**Jurnal Teknik Industri: Jurnal Hasil Penelitian dan Karya Ilmiah dalam Bidang Teknik Industri**

**Vol. 11, No. 2, 2025**

# Facility Layout Redesign for an SME Printing Industry Using Systematic Layout Planning: A Case Study in Dumai

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## *ABSTRACT*

*The printing SME sector often encounters inefficient facility layouts, leading to extended material flow, low productivity, and increased operational costs. This study aims to redesign the facility layout of Jasatama Computer SME in Dumai City to enhance spatial efficiency and workflow. The methods applied are Systematic Layout Planning (SLP) and a graph-based approach, using the rectilinear distance, activity relationship chart, and from-to chart to map the interrelationships among workstations. The practical implications of this study include improved spatial utilization, smoother material flow, and potential enhancement of productivity and workplace ergonomics in printing SME. From a scientific perspective, this research contributes by providing a comparative analysis of two layout design methods, SLP and the graph-based approach, in the SME printing sector, which has been rarely explored in prior studies. The findings highlight that adopting quantitative and systematic methods in facility layout redesign can be an effective solution to support SME sustainability and competitiveness. The analysis results indicate that the initial layout generated a total material transfer distance of 205.85 meters. The proposed SLP-based layout reduced the distance to 168.43 meters, while the graph-based approach produced 180.91 meters. Consequently, the SLP method achieved an 18.16% reduction in material handling distance, making it a more optimal alternative compared to the other method.*

***Keywords:*** *Facility Layout, Graph-Based Method, Material Flow Efficiency, Systematic Layout Planning*

## Introduction

Jasatama Computer Printing SME is a small and medium-sized enterprise engaged in printing services located in Dumai City. Its production activities include digital printing, offset printing, cutting, and finishing processes[1]. Small and medium enterprises (SMEs) in the printing sector often face challenges related to inefficient facility layouts[2]. The absence of structured planning results in long material flow, cross-traffic, and reduced labor productivity, which ultimately increases operational costs. This inefficiency aligns with the *lean manufacturing* perspective, where poor layout design is considered one of the major sources of waste in production systems[3]. Therefore, reassessing the facility layout is essential to align the production flow with the principles of efficiency and ergonomics[4]. One relevant and widely applied method in this context is Systematic Layout Planning (SLP)[5].

The Systematic Layout Planning (SLP) method was developed to produce an optimal layout by considering activity relationships, reducing material flow, and increasing the productivity of SME[6]. The SLP design process involves several stages, including data collection of production activities, development of relationship diagrams, and the generation of alternative layouts[7]. The application of this method has been proven effective in reducing material transfer distances, lowering material handling costs, and enhancing process efficiency across various industrial sectors[8]. This is evident in a study conducted at CV Mulya Mediatama Advertising (2025), which successfully reduced the material transfer distance by 47.6 meters. [9], as well as a study at PT Lambang Jaya (2024), which minimized material handling distance, time, and cost by 20%, 19%, and 15%, respectively, compared to the initial layout. [10]. Most of these studies focus on single-method applications, without comparing alternative approaches. Only a few studies have attempted to combine SLP with graph-based methods, especially in small-scale printing SME, which typically face limitations in space, resources, and production capacity[11]. This research gap highlights the need for a comparative study that evaluates the effectiveness of both methods in improving SME facility layouts. [12].

The objective of this study is to analyze the current facility layout of Jasatama Computer Printing SME and identify the sources of inefficiency within the material flow system. Furthermore, this research aims to develop alternative layout designs by applying the Systematic Layout Planning (SLP) method to inefficient layout, minimize material transfer distances, and enhance overall system productivity[13]. The evaluation process involves a comparative analysis between the existing and proposed layouts in terms of total material handling distance and process flow efficiency[14]. The findings of this study are expected to deliver an optimal and practically implementable layout recommendation that supports the SME operations with higher efficiency, improved ergonomics, and long-term sustainability[15][16].

Based on this background, the present study aims to redesign the facility layout of Jasatama Computer SME in Dumai City[17]. The objective is to analyze the inefficiencies in the existing layout and to propose alternative layouts using both SLP and graph-based methods[18]. The results of the two approaches are then compared quantitatively using total material transfer distance as the main indicator, in order to determine the most efficient design that supports improved productivity, smoother material flow, and better spatial utilization for SMEs in the printing industry.

## Research Methods

This study adopts a descriptive quantitative approach by applying the Systematic Layout Planning (SLP) method and the Graph-Based method[19]. Both approaches were selected to analyze the existing facility layout of Jasatama Computer SME and to develop more efficient layout alternatives[20]. The SLP method was employed because it systematically maps activity relationships qualitatively, while the Graph-Based method complements this by providing a quantitative assessment of inter-workstation distances[21].

The research was conducted at Jasatama Computer SME in Dumai City, a small-scale printing enterprise engaged in invitation card production[22]. The study focuses on the production area, particularly workstations related to printing, cutting, finishing, and cashier operations[23].

Primary data were collected through direct observation, interviews with the owner and employees, and measurements of workstation dimensions and distances in the production floor[24]. Secondary data were obtained from company documents and relevant literature on facility layout design[25]. Several analytical tools were applied, including:

1. From-To Chart (FTC): to record the intensity and distance of material transfers.
2. Activity Relationship Chart (ARC): to evaluate the closeness rating among activities.
3. Activity Relationship Diagram (ARD): to visualize the spatial relationships.
4. Rectilinear (Manhattan) Distance Formula: to calculate the distance of material transfers between workstations.
5. Microsoft Visio software: to design and visualize alternative block layouts.

The stages of the research are summarized as follows:

1. Analysis of the Initial Layout: reconstruction and measurement of the existing layout.
2. Data Collection: observation, interviews, and workstation measurements.
3. SLP Analysis: applying ARC, ARD, and FTC to develop layout alternatives.
4. Graph-Based Analysis: constructing relationship graphs based on closeness weights and inter-workstation distances.
5. Comparison of Alternatives: evaluating total rectilinear distance for each proposed layout.
6. Layout Recommendation: determining the most efficient layout.

