Jakarta, 03 August 2021

Dear Authors and Presenters of TICATE 2021,

Following the announcement that your paper has been accepted to be presented at Tarumanagara International Conference on the Applications of Technology and Engineering (TICATE) 2021 organized by Universitas Tarumanagara, Jakarta, on 5-6 August 2021, we would like to invite and welcome you to present your paper according to the schedule attached.

Below is **ZOOM meeting link, ID, and password** for plenary session on 05 August, 2021

Join Zoom Meeting
https://us02web.zoom.us/j/81921460901?pwd=OTVFSTIvdzY4bGs0UlVhMHc2azVuZz09

Meeting ID: 819 2146 0901
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We appreciate your contribution in TICATE 2021 and thank you for your kind attention and cooperation.

Sincerely,

Dr. Hugeng, S.T.,M.T.(SMIEEE)
Chairman

PARALLEL SESSION SCHEDULE
Thursday, August 5, 2021

Room : Conference Room 3
Time : 15.20 – 17.00 WIB
Track : Mechanical Engineering and Technology

NO	SCHEDULE	ID	PAPER TITLE	AUTHOR	INSTITUTION
1	15.20 – 15.30	075	IoT-Based Smart Garage Design With Solar Power	Hugeng Hugeng, Faris Luthfi Irawandi, Yohanes Calvinus	Universitas Tarumanagara
2	15.30 – 15.40	086	The Implementation of Cash Flows Optimization with Singularity Functions and Simulated Annealing for a Construction Project in Jakarta	Canfield Hubert and Onnyxiforus Gondokusumo	Universitas Tarumanagara
3	15.40 - 15.50	088	Redesign of Facility Layout with Systematic Layout Planning, Pairwise Exchange and Lean Manufacturing Method at PT. Adhi Chandra Jaya	Lina Gozali, I Wayan Sukania, Andrean	Universitas Tarumanagara
4	15.50 – 16.00	089	Proposed Improvement on Work Station Based on Ergonomic Analysis (Case Study of Eka Helmet Shop Tangerang)	Ribka Giovanni, Lamto Widodo, and I Wayan Sukania	Universitas Tarumanagara
5	16.00 – 16.10	092	Automated Pet Feeder for Cats	Kevin, Suraidi Suraidi, Wahidin Wahab	Universitas Tarumanagara
6	16.10 – 16.20	093	Design and Realization of a Microcontroller-Based Automatic Fire Extinguishing System Prototype in a 2-room House	Dani Mustofa, Suraidi, Hugeng	Universitas Tarumanagara
7	16.20 – 16.30	094	Design of Automatic Hand Washing System With Infrared Sensor Based on Arduino	Joepiter Djohan, Suraidi, Joni	Universitas Tarumanagara
8	16.30 – 16.40	095	Design of Temperature Checking and Mask Wear Detector Automated Verification System	Agung Cahyadi, Suraidi, Hadian Satria Utama	Universitas Tarumanagara
9	16.40 – 16.50	096	Design of 1000 VA Capacity Uninterruptable Power Supply (UPS) For Server Room at Film Sensor Institutions of The Republic of Indonesia	Bayu Kirana Erlangga, Joni Fat, Suraidi	Universitas Tarumanagara

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Tarumanagara International Conference on the Application of Technology and Engineering 2021

CERTIFICATE

OF ACHIEVEMENT

Lina Gozali, ST.,MM.,Ph.D

for the contribution as

PRESENTER

Paper Title:

Redesign of Facility Layout with Systematic Layout Planning, Pairwaise Exchange and Lean Manufacturing Method at PT. Adhi Chandra Jaya

August 5th - 6th, 2021 | Universitas Tarumanagara, Jakarta

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RESEARCH ARTICLE | DECEMBER 07 2023

Redesign of facility layout with systematic layout planning, pairwise exchange and lean manufacturing method at PT. Adhi Chandra Jaya FREE

