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Lina Gozali; Lamto Widodo; Graziella Michele Kustandi ✉; Frans Jusuf Daywin; Carla Olyvia Doaly



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The Improvement of Facility Layout at PT. FNP Using Pairwise Exchange Method for Food Powder Production

Lina Gozali^{1 b)}, Lamto Widodo^{1 c)}, Graziella Michele Kustandi^{1 a)}, Frans Jusuf Daywin¹, Carla Olyvia Doaly¹

¹Industrial Engineering Department, Universitas Tarumanagara, Jl. Letjen S. Parman No. 1, Jakarta 11440 Indonesia

^{a)} Corresponding author: graziella_michele@yahoo.com

^{b)} linag@ft.untar.ac.id

^{c)} lamtow@ft.untar.ac.id

Abstract. PT. FNP is a food and beverage company that produces food and beverages in powder form. One of the products is a flavored beverage powder that contains milk. The process to make this product is divided into a single-line and multi-line and go through the same steps, which is preparation, mixing, filling, and packing. Based on activity mapping, single-line products need 974.92 meters and 14967.8 seconds and multi-line products need 1007.32 meters and 19939.8 seconds for workers to process the materials. The distance needed to move the material from Mixing Area GBB to Filling Single-line and from Transit Silo Area to Mixing Area GBJ is far led to time and distance needed by worker increased. This research was conducted to make a recommendation to the production floor layout that can shorten the material movement distance. Based on the Pairwise Exchange method and Material Handling Evaluation Sheet (MHES), alternative layout 2 was chosen because of the shorter material movement distance of 948.38 m for single-line product and 935.93 m for multi-line product. The chosen alternative layout will be compared with the current layout using simulation on Promodel Software to obtain the total production.

Keywords: Layout, Pairwise Exchange, Simulation, Material Handling

INTRODUCTION

Every company certainly try to be superior from its competitor to survive in the market. It is essential to achieve that objective; a sound system planning is needed to support activities carried out at the company. Effectiveness and efficiency are one thing that is considered by every company because high effectiveness and efficiency are a sign that the system implemented by the company has been running well. One of the things that affect the level of effectiveness and efficiency in factory layout. PT. FNP is a manufacturing company that produces food and beverage powder. The products include milk and flavored powdered beverages, packaged powder for making jelly, jelly, or pudding containing milk. It is carried out through four processes: preparation, mixing, filling, and packing to manufacture those products. On PT. FNP production floor layout, the Distance of material movement for a single-line product and multi-line product is quite far from Mixing Area GBB to Filling Area Single-line and Transit Silo Area to Mixing Area GBJ. With changes made in the PT FNP facilities layout, the problems that occurred, such as the distance needed to move the material, can be minimized so the effectiveness and efficiency can be increased and become a profit for the company.

RESEARCH METHODS

The research methodology is a detailed procedure for conducting research. The type of research method used is a descriptive method to systematically describe the facts or characteristics of specific fields precisely and carefully use primary and secondary data

Layout

The layout is one of the critical decisions that will determine the company's efficiency level and will have a long-term impact. The layout has many strategic implications because the layout will determine its ability in terms of capacity, process, flexibility, cost, quality of the work environment, customer relations, and the company's image. A practical layout will help the company achieve strategies that can support differentiation and lower costs [1].

Pairwise Exchange Method

The pairwise exchange method is an algorithm to improve the existing layout. The location of possible exchanges from one department to another can be known with the Pairwise Exchange method to reduce the total costs spent [2].

Process Chart

A process chart is a tool that can describe work activities carried out systematically and clearly. The process chart is a comprehensive communication tool; the information needed to improve the work method can be obtained through the process chart [5]. These are the types of process chart:

1. Overall Process Chart

An overall process chart is a tool used to analyze overall work activities. The commonly used overall process chart is as follows:

- a. Operation Process Chart.
- b. Multi-Product Process Chart.
- c. Flow Process Chart.
- d. Flow Chart.

2. Local Process Chart

A local process chart is a tool used to analyze local work activities. The commonly used local process chart is as follows [3][4]:

- a. Man And Machine Process Chart.
- b. Left And Right Hand Process Chart.

Simulation

Simulation is an imitation of an imitation attempt, imitating a real system that is the object of the study to find answers to the system's problems [6].

System

A system is a group of integrated elements and has the same objective to achieve an outcome [7].

Model

Model is a simplified representation of a real system. The activities carried out must always be seen in the terms of the efforts of detailed system elements carried out in detail mechanics into all entity flows and resource utilization [8][9][10][11].

RESULTS AND DISCUSSION

PT. FNP current production floor layout can be seen in Figure 1.

