved by using class-based (ABC) method and First In First Out (FIFO) method. This research uses monthly demand data to get categories and avoid inventory buildup. The results of this research are the arrangement of goods in the forward area and block stage based on the capacity along with the specified categories.

Keywords: Warehouse, Storage Allocation, Class-Based (ABC), First In First Out (FIFO)

I. INTRODUCTION

PT SCN is a company that engaged in production and distribution. This company is engaged in the socks industry. Their products have been sold offline and online in national and international markets. All the problem that arises in warehouse such as problems caused by improper arrangement of goods and warehouse management that has not been running properly, so that it can cause construct of inventory in the warehouse. This problem can occur due to the incompatibility of physical stock with the data owned by operator in the warehouse because the warehouse management system has not been implemented yet.

The warehouse is a permanent building used for storing goods [1]. Warehouse is defined as the function of storing various types of products (inventory storage units) that have a small or large number of storage units between when the product is produced and needed. The functions of the warehouse include unpacking, receiving and inspecting goods. The warehouse is not used only for those functions, but it is also used for storage, sorting and maintenance in order to get loss prevention. Warehouse and distribution operations in all industries have storage and product movement facilities, both from single goods, cartons, pallet loads or bulk materials. Each warehouse operation or distribution has its own functions, such as receipt of goods, vertical or horizontal movement, storage, sorting, packing, checking and shipping of the goods [2]. The smooth operation of the company in manufacturing warehouses becomes one of the significant roles, same as in the storage of goods that be required by the company, because it is related to cost requirements by finding the best combination between large space and material handling. The things that should be considered in arranging the warehouse for reducing the buildup of the inventory.

II. LITERATURE STUDY

According to [3], there are four methods that can be used to arrange the storage location of an item, including:

- a. Dedicated the storage method, this method is often referred to certain and fixed storage because the location of 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. Storage space needed is cumulative of the maximum storage requirements of each type of product if the product to be stored is more than one type.

b. Randomized storage method, this method is often referred to floating lot storage, which is storage that allows the stored products to move their storage location at any time. Placement of goods only pays attention to the closest distance to a place of storage and the storage rotation uses FIFO (First In First Out) system. Other factors such as the type of stored goods, dimensions, and security guarantees of goods are not given sufficient attention. This makes storing goods less organized.

c. Class based dedicated storage method, this method is a compromise of the randomized storage and dedicated storage methods. This method makes existing products divided into three, four, or five classes based on the ratio of throughput (T) and storage ratio (S). This method makes the arrangement of places more flexible by dividing the storage area into several parts. Each place can be filled randomly by several types of goods that have been classified based on the type and size of the goods.

d. Shared storage method, this method shows different products using the same storage slot, even though only one product occupies one slot when the slot is filled. This storage model is called shared storage. The space requirements for the shared storage method is in the range between the space requirements for the randomized storage and dedicated storage methods depending on the amount of available information about the inventory level during a certain period of time. Shared storage and randomized storage methods have some differences. The randomized storage method is concerned with the total storage location specifications of the product. The shared storage method is related to the locations that depend on the appearance of empty spaces in the warehouse. The shared storage method is more suitable for the products that are stored in various types with relatively constant demand.

As one of the successes in research, it is necessary to conduct a literature study from previous research aimed at avoiding remanufacturing, identifying the methods that have been carried out, and knowing the same research and research areas in this field. Research conducted by [4] stated that the preparation of the warehouse layout currently applied in the warehouse uses the principle of similarity. The use of the principle of similarity makes the search and retrieval of goods longer and longer, because the items sought are located separately and far apart. It can have an impact on the disruption of the production process. The purpose of the study is to propose improvements to the layout of the placement of goods in the yarn warehouse by using the class-based ABC method. The result of this research is the class-based ABC method which in its preparation considers the principle of popularity, so the goods stored in a warehouse can be classified into three classes, those are class A, B, and C.

According to research conducted by [5] that has proposed improvements to the layout of the placement of goods in the warehouse of raw materials using the class-based ABC method. Implementation of the layout of the company's raw materials that have been studied using the arrangement of similarity. The arrangement was not appropriate, because the raw material that was often used is located far from the quality control & shorting room which was then used for production. Class-based ABC method divides goods into three groups, those are class A that is closest to the entry and exit, class B is between class A and C, while class C is in the area farthest from the entry and exit. The ABC method makes goods with high usage levels placed near the next processing site, namely the quality control & shorting room.

