Analysing And Improving Implementation of FIFO System at Warehouse

Rahmat Nurcahyo¹, Akhyar P Siddiq²

¹Industrial Engineering Department Faculty of Engineering
University of Indonesia, Depok 16424
Tel : (021) 78888805
E-mail : rahmat@eng.ui.ac.id

²Industrial Engineering Department Faculty of Engineering
University of Indonesia, Depok 16424
Tel : (021) 78888805
E-mail : akhyarps@indosat.net.id

ABSTRACT

Common objective of a warehouse is to minimize cost and maximize service to internal and external customers. The purpose of the research is to attain a new system that would resolve the First In First Out (FIFO) system in the Finished Product Store (FPS) warehouse. Analysis of historical data comes out with a new solution designed for the system, that is a periodic arrangement of items in FPS. Forecasting technique is used to determine a review period for rearrangement of goods placement in FPS. It also adapts some important material handling principles in a warehouse. One consideration used is the popularity of the product. Based on this concept, identical products are placed in zones, in order that each zone consist of one or just two brand of flour products. Some advantage expected to be gain by the enhancement of this storage and retrieval strategy is an improvement of FIFO system, also the ease of storage, retrieval, and identification of items which further would increase the FPS throughput.

Keywords

First In First Out (FIFO) system, warehouse

BACKGROUND

Warehouse must be able to meet customer demand with minimum cost. To be able to run effective and efficient operation of the warehouse, there are several factors to be considered, such as the availability of facilities and resources, production capacity, human resources, recording and documentation system, the market situation, and the distribution system.

This research was conducted at PT SRR, which produce finished product in the form of wheat flour with different kinds of variations. Products characteristics are:

- Wheat flour is frailty when stored too long.
- Finished product storage (FPS) is a temporary storage, before being distributed to the stock point or taken by the customer. The deadline is considered critical and product specification (best use of the product) for the storage of wheat flour is one month, starting from wheat flour is produced to finish in the hands of customers.
- If the time limit is exceeded, then the risk of being contaminated is greater due to the attack of head lice to the flour.
- Given the distribution chain wheat flour long enough, the storage in the FPS should be made with a certain time limit.
- Services provided to customers should consider the product quality, accuracy and the amount of time. In connection with this case, the storage of goods in the warehouse also prioritized the aspects of it.

PROBLEM DEFINITION

Based on the results of a Quality Audit, condition associated with the current FPS situation are:

- The problems appear after the system and procedures of FPS at this time cannot guarantee the success implementation of First In First Out (FIFO). FIFO cannot be run due to many factors, namely facilities, labor or based on direct loading instructions from management to the truck. One quite clear thing is the current system and procedure cannot trace the previously wheat flour used to enter FPS.
- Without the guarantee of FIFO implementation there is no certainty that storage time does not exceed the maximum time limit, ranging from flour handling time, including receiving, storage, and delivery at FPS or others stock point outside
FPS. This will impact the increased risk of damage to wheat flour. The increased risk of damage to wheat flour due to the failure of FIFO system at FPS and damage to wheat flour is related to the complaint of the buyer. A large number of customer complaints which are related to the quality of products, proving that it is time for PT SRR to evaluate the system of warehousing.

OBJECTIVES

Objectives of the research is to improve the system and procedures of FPS, such as:

- To generate a system and procedures that can guarantee the movement of goods in the FPS based on the implementation of the FIFO.
- To ensure information for the FPS, stock point, distributors and users about the date that is best use of the product.

PROBLEM LIMITATION

The problem is limited to the design of systems and procedures of the new FPS. The issues related to distribution and marketing must be solved first so that systems and procedures can be done well. In addition, the design of systematization storage procedure is made for the fixed production capacity, namely 35,000 wheat bags per day, without any additional production capacity.

RESEARCH METHODOLOGY

The steps of research methodology are:

1. The assessment of current FPS system and procedure
   The current system must be understood first before implementing the corrective action. By doing the assessment, the shortage, the system scope, problems and obstacles that are in it can be identified more clearly. The assessment also covers the facilities and manpower. The data collecting is done through interviews, direct observation and from primary and secondary data.

2. Making the plan of a new FPS system
   The making of this plan is done in the scope of the system, so that the collected data is not out of the determined scope, and the problem solving can be more focused.

