Proposal of Re-Layout Finished Goods Warehouse and Labour Scheduling in XYZ Inc.

Aurellia Victoria, Lidya Guestine, Noviana, Fransisca Dini Ariyanti
Industrial Engineering Department, Faculty of Engineering, Bina Nusantara University, Jakarta, Indonesia 11480
fransisca.ariyanti@binus.ac.id

Abstract

The objectives of this study are to find out the optimal layout for warehouse finished goods, to find out if the re-layout of warehouse finished goods which have been proposed provides significant change to the overtime of the workers, and to find out the best proposal of labour scheduling for non-staff to make the schedule more effective. The used methods are the integrated Class-Based Storage Method, Dedicated Storage Method, From-to-Chart Method for layout improvement and Tibrewala, Philippe, and Browne Algorithm for non-staff labour scheduling proposed. The results of re-layout the warehouse finished goods are obtained that the space efficiency is 48,66% and the reduction of cycle time from 3,33 minutes to 1,86 minutes, and the percentage of overtime decreased after partial implementation. The result obtained for the new labour scheduling of non-staff is needed to reduce the amount of labour by as many as two persons, so the workers become 85 people.

Keywords
Layout, Class-Based Storage, Dedicated Storage, From-To-Chart, Cycle Time.

1. Introduction

1.1 Objectives

At this time, the population continues to grow. This is directly proportional to the high demand for community needs, especially primary needs. One of the primary needs is a place to live and work. For that, it needs the raw material requirement in the manufacture of a building. Based on data obtained from the Central Bureau of Statistics (CBS), the trade price index for building materials based on building types in 2016 is as follows: in Table 1 -4.

Table 1. Index of building material trade price based on building types in 2016

No	Type of Building	Average
1	Residential and Non-Residential Buildings (26)	132
2	Public Works Building for Agriculture (15)	129
3	Public Works for Roads, Bridges and Ports (23)	125
4	Building and Electrical, Gas, Water and Communication Installation (21)	130
5	Other Buildings (18)	128
6	Indonesian Construction (27)	130

With a large amount of public demand in building construction, of course, this affects the industry of raw materials, which is growing rapidly. This can be seen in the many manufacturing industries that produce building raw materials. One of them is a manufacturing company that produces cement board raw materials (Frejyalds et al. 2009, Heragu et al. 2016, Jacobs et al, 2011, Kumar et al. 2008),

XYZ Inc is a pioneer company that manufactures cement board products and has a factory located in Citereup, West Java. There are 13 cement board products produced, which can be distinguished by their thickness. Based on observations at XYZ Inc, the export market owned reached 10% of XYZ's Inc product capacity in several countries

such as Japan, Taiwan, Singapore, Thailand and China. In comparison, 90% of the product capacity is sold in the local market for large project development.

In the XYZ Inc warehousing system, cement board products that have gone through the production process and are ready to be sent to customers will be placed in the final product warehouse area. In the current final product warehousing system, products that have passed the production stage and have passed the sorting stage are placed irregularly by their workers, and there are no boundaries between one product to another. The best-selling product also has a scattered area and is quite far from the door (I/O). In addition, one product has a separate product storage area within a considerable distance. These products are also placed without following the principle of First In First Out (FIFO) so that the possibility of products that have long been produced has not come out of the final product warehouse (Nahmias et al. 2015, Permana et al. 2013, Pinedo et al, 2016, Richards et al. 2014, Rocha et al. 2012, Sule etbal. 2008.)

Workers will experience some difficulties with warehousing systems like this. The first difficulty is the workers would take a long time to search for products ordered by customers because these products are not separated according to the type of thickness and size, so workers had to check it manually first. The second difficulty is if the customer orders a product with a certain thickness and it turns out that the product is in the middle of the final product warehouse area, then the worker must dis-mantle the area to get the product according to the order and takes a long time so the preparation and packing process will be delayed temporarily. The third difficulty is that the best-selling products have a location far enough from the I/O, so workers must travel longer distances with a considerable movement activity.
In addition, the labour scheduling system for non-staff workers also has constraints. Non-staff workers at XYZ Inc have five working days and two days off with the division of work shifts into 3, namely shift 1 (07.00-15.00), shift 2 (15.00-23.00), and shift 3 (23.00-07.00). However, if the number of customer requests is large and requires more time to do so, then workers will be asked to enter on holidays, and holidays will be exchanged with the day of entry the following week. It can be seen that the company does not anticipate the possibilities that occur if there is sufficient demand, so the scheduling of labour for non-staff workers has not been effective.