In observations made by [6] showed that the problem faced is the irregular arrangement of products, this will hamper the delivery process time. Other conditions also occur in product placement in an area that is not quite right, where one area should not be more than one type of product but still the order is still mixed with other products and the goods that have the most frequency of delivery which often go in and out too far from the exit. The results of data process using the shared storage method in the finished product warehouse, the conclusion can be drawn, that is the layout of the first proposal has a

total mileage that is smaller than the layout of the second proposal and the initial layout with improved layout and storage layout.

Comparison of the previous studies according to [4], [5], and [6] with current research is found in class-based ABC method calculation category. Previous research used the category of "absorption of funds" but the present study used a category based on the average demand for goods each month. In the preparation of the storage allocation of stored products using the fast moving category (fast and frequent turnover of goods), medium (the turnover of goods that is not too fast and often but not too slow), and slow moving (slow turnover of goods) to facilitate the collection of goods.

III. METHODOLOGY

This research was carried out in the PT SCN warehouse because there were problems regarding the improper arrangement of the goods and the management of the warehouse which had not been going well, causing the buildup of inventory in the warehouse. The research method was carried out by collecting data the last 6 months and then the data was compiled, processed, and analyzed to provide an overview of the existing problems. The data obtained will be processed using the class-based ABC method for structuring goods, which will affect the new warehouse layout design.

a. Warehouse Classification

According to [1], a warehouse is a building used to store goods or a place that is used to store goods in the form of raw materials, work in process or finished goods. According to [7], division of goods in warehouses can be divided into two classifications, namely based on the flow of goods and material characteristics. Material characteristics are divided into four (raw material, work in process storage, finish goods storage, and tools). The flow of goods is divided into three, namely fast moving, medium moving, and slow moving.

b. Control of the Goods

According to [8], the goods control system is a system that is carried out to track goods and track the allocation of goods in the warehouse. One strategy that can be used is first in first out (FIFO). This strategy is used to keep old products out first. The FIFO method is suitable for products that are not durable or products with short life cycles [2].

c. Class-Based ABC Method

Class-based ABC method can be used to classify goods based on the level of use of goods. Class-based ABC method is divided into three categories, which are as follows [9]:

1. Class A is the goods that provide high value. Although this group A is only represented by 20% of the total inventory available, the value given is 80%.
2. Class B is the goods that gives a medium value. This B class inventory group is represented by 30% of the total inventory and the resulting value is 15%.
3. Class C is the goods which gives low value. The C class inventory group is represented by 50% of the total available inventory and the value generated is 5%.

d. Shared Storage Method

According to [3], This method is a system of moving goods quickly to a product if each pallet is filled in a different warehouse area from time to time. The steps in this method include:

1. Calculation of warehouse area capacity (length of time worked in process, delivery time, and number of products).
2. Classification of products based on customers.
3. Calculation of area requirements for each item.
4. Determination of the order of moving for each area based on the distance of the entrance and exit.
5. Layout Determination.

e. Pick-order Method

The purpose of the pick-order routing pattern is to reduce or minimize the non-productive time of the operator running. To achieve maximum employee productivity, the right order picker routing pattern is implemented in conjunction with the basics of good warehouse practices. If the pick-order method makes the process effective and efficient, facilities must be designed with an understanding of flow patterns and product refilling requirements [2].

f. Pallet Load Dimensions

The amount of unit load and shelf weight determines the baseplate. The weight of the entire unit load, baseplate size, and wheel size of the lifting truck with the lift truck load determine the thickness of the floor. Floor construction costs are a function of floor thickness. The height of the unit load determines the amount of unit load in a vertical stack. Width determines the amount of unit load that matches between two levels of the upright rack. The depth of the unit determines the depth of the storage path or the depth of a standard upright rack frame [2].