The SLP method was chosen for its structured framework in mapping qualitative activity relationships, whereas the Graph-Based method was adopted to complement the analysis by quantifying distance-based efficiency[26]. This dual-method approach enables a more robust and comprehensive comparison of layout alternatives[27].

The primary criterion for selecting the "best" layout was the reduction of total material transfer distance, as it directly reflects material handling efficiency[28]. Other aspects, such as ergonomics and space utilization, were conceptually considered but not quantitatively measured in this study[29].

Several limitations were identified in this study:

1. Manual observation and measurement may be prone to human error.
2. The research object is limited to a single SME, which restricts generalizability.
3. Cost analysis and detailed ergonomic evaluation were not included, as the focus was confined to material transfer distances.

## Results and Discussion

Based on the problems addressed in this study, several types of data relevant to the research were collected. The data include the initial facility layout, production area size, machine and equipment dimensions, and details of production activities. The physical building of Jasatama Computer Printing SME is situated on a designated land area with a specific production floor size. In designing the proposed layout, an evaluation of the initial layout was first conducted. This initial evaluation involved reconstructing the existing layout to identify potential inefficiencies in workflow, space utilization, and operational convenience for operators within the production environment. By illustrating the initial layout in detail, the evaluation analyzed the interrelationships among work areas, material transfer points, and machine placement. The results of this evaluation serve as the foundation for designing an alternative layout that is more optimal, efficient, and aligned with the operational requirements of Jasatama Computer Printing SME. The initial layout of Jasatama Computer SME is presented in Figure 1.

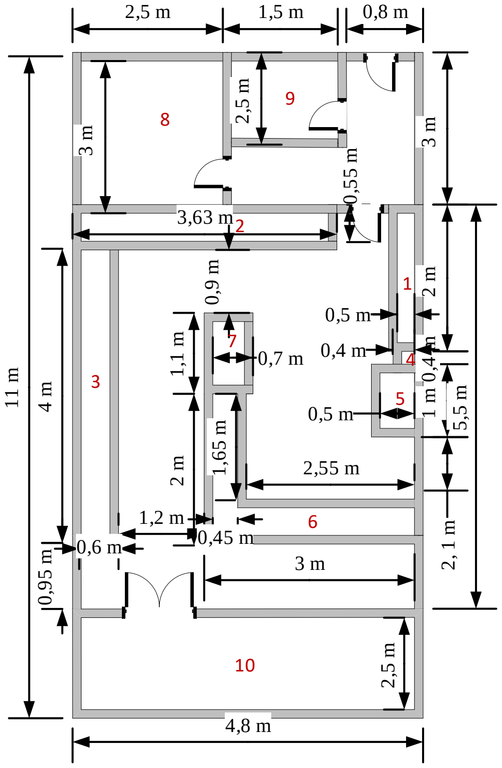


**Figure 1**. Initial Layout of Jasatama Computer SME

Figure 1 illustrates the initial facility layout of Jasatama Computer SME. The facility consists of ten production rooms, one prayer room, one restroom, and a designated customer parking area. The storage room for raw materials, namely paper and ink, is located within the main production building. In contrast, the prayer room, restroom, and parking area are situated outside the production area.

Description:

1. Paper Raw Material Cabinet
2. Printer Ink Rack
3. Design Editing Desk
4. Printing Machine
5. Finishing Table
6. Storage Cabinet
7. Cashier Desk
8. Prayer Room
9. Restroom
10. Parking Area

The evaluation of the initial layout of Jasatama Computer SME begins with calculating the distance between workstations using the rectilinear formula. The rectilinear distance is calculated as follows[30]:

$$d_{ij}=\left|x_i-x_j\right|+\left|y_i-y_j\right| \quad (1)$$

Before the calculation is carried out, the coordinate points of each workstation must be determined based on the initial block layout. The coordinate points of each workstation are presented in Table 1.

**Table 1**. Workstation Coordinates of Jasatama Computer SME

| No | Workstation | X | Y |
|---|---|---|---|
| 1 | Paper Raw Material Cabinet | 5,6 | 7 |
| 2 | Printer Ink Rack | 2,8 | 7,8 |
| 3 | Design Editing Desk | 1,3 | 5,4 |
| 4 | Printing Machine | 5,7 | 5,9 |
| 5 | Finishing Table | 5,4 | 5,3 |
| 6 | Storage Cabinet | 3,2 | 3,7 |
| 7 | Cashier Desk | 3,1 | 5,9 |
| 8 | Prayer Room | 2 | 9 |
| 9 | Restroom | 3,9 | 9,5 |
| 10 | Parking Area | 3,3 | 1,6 |

After determining the coordinate points of the workstations in the initial layout of Jasatama Computer SME, the rectilinear distance between workstations was calculated using Equation. The rectilinear distance calculations for the identified workstations were then analyzed using the From-To Chart (FTC), as presented in Table 2.

**Table 2**. From-To Chart of the Existing Layout

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Row Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 3,61 | 5,9 | 1,2 | 1,9 | 5,7 | 3,6 | 5,6 | 4,2 | 7,7 | 39,41 |
| 2 | | | 3,91 | 4,81 | 5,11 | 4,51 | 2,21 | 1,99 | 2,79 | 6,71 | 32,04 |
| 3 | | | | 4,9 | 4,2 | 3,6 | 2,3 | 4,3 | 6,7 | 5,8 | 31,8 |
| 4 | | | | | 0,9 | 4,7 | 2,6 | 6,8 | 5,4 | 6,7 | 27,1 |
| 5 | | | | | | 3,8 | 2,9 | 7,1 | 5,7 | 5,8 | 25,3 |
| 6 | | | | | | | 2,3 | 6,5 | 6,5 | 2,2 | 17,5 |
| 7 | | | | | | | | 4,2 | 4,4 | 4,5 | 13,1 |
| 8 | | | | | | | | | 2,4 | 8,7 | 11,1 |
| 9 | | | | | | | | | | 8,5 | 8,5 |
| 10 | | | | | | | | | | | 0 |
| Grand Total | | | | | | | | | | | 205,85 |

Table 2 presents the rectilinear distance values between each workstation. Based on the from-to chart, the largest distance is identified between Workstation 9 and Workstation 10, with a rectilinear distance of 8.5 units, corresponding to the distance between the restroom and the parking area.