3. Evaluation of the new FPS system
   Making the plan of a new system is not free from obstacles such as the cost, time, manpower, facilities and other resources, so that before the plan needs to be running, it needs a more mature consideration.

4. A good implementation procedure is required for the designed system to run well
   The research was conducted based on consideration of stock location and order taking.

Stock Location

Stock location or warehouse layout in the storage area are related to the location where the goods are placed in a warehouse. Factors that need to be considered in the storage area design procedure are:

1. The commodity
   Commodities are considered as factor that affecting the location and space needs, including:
   a. Similarity
      In general, materials are grouped in classes. Material has relevance (similarity) to one another.
   b. Popularity
      Level of turnover is another factor in choosing the location. For example, the goods with high level of turnover are placed at the front, and the lower turnover ones in the more remote locations.
   c. Size
      The consideration here is not only the size of unit, but also in the number of overall size.
   d. Characteristic
      Characteristics of the stored material should also be considered, such as:
      - Dangerous commodity
      - Frailty commodity
      - High value commodity
      - Short-lived commodity

2. The Space
   Factors associated with the space are important to determine where the commodity can be stored. These factors are:
   a. Space size (volume)
   b. Nature of the location (a match with a certain type of goods)
   c. Location-related with other relevant activities.
   d. Availability when needed
   e. Characteristics of the building, such as the capacity load of the floor, door (number, location, and size), loading facility, distance (pole field, size and number) and, limit height of stack
   f. Area required for the function and activity of service
   g. Space required for the gang.
   There are two basic systems to assign a particular location with the placement of stock items: fixed location and floating location. Both systems are used with attention to the factors above.

The Order Taking and Collection

Once the order is received, the listed goods in the order must be taken from the warehouse, collected
and prepared to be sent. All this activity requires labor and goods movement. This work should be arranged well in order to give desired service to the customer.

There are some systems that can be used to manage the work as follows:

1. Area system
   Order taker walks around to select items that are in order, such as those who shop in supermarkets. The goods are then taken to the delivery area. This order has been collected by itself when the order taker is finished doing its work. This system is usually used in a small warehouse with fixed location.

2. Zone system
   The warehouse is divided into zones, and the order taker is only working on their own zone. Orders are divided into zones, each order taker selects goods in the zone and takes them to the collection area where orders are assembled to be sent.

3. Multi-order system
   This system is similar to the zone system. The difference is this system does not only deal with one order, but a number of orders are collected and the goods are divided by their zone.

DATA COLLECTION AND ANALYSIS

In general, the assessment of FPS is good, but it is still found areas for improvement, they are:

- Material handling that requires few people, working with frequently hands, repetitive, and short distance.
- Difficulties in stock control
- Lack of Space
- Unused overhead space

Overhead is a region at up of the range of people. In the current conditions, the overhead area, especially in the middle of the FPS is still very minimal use. The main cause why the overhead space not being used is the limitation of palette capacity. Based on interviews, the addition of stacked palette has been tried but the lower palette is not capable of holding the load. The effect of unused the overhead space is low utilization of FPS.

- Difficult access to take the goods
- Orientation of good storage in the FPS is horizontal not vertical (non-accumulation). This results in a lot of wheat flour which is difficult to access, both to be controlled or to be taken. If the condition of FPS is full plus the use of additional los, the access of goods becomes more difficult because more additional los in the main street or alley for forklifts.

- Customer complaint
  Customer of FPS is the buyer who wants to take the ordered wheat flour. The current customer complaint is particularly about the availability of goods in FPS so that they have to wait long enough in the PT. SRR until their order can be taken.
- Too Narrow Gang
  Gang in the FPS is not planned layout. Layout are preferred to increase the storage capacity so that there are some narrow alleys. Especially when the additional los is used, the movement area will be more narrow.
- Stacking
  Stacking is the accumulation attached to the wall. This causes problems of access, control, and taking.
- Low level of in and out flow material is stored in the front; High level of in and out flow material is stored behind; Material with the same level of in and out flow is stored in the same place. This is because the selection of storage (los) is based only on the currently empty los at that time. There is no consideration based on the frequency of movement of each type of wheat flour.
- Limited building hampering the storage method
  The limited building can be observed through the dimensions of the FPS building that is different among the front, middle and back.
- Not planned material handling method
  Theoretically, FPS should have a schedule of materials handling as well as the production division has a production schedule. With the schedule, the utilization of equipment, manpower and space will be able to be maximized.