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Redesign of Facility Layout with Systematic Layout Planning, Pairwise Exchange and Lean Manufacturing Method at PT. Adhi Chandra Jaya

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Abstract. PT. Pt. Adhi Chandra Jaya is a manufacturing company that manufactures motor vehicle parts. The problem with the company is that the transfer of raw materials from one workstation to another is too far away. The layout of the production floor greatly affects the proxy process. This research was conducted to make the production floor layout better and efficient, reduce the time of moving raw materials from one workstation to another, and reduce the cost of material handling. The method used in this research is the SLP (Systematic Layout Planning) method and Pairwise Exchange method using a lean manufacturing approach. Data processing calculated with some method such as Operation Proces Chart (OPC), Flow Process Chart (FPC), From To Chart (FTC), routing sheet, Multi-Product Process Chart (MPPC), Activity Relationship Chart (ARC), Activity Relationship Diagram(ARD), Activity Template Block Diagram (ATBD), Area Allocation Diagram (AAD) and flow process materials to determine alternative layouts, adjustment and looseness factors, and value stream mapping to minimize waste. The research results were conducted in the form of two alternative layouts that have different distances, transfer times and material handling costs. The layout chosen is the SLP 1 layout because it has the shortest total distance of 36,4 m with a distance reduction of 30,11 m from the initial layout of 66,51 m and has the lowest handling material cost of Rp 20,781.21 with the highest cost reduction of Rp 17,190.78 from the initial layout of Rp 37,973.19.

INTRODUCTION

In a facility layout industry is one of the factors that play an important role in the company's efficiency [1]. A facility layout can be defined as a set of physical elements that are organized according to certain logic rules. Setting the initial layout of the existing facilities and work areas is a common problem in the industry [2]. Poor layout results in a less regular flow of materials resulting in alternating movements and excessive transportation, the level of performance is also less optimal [3]. PT. Adhi Chandra Jaya is a company engaged in the manufacture of stamping and car parts. Problems that occur in PT. Adhi Chandra Jaya is a waste of the movement of workers. This waste of worker movement because of the placement of workstations. This condition happened because they did not follow the order of the flow of the production process [4]. Therefore, it is necessary to redesign the layout of the facilities for PT. Adhi Chandra Jaya can increase the effectiveness of production. The methods used in the design of facility layouts are the Systematic Layout Planning (SLP) method and the Pairwise Exchange method.

METHODS

The research begins with the selection of topics and continued by conducting field studies. Further identification of problems that occur in the field. After identifying the problem is then formulated and determine the limitations of the problem in conducting research. If you have set the limits, the goal of the research is determined. Once the

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objectives are set, data collection can be done such as production floor size, machine size and equipment used, number of products per year and cycle time. Then the processing of the data that has been obtained so that a new facility layout proposal can be produced [5]. Finally, it gives conclusions and suggestions to the research that has been done. The flow chart of the research methodology can be seen in Figure 1.