IV. RESULTS AND DISCUSSION

General description of this research object in storage at PT SCN. This warehouse stores the results of finished goods which are packaged using cube-shaped boxes or cartons with a specific size 50 x 23 x 20.5 cm. This box packaging can make it easier for collection of goods and storage allocation in warehouse. Storage allocation of goods in PT SCN has few problems in improper arrangement of goods and reducing order picker's time. The following is layout of PT SCN's warehouse:



Figure 1. Layout of PT SCN's Warehouse

In Figure 1, the warehouse layout above is divided into several storage racks, namely, reserve area 1, reserve area 2, reserve area 3, forward area 1 and forward area 2. This reserve 1 and reserve 2 area is a storage area for goods that use shelves with 3 levels, in which each station can contain 2 pallets, while reserve 2 storage of goods does not use a rack but

only stored on a pallet. Forward area 1 is a storage area for goods that use a rack with 5 levels, while the forward area 2 where storage of goods uses shelves with 3 levels.

This research conducts storage allocation of goods with the class-based ABC method, on a pre-existing layout. PT SCN has a large variety of goods markete, consisting of 197 variations with different levels of demand. The data needed to find out how much storage area on each item is required monthly average inventory data. The average inventory data for each product family can be seen in the table below, namely:

Table 1. Inventory Data

Family Product	Average Inventory (Dozen)
X	28.742
Y	22.569
Z	2.881

Of all the variations are divided into 3 family of goods namely X, Y and Z. Each type of item has a different handling in its storage, for the type of product X in storage allocation goods cannot be mixed with other types because the product is a halal socks product which has been registered by the company to the Majelis Ulama Indonesia (MUI). Majelis Ulama Indonesia has determined that halal products can't be combined with other types, so that types of products Y and Z in their placement may be combined.

Class-Based ABC method is a method used group goods based on the number of requests. This grouping aims to regulate storage allocation of goods in the warehouse. Category A goods will be placed near the loading door or the front, category B goods will be placed in the middle of the warehouse while category C goods will be placed at the back of the warehouse. The data used in the Class-Based ABC method use monthly demand data on each type of item. The calculation also used data of demand for goods that were previously sorted from the largest demand to the smallest demand, these good for order to find out the cumulative value of each item. These group used to determine the category of each item. Class A is items that provide high score. Although this classification A is only represented by 20% of the number inventories that the customary is given 80%. Class B is goods which give medium value. Classification this class B inventory is represented by 30% of the amount of inventory and its value produced 15%. Class C is goods which give a low value. Classification class C inventory is represented by 50% of total inventory available and value produced 5%.

a. Reserve Area 2

Items stored in reserve area 2 using a pallet. This area not used a shelf as a storage area. Each pallet can hold 30 boxes and 1 box can hold 10 dozen items. Storage allocation for category A is placed on the front or close to the loading unloading door, these done because the frequency of goods of category A is quite frequent so it can facilitate everyone in storing goods coming in or shortening the collection of goods. Storage allocation category B is stored in the middle because the goods have a medium nature in the rotation of the goods. While category C kept at the back because the turnover of goods in this category can be said to be rare.

In the reserve area 2.1 and 2.2 the area is devoted to storing type X goods, where these types of goods are halal socks that have been registered at the Majelis Ulama Indonesia (MUI). Whereas in the reserve area 2.3 and 2.4 are storage areas of types of goods Y and Z where in storage both types of goods can be mixed and overall reserve area 2 can hold 104 pallets.



Figure 2. Layout of Reserve Area 2

As one example of storage allocation of goods in Figure 2 Layout reserve area 2, the storage allocation of goods with the SW code to SK.11 code requires a storage area location of 2 pallets because the goods only have as many as 120 dozen supplies and are stored at the front because they belong to category A and so on each item will require a storage location in accordance with their respective inventory. The following is the data of goods stored in reserve area 2 of 47 types of goods:

Table 2. Storage Allocation In Reserve Area

Code of Rack	Code of Item	Code of Rack	Code of Item	Code of Rack	Code Of Item
SK.11	SW	KA.15	KJTHM2	KN1.5	AOTHL
SK.12	SJL	KA.16	KBOTHPL	KN1.6	AOPM
SK.21	SJM	KA.17	KBOTHM	KN1.7	AJPM
SK.23	SB	KA.21	KBOMMK	KN1.8	AS
SO.11	SJVM	KA.22	KBJPL	KN1.9	AJTHM
SO.12	EP	KA.23	KBOM	KN1.10	AJPL
SO.13	SJS	KA.24	KBJTHS	KN1.11	AWTHA
SO.14	SJXL	KA.25	KJTHX1	KN1.12	AWPA
SK.15	SJL	KA.26	KTTH	KN1.13	AJTHXL
SO.16	SJL	KA.27	KKTAS	KN1.14	AJTHL
SO.23	BS	KA.28	KJTHL	KN2.1	AJPM
SO.21	SEL	KA.29	KBS	KN2.2	AJTHS
KA.11	KIWA	KN1.1	AWPA	KN2.3	AJPL
KA.12	KJTHL	KN1.2	ATHXL	KN2.4	AJTHM
KA.13	KJTHM1	KN1.3	ALL	KN2.5	AJTHL