Queue of truck

Gate Office (GO) is the entry gate for customers who want to take the ordered wheat flour. GO service is begun when the trucks arriving at the location of the factory until the truck leaving the factory. Last days, it is indicated that the truck queue is quite long, since they arrive to leave the factory.

The comparison of the total service time data, the loading time data with the queuing time data indicates the contrast difference, even the unit that is used is very different namely minute and day. This indicates a quite serious problem and must be handled to reduce losses, both losses in the PT. SRR and in the transportation.
Utilization of FPS

Utilization of storage space illustrates the comparison between the available volume of storage space (in cubic meters) with the available volume of room for storage (in cubic meters).

To calculate the available volume of warehouse space (Nett) then the number of cubic meters of warehouse space is subtracted from the part of the room that can not be used for storage, such as pole / column, space for movement, space and facilities. The available volume of FPS is 14,070.50 (max) and 12849.60 (normal) in cubic meters.

Volume of space that currently used for storage is calculated by counting the number of los and the stack. Los is the term currently used to describe the distribution of warehouse to be some place that can be filled with some palettes. There are various sizes of los namely los that can load 1 palette up to 9 palettes. In addition, there is also a temporary los that is only used when the warehouse full.

The current volume room used for storage in normal conditions is 2,862.09 (cubic meters). Based on the available volume of warehouse space and the volume of space that is currently used for storage, the utilization of FPS in normal conditions is 22.27%. Meanwhile, based on data storage, the utilization of FPS space in February was 18.42%.

Customer Complaints

Customer complaint data for 1 year was 44 complaints. This complaint data are grouped into 5 groups, namely: Expiration, contents do not match. After processed the product becomes worse, the stock and the number of deliveries, and quality (color, wad, wet). Based on this complaint, the largest number of complaints is about the results of processing wheat flour at PT. SRR which is considered less good finished products.

From 44 customer complaints, it needs to identify the possibility of not running FIFO system. Identification is done by utilizing the existing product code on each bag. Product code consists of 5 digits. The first digit indicates the production month (A = January, B = February, and so on). Second and third digits indicate the date (01 to 31). Fourth digits indicate carousel (4 units have carousel). Last digits indicate the bin (A = bin 1, B = bin 2, etc). This identification product code show the date of production. Date of production then is compared with the date the complaint submitted by the buyer / user to obtain the time interval. Assuming the best time since the wheat flour from the date of production to 2 weeks is used mostly, and the transportation time from PT SRR to the location (e.g. food industry) is 7 days old, the complaint may be a possibility due to the nor running of FIFO system

ALTERNATIVE SOLUTION AND EVALUATION

Through analysis of various indicators of issues, then the main cause of not running FPS system is the difficulties in storage. When examined further, it appears that this difficulty is influenced by the following conditions:

- Small size of FPS
  Small size of FPS limits the amount of products stored in there. In other words, the capacity becomes limited. The great number of demand makes the production to result a more output, while FPS is only able to accommodate as many as the production capacity of 2 days, namely 70,000 units sack of wheat.

- Low utilization of FPS
  With the limited storage capacity as described above, the space used for storage capacity is far below the available space.

- Not arranged storage and layout
  This can be identified from check sheet made by observing the FPS area directly. Products stored in the FPS are only based on the availability of empty
PERIODICAL GOODS STORAGE SYSTEMATIZATION

The effective and efficient alternative to implement is by storing the goods periodically. This alternative does not require great costs, simply perform the review of certain period to determine the amount of los allocation to specific products. Thus, FPS is able to provide more services to more popular products.

The proposal of this alternative is to assume that proportionality amount of wheat stored in the FPS is not arranged yet optimally according to the frequency and number of orders. So far, the popular products are sometimes not able to be stored in the FPS, if the FPS is full. Under this circumstance, the direct loading is not arranged yet optimally according to the frequency and number of orders. So far, the popular products are sometimes not able to be stored in the FPX, if the FPS is full. Under this circumstance, the direct loading is executed.

