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

Vol. 11, No. 2, 2025

Facility Layout Redesign of Goat Leather Kompang SME in Dumai Using Systemic Layout Planning dan Graph Method

Reza Lesmana [1], Fitra[2], Wahyu Prayogi [3], Marzuki [4]
1.2 Department of Industrial Engineering, Institut Teknologi dan Bisnis Riau Pesisir
Jl. Utama Karya Bukit Batrem II Dumai Telp. (0765) 7007750 Fax. (0765) 35461
Email: lreza599@gmail.com, famukhtyfitra@gmail.com, wahyuprayogi402@gmail.com, zukimarzuki939@gmail.com

ABSTRACT

The traditional instrument manufacturer IKM Kompang Kulit Kambing Medan Kampai experienced major problems with inefficient facility layout. This resulted in losses for the company due to high material handling costs, long production times, and decreased productivity. Systemic Layout Planning (SLP) was the method used in this study, supported by data collection and analysis through the use of relationship diagrams and process flow diagrams. Several new layouts were created to reduce transfer distances and material management costs. This study recently focused on traditional instrument SMEs using structured industrial techniques. In addition, comparing SLP with graphical methods provides a culture-based industrial perspective. The evaluation results show that the SLP approach is the best layout method, resulting in the shortest distance of 78. Meanwhile, the Graph Method resulted in a distance of 184.8. Thus, the Kompang Kulit Kambing Medan Kampai SME must reorganize its production space to be more efficient and effective. This will increase the competitiveness of SMEs and help preserve cultural heritage through sustainable production.

Keywords: *Facility Layout, Systematic Layout Planning (SLP), Graph Method, Production Efficiency, Culture-Based Industry.*

Introduction

The Kompang Kulit Kambing (Goat Leather) SME in Medang Kampai, Dumai City, is a key entity in efforts to preserve Malay culture through the production of traditional musical instruments. However, Production methods that still rely on conventional methods are identified as a source of inefficiency and wasted time [1]. The most prominent industrial engineering problem inefficiency of production facility layout. The arrangement of equipment and work areas that are not well organised causes the flow of movement of raw materials and semi-finished products to be suboptimal, which results in lengthening of travel distance between work stations, increasing costs of material *handling*, and increased work safety risks. This situation directly reduces productivity levels and potentially damages the competitiveness of SMEs in the future. Improving operational efficiency is essential, regardless of the small scale of the business[2].

Research Gap: Although facility layout design methods such as Systematic *Layout Planning* (SLP) have been widely used in manufacturing contexts, particularly on a large scale. Its application to SMEs, particularly those operating in traditional crafts or cultural industries, remains limited and underexplored. Yet, layout optimization is crucial for improving efficiency and supporting business sustainability at the SME level[3].

To address this layout inefficiency problem, this study proposes a redesign of the factory layout using a combination of methods. Systematic Layout Planning (SLP) and Graphic methods were chosen as a systematic approach that considers the relationships between activities and has proven effective in reducing transfer costs and production time[4]. Meanwhile, a graphical method is used to visualize the proximity of production areas based on distance weighting. This study also considers the use of algorithms such Computerised *Relative Allocation of Facilities Technique*(CRAFT) as an improvement program to find the ideal design[5].

This research aims to redesign the layout of production facilities at the Kompang Kulit Kambing UKM to achieve maximum operational efficiency, which is measured explicitly through minimising the total distance of material movement. This plan is expected to provide an effective layout model to increase production capacity, strengthen business competitiveness, and directly support the sustainability of SMEs in carrying out the role of preserving local culture through optimal facility management[6].

Research Methods

This study was conducted at the Small and Medium Industry (IKM) Kompang Kulit Kambing Medang Kampai, located on Jalan Navigasi, Medang Kampai District, Dumai City. The research period ran from May to August 2025. The main object of the study was the layout of production facilities, with a focus on redesigning the layout to improve the efficiency of material flow and production processes.