KA.14	KBAJM	KN1.4	AOTHM		
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b. Reserve Area 1 and 3

Reserve area 1 and reserve area 3 has a storage capacity of 42 pallet. This rack also has 3 levels, where each stage can contain 2 pallets. Storage allocation that have category A are stored at the bottom shelf or the first stage, these done in order to facilitate taking of goods and layout of goods. Category B stored in the second stage due to the rotation of category B medium items, while category C stored on the topmost shelf level or the third stage due to slow item turnover. The following storage allocation arranged according to their respective categories:

INFORMATION		RESERVE AREA 1							RESERVE AREA 3						
		A								K3.1	K3.2	K3.3	K3.4		
B								K2.1	K2.2						
C	RBK. 01	RBK. 01	RBK. 01	RBK. 01	RBK. 01	RBK. 01	RBK. 01	K1.1	K1.1	K1.1	K1.1	K1.1	K1.1	K1.1	K1.1

Figure 3. Layout of Reserve Area 1 and Resrve Area 3

Table 3. Storage Allocation In Reserve Area

Code of Rack	Code of Item	Code of Rack	Code of Item	Code of Rack	Code of Item
RBK. 01	Soka Jempol M	K2.2	KBJS A	K3.2	KIMSSTA
K1.1	KJTHM	K2.2	KTTH	K3.2	KIMFSTA
K2.1	KJTHL	K3.1	KBOPM	K3.3	KIMBSTA
K2.1	KJTHM	K3.1	KBOPPL	K3.3	KIMD
K2.1	KJTHL	K3.1	KBOTHPM	K3.3	KIMLS
K2.1	KJTHXL	K3.1	KBJPXL	K3.3	KIMP
K2.1	KKTAS	K3.1	KKTAS	K3.4	KIMSL
K2.1	KKTMT	K3.1	KKTMS	K3.3	KIMA
K2.2	KKTMS	K3.2	KKTMP	K3.3	KIMAA
K2.2	KKTMF	K3.2	KKTMS	K3.3	KIMC
K2.2	KKTMP	K3.2	KBJS A	K3.3	KB
K2.2	KKTMS	K3.2	KK	K3.3	KANIK HENNA

In this reserve area 3 storage of goods is carried out by combining the storage of each type of goods in a pallet. These done because the inventory of goods of each type is less than 5 boxes so as to maximize storage on each pallet do the arrangement of goods with other types goods so that storage utilities can increase.

c. Forward Area 1 and Forward Area 2

Storage of goods in the forward area using doesn't units (retail). Storage on the rack forward area, usually used for picking operators because in this company the demand that often occurs is retail but incoming goods are always in large quantities and already in the form of boxes, so there must be repacking done by the operator. Item in category A are stored on stage 2 and 3, these done because when viewed in terms of ergonomics it's easier to retrieve item, if the item are aligned with the posture of the human body because the rotation of item category A is fast so we have to think up to the ergonomic aspects. Storage allocation for category B at the bottom (first stage) because the movements of goods is slow, while category C is stored at the top (stage 4 and 5) because the movements of goods is very slow. Other provisions in this forward area rack cannot be mixed with each item in the storage of goods, must according to their respective types. These done so that the packaging repacking makes it easy for pickers to pick up each item without having to sort things first. The following arrangement or storage allocation in the forward area 1 and forward area 2:

