Re-Layout of Product Placement in Retail Industry to Minimize Order Picking Time with Group Technology Method

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Abstract. In retail industry, warehousing is the main activity. The warehouse can also function as a product distribution center (DC) to consumers or retailers. Distribution centers have an important role in supply chain management. DC performance is strongly influenced by many factors. One of them is picking order performance, which is a product taking operation from a certain storage place ordered by consumer. Total picking time is influenced by picker operator activity, which includes searching activity, traveling / transportation, taking, setting, and other activities/idle. The researched examined the possibility of redesigning the layout and structuring of products on the warehouse rack shelf so as to minimize picking time process. The method to be used in design is the group technology method. Based on the results in a retail industry in Bandung, the completion of the picking time is better by decreasing the average picking order completion time around 61.65% of the current system.

1. Introduction
The competition in the retail industry is getting higher. According to the Association of Indonesian Retail Companies (Aprindo), in the period of 2007 - 2012, the number of retail outlets, especially modern retail in Indonesia experienced an average growth of 17.57% per year. This growth begins to slow down in 2017, which is predicted to reach only 7.5-8%. Slowing industrial growth has prompted retail companies to make efficiency in their line of operations. Sub systems that greatly affect the smooth operation of the retail industry is the working procedure in the warehouse of product storage. Warehouse is a place to store products in large quantities to anticipate fluctuating consumer demand. In companies engaged in retail, warehousing is the main activity. Items shipped by the manufacturer are temporarily stored in the Warehouse, to be distributed to stores in various corners. According to Tompkins et.al (2010) [12] good warehouses must have adequate amounts of labor and equipment, regular intercontinental storage distances, and adequate material transfer alleyways for the smooth operation of the warehouse operations. A good warehouse layout should use the available floor area of storage effectively to minimize material removal and storage costs.
The warehouse can also function as a product distribution center to consumers or retailers. Distribution centers (DCs) have an important role in supply chain management. Some industries have their own distribution companies, and some involve third parties to deliver their products to consumers. In the retail industry, DC becomes the main regulator in ensuring products reach consumers ([6], [2], [8]). Therefore, the business growth, competitiveness and success of the retail industry is largely determined by the accuracy of the delivery of its products from DC.

DC performance is strongly influenced by many factors. One of them is picking order performance, which is a product taking operation from a certain storage place ordered by consumer / retailer [11]. Order picking is known as a workforce activity in a warehouse that operates with a manual system, or the activity of a machine / robot in a warehouse that operates with an automated system. Generally picking order activities contribute between 55-65 percent of operational costs [1].

A variety of picking order systems have been developed and used to help DC in improving the performance of picking order operations. One of them is the sequential zone system / sequential zone picking line [4]. In this system, at a time there is only one order that is handled by an employee. So that although easy to implement, this system has a weakness in the rate of taking products by employees. Product search time contributes the most in the overall picking order process.

The longer product search time occurs because the storage of products in the warehouse is based solely on the general categorization such as food and nonfood categories only. The overly general category of food and nonfood categories causes the product to not have a specific setup address that slows the operator in the picking process. Preliminary observations have been made in one of the large retail enterprise warehouses in West Java.

The retail company (PT X) has more than 200 outlets, and each outlet will request delivery of the product at PT X Warehouse. The operator will collect the product at the Warehouse on request from each outlet, as stated in the order request letter. Based on the order request letter, the ordered product will be stored in pallet to then sent to the customer's store. The process of taking the product from the shelf to the pallet is called the picking process. The company targets picking order pickup times for 1 item/store between 1-2 minutes. In fact, the average completion of picking order for each shop is 3-5 minutes. Therefore, the target of taking the product is often not achieved, so it is done overtime for 1-2 hours per day. Overtime, causing labor costs to increase by 5% per month. This study will examine the possibility of redesigning the layout and structuring of products on the warehouse rack shelf so as to minimize the product search time during the picking process. The method to be used in design is the group technology method [10] originally used in designing a manufacturing system. The warehouses observed in PT X have 20 zones, and each zone has a picking area and storage area. Picking area is where the process of preparing the product, ranging from taking the product on the shelf until the product is inserted into the carton. This picking area is on rack 1 and rack 2 on each line in each of its zones. While the storage area is a temporary storage of products that will be taken by the operator if the product contained in the picking area are out. This storage area is on the 3 rack up to 8 racks on each line in each of its zones.

2. Model Development

Total picking time is influenced by picker operator activity, which includes searching activity (20%), traveling / transportation (50%), taking (15%), setting (10%) and other activities / idle (5%) [12]. The company where the research is, made policy that the picking activity for each item should not be more than 2 minutes. In fact, picking time is more than 4 minutes for each item. The conceptual model of the picking process is shown in Figure 1.
Process  

Objective
- Picking Time (PT)

Controlable input
- Searching activity
- Transportation activity
- Taking activity
- Setup activity
- Idle time

Uncontrolable input
- Work hours
- Distance
- Tools
- Setup time

Figure 1. The conceptual model of picking process

Referring to the conceptual model in Figure 1, the objective function to be achieved is to minimize picking time. Total time picking is the sum of time searching, traveling, taking, setting and idle activity. Therefore, to minimize the total picking time, it is necessary to minimize the time of each forming activity. Minimize the time each activity is done by rearranging the product, so that the movement of the operator becomes more effective and efficient. The product rearrangement is done by group technology (GT) method, which was originally developed for structuring machines in a manufacturing system. The analogy approach in modeling system is done to compare GT condition in machine arrangement with product arrangement. The comparison results are shown in Table 1.