This study employs a quantitative approach. Data collection was conducted through observation, interviews, as well as literature and documentation studies. The data used includes primary data, collected directly at the research site, such as workstation sizes, operational process details, and distances between workstations, as well as secondary data obtained from various relevant literature and scientific journals on facility layout design and the Systematic Layout Planning (SLP) method[7].

This research uses the Systematic Layout Planning (SLP) method to arrange the factory layout. This method places two work areas with high activity frequency and logical relationships close to each other[8]. In addition, this research also uses the Computerized Relative Allocation of Facilities Technique (CRAFT) algorithm, an improvement program that gradually optimizes the layout to find the ideal design[9].

Systematic Layout Planning (SLP) provides several important benefits for companies. By placing departments that interact with each other in proximity, SLP effectively cuts material transfer costs because travel distances and transportation times are reduced[10].

In addition, this method also improves production efficiency by reducing waiting times and obstacles, thereby speeding up the production process and increasing productivity. SLP also helps maximize the use of available space, making the work area more organized and efficient.[11]

The SLP method also aims to increase production output and material handling efficiency. In this study, the researcher used SLP to analyze material flow, design, and evaluate several alternative production area layouts[12].

This study employs the Systematic Layout Planning (SLP) method to design an optimal layout. The process involves the MPPC, ARC, ARD, and AAD stages to analyze and design the production facility layout. From the research results, two layout alternatives were successfully developed[13]. The first alternative was chosen because it successfully minimized material transportation time and increased movement efficiency between production areas. This proves that the SLP method is effective in creating a more efficient factory layout, thereby supporting increased company productivity[14].

This study applied a combination of the Systematic Layout Planning (SLP) method and the Graph method, which was carried out through several systematic stages. The initial stage was data collection, which included observation, interviews with Kompang Kulit Kambing SMEs, and measurements of the distances between departments. The validity of this data was reinforced through business license verification[15].

The next stage is data processing, which begins with an evaluation of the initial layout and measurement of the dimensions of each workstation to serve as the basis for redesign[16]. Based on this data, a From to Chart (FTC) is created to group the rectilinear distance values between workstations. The analysis of the proximity relationship between workstations is then carried out using the Activity Relationship Chart (ARC) and Activity Relationship Diagram (ARD)[17].

After that, the area requirements are determined by considering the needs of machines, equipment, and the number of workers. The Graph method is used to determine the weight and proximity relationship between stations based on the most significant rectilinear distance from the FTC[18]. As a final step, several proposed layouts from both methods (SLP and Graph) are created and then compared to determine which layout is most optimal for the Goat Leather Kompang SME.

The research flowchart for the redesign of the layout of the Kompang Kulit Kambing SME can be seen in the diagram below. The diagram visualizes all the steps of the methodology used, from the initial stage of data collection to the proposed layout design[19].

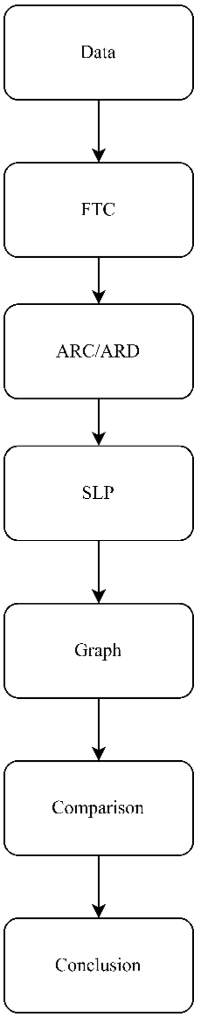

Figure 1. Research Flow Chart

After obtaining the layout data and dimensions from the initial layout, the first step is to determine the coordinates of the centre point (X and Y) and then calculate the distance between workstations that are interconnected according to the production process sequence[20]. The coordinates determined using the layout block are used to calculate the distances between each workstation, the rectilinear distance. The rectilinear formula is:

$$d_{ij}=|x_i-x_j|+|y_i-y_j|$$

In this case, the calculation is performed using a from-to chart (FTC).