Determination Review Period

To set the storage periodically, the first note is how many times the storage systematization at FPS will be reviewed and changed in a year. The periodic time is determined in accordance with the fluctuation of pattern, so that FPS is still able to handle the fluctuation of demand under the period of observation.

The observation of storage systematization can be done more often when there are symptoms that the level of demand between products is fluctuation from time to time. However, the frequent changes of systematization way will be fused over and not efficient. Therefore, the storage systematization should be done more frequently, that is to anticipate demand, but the period should be also long enough so that it is not too difficult to make changes in how the storage is.

In general, the steps undertaken to determine the frequency and period of time to change how the storage of goods in the FPS is as follows:
1. To make demand forecasting for each product and for some period of time.
2. To calculate the forecast error.
3. To specify the periodic time for observation according to the smallest error.

Creating Demand forecasting

Requests are evaluated by using fulfilled Delivery Order (delivered DO) data, as in table 1. From the table, it can be seen that the highest demanded product is NM and followed by BB. Evaluation based on the delivered DO with the reason the fulfilled DO is actual demand.

Forecasting is done by three methods, namely Moving Average method, Single Exponential Smoothing, and Double Exponential Smoothing. The calculation of forecasting was made with the help of MINITAB software.

Creating Demand forecasting

The time period tested in the forecasting is the multiplication factor 12, without using 2, that is 3, 4 and 6. So, an alternative way to observe it can be done every 3, 4 or 6 months. Time-periodic 2 months is not

<table>
<thead>
<tr>
<th>MONTHS</th>
<th>WHEAT FLOUR (BAGS)</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TE</td>
<td>BB</td>
</tr>
<tr>
<td>Jan</td>
<td>51,048</td>
<td>154,990</td>
</tr>
<tr>
<td>Feb</td>
<td>85,815</td>
<td>172,900</td>
</tr>
<tr>
<td>Mar</td>
<td>80,360</td>
<td>137,845</td>
</tr>
<tr>
<td>Apr</td>
<td>52,795</td>
<td>112,715</td>
</tr>
<tr>
<td>May</td>
<td>97,330</td>
<td>132,530</td>
</tr>
<tr>
<td>Jun</td>
<td>63,210</td>
<td>161,530</td>
</tr>
<tr>
<td>Jul</td>
<td>94,310</td>
<td>170,145</td>
</tr>
<tr>
<td>Aug</td>
<td>108,495</td>
<td>137,150</td>
</tr>
<tr>
<td>Sep</td>
<td>117,238</td>
<td>114,123</td>
</tr>
<tr>
<td>Oct</td>
<td>98,715</td>
<td>143,690</td>
</tr>
<tr>
<td>Nov</td>
<td>116,030</td>
<td>169,017</td>
</tr>
<tr>
<td>Dec</td>
<td>69,298</td>
<td>82,515</td>
</tr>
<tr>
<td></td>
<td>1,034,644</td>
<td>1,689,150</td>
</tr>
</tbody>
</table>

In forecasting method with Single Exponential Smoothing (SES) and Double Exponential Smoothing (DES), the weight used is the result of the calculation done by MINITAB to find the smallest value of the error (Square Error).
included because 2 months is considered too fast to do changes of storage at FPS.

Forecasting is done by using the actual data for the calculated period. Then, forecasting is done for some future period of time in accordance with the currently tested period. For example, a review conducted for 4 months, forecasting is done for 4 months in the future using the data from the previous 4 months.

Forecasting is done for each type of wheat flour produced by PT SRR for a year, so with a certain periodic time, it is known how many times the review should be conducted during the year.

**Calculation of the error value of forecasting**

The forecasting error is simply the diversion of forecast value to actual value. The small value of the error then the better the forecasting is done.

The best periodic time is chosen based on the smallest forecasting error for each of the tested periodic time. The forecasting error for a tested periodic time is compared with each type of wheat. The used type of error is Mean Absolute Deviation (MAD), Mean Absolute Percentage (MAP) and Mean Square Deviation (MSD).

Types of error that become main priority is MAD and is followed by MAP. MAD shows the average of the amount of wheat that are less or more than the actual amount of wheat required. MAP shows the average percentage of the diversion of wheat amount from the actual demanded wheat.

The chosen periodic time is especially focused for the popular products, the highest demanded products. It needs to pay attention to two products that have the highest demand, they are NM and BB. Table 2 and Table 3 respectively show the error value of the NM and BB forecasting, for each methods, and for each periodic time.

