Re-layout facility to minimize defects and production cost in PT. Sendanis Jaya Makmur

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Abstract. This research conducted at PT Sendanis Jaya Makmur’s facility. There are some problems regarding lack of equipment, product defects and distances between facilities that impact for delayed. The Operation Process Chart (OPC), Multi Product Process Chart (MPPC), and Routing sheet utilized to map the main problem in the facility. Activity Relationship Chart (ARC) method, Dimensionless Block Diagram, Activity Relationship Diagram (ARD), and aisle method applied in design new layout facility to improve its effectiveness. The proposed layout efficiency level is 55.7% compared to the current layout. This research is expected to solve the problem which become one of the main focus point at PT Sendanis Jaya Makmur.

Keywords: Operation Process Chart (OPC), Multi Product Process Chart (MPPC), Routing sheet, Activity Relationship Chart (ARC), Dimensionless Block Diagram, Activity Relationship Diagram (ARD)

1. Introduction
In this study, the object of research was PT Sendanis Jaya Makmur. PT Sendanis Jaya Makmur is a company engaged in the shoe making industry. Located in Dadap, Tangerang, PT Sendanis Jaya Makmur has been operating since 1993 and has had customers such as Hush Puppies, Cardinal, Playboy, Nappamilano and many more. The problem with PT Sendanis Jaya Makmur is that there is a production delay which results in less effective production. The production process at PT Sendanis Jaya Makmur has undergone several changes so that at this time the distance between facilities is far apart and has an unfavorable process flow, coupled with several facilities that experience a shortage of machines or tools, resulting in bottlenecks.

Bottlenecks in the production process carried out by PT Sendanis Jaya Makmur are estimated to be at two facility points. The first facility is the skin withdrawal facility and the second facility is the assembly facility. Bottlenecks can be seen in the two facilities which are proven by the accumulation of shoes that cannot be processed at the facility. The next problem is the problem of defects or defects found in shoes. Defects or defects in shoe making at PT Sendanis Jaya Makmur have an impact on the finishing process which will take longer to eliminate the defects that exist in these shoes, so that with a defect or defect in the shoe product will cause a delay in production that has been approved by both parties.

Based on interviews with company owners, it is known that the defects found in the shoe-making process by PT Sendanis Jaya Makmur were most found in the window connecting the leather withdrawal facility with the assembly facility. The defects referred to in the production shoes of PT
Sendanis Jaya Makmur such as defects or injuries to the skin caused by shoes clash with other shoes while waiting for the process on the side of the window that connects the laste facility or the withdrawal of the skin with the assembly facility. Defects in that section, according to the company owner, are approximately 80% of the total defects. While the remaining defects are found in the process of gluing is not good, screen printing on the insole that is less neat, or a defective strap used in leather shoes.

Based on the background of the problems that have been made in the previous section, some problems that can be identified concerned with the inefficiency and production delays as well as the bottlenecks and defects in production at PT Sendanis Jaya Makmur. Hence, the research aims to provide a more effective and efficient proposal layout at PT Sendanis Jaya Makmur to overcome the production ineffectiveness, as well as to analyze which cost that can be optimized from changes in facility layout.

2. Research Method

The research employs several methods to reach the final analysis. The methods used are fishbone diagram, the operation process chart, the ordering production, the multi product process chart, activity relationship chart, dimensionless block diagram, and the activity relationship chart.

Fishbone research or what can be called a fishbone method is useful to show what factors can affect the system and the cause and effect of an existing problem. By looking at the arrows that resemble the fish bones, we will be able to find out the main factors [1]. Operation process chart (OPC) is a map of the operational process that illustrates the work steps and checks them from beginning to end [2]. The map can show the process steps that will be experienced by raw materials regarding the sequence of processes and checks [3].

A Routing Sheet is a tabulation of the steps involved in producing certain components and the necessary details of related matters [4]. Routing sheet shows how the parts will be produced, the machines needed, the tools used, the estimated time for each machine and production in the expected number of units per hour of each machine [5].

Multi Product Process Chart (MPPC) is a diagram showing the sequence for each component to be produced [4]. The map can also be useful as a general description, relating to the work steps of each existing product so that information is obtained about the similarity of the process of each product with the others. The MPPC is also commonly called a map that illustrates the amount of machine needed from the Routing Sheet [4].