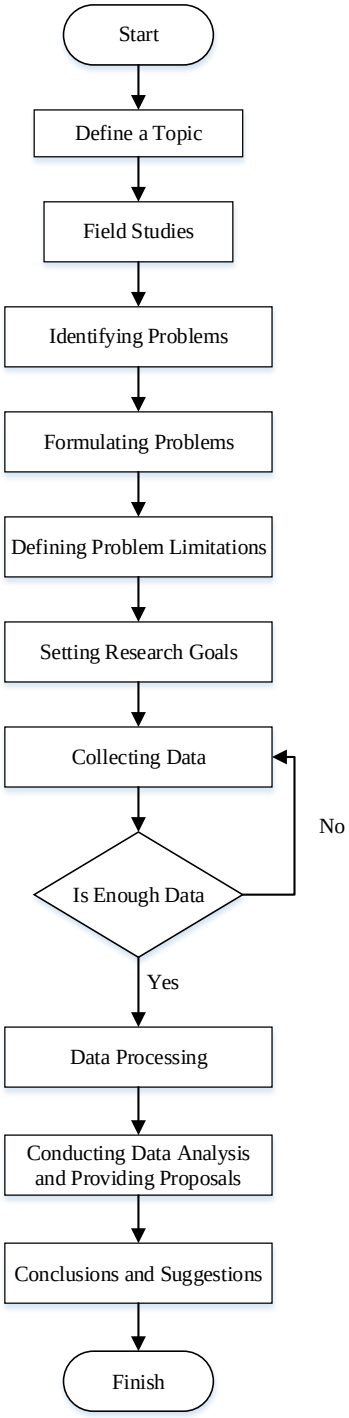

FIGURE 1. Flow chart of the research methodology

Systematic Layout Planning

Systematic Layout Planning is one of the procedures that outlines the steps in the production layout planning process. The basic steps of SLP can be categorized into three stages, namely the analysis stage ranging from material flow analysis, activity analysis, activity relationship diagram, space requirement consideration. The second stage of research starts from planning the diagram of the room's relationship to the design of alternative layouts. In contrast, the last stage of the selection process by evaluating alternative layouts that have been designed. The steps in creating systematic layout planning are as follows:

1. Initial Data Collection and Activities

Data related to product design is very important and has a big effect on creating the layout. Therefore, in this first step, it is necessary to have information data related to work drawings, assembly charts, part lists, bill of materials, route sheets, operation/flowcharts, etc.

2. Material Flow Analysis

The flow of material analysis will be related to quantitative measurement analysis efforts for each material movement transfer between departments or operational activities.

3. Flow Process Chart

A process flow map is a map that describes all activities, both productive (operations and inspections) and unproductive activities (transportation, waiting, and storing), where the activities involved in the work implementation process are described in detail from start to finish.

4. Operation Process Chart

An operation process map is a diagram that describes the process steps of the raw materials. This Operation process will experience the sequence of operations and inspections from the initial stage to becoming the finished product or component and contains the necessary information to further analysis such as the time, materials, places, tools, and machines used.

5. Multi-Product Process Chart (MPPC)

The multi-product process chart shows the production relationship between its constituent components. MPPC is also used to analyze the flow or flow of materials in a series of production processes.

6. Routing Sheet

A routing sheet is the tabulation of the steps covered in producing a particular component and the necessary details of the related matters. Production sequencing becomes the backbone of production activities, recollection of all data developed by process engineering and basic communication tools between product engineer and production person.

7. From to Chart (FTC)

From To Chart or trip frequency or travel chart is a conventional technique commonly used for factory layout planning and moving goods in a production process.

8. Activity Relationship Chart (ARC)

ARC is a technique used to plan relationships between each activity related to each other. ARC uses the priority scale symbol as a proximity level marker. ARC is performed after the value of the proximity relationship has been determined for each facility.

9. Activity Relationship Diagram (ARD)

Activity Relationship Diagram (ARD) is a diagram of relationships between activities (departments or machines) based on the priority level of proximity, so it is expected that the minimum handling cost. The basis for creating an ARD is a priority scale table (TSP), so the top priority of the TSP must be approached and then followed by the next priority.

10. Area Allocation Diagram (AAD)

Area Allocation Diagram (AAD) is a continuation of ARD where in ARD is known conclusions of the level of interest between activities. Thus it means that some activities should be close to other activities and vice versa. So it can be said that the relationship between activities affects the level of closeness between the activity's layout.

11. Layout Alternative Selection

This stage is a step used to decide a proposed layout design that must be selected or applied. The decision to choose an alternative layout is based on comparing distance and time with an existing layout.

Pairwise Exchange

Pairwise exchange is a type of layout improvement method. This method can be used based on proximity and distance between departments. (Tompkins, et al., 2010). This method aims to minimize the cost of moving materials on the production floor and between departments. The basis of this method is done by replacing the placement of one machine or department with another machine. Site replacement is performed on two machines or departments of the same area with the minimum distance and cost of material transfer.