**Activity Relationship Chart (ARC)**

One of the stages in designing the proposed facility layout using the Systematic Layout Planning (SLP) approach is analyzing the degree of importance of activities between workstations through the Activity Relationship Chart (ARC). The ARC used in this study is presented in Figure 2.

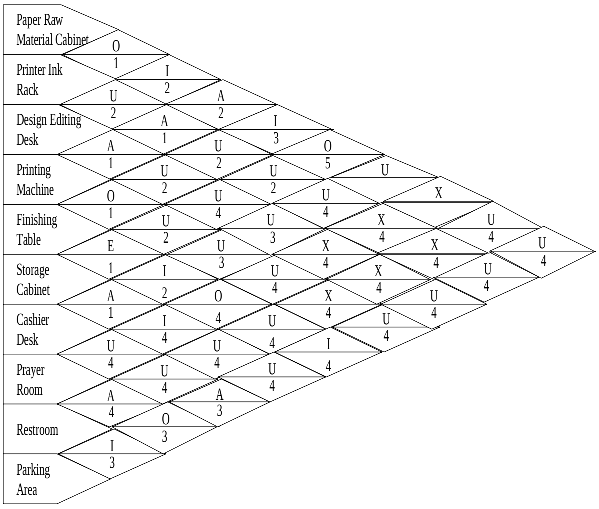


**Figure 2**. Activity Relationship Chart (ARC

### Activity Relationship Diagram (ARD)

The degree of activity relationships between workstations, as identified through the Activity Relationship Chart (ARC), is then followed by an analysis of the degree of closeness using the Activity Relationship Diagram (ARD), which is presented in Figure 3

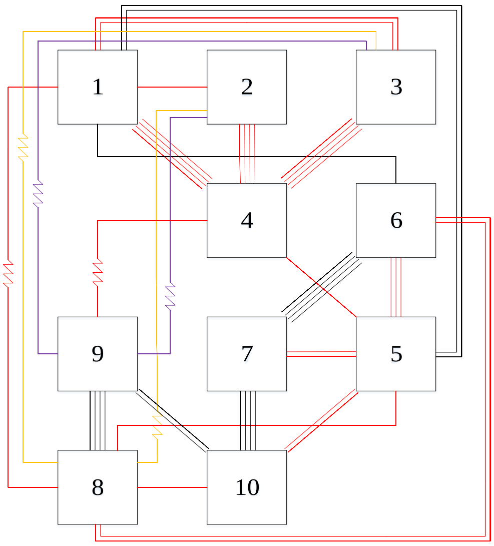


**Figure 3**. Activity Relationship Diagram (ARD)

### Determination of Area Requirements

The determination of area requirements considers the space needed for each room. This calculation is based on the requirements of machines, equipment, and operators within the production area. The detailed calculation of the required area is presented in Table 3.

**Table 3**. Calculation of Area Requirements

| No | Workstation Name | Quantity | P (m) | L (m) | D(m) | Unit Area (m²) | Total Area (m²) | Allowance (%) | Required Area (m²) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Paper Raw Material Cabinet | 1 | 2 | 0,5 | | 1 | 1 | 20% | 1,2 |
| 2 | Printer Ink Rack | 1 | 3,63 | 0,55 | | 2,0 | 2,0 | 30% | 2,6 |
| 3 | Design Editing Desk | 1 | 4 | 0,6 | | 2,4 | 2,4 | 50% | 3,6 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4 | Printing Machine | 1 | 0,4 | 0,4 | 0,16 | 0,2 | 60% | 0,26 |
| 5 | Finishing Table | 1 | 1 | 0,5 | 0,5 | 0,5 | 50% | 0,75 |
| 6 | Storage Cabinet | 2 | 5 | 0,45 | 2,25 | 4,5 | 20% | 2,7 |
| 7 | Cashier Desk | 1 | 1,1 | 0,7 | 0,77 | 0,77 | 40% | 1,08 |
| 8 | Prayer Room | 1 | 3 | 2,5 | 7,5 | 7,5 | 30% | 9,75 |
| 9 | Restroom | 1 | 2,5 | 1,5 | 3,75 | 3,75 | 10% | 4,13 |
| 10 | Parking Area | 1 | 4,8 | 2,5 | 12 | 12 | 0% | 12 |
| | | | **Total Required Area** | | | | | **38,05** |

Based on Table 3, the total required area for all workstations at the Jasatama Computer SME is 38.05 m². The calculation was carried out by considering the number of units, the dimensions of each piece of equipment, and the required space allowance for operational activities. The largest area requirement is the parking area with 12.00 m², while the printing machine has the smallest requirement of 0.26 m². The calculation of area requirements is crucial in designing a facility layout that is both efficient and aligned with the actual workspace needs of the SME.

**Facility Layout Design Using the Graph-Based Method**

The design stage using the Graph-Based Method is carried out through several steps. First, a from-to chart is constructed to obtain data on the intensity of material transfers between workstations. These data are then converted into a relationship graph, where each workstation is connected to others based on the assigned weight value. A higher weight value indicates a stronger closeness relationship, meaning that such workstations should be placed in proximity within the proposed layout. In the graph-based approach, the weights between workstations are determined and subsequently connected according to the highest weight values. As shown in Table 2, the greatest weight is identified between Workstation 8 and Workstation 10; therefore, these two workstations are initially connected in the relationship graph.