With these constraints, the layout of the final product warehouse owned by XYZ Inc and the labour scheduling system for non-staff workers is now a problem that needs to be fixed so that workers can work optimally and efficiently, which can reduce overtime hours of workers.

1.2. Problem Formulation

The problems that exist in XYZ Inc can be seen from the final product warehouse which is still lacking as follows:

1. How do you propose an optimal layout for the final product warehouse layout at XYZ Inc?
2. Does the proposed improvement in the layout of the final product warehouse proposed make a significant change to the overtime of workers?
3. What is the proposed workforce scheduling system for good non-staff workers so that workers have a more effective work day?

2. Research Method

At this stage explain what methods will be used to solve the problem of the final product warehouse layout and the existing of the scheduling labour at XYZ Inc.

2.1. Research Methods

Observations were made at XYZ Inc, specifically in the final product warehouse area, starting from the storage of the final product to the process of taking the final product to be sent directly to the customer. Observations were also made to find out the problems that occur so that suggestions on designing an optimal warehouse layout can be given and tested with current cycle time observations with proposals. Besides that, it also scheduled the workforce of non-staff workers. Furthermore, the literature study is carried out by collecting data and searching for theories or literature relating to the final project research that will be discussed. Sources used are obtained from official books and journals to find the theoretical basis to be used and process data in order to get the right discussion results for this final project report.

By identifying the problems that occur in the company's final product warehouse, it can be given the results of an appropriate discussion to solve the problems that exist in the company's final product warehouse. Based on the identification of the problem, a complete question can be made about the problem to be investigated. The formulation of problems related to the problems to be solved in this study. After the problem formulation has been determined, the next step must determine the objectives and benefits of the research that has been done in order to know the layout design of the final product warehouse at XYZ Inc well. Determine the boundary of the problem so that research focuses on the problem that has been chosen. Limitations of the problem in this study related to the place of research, research problems, and theories used in research.

Data collection is carried out to obtain information needed in data processing to improve the layout of the final product warehouse. The data collected is raw data that will be processed in the study. Data collected in this study include activity process data, final product warehouse layout data, product type data, 2016 demand data, pallet sizes, sending and receiving activity data, optimum stock data, cycle time data, number of workers, logistical overtime data and logistical work schedule data. Cycle time data that has been obtained will be tested for data sufficiency to determine whether the data that has been taken is sufficient or still lacking. If there is insufficient data, then another data collection must be performed. Conversely, if the data is sufficient, it can proceed to the next stage, namely data processing. Data processing is done to process data that has been obtained from data collection using predetermined methods and in accordance with existing problems. Data to be processed, namely data adequacy test, Class-Based Storage, Dedicated Storage calculations, final product warehouse layout design using From-to-Chart, cycle time comparison calculation, number of workers calculation, labour schedule calculation using Tribewala Modification Algorithm, Phillipe, Browne (Larson, et.al 1997, Zaerpour et al. 2013, Guo et al. 2016, Aminia et al. 2013)
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After conducting data processing, the layout of the proposed final product warehouse and scheduling of the logistics workforce that will be made can optimize the operating system in the warehouse so as to minimize workers' overtime which also affects on-time delivery and customer satisfaction. The results obtained from data processing will then be discussed and analyzed to get the optimal final product warehouse layout design by comparing the current layout cycle time and proposals as well as decreasing worker overtime. The final step of the research flow diagram is to draw conclusions from the entire study that can answer the problem formulation so that it can provide appropriate advice to XYZ Inc as a solution to optimizing the layout design of the final product warehouse.

3. Results and Discussion

At this stage the results and discussion of research obtained from the processing and calculation of data to get the final product warehouse layout and optimal workforce scheduling at XYZ Inc.

3.1. Layout of XYZ Inc Final Product Warehouse

3.1.1. Calculation of Class Based Storage

To find out which product priority is the highest demand or most desirable customer, a priority order classification is performed based on the average data of the company's demand in 2016. The following is the calculation result of class-based storage obtained:

Table 2. Calculation results of XYZ Inc cement board based class.