Results and Discussion

Initial Layout of the Goat Leather Kompang IKM

The IKM Kompang Kulit Kambing facility was constructed on an area of 229.5 square meters. Based on the survey results, the layout of the IKM Kompang Kulit Kambing facility consists of 7 production rooms: raw material storage, wooden ring forming, leather drying, leather sanding, leather pressing onto rings, storage, and parking area. Additionally, the survey revealed that the wooden ring forming room and the leather pressing room are under the same roof. Meanwhile, the storage room used to store finished kompang, which is managed by the owner of the IKM Kompang Kulit Kambing Medang Kampai, is located within the production area**.**

Workstation Size

The size of each workstation can be seen in Table 1.

Table 1. Workstation Size

No	Workstation Name	Size (m)		Area m²
		Length	Width	
1	Raw Material Storage	2,6	6	12,48
2	Wood Ring Forming Station	4,1	4	16,4
3	Leather Drying Station	4,5	3,5	15,75
4	Sanding Area	4,5	4	18
5	Leather Pressing to Rings Area	2	6	12
6	Storage Area	4	6	24
7	Parking Area	10	6	60
	Total			**161,75**

Production Flow

The production of kompang consists of several processes, which can be seen in the image.

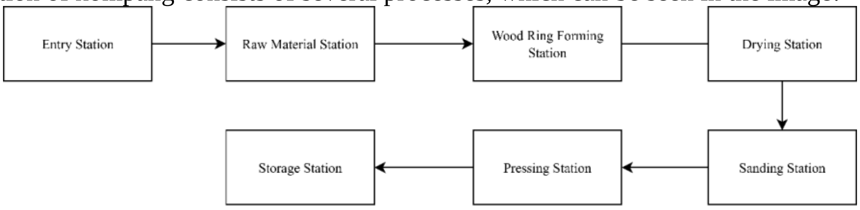

Figure 2. Production Flow

Discussion

In this study, data processing was carried out in three stages, namely processing the initial layout data, then designing the proposed layout using the SLP method and the graphical method, and finally analyzing and evaluating the results of the proposed layout design.

Initial Layout Analysis

Before designing the proposed layout for the Medang Kampai Goat Leather Kompang SME, a comprehensive analysis of the initial layout was conducted. This analysis included an evaluation of the flow of materials, transfer distances, and operating times in the production process.

Time and Process Flow Map

The first analysis conducted was on the operational time of the goat Leather kompang production process. This analysis was followed by creating a process flow map to visualize all stages of kompang production at the IKM.

Distance Between Work Stations

To evaluate the initial layout, the distance between work stations was calculated using Formula 2.1 with the rectilinear method[21]. The distance was determined based on the coordinates of each work station, which can be seen in Figure 3, showing the block layout plan of the Medang Kampai Goat Leather Kompang IKM.

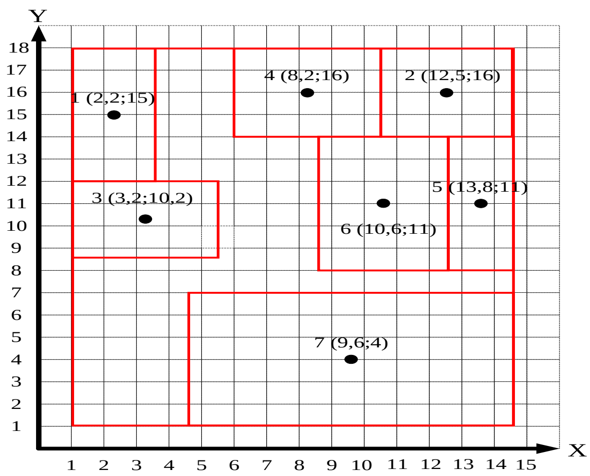

Figure 3. Block Layout Coordinate Points

Table 2. Work Station Coordinate Points

No	Workstation Name	Coordinates	
		X	Y
1	Raw Material Storage Area	2,2	15
2	Wood Ring Forming Area	12,5	16
3	Leather Drying Area	3,2	10,2
4	Sanding Area	8,2	16
5	Leather Pressing to Ring Area	13,8	11
6	Storage Area	10,6	11
7	Parking Area	9,6	4

Table 2 contains the coordinate points of the work stations in the initial layout of the Kompang Kulit Kambing Medang Kampai IKM. Based on these coordinates, the rectilinear distance between work stations can be calculated using Formula 2.1.