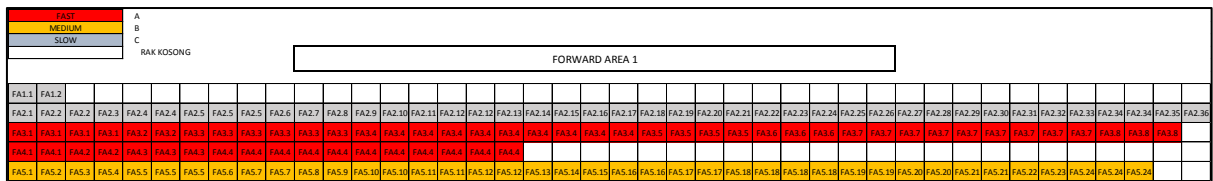


Figure 4. Layout of Forward Area 1

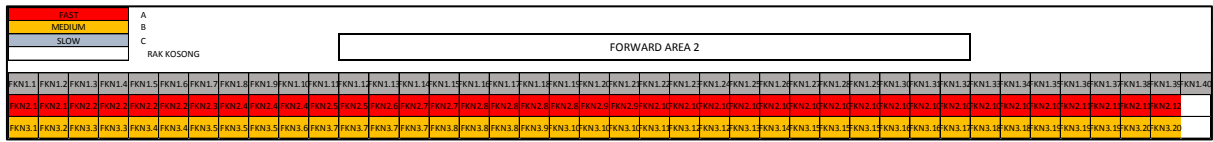


Figure 5. Layout of Forward Area 2

Table 4. Items Data Information

Code of Rack	Code of Item	Code of Rack	Code of Item	Code of Rack	Code of Item
FKN2.1	KBOMMK	FKN3.13	KKTMS	FKN1.17	KIMLS
FKN2.2	KBOM	FKN3.14	KBJS	FKN1.18	KIMP
FKN2.3	KBJPL	FKN3.15	KBAJM	FKN1.19	KIMSL
FKN2.4	KBJTHS	FKN3.16	KBAJTHM	FKN1.20	KIMA
FKN2.5	KJTHM	FKN3.17	KIMD	FKN1.21	KIMA2
FKN2.6	KJTHL	FKN3.18	KIMLS	FKN1.22	KIMC
FKN2.7	KTJHXL	FKN3.19	KIMP	FKN1.23	KH
FKN2.8	KKTAS	FKN3.20	KIMSL	FKN1.24	AOPM
FKN2.9	KTTH	FKN1.1	KBOPPM	FKN1.25	AOTHL
FKN2.10	KBBS	FKN1.2	KBOPPL	FKN1.26	AS
FKN2.11	KIWA	FKN1.3	KBOTHPL	FKN1.27	AJPM
FKN2.12	KBAJM	FKN1.4	KBOMMK	FKN1.28	AJPL
FKN3.1	KBOTHPL	FKN1.5	KBOM	FKN1.29	AJPXL
FKN3.2	KBJPM	FKN1.6	KBJPM	FKN1.30	AJTHS
FKN3.3	KBJPL	FKN1.7	KBJPL	FKN1.31	AJTHM
FKN3.4	KBJPXL	FKN1.8	KBJPXL	FKN1.32	AJTHL
FKN3.5	KBJTHS	FKN1.9	KKTAS	FKN1.33	AKJTHKAS

FKN3.6	KJTHM	FKN1.10	KKTMS	FKN1.34	AKTMT
FKN3.7	KJTHL	FKN1.11	KKTMP	FKN1.35	AKTMS
FKN3.8	KJTHXL	FKN1.12	KBJSA	FKN1.36	AKTMF
FKN3.9	KKTHA	FKN1.13	KIMSSTA	FKN1.37	AKTMP
FKN3.10	KKTMT	FKN1.14	KIMFSTA	FKN1.38	AKTMS
FKN3.11	KKTMF	FKN1.15	KIMBSTA	FKN1.39	AWPA
FKN3.12	KKTMP	FKN1.16	KIMD	FKN1.40	AWTHA

In the forward area 1 and forward area 2 also have differences in the level of the shelf, for the forward area 1 has 5 levels, with 42 rows so that the load in the forward area 1 quite large because this forward area used specifically for the type of item X or socks products halal, while the forward area 2 has 3 tiers and this rack is used to store Y and Z types of item. The forward area rack also holds 40 dozen items per stage.

V.CONCLUSION

Storage allocation using ABC method in this research, goods are classify based on the number of demand . This classification is also based on the rotation of goods whether goods are fast moving, medium moving and slow moving. Group of goods can also be one way to find out which items require priority in controlling inventory levels. The classification of goods in the storage of these goods also becomes more effective because it can facilitate the process of picking and putaway. Warehouse utility 54.67% with a storage capacity of 69,600 dozen and 38,049 dozen stored items. The results of this research will provide information for companies in optimizing the storage allocation in their warehouse.

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