Product Name	Demand per Year (sheet)	Cumulative Demand (sheet)	Percentage	Cumulative Percentage	Classification
Internal Cement Board 1.220 x 2.440 x 4	2.160.000	2.160.000	66,67	66,67	**A**
Internal Cement Board 1.220 x 2.440 x 6	324.000	2.484.000	10,00	76,67	
Internal Cement Board 1.000 x 1.000 x 4	119.000	2.603.000	3,67	80,34	
External Cement Board 100 x 2.440 x 9	112.000	2.715.000	3,46	83,80	**B**

External Cement Board 200 x 2.440 x 9	112.000	2.827.000	3,46	87,25	
Internal Cement Board 1.220 x 2.440 x 8	108.000	2.935.000	3,33	90,59	
External Cement Board 1.220 x 2.440 x 9	72.000	3.007.000	2,22	92,81	
External Cement Board 300 x 2.440 x 9	56.000	3.063.000	1,73	94,54	
Internal Cement Board 1.220 x 2.440 x 5	54.000	3.117.000	1,67	96,20	
Internal Cement Board 1.220 x 2.440 x 10	54.000	3.171.000	1,67	97,87	
Internal Cement Board 500 x 1.000 x 4	51.000	3.222.000	1,57	99,44	**C**
External Cement Board 1.220 x 2.440 x 12	10.800	3.232.800	0,33	99,78	
External Cement Board 1.220 x 2.440 x 15	7.200	3.240.000	0,22	100,00	

Based on the calculation results of the classification, then the product will be grouped, and products that fall into the classification A is the product with demand at most be placed closest to the entrance to facilitate the movement activity and can minimize the time laying and retrieval of products. Then the product laying continues with the product classifications B and C.

3.1.1. Calculation of Class Based Storage

To consider the placement of the product area by using a dedicated approach to the placement area storage products based on the predetermined area. Then an area is calculated for each area by knowing the number of slots needed in accordance with the optimum stock of each product. From what has been determined, the slot size is 6 m x 2,92 m, and one slot size can be set with an array of 4 x 1 pallets with five stack pallets. One pallet contains 150 sheets of cement board. Here are the results of the calculation of dedicated storage:

Table 3. Calculation results of space needs using methods of dedicated storage of XYZ Inc.

Area Name	Slot (pallet)			Maximum Storage Needs of Each Product per Day (pallet)	Capacity of Pallet Storage (slot)	Space Needs (slot)	Floor Area Needs (m^2)
	P	L	T				
Internal Cement Board 1.220 x 2.440 x 4	4	1	5	347	20	18	315,36
Internal Cement Board 1.220 x 2.440 x 6	4	1	5	120	20	6	105,12
Internal Cement Board 1.000 x 1.000 x 4	4	1	5	120	20	6	105,12
External Cement Board 100 x 2.440 x 9	4	1	5	120	20	6	105,12
External Cement Board 200 x 2.440 x 9	4	1	5	120	20	6	105,12
Internal Cement Board 1.220 x 2.440 x 8	4	1	5	120	20	6	105,12
External Cement Board 1.220 x 2.440 x 9	4	1	5	67	20	4	70,08
External Cement Board 300 x 2.440 x 9	4	1	5	67	20	4	70,08
Internal Cement Board 1.220 x 2.440 x 5	4	1	5	54	20	3	52,56
Internal Cement Board 1.220 x 2.440 x 10	4	1	5	54	20	3	52,56
Internal Cement Board 500 x 1.000 x 4	4	1	5	54	20	3	52,56
External Cement Board 1.220 x 2.440 x 12	4	1	5	14	20	1	17,52
External Cement Board 1.220 x 2.440 x 15	4	1	5	7	20	1	17,52
Rework	4	1	5	3	20	1	17,52
Ready to Rework	4	1	5	3	20	1	17,52
Office	-	-	-	-	-	-	34,11
Sort	4	1	5	70	20	4	70,08
Setup	4	1	5	92	20	5	87,60
Packing	4	1	5	92	20	5	87,60
Transit Location	4	1	5	70	20	4	70,08
Ready to Send	4	1	5	92	20	5	87,60
Total				**1.686**	**400**	**92**	**1.645,95**