Time Study

Time study is a technique of measuring work by collecting data based on completing a job. The time study method is used to calculate the standard time value of a job.

1. Cycle Time
   Cycle time is the time required to create one product unit on one workstation (Purnomo, 2003). Cycle times are calculated using the following equations:
   $$Ws = \frac{\sum Xi}{N}$$
   Description: Ws = Cycle Time
   Xi = Measurement Data
   N = Number of Observations Made
2. Normal Time
   Normal time is an element of work operation that shows that a well-qualified worker will work to complete the work at a normal working tempo (Wignjosoebroto, 2003). The following equation can calculate normal time:
   Wn = Ws (1 + p)
   Description: Wn = Normal Time
   Ws = Cycle Time
   p = Adjustment Factor
3. Default Time
   A normal worker requires standard time to complete a job carried out in the best work system (Sutalaksana, 2006). The default time can be calculated by the equation as follows:
   Wb = Wn (1 + L)
   Description: Wb = Default Time
   Wn = Normal Time
   L = Allowance

RESULTS AND DISCUSSION

Here is the initial layout of PT. Adhi Chandra Jaya can be seen in Figure 2.

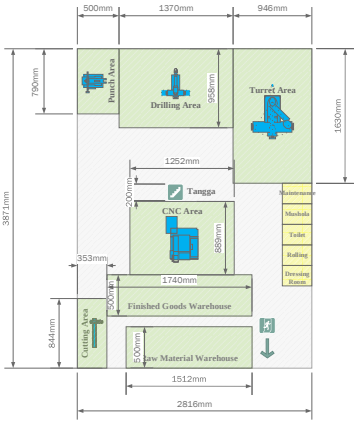

FIGURE 2. Initial layout PT. Adhi Chandra Jaya

The following figures are the pairwise exchange layout 1 and the pairwise exchange layouts 2 can be seen in Figure 3 and Figure 4.

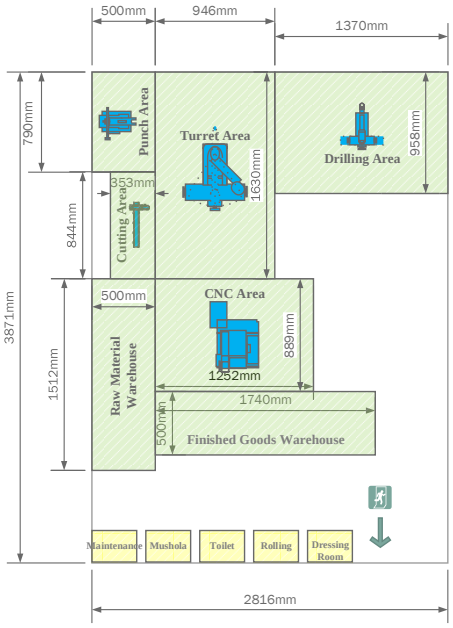

FIGURE 3. Pairwise exchange layout 1

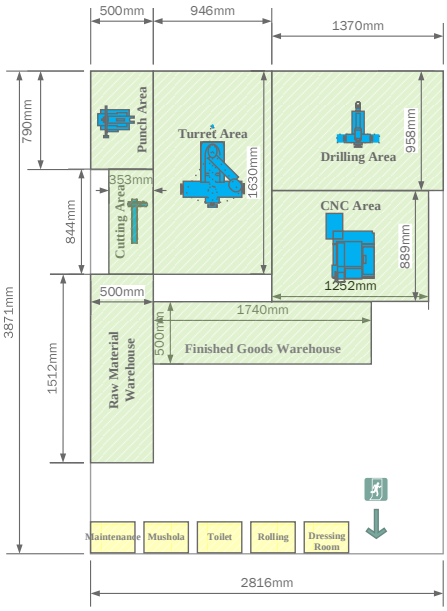

FIGURE 4. Pairwise exchange layout 2

The cost of handling materials can be seen in Table 1.