Activity relationship chart is a simple method or technique in planning the layout of a facility or department based on the degree of activity relations that are often expressed in “qualitative” assessments and tend to be based on subjective considerations of each facility or department [6].

Dimensionless block diagram is a technique for depicting facilities in which data is contained in a worksheet, where if an activity with another has a level of relationship A, then the two sides stick together. Dimensionless block diagram here only gives an explanation of the relationship between the activities of one department with another department, for that the scale of the area and each department does not need to be considered.

Activity Relationship Diagram (ARD) is a diagram of the relationship between activities (departments or machines) based on the priority level of closeness, so that minimum handling costs are expected [4].

Material handling is a type of transportation or transportation which is carried out in a manufacturing industry, transportation is related to the movement of raw materials or semi-finished goods or ready-made goods from the starting point of manufacture to their destination [7]. Material handling costs or also can be called also OMH identical are used for analysis purposes regarding the effectiveness of a change in company layout. The layout chosen as a proposal to the company is the layout that has the smallest material handling costs [7].
3. Result and Discussion

3.1 Fishbone Diagram
The Fishbone diagram in this study analyzes a problem found in PT Sendanis Jaya Makmur. The current problem has become a focal point of concern for the company. After analyzing the existing problems, namely delays and defects in production, the fishbone is determined in five categories that can explain the existing problems at PT Sendanis Jaya Makmur as shown in Figure 1.

![Fishbone Diagram](image)

**Figure 1.** Related factor to ineffectiveness and defects in production

3.2 Operation Process Chart
Operation Process Chart (OPC) or a map of the operation process is a depiction of the steps of the operation or inspection from the manufacture of leather shoes from the beginning to the finished product. In OPC leather shoes, there are operations and inspection activities of making these leather shoes. Shown here in Figure 2 is an OPC from making leather shoes:

![Operation Process Chart](image)

**Figure 2.** Operation Process Chart for Leather Shoes

3.3 Routing sheet
The routing sheet is used to observe shows how the parts will be produced, the machines needed, the tools used, the estimated time for each machine and production in the expected number of units per hour of each machine in PT Sendanis Jaya Makmur. The routing sheet is displayed in Table 1 below.
Table 1. Production Routing Sheet

| No. | Description                  | Machine name                  | Production | % Scrap | Material Requested | Material Prepared | Product Efficiency | Theoretical Prepared | Current Prepared | Owned machine |
|-----|------------------------------|--------------------------------|------------|---------|--------------------|-------------------|---------------------|----------------------|-------------------|----------------|
| 1   | Intake of leather            | Leather storage               | 30         | 0       | 19                 | 19                | 19                  | 0.6333               | 1                 | 1              |
| 2   | Make patterns and cuts       | Upper fabrication table       | 12         | 0.002   | 19                 | 19.038076         | 19.04               | 1.59                 | 2                 | 2              |
| 3   | Pattern Tailoring            | Sewing machine                | 5          | 0       | 19                 | 21.11             | 4.22                | 5.4                  | 6                 | 8              |
| 4   | Withdrawal of the leather   | Leather pull table            | 3.52941    | 0       | 19                 | 19.00             | 5.4                 | 6.4                  | 4                 |                |
| 5   | Outsole production           | Pond Machine                  | 60         | 0       | 19                 | 21.11             | 0.35                | 1.06                 | 2                 |                |
| 6   | Insole production            | Insole printing table         | 30         | 0       | 19                 | 19.00             | 0.6333              | 1.06                 | 2                 |                |
| 7   | Assemble                     | Assembly bench                | 4          | 0       | 19                 | 19.00             | 4.75                | 5.3                  | 3                 |                |
| 8   | Inspection                   | Assembly bench                | 60         | 0       | 19                 | 19.00             | 0.3166              | 1.06                 | 2                 |                |
| 9   | Press                        | Press Machine                 | 20         | 0       | 19                 | 21.11             | 0.35                | 1.06                 | 2                 |                |
| 10  | Drying                       | Dryer                         | 60         | 0       | 19                 | 21.11             | 0.3518              | 1.06                 | 2                 |                |
| 11  | Inspection                   | Dryer                         | 60         | 0       | 19                 | 21.11             | 0.3518              | 1.06                 | 2                 |                |
| 12  | Finishing                    | Buffing & Brasing machine     | 12         | 0       | 19                 | 21.11             | 1.8                 | 2.2                  | 2                 |                |
| 13  | Examination 3                |                                |            |         |                    |                   |                     |                      |                   |                |
| 14  | Packaging                    | Packaging Table               | 30         | 0       | 19                 | 21.11             | 0.703               | 1.06                 | 2                 |                |