The following is an example of calculation of internal cement board space needs 1.220 x 2.440 x 4:

$$\text{Space Needs (S)} = \frac{347}{20} = 17{,}35 \approx 18 \textit{ slot}$$

Floor Area Needs = 18 x 6 x 2,92 = 315,36 m^2

Based on the Indonesian Anthropometry Data on the dimensions of the shoulder width, i.e., D17 with the percentile P95 = 45,51 cm rounded to 0,46 meters and an allowance of 10% is given, so the width of the aisle between pallets of 0,51 meters is as follows:

$$\text{Panjang Diagonal } \textit{Forklift} = \sqrt{(\text{panjang } \textit{forklift})^2 + (\text{lebar } \textit{forklift})^2}$$

$$\text{Panjang Diagonal } \textit{Forklift} = \sqrt{(4{,}30)^2 + (1{,}90)^2}$$

$$\text{Panjang Diagonal } \textit{Forklift} = 4{,}70 \text{ m}$$

Allowance given = 4,80 m

Based on the Indonesian Anthropometry Data on the dimensions of the shoulder width i.e., D17 with the percentile P95 = 45,51 cm rounded to 0,46 meters and an allowance of 10% is given, so the width of the aisle between pallets of 0,51 meters is as follows:

P95 = 0,46 meters

Allowance = 0,46 x 10% = 0,05

Aisle Width Between Pallet = 0,46 + 0,05 = 0,51 meters

Based on data on average daily receiving and shipping activities obtained from PT XYZ will be used to calculate the throughput per activity in 1 day at the final product warehouse using the Dedicated Storage Method as follows:

Table 4. Calculation result of throughput using dedicated storage method

Product Name	Throughput (activity)
Internal Cement Board 1.220 x 2.440 x 4	96
Internal Cement Board 1.220 x 2.440 x 6	21
Internal Cement Board 1.000 x 1.000 x 4	8
External Cement Board 100 x 2.440 x 9	7
External Cement Board 200 x 2.440 x 9	7
Internal Cement Board 1.220 x 2.440 x 8	6
External Cement Board 1.220 x 2.440 x 9	5
External Cement Board 300 x 2.440 x 9	3
Internal Cement Board 1.220 x 2.440 x 5	3
Internal Cement Board 1.220 x 2.440 x 10	3
Internal Cement Board 500 x 1.000 x 4	3
External Cement Board 1.220 x 2.440 x 12	2
External Cement Board 1.220 x 2.440 x 15	2

Following is an example of calculation of internal cement board throughput 1.220 x 2.440 x 4:

$$T = \frac{\text{aktivitas penerimaan rata-rata / hari}}{\text{jumlah pemindahan sekali angkut}} + \frac{\text{aktivitas pengiriman rata-rata / hari}}{\text{jumlah pemindahan sekali angkut}}$$

$$T = \frac{6.500}{150} + \frac{7.800}{150}$$

$$T = 95{,}33 \approx 96$$

After calculating the space needs using the Method of Dedicated Storage, obtained efficient use of warehouse space XYZ Inc final products are as follows:

Remaining area = available area – area used
= 6.337,58 m^2 – (1.645,95 m^2 + 1.607,99 m^2)
= 6.337,58 m^2 – 3.253,94 m^2
= 3.083,65 m^2

Then the efficiency of the unused area in XYZ's Inc final product warehouse is as follows:

$$\% \text{ remaining unused area} = \frac{\text{sisa luas area}}{\text{luas area tersedia}} \text{ x } 100\%$$

$$= \frac{3.083{,}65}{6.337{,}58} \text{ x } 100\ \%$$

$$= 48{,}66\ \%$$

% percent of area used = 100% - 48,66%
= 51,34 %

3.1.3 The Calculation Results of From-to-Chart

To find out the most effective closeness between each area of the company can do so using the From-to-Chart Method. In making from-to-chart data needed, the amount of movement between one area to another as outlined in the form of flow matrix diagrams. After knowing the amount of movement between one area to another, we can calculate the closeness between areas. Here is a picture of the results of the initial layout and attraction preparation of the closeness calculation between the final product warehouse area, which is done until iteration 7 (Figure 1).