TABLE 1. Cost of material handling

Description	Cost
Trolley price	Rp 445,000.00
Residual value	Rp 80,000.00
Depreciation	Rp 73,000.00
Number of working days/years	288 days
Cost/day	Rp 253.47
Operator salary/hour	Rp 20,500.00
Effective working hours	1.84
Salary of trolley usage operator	Rp 37,720.00
Usage (m)	66.51
Total Cost	**Rp 37,973.47**
Usage Fee/m	**Rp 570.94**

The chosen layout alternative is the SLP layout 1. This chosen alternative has a greater distance reduction than other layout alternatives, which is equal to 30.11 meters from the initial layout, has reduced material handling costs, which is larger compared to other layout alternatives, namely amounting to Rp. 17,190.18 from the initial layout.

The conclusion of the comparison of distance and cost of material handling can be seen in Table 2.

TABLE 2. Conclusion of comparison results

Description of Method Used	Total Distance	Material Handling Cost (Rp)	Distance Reduction (m)	Material Handling Cost Reduction (Rp)	The efficiency of Distance Reduction (%)	The efficiency of Material Handling Cost Reduction (%)
Starting Distance	66.51	37,973.19	-	-	-	-
SLP 1 Layout	36.4	20,782.21	30.11	17,190.98	45.27	45.27
SLP 2 Layout	41.81	23,870.99	24.70	14,102.20	37.13	37.13
Pairwise Exchange 1 Layout	54.73	31,247.53	11.78	6,725.66	17.71	17.71
Pairwise Exchange 2 Layout	47.87	27,330.89	18.64	10,642.30	28.02	28.02

Based on the selected alternative layout design results, the following is a simulation of Promodel that can be seen in Figure 5.