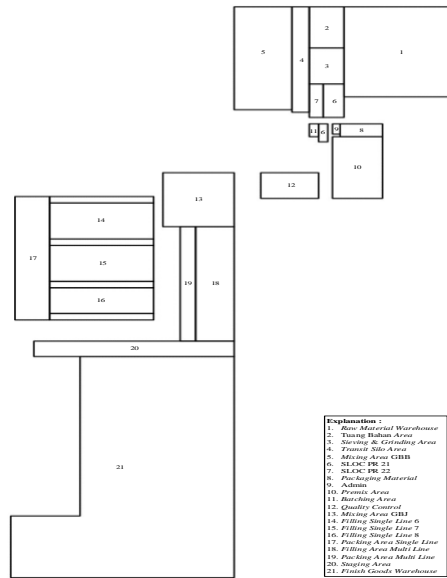


FIGURE 1. PT. FNP Current Production Floor Layout

The room area on the PT FNP current production floor can be seen in Table 1.

TABLE 1. Room Area On The PT. FNP Current Production Floor

Room	Area (m ²)
<i>Raw Material Warehouse</i>	1,032.5
<i>Tuang Bahan Area</i>	144
<i>Sieving & Grinding Area</i>	126
<i>Transit Silo Area</i>	184.5
<i>Mixing Area GBB</i>	600
<i>SLOC PR 21</i>	87
<i>SLOC PR 22</i>	46.8
<i>Packaging Material</i>	56
<i>Admin</i>	8
<i>Premix Area</i>	312
<i>Batching Area</i>	12
<i>Quality Control</i>	150
<i>Mixing Area GBJ</i>	388.5
<i>Filling Area Single-line 6</i>	378
<i>Filling Area Single-line 7</i>	378
<i>Filling Area Single-line 8</i>	270
<i>Packing Area Single Line</i>	432
<i>Filling Area Multi-line</i>	445
<i>Packing Area Multi-line</i>	178
<i>Staging Area</i>	312
<i>Finish Goods Warehouse</i>	5,792

Material flow in the single-line product starts from the preparation, mixing, filling, and packing process seen on the operation process chart. Operation process chart single-line product can be seen in Figure 2.

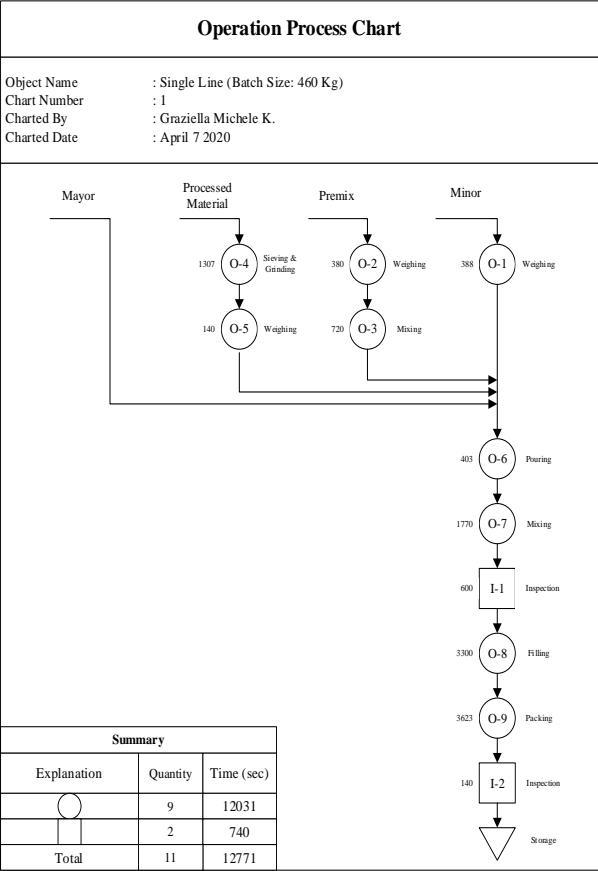


FIGURE 2. Operation Process Chart Single-line Product

Material flow in the multi-line product starts from the preparation, mixing, filling, and packing process seen on the operation process chart. Operation process chart multi-line product can be seen in Figure 3.