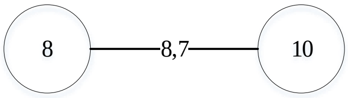


**Figure 4**. Closeness Relationship Graph Between Workstation 8 and Workstation 10

Figure 4 illustrates the closeness relationship graph between Workstation 8 and Workstation 10 with a closeness weight value of 8.7. This value indicates that the two workstations have a relatively strong interrelationship; therefore, their placement in the proposed layout must be carefully considered to minimize material transfer distance. Subsequently, the determination of closeness relationships is conducted step by step for Workstation 3 through Workstation 10 by referring to the respective closeness graphs. The closeness graph for Workstation 10 is further presented in Figure 5.

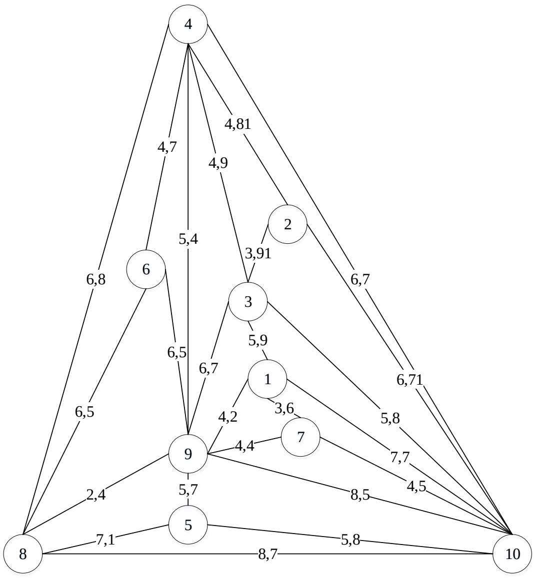


**Figure 5**. Closeness Relationship Graph for Workstation 10

Figure 5 presents the closeness relationship graph of all workstations at Jasatama Computer SME. This graph illustrates the degree of closeness between workstations based on the sequence and intensity of activity flows. A higher weight value between two workstations indicates a higher frequency of material transfers or interactions between them.

**Design of the propesd Facility Layout**

The design stages of the proposed layout for Jasatama Computer SME using the Systematic Layout Planning (SLP) method were carried out through an analysis of the importance and interrelationships among activities, as well as the spatial relationships that had been determined. The proposed layout generated using the SLP method is presented in Figure 6

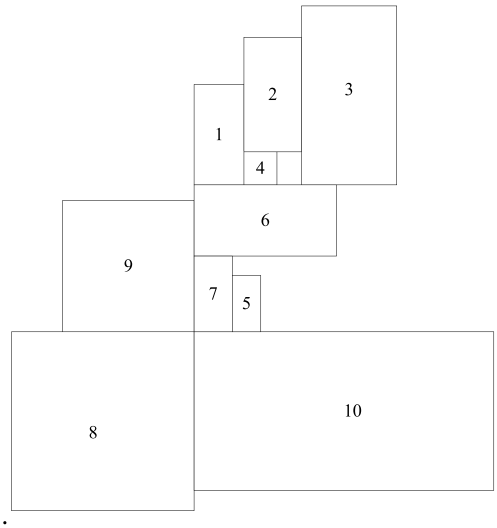


**Figure 6**. Proposed Block Layout Using the SLP Method

**Table 4**. Coordinates of the Proposed SLP Layout

| No | Workstasion Name | Coordinates X | Coordinates Y |
|---|---|---|---|
| 1 | Paper Raw Material Cabinet | 4,51 | 7,17 |
| 2 | Printer Ink Rack | 5,34 | 7,79 |
| 3 | Design Editing Desk | 6,52 | 7,86 |

| | | | |
|---|---|---|---|
| 4 | Printing Machine | 5,15 | 6,65 |
| 5 | Finishing Table | 4,93 | 4,56 |
| 6 | Storage Cabinet | 5,22 | 5,84 |
| 7 | Cashier Desk | 4,42 | 4,71 |
| 8 | Prayer Room | 2,56 | 2,56 |
| 9 | Restroom | 3,11 | 5,14 |
| 10 | Parking Area | 6,57 | 2,90 |

Figure 6 illustrates the proposed block layout designed using the SLP method. The positioning of each workstation was determined based on the analysis of activity relationship levels using the ARC and the spatial relationship levels of the rooms using the ARD. Subsequently, coordinate points were assigned for each workstation. The coordinate points of the proposed layout generated through the SLP method are presented in Table 4.

After the coordinates of the workstations in the proposed layout using the SLP method were established, the rectilinear distances between the workstations were calculated using Equation 1. The rectilinear distance analysis for the determined workstations was then performed using the Flow-Traffic Chart (FTC), as presented in Table 5.

**Table 5**. Form-To Chart SLP Method

| No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Row Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1,45 | 2,71 | 1,16 | 3,04 | 2,04 | 2,55 | 6,55 | 3,43 | 6,34 | 29,26 |
| 2 | | | 1,26 | 1,33 | 3,64 | 2,06 | 4,00 | 8,00 | 4,88 | 6,13 | 31,29 |
| 3 | | | | 2,59 | 4,89 | 3,32 | 5,26 | 9,26 | 6,14 | 5,02 | 36,46 |
| 4 | | | | | 2,31 | 0,88 | 2,67 | 6,67 | 3,55 | 5,18 | 21,25 |
| 5 | | | | | | 1,58 | 0,67 | 4,37 | 2,41 | 3,30 | 12,31 |
| 6 | | | | | | | 1,94 | 5,94 | 2,82 | 4,30 | 15,00 |
| 7 | | | | | | | | 4,00 | 1,74 | 3,97 | 9,71 |
| 8 | | | | | | | | | 3,12 | 4,35 | 7,47 |
| 9 | | | | | | | | | | 5,71 | 5,71 |
| 10 | | | | | | | | | | | 0 |
| Grand Total | | | | | | | | | | | 168,43 |

Table 5 presents the Flow-Traffic Chart (FTC) obtained from the rectilinear distance calculations of the proposed layout developed using the SLP method. Subsequently, the proposed layout was analyzed using the Graphic Method. The design of the proposed layout using the Graphic Method serves as an alternative approach for the layout planning of IKM Jasatama Komputer. The proposed block layout based on the Graphic Method is shown in Figure 7.