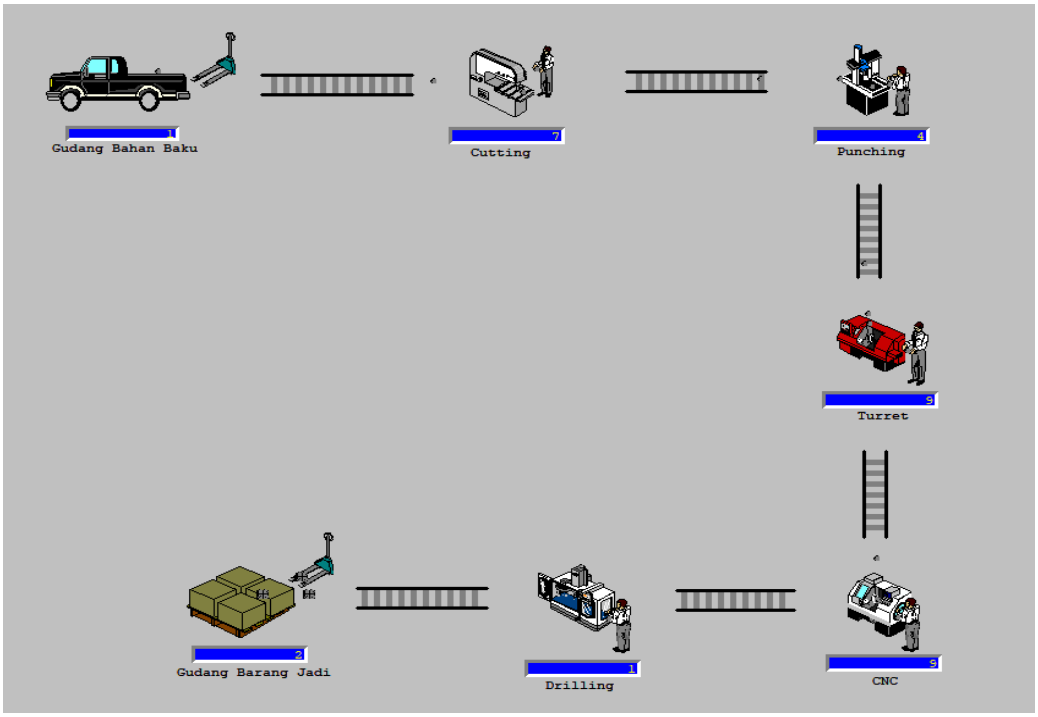

FIGURE 5. Promodel simulation

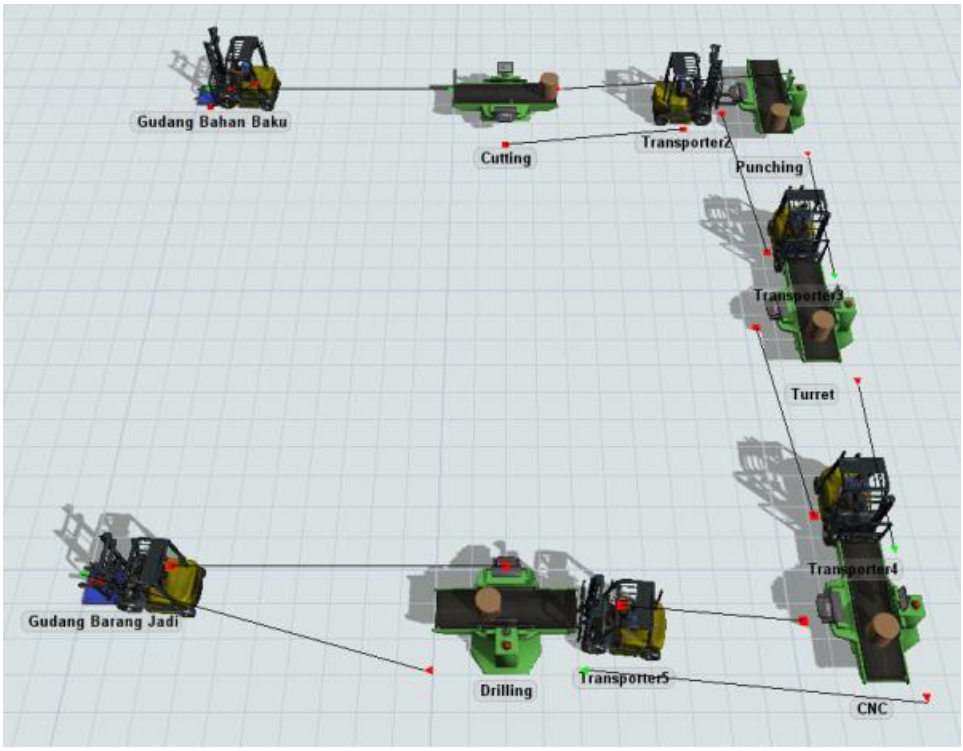

FIGURE 6. Flexim simulation

The simulation results are obtained from 8 working hours in one day and the following is a comparison of simulation results that can be seen in Table 3.

TABLE 3. Comparison of simulation results

Simulation	Total Production (unit)	Average Time in System (min)
Initial Layout	434	50,79
Alternative Layout	439	41,12
Total Increase and Reduction (%)	**1,14%**	**-19,04%**

Based on the comparison of simulation results, the total production of 439 units was obtained on alternative layouts, with an increase of 1.14% from the initial layout of 434 units. The average time in the system on alternate layouts was 41.12 minutes, with a decrease of 19.04% from the initial layout for 50.79 minutes.

CONCLUSION

From the results of the research obtained, alternative layout proposals can be applied to increase the productivity of PT. Adhi Chandra Jaya. The alternative layout chosen was the proposed SLP 1 Layout because it reduces displacement distance of 30.31 m from the initial layout of 66.51 m and a reduction in material handling costs of Rp 17,190.98 from the initial layout of Rp 37,973.19.

Based on the comparison with the Promodel and Flexim simulation results, it is obtained that the total output production of 439 units on an alternative layout with an increase by 1.14% of the initial layout.

Average time in the system on layout alternative of 41.12 minutes with a decrease of 19.04% from the initial layout.

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