1. The rectilinear distance between the raw material location and the wood ring formation location is calculated as follows:

Dij = [(2.2-12.5) + (15-16)] = 11.3

2. The calculation of the rectilinear distance between the raw material site and the leather drying site is:

Dij = [(2.2-3.2) + (15-10.2)] = 5.8

Form to Chart (FTC)

The rectilinear distance between work stations at the Kompang Kulit Kambing Medang Kampai SME was analyzed using a From to Chart (FTC), which is presented in Table 3.

Table 3. From To Chart

Station	1	2	3	4	5	6	7	Total
1		11,3	5,8	7	15,6	12,4	18,4	70,5
2			15,1	4,3	6,3	6,9	14,9	47,5
3				10,8	11,4	8,2	12,6	43
4					10,6	7,4	13,4	31,4
5						3,2	11,2	14,4
6							8	8
7								0
Total								**214,8**

Based on the FTC table above, the greatest distance was found between station 1 (raw material location) and station 7 (parking area). Overall, the total distance from the initial FTC layout was 214.8.

Design Using the SLP Method

Research into the redesign of the layout of the Kompang Kulit Kambing Medang Kampai SME uses the SLP method, among others[22]. This method is based on the importance of activities between each workstation. The importance of activities will be analyzed using ARC and ARD.

Activity Relationship Chart (ARC)

One of the stages in designing the proposed layout using the SLP method is to analyze the degree of importance of activities between stations using ARC[23]. The ARC in this study can be seen in Figure 4.

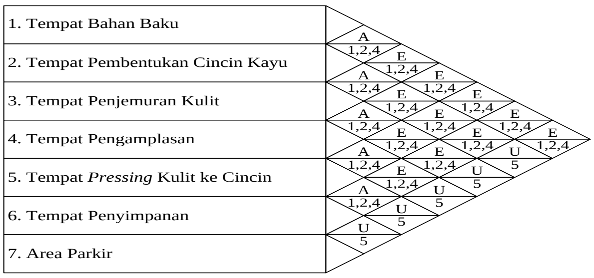

Figure 4. ARC IKM Goat Leather Kompang

Table 4. Activity Relationship Chart

Value	Proximity	Code	Reason
A	Absolutely Necessary	1	Process Flow
E	Very Important	2	Material Flow
I	Important	3	Information Flow
O	Normal Proximity	4	Worker Movement
U	Not Important	5	Not Process Flow

Activity Relationship Diagram (ARD)

After analyzing the level of relationship between work stations using the Activity Relationship Chart (ARC), the next step is to analyze the level of closeness using the Activity Relationship Diagram (ARD)[24]. The ARD can be seen in Figure 5.

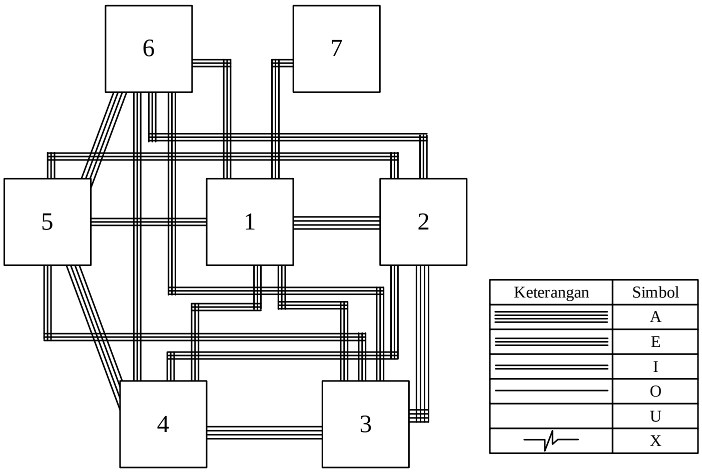

Figure 5. ARD IKM Goat Leather Kompang

Determining the Required Area

Before determining the required area, this study considered the space requirements based on the number of machines, equipment, and workers[25]. Detailed calculations of the required area can be seen in table 5.