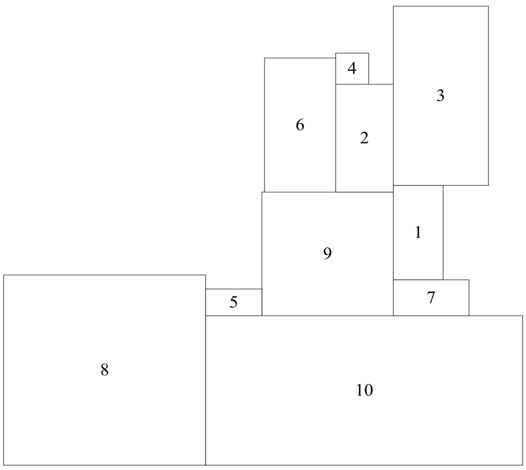


**Figure 7**. Proposed Block Layout Using the Graphical Method

**Table 6**. Proposed Layout Coordinates Using the Graphical Method

| **No** | **Workstation Name** | **Coordinates** | |
|---|---|---|---|
| | | **X** | **Y** |

| | | | |
|---|---|---|---|
| 1 | Paper Raw Material Cabinet | 7,41 | 4,82 |
| 2 | Printer Ink Rack | 6,58 | 6,37 |
| 3 | Design Editing Desk | 7,76 | 7,06 |
| 4 | Printing Machine | 6,39 | 7,51 |
| 5 | Finishing Table | 4,56 | 3,67 |
| 6 | Storage Cabinet | 5,58 | 6,58 |
| 7 | Cashier Desk | 7,61 | 3,75 |
| 8 | Prayer Room | 2,56 | 2,56 |
| 9 | Restroom | 6,01 | 4,47 |
| 10 | Parking Area | 6,57 | 2,23 |

Figure 7 illustrates the proposed layout for IKM Jasatama Komputer using the Graphical Method. The layout was determined based on the closeness ratings between workstations, which were processed using graphs. Subsequently, the coordinates of the proposed layout using the Graphical Method are presented in Table 6.

After the coordinates of the workstations were established, the rectilinear distances between the workstations were calculated using Equation 1. The resulting rectilinear distances were then analyzed using the Flow-Traffic Chart (FTC), as presented in Table 7.

**Table 7**. Proposed Layout Coordinates Using the Graphical Method

| No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Row Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 2,38 | 2,60 | 3,71 | 4,00 | 3,59 | 1,27 | 7,10 | 1,75 | 3,43 | 29,82 |
| 2 | | | 1,88 | 1,33 | 4,72 | 1,21 | 3,65 | 7,82 | 2,47 | 4,15 | 27,22 |
| 3 | | | | 1,82 | 6,59 | 2,66 | 3,47 | 9,70 | 4,35 | 6,02 | 34,59 |
| 4 | | | | | 5,67 | 1,73 | 4,98 | 8,77 | 3,42 | 5,47 | 30,03 |
| 5 | | | | | | 3,94 | 3,13 | 3,11 | 2,25 | 3,46 | 15,87 |
| 6 | | | | | | | 4,86 | 7,04 | 2,54 | 5,35 | 19,79 |
| 7 | | | | | | | | 6,23 | 2,32 | 2,56 | 11,11 |
| 8 | | | | | | | | | 5,35 | 4,35 | 9,70 |
| 9 | | | | | | | | | | 2,81 | 2,81 |
| 10 | | | | | | | | | | | 0 |
| Grand Total | | | | | | | | | | | 180,91 |

Table 7 presents the From-To Chart illustrating the movement distances between workstations in the proposed layout of IKM Jasatama Komputer based on the Graphical Method. A comparative analysis was conducted by calculating the movement distances between workstations in the initial layout and the proposed layout. The results of this comparison are presented in Table 8.

**Comparison of Material Handling Distance Across Layouts**

The comparison of facility layouts between the initial condition, the proposed design using the Systematic Layout Planning (SLP) method, and the graphical method is presented below. The visualizations were developed using Microsoft Visio to clearly illustrate the differences in spatial configuration and workstation arrangements resulting from each approach. The comparative layouts are shown in the figures below.