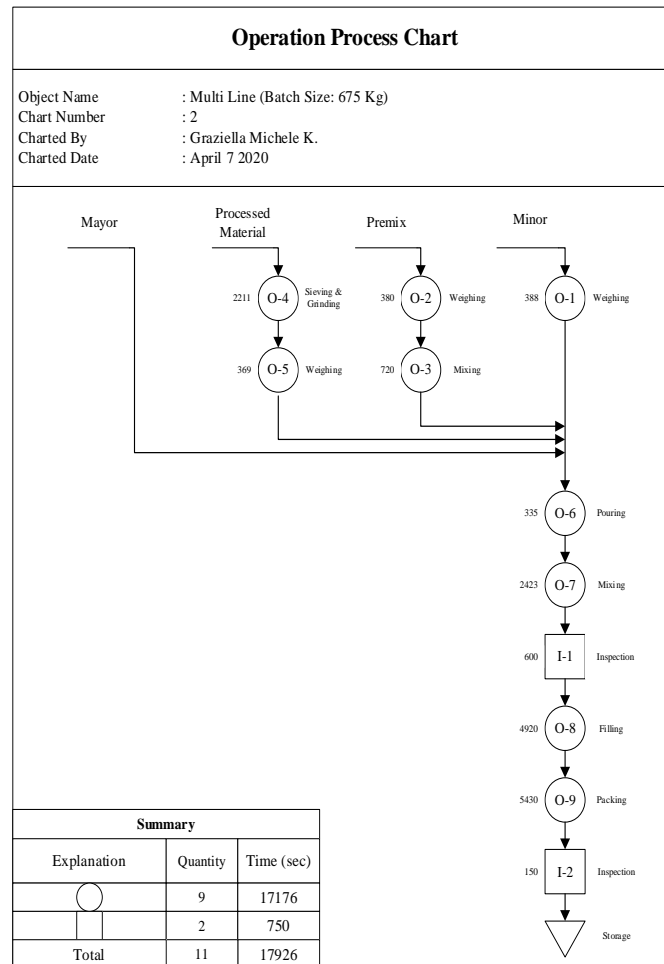


FIGURE 3. Operation Process Chart Multi-line Product

TABLE 2. Cost Calculation Of Using Material Handling Used On The PT. FNP Production Floor

<i>Material Handling</i>	Utilization Cost/second (Rp)	Operator Wages/second (Rp)	Electricity Cost/second	Total Cost/second
<i>Hand Pallet</i>	0.05	6.68	-	6.73
<i>Forklift</i>	3.43	7.65	0.32	11.4
<i>Roller Conveyor Single Line</i>	0.11	-	0.32	0.43
<i>Roller Conveyor Multi Line</i>	0.22	-	0.32	0.54
<i>Gantries Crane</i>	0.10	6.68	0.32	7.1
<i>Hand Stacker Forklift</i>	0.25	6.68	0.32	7.25
<i>Pallet Mover</i>	0.98	7.08	0.32	8.38
<i>Silo Trolley</i>	0.03	6.68	-	6.71
<i>Packaging Material Trolley</i>	0.03	6.68	-	6.71
<i>Lift Mixing Area GBJ</i>	4.93	6.68	0.32	11.93
<i>Barrel</i>	0.01	6.68	-	6.69

Based on the calculation on table 2 of the material handling cost, it can be seen that the largest total cost/second is the Lift Mixing Area GBJ for Rp 11.93 and the smallest total cost/second is the Single Roller Conveyor for Rp 0.43.

The results of the Material Handling Evaluation Sheet (MHES) analysis of the single-line and multi-line product for each layout can be seen in Table 3.

TABLE 3. Material Handling Evaluation Sheet (MHES) Analysis Of The Single-line And Multi-line Product For Each Layout

Layout	Product	Method	Total Distance (m)	Material Handling Costs (Rp)	Material Handling Costs Deviation (Rp)
Alternative 1	Single Line	MHES	956,47	54.341.080,87	Single-line = 12,71 Multi-line = 420.613,53
	Multi-Line		962,62	79.468.580,95	
Alternative 2	Single Line		948,38	54.341.093,58	
	Multi-Line		935,93	79.047.967,42	

Based on the material handling calculation costs using Material Handling Evaluation Sheet (MHES), it can be seen that from the two available alternative layouts, layout 2 is chosen because the total material movement is shorter when compared to alternative layout 1. The Distance between single-line product and multi-line for alternative 2 are 8.09 m and 26.69 m. shorter material movement is from SLOC PR 21 to Premix Area and to Batching Area, Sieving & Grinding Area to Mixing Area GBB, Mixing Area GBB to Quality Control, Transit Silo Area to Mixing Area GBJ and also from Transit Silo Area to Tuang Bahan Area.

Alternative layout 2 is the selected alternative layout. This layout drawing was made with a scale of 1 cm = 10 m. The selected alternative layout image can be seen in Figure 4.