<table>
<thead>
<tr>
<th>Periodic Time</th>
<th>MA</th>
<th>MAP</th>
<th>MSE</th>
<th>SES</th>
<th>MAP</th>
<th>MSE</th>
<th>DES</th>
<th>MAP</th>
<th>MSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>231,340.3</td>
<td>85.12</td>
<td>6.34E+10</td>
<td>103,148.5</td>
<td>46.14</td>
<td>1.85E+10</td>
<td>95,903.6</td>
<td>46.14</td>
<td>1.41E+10</td>
</tr>
<tr>
<td>4</td>
<td>259,981.5</td>
<td>85.38</td>
<td>7.23E+10</td>
<td>160,305.2</td>
<td>53.83</td>
<td>3.79E+10</td>
<td>144,121.3</td>
<td>52.19</td>
<td>2.71E+10</td>
</tr>
<tr>
<td>6</td>
<td>314,985.3</td>
<td>97.36</td>
<td>1.04E+11</td>
<td>59,239.7</td>
<td>15.54</td>
<td>7.58E+09</td>
<td>101,063.0</td>
<td>36.41</td>
<td>1.80E+10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Periodic Time</th>
<th>MA</th>
<th>MAP</th>
<th>MSE</th>
<th>SES</th>
<th>MAP</th>
<th>MSE</th>
<th>DES</th>
<th>MAP</th>
<th>MSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>24,314.3</td>
<td>20.93</td>
<td>9.12E+08</td>
<td>24,624.9</td>
<td>21.69</td>
<td>9.09E+08</td>
<td>34,583.2</td>
<td>27.10</td>
<td>1.77E+09</td>
</tr>
<tr>
<td>4</td>
<td>23,920.3</td>
<td>21.21</td>
<td>9.31E+08</td>
<td>23,487.8</td>
<td>20.82</td>
<td>8.81E+08</td>
<td>29,979.1</td>
<td>20.97</td>
<td>1.22E+09</td>
</tr>
<tr>
<td>6</td>
<td>25,420.0</td>
<td>23.23</td>
<td>1.03E+09</td>
<td>26,047.0</td>
<td>23.96</td>
<td>1.07E+09</td>
<td>65,527.0</td>
<td>59.69</td>
<td>5.99E+09</td>
</tr>
</tbody>
</table>

**Determining The Review Period**

The review period or periodic time is determined based on the smallest error value of forecasting without considering the forecasting method used.

The choosing of the smallest error value is prioritized by considering the value of MAD first. MAD values in the table above shows the average amount of wheat flour that deviates from the actual required amount of wheat flour. This is the amount for a month. The second priority is to consider the value of MAP. MAP values in the table above shows the average percentage of wheat flour that deviates from the actual required amount of wheat flour. The percentage is derived from the deviation in the amount of wheat a month. Thus, for this case the value of MAD can be interpreted more easily.

The table 2 indicates that the minimum value for the MAD for the type of wheat NM occurs when forecasting is done for the period of 6 months, i.e. 59,240 units. With this value, it is estimated that FPS can meet with the lack or excess of NM production approximately 59,240 units per month. So it is MSE value which reaches the minimum value 15.54% for the same periodic time, i.e. 6 months. This MAP values can be interpreted that the FPS may be excess.
or shortage of stock of 15.54% of the NM quantity demanded.

Because the demand for wheat NM is greater than the BB, the priority can be given to more wheat flour NM periodically so that the time chosen to make the observation room is 6 months.

Demand patterns and forecasting for product NM are shown in the table 4. Forecasting is done in the diagram is the Single Exponential Smoothing (SES) method for the period of 6 months.