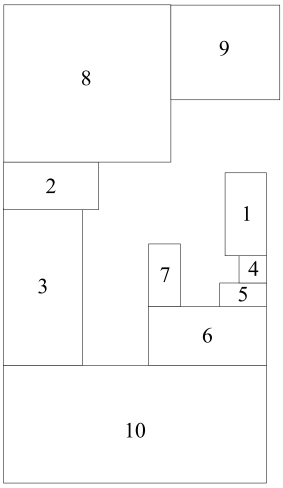


**Figure 8**. *Layout* Awal

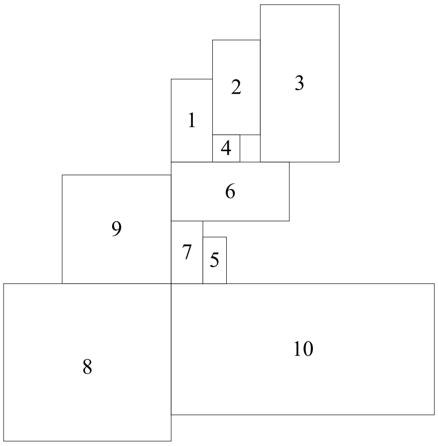


**Figure 9**. Layout SLP Method

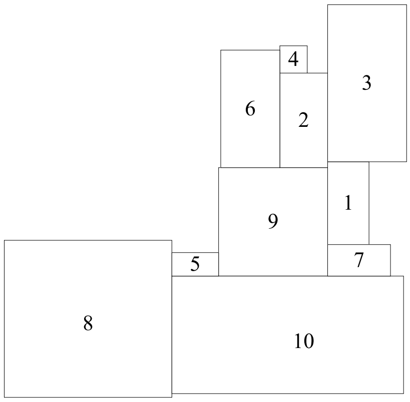


**Figure 10**. Layout Graphical Method

The movement distances between workstations were compared for the initial layout, the proposed layout using the SLP method, and the proposed layout using the graphical method. This analysis aims to determine the extent to which each approach can reduce the total material handling distance, thereby producing a more efficient facility layout. The results of the layout distance comparison are presented in Table 8.

**Table 8**. Comparison of Movement Distances Between Layouts

| No | Dari | Workstation | Awal | SLP | %Reduction SLP | Grafik | %Reduction Graph |
|---|---|---|---|---|---|---|---|
| 1 | Paper Raw Material Cabinet | 2,3,4,5,6,7,8,9,10 | 39,41 | 29,26 | 25,75% | 29,82 | 24,33% |
| 2 | Printer Ink Rack | 3,4,5,6,7,8,9,10 | 32,04 | 31,29 | 2,34% | 27,22 | 15,04% |
| 3 | Design Editing Desk | 4,5,6,7,8,9,10 | 31,8 | 36,46 | 14..65% | 34,59 | 8,77% |
| 4 | Printing Machine | 5,6,7,8,9,10 | 27,1 | 21,25 | 21,59% | 30,03 | 10,81% |
| 5 | Finishing Table | 6,7,8,9,10 | 25,3 | 12,31 | 51,34% | 15,87 | 37,27% |
| 6 | Storage Cabinet | 7,8,9,10 | 17,5 | 15,00 | 14,29% | 19,79 | 13,09% |
| 7 | Cashier Desk | 8,9,10 | 13,1 | 9,71 | 25,88% | 11,11 | 15,27% |
| 8 | Prayer Room | 9,10 | 11,1 | 7,47 | 32,70% | 9,70 | 12,61% |
| 9 | Restroom | 10 | 8.5 | 5,71 | 32,882% | 2,81 | 66,94% |
| Total Jarak | | | 205,85 | 168,46 | 18,16% | 180,91 | 12,11% |

The research findings indicate a significant difference in material handling efficiency after the redesign of the facility layout using the Systematic Layout Planning (SLP) method and the Graph-Based method. In the initial layout, the total material transfer distance was recorded at 205.85 meters. The alternative layout generated through the Graph-Based method reduced the total transfer distance to 180.91 meters, representing a reduction of 24.94 meters or 12.11% compared to the initial condition. Meanwhile, the proposed layout developed using the SLP method demonstrated a more optimal result, with a total transfer distance of 168.43 meters, corresponding to a reduction of 37.42 meters or 18.16% from the initial layout.

This study confirms that the SLP method outperforms the Graph-Based method in the context of facility layout design for printing SMEs. The superiority of SLP lies in its emphasis on activity relationships (through the ARC and ARD), rather than relying solely on distance minimization. As a result, SLP is capable of producing a more logical material flow, reducing backtracking, and supporting the principles of lean manufacturing by eliminating motion waste. Furthermore, the advantages of SLP are also associated with improved ergonomics and workflow continuity. By minimizing transfer distances and strengthening the closeness of inter-workstation relationships, operators are not required to perform excessive movements, which in practice enhances productivity and reduces worker fatigue.

Research is consistent with recent SME-oriented studies showing that SLP, often combined with lean tools, yields larger distance and flow reductions than layouts derived solely from quantitative adjacency or graph formulations. For example, a 2024 case in the steel-processing sector reported a 34% reduction in material flow and 26% improvement in space utilization after applying SLP alongside lean practices, underscoring the value of integrating qualitative activity relationships (ARC/ARD) with quantitative checks[31]. IEOM case studies that coupled SLP with 5S/Kanban or warehousing improvements documented meaningful gains in productivity and travel distance, highlighting SLP's suitability for small firms with linear or semi-linear flows[32]. It can be concluded that the application of the SLP method provides more optimal results compared to the Graph-Based method in the redesign of facility layouts within printing SME. This outcome is consistent with the facility planning literature, which emphasizes the importance of integrating qualitative aspects (activity relationships) and quantitative aspects (material transfer distances) to produce facility layouts that are efficient, ergonomic, and supportive of productivity improvement in SME.

## Conclusion

Based on the analysis, the facility layout redesign of Jasatama Computer SME using the Systematic Layout Planning (SLP) and Graph-Based Method produced two alternative layouts. After comparison, the optimal layout was obtained using the SLP approach, resulting in a total material handling distance of 168.43 meters, which corresponds to an 18.16% reduction compared to the initial layout of 205.85 meters. This finding demonstrates that the SLP method is more efficient and better suited to the available production space. From a practical implication perspective, this study confirms that SMEs can adopt simple and structured planning tools such as SLP to improve material flow efficiency and productivity without requiring substantial investment. The implementation of SLP can therefore serve as a cost-effective improvement strategy, particularly relevant for small and medium-sized enterprises in the printing sector. This study has certain limitations, as it focused only on a single SME case with a limited scope. Cost analysis, worker ergonomics, and production time efficiency were not quantitatively evaluated, making the findings partial in nature.