4
After analyzed the routing sheet table, a number of bottlenecks were found in several operating machines so that additional machines are needed to meet production quantities. A leather withdrawal table and assembly bench are machines or facilities that need to be added in number. The leather withdrawal table which was originally 4 was added to 6 and the assembly bench which was originally 3 was added to 5. For other facilities, there is no need to add machines or facilities because the number of machines or facilities at PT Sendanis Jaya Makmur currently meets the number of machines needed. By adding the machines it is expected to be able to meet the required amount of production.

3.4 Multi Product Process Chart
The MPPC table in PT Sendanis Jaya Makmur will be showing the sequence for each component to be produced. The chart is shown in Figure 3.

![Multi Product Process Chart](image)

As can be seen in MPPC table, there is no similarity in the use of machines in the order of operations of making leather shoes. So that it can be interpreted as the activity of material transfer between equipment or machinery is good. T Next is to determine the closeness of the relationship between facilities using the Activity Relationship Chart (ARC), make an overview of a facility based on ARC calculations and worksheets using dimensionless block diagrams, and make a diagram of the relationship between activities (departments or machines) based on the priority of proximity for get minimum handling costs with ARD.

3.5 Activity Relationship Chart
ARC or which means activity relation chart is a calculation of the determination of a layout with the importance of a comparison between each room. At PT. Sendanis Jaya Makmur comparison is done with 11 existing facilities namely, Leather Storage, Upper Components Cutting, Stitching, Outsole Production, Insole Production, Laste/Skin Withdrawal, Assembly (upper & bottom), Pressing, Drying, Finishing, and Packaging. The chart is shown in Figure 4 below.
The following Table 2 is an overview of the worksheet in accordance with the ARC that was obtained from the results of an interview with the owner of the company PT Sendanis Jaya Makmur:

| No | Facility                  | A | E  | I  | O  | U  | X  |
|----|---------------------------|---|----|----|----|----|----|
| 1  | Storage                   | 2 | 3,6| 4,5,7 | 10,11 | 8,9 |
| 2  | Upper Components Cutting  | 1 | 3  | 6  | 4,5,7 | 8,9,10,11 |
| 3  | Stitching                 | 2,6| 1,4| 5,7 | 8,9,10,11 |
| 4  | Outsole Production        | 7 | 3,5,6 | 1,2 | 8,9,10,11 |
| 5  | Insole Production         | 7 | 4,6 | 1,2,3 | 8,9,10,11 |
| 6  | Laste/Leather Withdrawal  | 3,7| 1,2,4,5 | 8 | 9,10,11 |
| 7  | Assembly (Upper & Bottom) | 4,5,6,8 | 1,2,3,9,10 | 11 |
| 8  | Press                     | 9 | 7  | 6,10,11 | 2,3,4,5 | 1 |
| 9  | Drying                    | 8 | 10 | 7,11 | 2,3,4,5,6 | 1 |
| 10 | Finishing                 | 11| 9  | 7,8 | 1,2,3,4,5,6 |
| 11 | Packaging                 | 10| 8,9 | 1,2,3,4,5,6,7 | 4 |

3.6 Dimensionless block diagram
Dimensionless block diagrams are made as general depictions of a facility based on ARC calculations and worksheets. Dimensionless block diagram has the aim so that companies can have a shadow or picture of the preparation of each facility in accordance with the value or weighting that has been made previously in the ARC method. The placement of each facility in PT Sendanis Jaya Makmur must have a good explanation in order to provide a good and effective product process flow and information flow. The following Figure 5 is a picture of PT SendanisjayaMakmur's dimensionless block diagram according to ARC data and worksheets:
3.7 Activity Relationship Diagram

Activity relationship diagram or also known as ARD is a further step to describe the location of the facility more effectively according to the results of the analysis of the activity relationship chart or ARC and dimensionless block diagram. Figure 6 below illustrated the ARD at PT Sendanis Jaya Makmur, while Figure 7 pictured the first proposal process flow according to ARD at the company.
The following Figure 8 is a picture of the first proposal layout according to ARD, the first proposal for PT Sendanis Jaya Makmur, whereas Figure 9 displayed the legend.