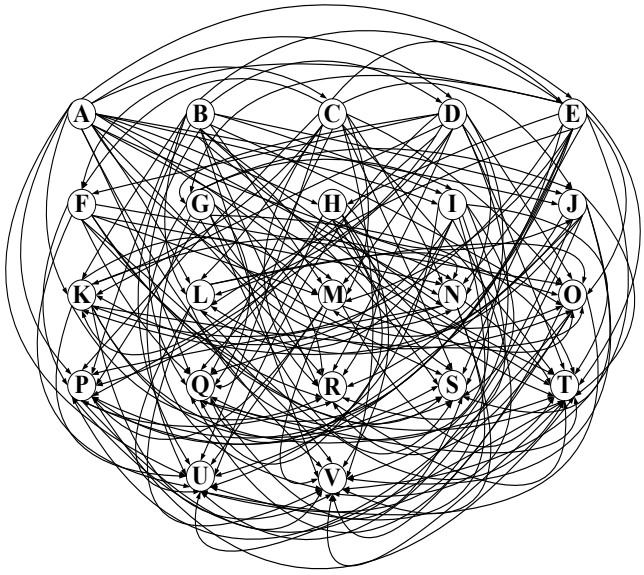

Figure 1. Calculation from-to-chart of iteration 1

In the first iteration, 165 lines connected the area of the warehouse. Based on the calculation of iteration 1 and also from the results of the calculation of the flow matrix in iteration 1 attachment, the total activity level of the forklift in the delivery process is 14.813 movements. In doing iteration, the calculation stops at iteration 7 because, in the iteration 8 calculation, it gets a bigger number of values, so the calculation has to stop, and then iteration 7 is the most optimal result. Here is a picture of the results of iteration 7:

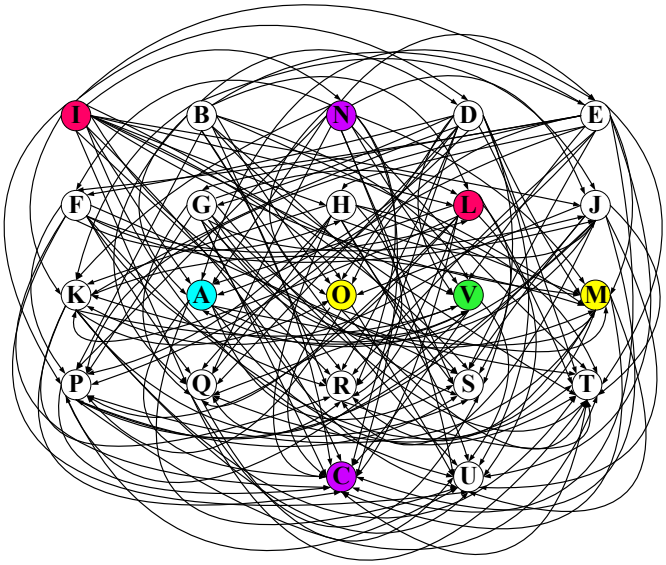

Figure 2. Calculation from-to-chart of iteration 7

From the results of iteration 7, 97 flow calculations were obtained by continuing the calculations in the previous iteration, which changed the laying between areas C and N (Figure 2). Based on the results of calculations done with iteration 7 attachments, there was a decrease in the total flow of 522 movements, from 2.327 which can be seen from the result of iteration 6 becomes 1.805. This shows that moving closer to the location of the area that has the greatest activity linkages can minimize movement in each area.

3.2. Proposal Layout of XYZ Inc Final Product Warehouse

After doing the calculations and considerations made, the following is the optimal proposed layout of the final product warehouse at XYZ Inc:

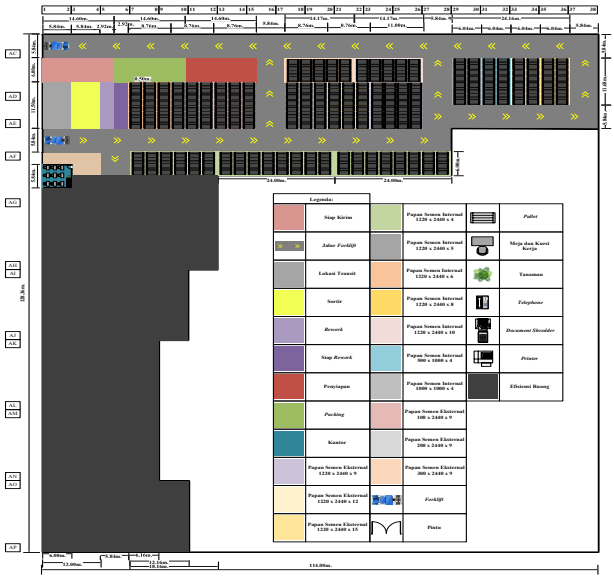

Figure 3. Proposal layout of XYZ Inc final product warehouse.