For future research, it is recommended to integrate the SLP method with simulation approaches flexSim or Arena, to capture the dynamic behavior of production systems more realistically. Further investigations could also apply multi-objective optimization that simultaneously considers distance, cost, and ergonomics. Moreover, extending the application to a broader range of SMEs with different characteristics is suggested to enhance the validity and generalizability of the results.

## References

[1] J. Immanuel, Amelia Santoso, and Markus Hartono, "Analisis perancangan tata letak fasilitas di perusahaan XYZ produksi kedelai dengan systematic layout planning," *JENIUS J. Terap. Tek. Ind.*, vol. 4, no. 2, pp. 250–261, 2023, doi: 10.37373/jenius.v4i2.555.

[2] F. Yulianti, L. Gozali, and L. Tiffany, "New Layout Design for PT ABC Using Systematic Layout Planning and CORELAP Methods with ANN's Forecasting Production Capacity at Repackaging Company," *Proc. Int. Conf. Ind. Eng. Oper. Manag.*, pp. 2082–2094, 2022, doi: 10.46254/an12.20220371.

[3] U. Amrina, R. A. Oktora, D. L. Widaningrum, and I. D. Mayangsari, "Analysis of production area layout design based on lean and green thinking in the micro, small and medium enterprises (MSME) industry," *J. Sist. dan Manaj. Ind.*, vol. 8, no. 2, pp. 107–118, 2024, doi: 10.30656/jsmi.v8i2.8981.

[4] N. M. Wiati, M. Z. Zaman, and F. Kautsar, "Analisis Dan Perancangan Ulang Tata Letak Fasilitas Produksi Dengan Metode Systematic Layout Planning," *J. Ind. View*, vol. 3, no. 2, pp. 55–63, 2021, doi: 10.26905/jiv.v3i2.6678.

[5] S. Panrelli, M. Rexoprodjo, R. Safitri, and I. H. Lahay, "Perancangan Ulang Tata Letak Fasilitas Menggunakan Metode Systematic Layout Planning Pada Umkm Xyz," *J. Tek. Ind.*, vol. 27, no. 1, pp. 76–85, 2024, [Online]. Available: http://univ45sby.ac.id/ejournal/index.php/industri/

[6] M. Mudhofar, H. C. Suroso, A. R. Rahadian, and L. N. Sholekhah, "Perancangan Ulang Tata Letak Fasilitas Produksi dengan Menggunakan Metode Systematic Layout Planning dan CRAFT untuk Mengurangi Biaya Material Handling pada PT. Prima Daya Teknik," *Pros. Semin. Nas. Teknol. Ind. Berkelanjutan III*, pp. 1–8, 2023.

[7] M. I. Amal and N. A. Mahbubah, "Integrating Lean Implementation and Relayout Design for Efficiency Improvement," *J. Ilm. Tek. Ind.*, vol. 21, no. 2, pp. 238–250, 2022, doi: 10.23917/jiti.v21i2.19748.

[8] M. J. D. Firmansyah and E. P. Putri, "Relayout of Production Layout to Reduce Material Handling Costs," *J. LA MULTIAPP VOL.*, vol. 06, no. 01, pp. 34–49, 2025, doi: 10.37899/journallamultiapp.v6i1.1818.

[9] Ibnu Syakur Almauludi, D. Rachmawaty, and H. Q. Karima, “Perancangan Ulang Tata Letak Fasilitas pada CV. Mulya Mediatama Advertising,” *Tek. Ind.*, vol. 12, no. 2, pp. 3161–3167, 2025.

[10] R. Wahyudi, R. R. N. Garamba, and A. T. Nugraha, “Evaluasi Tata Letak Fasilitas Menggunakan Metode Systematic Layout Planning di PT Lambang Jaya,” *J. Ind. Manuf. Eng.*, vol. 8, no. 1, pp. 66–77, 2024, doi: 10.31289/jime.v8i1.10618.

[11] F. Febriani and F. Wurjaningrum, “Systematic Layout Planning to Improve Facility Layout in Small and Medium Food Enterprise,” *Southeast Asian Bus. Rev.*, vol. 2, no. 2, pp. 111–117, 2024, doi: 10.20473/sabr.v2i2.60850.

[12] I. Adiasa, R. Suarantalla, M. S. Rafi, and K. Hermanto, “Perancangan Ulang Tata Letak Fasilitas Pabrik Di CV Apindo Brother Sukses Menggunakan Metode Systematic Layout Planning (SLP),” *Media Ilm. Tek. Ind.*, vol. 19, no. 2, pp. 151–158, 2020, doi: 10.20961/performa.19.2.43467.

[13] D. Nurkertamanda, Y. Widharto, and L. Oki Oktavian, “Facility Layout Design for Cv. Julang Marching With Systematic Layout Planning Method,” *Int. J. Appl. Sci. Eng. Rev.*, vol. 4, no. 6, pp. 35–44, 2023, doi: 10.52267/ijaser.2023.4603.

[14] E. Hartari and D. Herwanto, “Perancangan Tata Letak Stasiun Kerja dengan Menggunakan Metode Systematic Layout Planning,” *J. Media Tek. dan Sist. Ind.*, vol. 5, no. 2, p. 118, 2021, doi: 10.35194/jmtsi.v5i2.1480.

[15] V. P. Purnomo, A. N. Teppo, S. Husin, and I. H. Lahay, “Perancangan Ulang Tata Letak Fasilitas dengan Metode Systematic Layout Planning Pada UMKM Olahan Tuna Fresh h Tuna Processed,” *Tek. Ind.*, vol. 27, no. 1, pp. 64–75, 2024, [Online]. Available: http://univ45sby.ac.id/ejournal/index.php/industri/index

[16] B. Suhardi, L. Elvira, and R. D. Astuti, “Facility Layout Redesign Using Systematic Layout Planning Method in PT Pilar Kekar Plasindo,” *J. Technol. Oper. Manag.*, vol. 16, no. 1, pp. 57–68, 2021, doi: 10.32890/jtom2021.16.1.5.