![Figure 8. Proposed Layout](image)

![Figure 9. Layout Legend](image)

### 3.8 Facility Layout Redesign

The results of the calculation of the first proposal Material handling cost with the material handling method is shown in Table 3 below.

#### Table 3 Proposed Material Handling

| Facility                  | Facility                        | Frequency | Distance (m) | Mileage (m) | UMR (IDR) | Working Time (IDR) | Wage/ Detik (IDR) | Travel Time (IDR) | OMH/ Meter (IDR) | OMH (IDR) |
|---------------------------|---------------------------------|-----------|--------------|-------------|-----------|--------------------|-------------------|------------------|------------------|-----------|
| Storage                   | Upper Components Cutting        | 43        | 3,9          | 167         | 3,500,000 | 184                | 5,3               | 2                | 11               | 1,766     |
| Upper Components Cutting  | Stitching 1                     | 57        | 16           | 914         | 3,500,000 | 184                | 5,3               | 2                | 11               | 9,662     |
| Upper Components Cutting  | Stitching 2                     | 34        | 29           | 994         | 3,500,000 | 184                | 5,3               | 2                | 11               | 10,507    |
| Stitching 1               | Lasie / Penarikan Kulit         | 33        | 14           | 467         | 3,500,000 | 184                | 5,3               | 2                | 11               | 4,932     |
| Stitching 2               | Lasie / Penarikan Kulit         | 30        | 6            | 180         | 3,500,000 | 184                | 5,3               | 2                | 11               | 1,902     |
| Outside Production        | Assembly (upper & bottom)       | 50        | 7,5          | 375         | 3,500,000 | 184                | 5,3               | 2                | 11               | 3,963     |
| Insole Production         | Assembly (upper & bottom)       | 30        | 5            | 150         | 3,500,000 | 184                | 5,3               | 2                | 11               | 1,585     |
| Lasie / Penarikan Kulit   | Assembly (upper & bottom)       | 75        | 6            | 450         | 3,500,000 | 184                | 5,3               | 2                | 11               | 4,755     |
| Assembly (upper & bottom) | Press                           | 7         | 20,3         | 135         | 3,500,000 | 184                | 5,3               | 3                | 16               | 2,145     |
| Processing                | Pengeringan                     | 7         | 4            | 27          | 3,500,000 | 184                | 5,3               | 3                | 16               | 423       |
| Processing                | Finishing                       | 7         | 27           | 180         | 3,500,000 | 184                | 5,3               | 3                | 16               | 2,853     |
| Packaging                 |                                 | 7         | 11           | 73          | 3,500,000 | 184                | 5,3               | 3                | 16               | 1,162     |
Cost of material handling results at PT Sendanis Jaya Makmur the first proposal can be said to be more optimal than the current facility layout, because the results of the first proposal OMH have an efficiency of 55.7%, which if the layout is applied to PT Sendanis Jaya Makmur then production can be increased which was originally a production target of 150 pairs per day to 234 pairs of shoes per day.

4. Conclusion
The main problem in inefficiency and production delays experienced by PT Sendanis Jaya Makmur is the layout of each important facility which is far apart and has a non-conducive flow. There are also production defects in some facilities that cause additional time for each shoe that has a defect to be repaired at the finishing facility, causing a delay in production.

An effective proposal layout is found in the first proposal. Changes made are the displacement of several facilities in accordance with the method of activity relationship chart (ARC), activity relationship diagram (ARD) and dimensionless block diagram. A significant change is the merging of the four facilities at the back with the removal of plywood-made insulation that has no effect on the level of building safety. Moreover, bottlenecks or narrowing of production can be completed by adding tools and tables to the last facility or pulling skin and adding tools and benches to the assembly facilities. Furthermore, the defect in shoes can be resolved by changing the window because according to the defect data of PT Sendanis Jaya Makmur, 80% of defects occur in the window, so that in the proposed layout a change is made from the window to the door, the change also adds access to the movement of goods to make it more effective.

The current facility layout has a monthly material handling cost (OMH) value of Rp 1,187,056.00 and for the proposed OMH value, the smallest OMH value is found in the first proposal of Rp 525,772.00. Thus an efficiency of OMH value of 55.7% and an increase in production that was originally 150 pairs per day to 234 pairs of shoes per day.

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