In the layout of the proposed final product warehouse, the laying of the product area is also considered based on the calculation of the Class-Based Storage method (Figure 3), i.e., products with classification A must be placed close to the point I/O, then product classification B, and so on, because products with classification A have the highest level of activity and products are arranged by FIFO.

Then consider the proximity of each area based on the results of the From-to-Chart calculation, namely, the sorting, ready-to-send, preparation, and packing areas must be close to products with classification A. For transit, location areas must be close to the sorting, reworking, and ready-to-rework areas. These areas must be close together because they have the highest activity, so if these areas are located close together, it can minimize the time of activity in the final product warehouse. Then for the area of space needs, each area is calculated using the Dedicated Storage Method obtained by the board product area 4 x 1.220 x 2.440 internal cement with the largest space requirements. For the width of the main road, there are two, namely based on the entrance and exit of 5,84 m and the entrance and exit lanes are made separately and in a direction so that it does not interfere with the movement of the forklift in or out which in the previous warehouse layout the lane only uses 1 door because at other doors are closed by the product so sometimes the forklift has to stop for a moment and also causes a greater risk of accidents.

The width of the forklift track is made based on the diagonal forklift, which is 4,80 m so that the forklift can do enough rounds or lanes for two forklifts to pass. Then the width or distance between each pallet is considered with the principle of ergonomics based on Indonesian Anthropometry data that is the width of the shoulder side (D17) with 95th percentile and given a 10% allowance of 0,51 m so that the operator can safely check the number of pallets in each area that still done manually so that the proposed layout obtained room efficiency of 48,66% and a decrease in cycle time from 3,33 minutes to 1.86 minutes when taking products.

3.3. Scheduling System of XYZ Inc Non-Staff Labour

Based on data of work shifts, workdays, needs per day, and needs per shift warehouse end products obtained from PT XYZ, it can be done scheduling of labour for non-staff by using the Modification Algorithm Method Tibrewala, Philippe, and Browne are as follows in Table 5 and Table 6.

Table 5. Data of work shift in XYZ Inc.

Work Shift	
I	07.00 – 15.00 WIB
II	15.00 – 23.00 WIB
III	23.00 – 07.00 WIB

Table 6. Calculation results of first scheduling using the modification method of the Tibrewala, Philippe, and Browne algorithms.

Workday	Monday			Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday
Needs per day	60			60			60			60			60			60			0
Work Shift	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
Needs per Shift	28	18	14	28	18	14	28	18	14	28	18	14	28	18	14	28	18	14	
Schedule	-1			-1				-1			-1				-1	0	0	0	
New Needs	27	18	14	27	18	14	28	17	14	28	17	14	28	18	13	28	18	14	
Holiday (H)	-18			-18			-18			-18			-18			-18			

Table 7. Calculation results of last scheduling using the modification method of the Tibrewala, Philippe, and Browne algorithms.

Workday	Monday			Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday
Needs per day	10			-9			-9			-9			-9			-9			0
Work Shift	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
Needs per Shift	0	-5	-5	1	-5	-5	1	-5	-5	0	-4	-5	0	-5	-4	0	-5	-4	
Schedule	0	0	0	-1			-1			-1					-1			-1	
New Needs	0	-5	-5	0	-5	-5	0	-5	-5	-1	-4	-5	0	-5	-5	0	-5	-5	
Holiday (H)	7			5			4			4			4			5			

In this modification (Table 6 and Table 7), to schedule workforce based on a shift in and the day of entry is first to determine the needs of non-staff workers in 1 day at XYZ Inc as many as 60 non-staff workers and the needs of the shift I are 28 workers, shift II is 18 workers, and shift III are 14 workers. In the proposal scheduling system, a preposition is given that if the worker wants to take a day off, then the day before the holiday, the worker must enter shift III, and the day after the day off, the worker must enter shift I. A good holiday is when the need for shift III before holidays and shift I need after holidays at most with the number of needs per day on the few selected holidays. For this reason, the calculation of holidays (H) can be done by adding up the needs per shift of workers in shift III before the holidays with the shift I after the holidays, then the results of the sum are reduced by the needs per day on selected holidays. This stage is carried out on other days. After that, select the most H values to be used as a holiday. After that, give a value of -1 on the shift schedule III on Friday and -1 on the shift schedule I on Monday. After that, between the entry days from Monday to Friday, there is Wednesday. Therefore, Wednesday workers are scheduled to work in shift II. Between Monday and Wednesday, there is Tuesday. Because Monday workers are scheduled for the shift I and on Wednesday in shift II, then on Tuesday, workers work in shifts with the most needs between the comparison needs of the shift I and II by giving a value of -1 on the selected shift. Likewise, on Thursday. Because

on Wednesday, workers enter shift II and on Friday enter shift III, then Thursday is chosen between shift II and III with the most workers' needs by giving a value of -1 on the selected shift. After doing this stage, new needs will be obtained by adding the needs per shift with the schedule. These stages are continued again and again until an iteration is obtained with new needs of 0 or negative (Table 8).