Table 5. Area of Production Area Requirement Point

Machine	Number	Size (m^2)			Area (m^2)	Total Area (m^2)	Clearance	Area Requirement (m^2)
		P	L	D				
Raw Material Storage Area								
Area	1	2,6	6		15,6	15,6	-	15,6
Wood Ring Formation Area								
Area	1	4,1	4		16,4	16,4	20%	19,68
Leather Drying Area								
Area	1	4,5	3,5		15,75	15,75	-	15,75
Sanding Area								
Area	1	4,5	4		18	18	15%	20,7
Leather Pressing Area to Rings								
Area	1	2	6		12	12	-	12
Storage Area								
Area	1	4	6		24	24	-	24
Parking Area								
Area	1	10	6		60	60	-	60
Total (m^2)								167,73

On the other hand, some areas, such as the leather drying area, the leather pressing area, and the parking area, do not require additional allowances as the existing space is sufficient. A detailed comparison of the increase in area for each station can be seen in Table 6.

Table 6. Comparison of Initial Layout Area with Required Layout

No	Station Name	Initial Layout (m^2)	Required Layout (m^2)
1	Raw Material Storage	12,48	15,6
2	Wood Ring Formation Area	14,35	19,68
3	Leather Drying Area	15,75	15,75
4	Sanding Area	15,75	20,7
5	Leather Pressing to Ring Area	12	12
6	Storage Area	24	24
7	Parking Area	60	60
	Total	**161,75**	**167,73**

Designing with the Graphical Method

The next approach to designing the layout is with the graphical method, which aims to determine the proximity between workstations[26]. In this method, the weight between stations is determined based on the From to Chart (FTC) as shown in Table 7. Once the weight is determined, the workstations will be connected based on the largest weight.

Table 7 FTC IKM Kompang Kulit Kambing

Station	1	2	3	4	5	6	7	Total
1		11,3	5,8	7	15,6	12,4	18,4	70,5
2			15,1	4,3	6,3	6,9	14,9	47,5
3				10,8	11,4	8,2	12,6	43
4					10,6	7,4	13,4	31,4
5						3,2	11,2	14,4
6							8	8
7								0
				Total				**214,8**

Table 7 shows the rectilinear distance weights between work stations at the Kompang goat Leather IKM in Medang Kampai. These weights were calculated using Formula 2.1. Based on the table, the greatest weight is between stations 1 and 7, so these two will be connected in the layout design.

Table 8 Proximity to Work Stations 1, 7, 5, 2, 3, and 4

Station	weight						
	1,2,7	1,2,5	7,3,2	3,5,2	7,4,3	7,4,5	4,5,3
6	27,3 The Best	22,5	23,1	18,3	23,6	18,6	18,8

Based on Table 8, it can be seen that station 6 has the largest weight, which will then be entered into the proximity graph between stations 1, 7, 5, 2, 3, and 4, as shown in Figure 6.

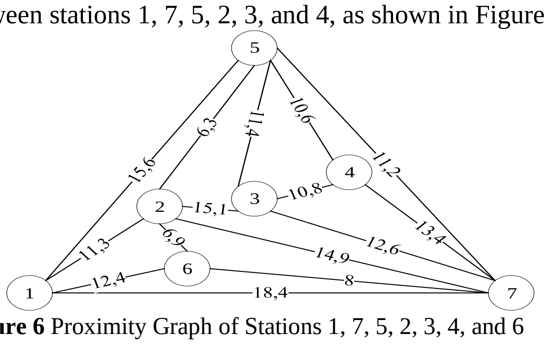

Figure 6 Proximity Graph of Stations 1, 7, 5, 2, 3, 4, and 6

Layout Design Proposals

After conducting an analysis using the Systematic Layout Planning (SLP) method and graphs, several layout alternatives for the Medang Kampai Goat Leather Kompang SME were successfully developed. Using the SLP method, we determined the area of each workstation based on machine requirements and the necessary clearance[27]. Activity Relationship Chart (ARC) and Activity

Relationship Diagram (ARD) analyses were used to determine the optimal position of workstations and organize material flow[28]. The proposed layout from this analysis can be seen in Figure 7.