Table 1. GT & product retail analogy

| No | Grouping of technology groups (GT) | Grouping of product retail |
|----|-----------------------------------|----------------------------|
| 1  | Grouping by process similarity to create a part or component | Grouping products based on similarity of product types and categories from each zone |
| 2  | Identify what components will be processed on each machine. | Determine the product category of each existing product, which will be picked in each zone. |
| 3  | Identify each machine involved in the production process for each component | Identify each zone involved in the picking process. |

3. Search solution
The search for solutions to minimize picking time is done by building heuristic algorithms for product structuring based on group technology.

Search algorithm solution is as below.
Step 1.
Prepare existing layout data in storage area
Step 2
Specify the category of each product in the storage area
Step 3
Categorize products with rank order cluster (ROC) method
Step 4
Group the products of each zone based on product criteria
Step 5
Perform class divisions based on the frequency of picking up the product in the picking area of each shelf to determine storage of the product on the storage rack. The determination of this product class, calculated for each shelf located in each zone.

Step 6
Determine the appropriate storage of products on each shelf with respect to the product class, and the number of store requests (consumers) per month for each product in the storage area.

In addition to developing product rearrangement algorithms, the study also developed the picking operator activity procedure as shown in Figure 2.

Figure 2. The picking operator activity procedure

The results of the implementation of steps 1 and 2 are shown in Table 2. The results of step 3 implementation are shown in Table 3, step 4 in Table 4, step 5 and 6 in Table 5.
Table 2. Product category

| No | Product type | Product code | Product category   | Brand   |
|----|--------------|--------------|--------------------|---------|
| 1  | Food         | BC           | Cooking Basic      | Bogasari|
| 2  | NonFood      | FC           | Facial Care        | Biore   |

Table 3. Product grouping with ROC.

| Zona | Product type | Product category |
|------|--------------|------------------|
| 1    | Food         | SN, BR,BC        |
| 2    | Food         | BR,BC,BN,NP,BS,LB,DG,CO,SP,DA |
| 3    | Food         | SN, BR,BC        |
| 4    | Food         | MP,BV,CP         |
| 5    | Food         | MP,BV,CP         |
| 6    | Food         | MP,BV,CP         |
| 7    | Food         | BN,NP,BS,MP,BV,CP |
| 8    | Food         | SN, BR,BC,BN,NP,BS |
| 9    | Food         | MP,BV,CP,TS      |
| 10   | Food         | MP,BV,CP,TS      |
| 11   | NonFood      | LB,DG,CO,SP,DA   |
| 12   | NonFood      | TS,DP,CPR,LC     |
| 13   | NonFood      | TS,DP,CPR,LC     |
| 14   | NonFood      | TS,DP,CPR,LC,BCL,OC,TB,F C |
| 15   | NonFood      | TS,DP,CPR,LC,BCL,OC,TB,F C |
| 16   | NonFood      | TS,DP,CPR,LC     |
| 17   | NonFood      | TS,DP,CPR,LC     |
| 18   | Food         | MP,BV,CP,TS,SN, BR,BC |
| 19   | Food         | BN,NP,BS,MP,BV,CP,TS,SN, BR,BC,LB,DG,CO,SP,DA |
| 20   | NonFood      | BCL,OC,TB,FC     |

Table 4. Class Division by Frequency of Fetch

| Zona | Class     | Total take (time) |
|------|-----------|-------------------|
| 1    | Class A   | >4654             |
|      | Class B   | 1163-4654         |
|      | Class C   | <1163             |
4. Design of Product Taking Mechanism
The pickup mechanism is made for picker operators and helper operators. So that the picker operator can run the picking process on time and have a more effective job procedure. The procedure as seen in Figure 2.

5. Model Validation
The developed algorithm is validated by comparing the existing system performance criteria with the proposed method. The proposed algorithm can provide the performance of the actual system, as shown in Table 6. Picking time with proposed algorithm is better than actual system up to 61.65%. Every item product has an address, which can minimize searching activity. Product placement more structured than existing system, and there is procedure to product retrieval mechanism.

Table 6. The result of comparison between the actual system with the proposed system:

| Process             | Actual system | Proposed system          |
|---------------------|---------------|--------------------------|
| Picking Time        | 3-4 minute    | 1-2 minute               |
| Product grouping    | Food          | Food: BC,BN,BS,SN,BR,LB,DG,SP,CP,CO,NP,MP,BV,DA |
|                     | Non Food      | NonFood : FC,DP,TS,BCL,CPR,LC,OC,TB |
| Product placement   | Random        | Structured               |
|                     | - has no address yet | Has an address         |
| the product retrieval mechanism | No procedure | Has procedure |

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Table 5. Storage of products on the shelf

| Line | Product  |
|------|----------|
| 1    | RAK 8    |
| 2    | 2        |
| 3    | 3        |
| 4    | 1        |
| 5    | 1        |
| 6    | 3        |
| 7    | 8        |
| 8    | 6        |
| 9    | 8        |
| 10   | 1        |
| 11   | 1        |
| 12   | 3        |
| 13   | 3        |
| 14   | 6        |
| 15   | 6        |
| 16   | 8        |
| 17   | 8        |
| 18   | 9        |
| 19   | 9        |
| 20   | 11       |
| 21   | 11       |
| 22   | 14       |
| 23   | 14       |
| 24   | 16       |
| 25   | 16       |
| 26   | 20       |
| 27   | 20       |
| 28   | 24       |
| 29   | 24       |
| 30   | 28       |
| 31   | 28       |
| 32   | 32       |
| 33   | 32       |
| 34   | 36       |
| 35   | 36       |
| 36   | 40       |
| 37   | 40       |
| 38   | 44       |
| 39   | 44       |
| 40   | 46       |
| 41   | 46       |
| 42   | 46       |
| 43   | 46       |
| 44   | 46       |
| 45   | 46       |
| 46   | 46       |

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