Table 8. Calculation results for holidays and number of workers off

Holiday		**Number of Holiday Workers (People)**
Monday	Sunday	14
Tuesday	Sunday	14
Wednesday	Sunday	14
Thursday	Sunday	15
Friday	Sunday	14
Sunday	Sunday	14
Total		**85**

From the results of the new scheduling of proposals given, it was found that there were 85 iterations, which means that to meet the needs per day, 85 workers were needed. That is, PT XYZ is advised to reduce workers by two people to adjust the needs per day that have been determined and reduce the cost of workers' wages and overtime costs. From the results of the scheduling, it was found that workers who are on Monday and Sunday are 14 workers, on Tuesday and Sunday are 14 workers, on Wednesday and Sunday are 14 workers, on Thursday and Sunday are 15 workers, on Friday and Sunday are 14 workers, and on Saturdays and Sundays are 14 workers which can be seen in Table 8 Calculation Results for Holidays and Number of Workers Off.

On the 85th iteration, there is a new negative requirement, meaning that there is an excess of labour on that day so that if workers want permission not to enter, it can be on that day, or workers can go to another shift on the same day if another shift requires additional labour work.

4. Conclusion and Suggestion

4.1 Conclusion

Based on the results of research conducted at XYZ Inc, the following conclusions are obtained:

1. The proposed improvement in the layout of the final product warehouse given is to change the placement of the product areas according to a large number of requests. To minimize the time required, products with large quantities of demand will be placed closest to the door (I/O) using the Class-Based Storage Method and arranged in accordance with the principle of first-in, first-out (FIFO) in order to make it easier for workers to pick up products according to customer orders. To determine the space requirements, a calculation using the Dedicated Storage Method is obtained, and space efficiency of 48,66% can be used for the needs of other departments. In addition, determining the proximity relationship between areas using the From-to-Chart Method, so that time and movement become more efficient and effective.

2. The proposed improvement in the layout of the final product warehouse proposed provides a significant change to the overtime of workers. It can be seen after the layout of the final product warehouse is gradually changed, then there is a decrease in cycle time from 3,33 minutes to 1.86 minutes to pick up products that will be sent to customers. In addition, there was a decrease in the percentage of overtime little by little each month from 8,40% in July 2016 to get a percentage of 1,18% in June 2017, which means that changing the layout of the final product warehouse can minimize the time of work so that this influence the decrease in the percentage of overtime each month.

3. The proposed good labour scheduling system for non-staff workers is to reduce the number of workers by two people to 85 people and 0% over time. In the iteration results, it was found that there were 14 workers on Monday

and Sunday, Tuesday and Sunday, Wednesday and Sunday, Friday and Sunday, and Saturday and Sunday. Whereas on Thursday and Sunday there are 15 workers off.

4.2 Suggestion

Based on the results of research conducted, the suggestions that can be given to XYZ Inc are as follows:

1. XYZ Inc is expected to continuously make improvements to the layout that has been proposed for the final product warehouse so that the layout of the final product warehouse that is owned can be more effective on the movement of the forklifts and is efficient with the time spent doing the product input and output processes so that workers become more productive.
2. XYZ Inc is advised to dispose of old products that have been damaged and apply the principle of First In First Out (FIFO) on the placement of products sold so that there is no damage to the product.
3. XYZ Inc is recommended to maximize the use of pallets and reduce the number of pallets to prevent buildup so that the warehouse becomes more spacious and efficient and can be used for other departmental needs such as quality control.
4. XYZ Inc is advised to carry out routine rotating activities to tidy up departmental areas so that the layout of each department can always be maintained.
5. XYZ Inc should schedule a fixed schedule for non-staff entry and determine reserve workers in anticipation of high customer demand.
6. XYZ Inc is advised to reduce the number of workers in order to minimize the cost of workers' wages and overtime.

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