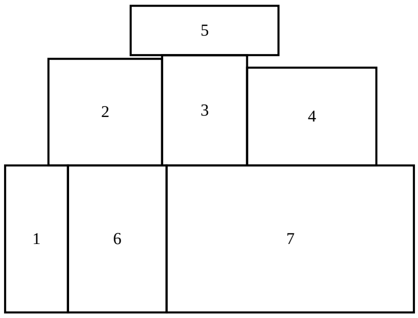

Figure 7 Layout Proposal Using Graphic Methods

Figure 7 presents the proposed layout for the Medang Kampai Goat Leather Kompang SME, which was designed using the Graphical method. This layout was determined based on the proximity weight between work stations that had been analyzed. The layout includes the following areas: Raw Material Storage, Wood Ring Formation Area, Leather Drying Area, Leather Sanding Area, Leather Pressing to Ring Area, Storage Area, and Parking Area.

Both approaches, Systematic Layout Planning (SLP) and the Graphical method, produce different proposed layouts. The analysis for the SLP proposed layout, including the calculation of its coordinate points, can be seen in Figure 8.

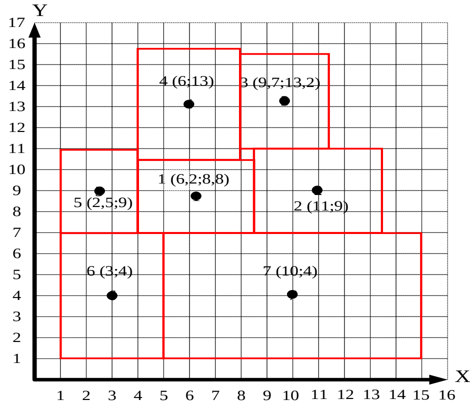

Figure 8 Layout Coordinate Points SLP Method

Figure 8 shows the coordinate points of the workstation layout block for the proposal created using the SLP method. These coordinate details are presented in Table 9.

Table 9 SLP Method Work Station Coordinate Point

No	Workstation Name	Coordinates X	Coordinates Y
1	Raw Material Storage	6,2	8,8
2	Wood Ring Formation Area	11	9
3	Leather Drying Area	9,7	13,2
4	Sanding Area	6	13
5	Leather Pressing to Ring Area	2,5	9
6	Storage Area	3	4
7	Parking Area	10	4

Table 9 contains the coordinate points of the work stations for the proposed SLP method layout at the Medang Kampai Goat Leather Kompang IKM. Based on these coordinates, the rectilinear distance between work stations can be calculated using Formula 2.1. The detailed calculations are presented in Appendix 3, and the results of the analysis using the From To Chart (FTC) can be seen in Table 10.

Table 10 FTC SLP Method

Station	1	2	3	4	5	6	7	Total
1		5	7,9	4,4	3,9	8	8,6	37,8
2			5,5	9	8,5	13	6	42
3				3,9	11,4	15,9	9,5	40,7
4					7,5	12	13	32,5
5						5,5	12,5	18
6							7	7
7								0
Total								**178**

Table 10 shows the values based on rectilinear distance calculations for the proposed layout using the SLP method. The Total From To Chart (FTC) for this method is 178. Next, the analysis of the proposed layout using the Graph method was carried out by calculating the coordinate points, which can be seen in Figure 9.