[17] I. Adiasa, Sartika, and N. Hudaningsih, “Perancangan Tata Letak Fasilitas Gudang Pada Proyek Pembangunan Jetty Pltmgu Lombok Peaker Menggunakan Metode Systematic Layout Planning (Slp) Dengan Algoritma Blocplan,” *J. Inform. Teknol. dan Sains*, vol. 5, no. 1, pp. 202–209, 2023, doi: 10.51401/jinteks.v5i1.2609.

[18] G. Halim, L. Gozali, H. J. Kristina, and C. Robin, “Perancangan Tata Letak Relokasi Lantai Produksi Dengan Metode Systematic Layout Planning, Blocplan, Dan Flap,” *J. Ilm. Tek. Ind.*, vol. 12, no. 1, pp. 57–68, May 2024, doi: DOI: https://doi.org/10.24912/jitiuntar.v12i1.2964129641.

[19] B. Febriyanto and W. Setiafindari, “Optimasi Tata Letak Fasilitas Produksi dengan Metode Systematic Layout Planning ( SLP ) untuk Meningkatkan Efisiensi Material Handling,” *J. Teknol. dan Manaj. Ind. Terap.*, vol. 4, no. 1, pp. 10–19, 2025.

[20] N. A. Nugraha and E. P. Widjajati, “Analysis of Bottle Warehouse Facility Layout Design Using the System Layout Planning Method (SLP) Using Software Craft In PT.XYZ,” *Adv. Sustain. Sci. Eng. Technol.*, vol. 6, no. 3, pp. 1–8, 2024, doi: 10.26877/asset.v6i3.628.

[21] M. Mansur, A. A. Ahmarofi, and A. Gui, “Designing the Re-layout of the Production Floor Using Integrated Systematic Layout Planning (SLP) and Simulation Methods,” *Int. J. Ind. Manag.*, vol. 10, no. 1, pp. 151–159, 2021, doi: 10.15282/ijim.10.1.2021.6058.

[22] C. J. Roca-limache, D. M. Quispe-leon, and E. L. Tupia-de-la-cruz, “Designing a Lean Production Model Using 5S and Systematic Layout Planning for Efficiency in Footwear Manufacturing : A Case Study,” *Int. J. Recent Eng. Sci.*, vol. 12, no. 1, pp. 33–42, 2025, [Online]. Available: https://www.semanticscholar.org/paper/Designing-a-Lean-Production-Model-Using-5S-and-for-Roca-Limache-Quispe-León/93900c539951b3b7768bfb238210af764dd2183d

[23] A. Merjani and D. Mulyadi, “Area Optimalization with systematic layout planning and class based storage methods to increase storage capacity,” *J. Sigma Tek.*, vol. 6, no. 2, pp. 352–359, 2023.

[24] J. Albert *et al.*, “Feasibility Study and Planning New Factory Layout Using Systematic Layout Planning (SLP) Method for Smart Trolley,” *Int. Conf. Ind. Eng. Oper. Manag.*, pp. 3431–3446, 2022, doi: 10.46254/an12.20220622.

[25] I. Kholidasari, yulia sridewi Syahri, and S. Sundari, “Penerapan Metode Systematic Layout Planning Untuk Meminimasi Jarak Perpindahan Material Pada Ukm X,” *Ind. J. Ilm. Tek. Ind.*, vol. 7, no. 1, pp. 93–102, 2022, doi: 10.37090/indstrk.v7i1.943.

[26] H. W. Ramadhan and R. Indiyanto, “Analisis Perancangan Ulang Tata Letak Fasilitas Lantai Produksi Menggunakan Metode Slp (Systematic Layout Planning) Di PT XYZ Mojokerto,” *J. Ind. Eng. Manag.*, vol. 19, no. 2, pp. 181–193, 2024, doi: 10.33005/tekmapro.v19i2.420.

[27] A. R. Naufalah, M. Ridwan Enan Sanusi, and A. Lazuardy, “Redesign The Facility Layout with

Systematic Layout Planning Method on Battery Workshop at PT GMF Aeroasia," *Int. Conf. Ind. Mech. Eng. Oper.*, pp. 977–987, 2023, doi: 10.46254/bd05.20220277.

[28] E. Joshua, K. L. Mandagie, B. W. Utomo, and Indramawan, "Perancangan Ulang Tata Letak Pabrik Pada Home Industry Pembuatan Ikat Pinggang Menggunakan Metode Systematic Layout Planning (Slp)," *J. Tek.*, vol. 12, no. 2, pp. 139–152, 2023, doi: 10.35968/jtin.v12i2.1155.

[29] A. Fajri, "Perancangan Tata Letak Gudang Dengan Metode Systematic Layout Planning," *J. Tek. Ind. J. Has. Penelit. dan Karya Ilm. dalam Bid. Tek. Ind.*, vol. 7, no. 1, pp. 27–36, 2021, doi: 10.24014/jti.v7i1.10533.

[30] Santoso and R. M. Heryanto, *Perancangan Tata Letak Fasilitas*, 1st ed. Kota Bandung: Ikatan Penerbit Indonesia, 2020.

[31] S. S. Salins, S. A. R. Zaidi, D. Deepak, and H. K. Sachidananda, "Design of an improved layout for a steel processing facility using SLP and lean Manufacturing techniques," *Int. J. Interact. Des. Manuf.*, vol. 18, no. 6, pp. 3827–3848, 2024, doi: 10.1007/s12008-024-01828-9.

[32] R. L. Garcia and M. vidal Asencios, "Application of Lean Manufacturing and SLP tools to increase productivity in an SME in the textile sector," *Int. Conf. Ind. Eng. Oper. Manag.*, vol. 4, no. 6, pp. 82–92, 2023, doi: 10.46254/af04.20230015.