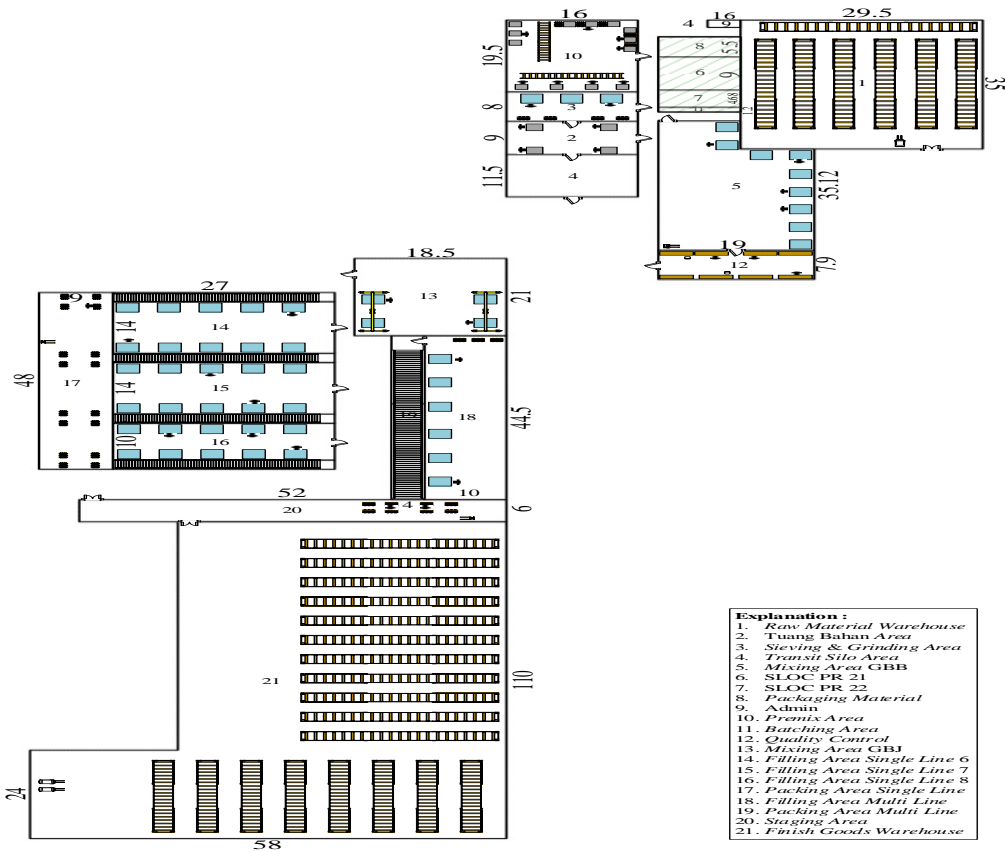


FIGURE 4. Selected Alternative Layout

In the selected alternative layout, the shorter material movement distance is 948.38 m for single-line product and 935.93 m for multi-line product.

Simulation performed on Promodel software run for 175 hours (1 shift is 7 effective working hours and 25 working days in 1 month). Comparison results of the simulation on the PT. FNP current production floor layout and the selected alternative layout can be seen in Table 4.

TABLE 4. Comparison Results Of The PT. FNP Current Production Floor Layout And The Selected Alternative Layout

Simulation	Product	Total Production	Average Time In System (min)
Current Layout	Single Line	12,599	79.19
	Multi Line	1,499	454.39
Selected Alternative Layout	Single Line	12,599	79.19
	Multi Line	1,499	454.39

Based on the table 4, it can be seen that the total production and Average Time In System for the PT. FNP current production floor layout and selected alternative layout have the same value. Therefore, the best layout selection in terms of the material movement distance and the material handling costs was spent.

CONCLUSION

The following are conclusions obtained based on the conducted research at PT. FNP:

Based on the production process carried out on the PT. FNP production floor, department, or room that should be close together are SLOC PR 21 with Sieving & Grinding Area. The Premix Area, SLOC PR 22 with Tuang Bahan Area, Mixing Area GBB with Filling Area Single Line, and Transit Silo Area with Mixing Area GBJ.

The facility layout redesign is determined based on the shorter material movement distance and the material flow. Of the two existing layouts, alternative layout 2 was chosen because of the shorter material movement distance for single-line and multi-line products which is 948.38 m for single-line products and 935.93 m for multi-line products. The material flow on the alternative layout 2 is more organized than alternative layout 1.

The validation layout, the Material Handling Evaluation Sheet (MHES) method calculates the material movement distance, and the material handling costs spent on single-line and multi-line products. As well as simulation carried out to determine the output produced for each product.

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