Table 3: Product NM 6 months period forecast with Single Exponential Smoothing

<table>
<thead>
<tr>
<th>Month</th>
<th>Forecast</th>
<th>Actual</th>
<th>Error</th>
<th>ABSOLUTE ERROR</th>
<th>Square of Error</th>
<th>Percentage of Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul</td>
<td>269295</td>
<td>340540</td>
<td>71245</td>
<td>71245</td>
<td>5.076E+09</td>
<td>0.209</td>
</tr>
<tr>
<td>Aug</td>
<td>269295</td>
<td>280895</td>
<td>11600</td>
<td>11600</td>
<td>1.346E+08</td>
<td>0.041</td>
</tr>
<tr>
<td>Sep</td>
<td>269295</td>
<td>327522</td>
<td>58227</td>
<td>58227</td>
<td>3.390E+09</td>
<td>0.178</td>
</tr>
<tr>
<td>Oct</td>
<td>269295</td>
<td>276408</td>
<td>7113</td>
<td>7113</td>
<td>5.059E+07</td>
<td>0.026</td>
</tr>
<tr>
<td>Nov</td>
<td>269295</td>
<td>460550</td>
<td>191255</td>
<td>191255</td>
<td>3.658E+10</td>
<td>0.415</td>
</tr>
<tr>
<td>Dec</td>
<td>269295</td>
<td>253297</td>
<td>-15998</td>
<td>15998</td>
<td>2.559E+08</td>
<td>0.063</td>
</tr>
</tbody>
</table>

Making Procedure Storage Systematization

After the periodic time to perform storage review has been determined, that is 6 months, then the storage systematization procedure can be carried out every 6 months.

To be able to make the storage systematization, FPS (warehouse) is divided into three parts according to the Pareto principle, namely:

- Zone A, the front room of FPS that can be used to store the most high-frequency (high popularity) wheat flour.
- Zone B, the deeper room of FPS that is used to store for the lower frequency (the medium popularity) wheat flour.
- Zone C is the behind space of FPS that is used to store the most low frequency (low popularity) wheat flour.

To determine the capacity of zone A, B and C, it needs to observe the order frequency for each type of wheat, and the amount ordered. The frequency of ordered wheat determines whether a type of wheat are placed in Zone A, Zone B or Zone C. The quantity of order determines the capacity of each zone by considering the minimum stock.

Based on the Pareto principle, the product grouping used is a small part of high frequency order and a huge part of low frequency order.

In this way, products are grouped based on ABC classification. ABC classification of Pareto settles that:

- Class A is item with cumulative percentage 10% - 55%.
- Class B is item with cumulative percentage 56% - 90%.
- Class C is item with cumulative percentage 91% - 100%.

The steps of classification are as follows.

- The order frequency of each product is calculated in total.
- The ordered product is arranged by the order frequency.
- Create the percentage calculation of cumulative frequency.
- The classification is done based on ABC classification of Pareto.

Table 4: Order Frequency

<table>
<thead>
<tr>
<th>Type</th>
<th>Frequency</th>
<th>Cumulative Frequency</th>
<th>Cumulative Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM</td>
<td>517</td>
<td>517</td>
<td>44.23%</td>
</tr>
<tr>
<td>BB</td>
<td>284</td>
<td>801</td>
<td>68.52%</td>
</tr>
<tr>
<td>TE</td>
<td>201</td>
<td>1002</td>
<td>85.71%</td>
</tr>
<tr>
<td>NB</td>
<td>121</td>
<td>1123</td>
<td>96.07%</td>
</tr>
<tr>
<td>PM</td>
<td>46</td>
<td>1169</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Table 6: The amount of ordered wheat

<table>
<thead>
<tr>
<th>Type</th>
<th>Amount of order (unit)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM</td>
<td>2,476.012</td>
<td>39.84%</td>
</tr>
<tr>
<td>BB</td>
<td>1,689.150</td>
<td>27.18%</td>
</tr>
<tr>
<td>TE</td>
<td>1,034.644</td>
<td>16.65%</td>
</tr>
<tr>
<td>NB</td>
<td>594.230</td>
<td>9.56%</td>
</tr>
</tbody>
</table>
Table 6 shows the order quantity for each type of wheat. NM ranks first with a percentage of 44.23%, so that items classified as group A. BB and PB belong to group B, while NB and PM are group C.

The size of the zones A, B and C are determined from the percentage of ordered wheat quantity.
- Zone A consists of wheat NM, with percentage of 39.84%. So that the capacity for the zone A:
  \[ \text{Zone capacity} = 39.84\% \times 62,100 \text{ units} = 24,740.64 \text{ units} \]
- Zone B consists of wheat BB and TE, with percentage of 43.38%. Capacity for the zone B:
  \[ \text{Zone capacity} = 43.38\% \times 62,100 \text{ units} = 27,218.43 \text{ units} \]
- Zone C consists of wheat NB and PB, with total percentage of 16.34%. Capacity for the zone C:
  \[ \text{Zone capacity} = 16.34\% \times 62,100 \text{ units} = 10,147.14 \text{ units} \]

Table 7: The Calculation of Capacity for Each Los

<table>
<thead>
<tr>
<th>Los No.</th>
<th>Capacity (unit)</th>
<th>Cumulative Capacity (unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1620</td>
<td>1620</td>
</tr>
<tr>
<td>2</td>
<td>1620</td>
<td>3240</td>
</tr>
<tr>
<td>3</td>
<td>1620</td>
<td>4860</td>
</tr>
<tr>
<td>4</td>
<td>1620</td>
<td>6480</td>
</tr>
<tr>
<td>5</td>
<td>1620</td>
<td>8100</td>
</tr>
<tr>
<td>6</td>
<td>1620</td>
<td>9720</td>
</tr>
<tr>
<td>7</td>
<td>1620</td>
<td>11340</td>
</tr>
<tr>
<td>8</td>
<td>1620</td>
<td>12960</td>
</tr>
<tr>
<td>9</td>
<td>1620</td>
<td>14580</td>
</tr>
<tr>
<td>10</td>
<td>1620</td>
<td>16200</td>
</tr>
<tr>
<td>11</td>
<td>1620</td>
<td>17820</td>
</tr>
<tr>
<td>12</td>
<td>1620</td>
<td>19440</td>
</tr>
<tr>
<td>13</td>
<td>1620</td>
<td>21060</td>
</tr>
<tr>
<td>14</td>
<td>1620</td>
<td>22680</td>
</tr>
<tr>
<td>15</td>
<td>1620</td>
<td>24300</td>
</tr>
<tr>
<td>16</td>
<td>1620</td>
<td>25920</td>
</tr>
<tr>
<td>17</td>
<td>1620</td>
<td>26540</td>
</tr>
<tr>
<td>18</td>
<td>1620</td>
<td>28260</td>
</tr>
<tr>
<td>19</td>
<td>1620</td>
<td>29880</td>
</tr>
<tr>
<td>20</td>
<td>1620</td>
<td>31500</td>
</tr>
<tr>
<td>21</td>
<td>1620</td>
<td>33120</td>
</tr>
<tr>
<td>22</td>
<td>1620</td>
<td>34740</td>
</tr>
<tr>
<td>23</td>
<td>1620</td>
<td>36360</td>
</tr>
</tbody>
</table>

By observing Table 7, the boundaries of Zone A are los 1 to los 16 (total capacity of 25,020 units). The limit of Zone B is from los 17 until los 38 (total capacity of 27,720 units). Then, the remaining los, they are los 39 to los 50 are allocated as Zone C (total capacity of 9360 units). Recapitulation zone capacity can be seen in table 8.

The los allocation also must consider the minimum quantity to be saved for each product in each period. The quantity of stored product is determined based on the daily maximum demand occurred in the previous period (last six months).

If the minimum quantity of wheat exceeds the zone capacity, then the zone capacity needs to be adjusted by taking one or more los to the nearest zone, so that the zone capacity can anticipate the minimum requirement.

The mechanism of the storage systematization is prepared to be additional procedures from the existing procedures of FPS.

### CONCLUSION

There are some conclusions derived from this research:

1. The main cause of not running FIFO system at PT SRR is the difficulty of wheat flour storage.
2. The storage difficulty is caused by a lot of factors, they are the limitations of FPS, such as:
   a. Capacity of FPS, which is only able to accommodate 70,000 bag (2 days of production)
   b. The low utilization, which is only 22.27% in normal condition.
3. The most efficient alternative in terms of time and money to solve problems and improve the system FIFO is making periodical storage systematization,
which is written in the form of operational procedure.

4. The storage systematization is done periodically based on the popularity of the product, so that the high frequency wheat is placed on the front and the low frequency one is placed on the back of the FPS.

5. Based on the forecasting by using Single Exponential Smoothing method and historical data, the periodic time to conduct storage systematization is every 6 months.

6. To prevent the occurrence of the expired product delivery, the wheat bags are labeled with the date that is the best use of products.

REFERENCES