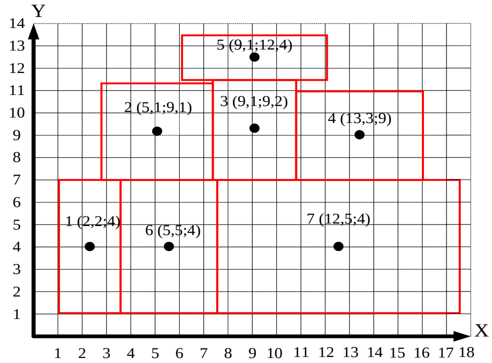

Figure 9 Layout Coordinate Points Graphic Method

Table 11 Graphical Method Work Station Coordinate Points

No	Workstation Name	Coordinates	
		X	Y
1	Raw Material Storage	2,2	4
2	Wood Ring Formation Area	5,1	9,1
3	Leather Drying Area	9,1	9,2
4	Sanding Area	13,3	9
5	Leather Pressing to Ring Area	9,1	12,4
6	Storage Area	5,5	4
7	Parking Area	12,5	4

Based on Table 11, the coordinate points of the work stations for the proposed layout of the Graphical Method at the Medang Kampai Goat Leather Kompang IKM have been determined. Using these coordinates, the rectilinear distance between work stations is calculated using Formula 2.1. The complete calculation is provided in Appendix 4, and the results of the From to Chart (FTC) analysis can be seen in Table 12.

Table 12 FTC Graph Method

Station	1	2	3	4	5	6	7	Total
1		8	12,1	16,1	15,3	3,3	10,3	65,1
2			4,1	8,3	7,3	5,5	12,5	37,7
3				4,4	3,2	8,8	8,6	25
4					7,6	12,8	5,8	26,2
5						12	11,8	23,8
6							7	7
7								0
Total								184,8

Table 12 shows the values of the rectilinear distance calculations for the proposed layout using the Graph method. The Total From To Chart (FTC) for this method is 184.8. Furthermore, a comparison of the distances between work stations in the initial layout and the proposed layout can be seen in Table 13.

Table 13 Perbandingan Jarak Perpindahan Antar Layout

No	Station	Initial Layout	SLP	Graph
1	Raw Material Storage	70,5	37,8	65,1
2	Wood Ring Formation Area	47,5	42	37,7
3	Leather Drying Area	43	40,7	25
4	Sanding Area	31,4	32,5	26,2
5	Leather Pressing to Ring Area	14,4	18	23,8
6	Storage Area	8	7	7
7	Parking Area	0	0	0
	Total	**214,8**	**178**	**184,8**

Table 13 presents a comparison of the distances between work stations in the initial layout and the proposed layout. The transfer distance in the initial layout is known to be 214.8.

Based on this comparison, the proposed layout from the Systematic Layout Planning (SLP) method has the smallest transfer distance, which is 178. This figure is smaller than that of the Graph method, which yields a distance of 184.8. Therefore, the proposed layout selected for the IKM Kompang Kulit Kambing Medang Kampai is the one generated by the SLP method, as it effectively minimizes material movement distances.

Comparative Analysis of Layout

This analysis compares the initial layout with two proposed improvements: Systematic Layout Planning (SLP) And Graphical Method. The main criterion for comparison is the total distance moved (*Material Handling Distance*) which is calculated using the rectilinear method through *From-To Chart* (FTC).

Table 14, which contains a comparison of displacement distances, shows that the total initial distance is 214.8 meters.

The proposed SLP layout resulted in the smallest total displacement distance of 178 meters 101010, achieving a reduction of 17.13% compared to the initial layout (214.8 meters)11. Therefore, the proposed SLP was selected as the optimal design12

Table 14. Comparative Analysis of Layout

No	Information	Initial Layout (m)	SLP Proposal (m)	Graphic Proposal (m)	Reduction vs Initial (m)	% Reduction	Advantages/Limitations
1	Total Displacement Distance	214,8	178,0	184,8	36,8	17,13%	Minimize total material distance.
2	Required Area	161,75	167,73	167,73	n/a	n/a	Ensure all areas have work space and clearance which is sufficient.
3	Advantages of the Method	Limitations (Inefficient flow)	Integrating qualitative + quantitative, resulting in optimal distance.	Pure focus on quantitative distance, less flexibility on functional relationships.	n/a	n/a	More systematic in planning.

Explanation of the Advantages of SLP (Qualitative and Quantitative Integration)

The proposed SLP layout (178 m) outperforms the Graphical Method (184.8 m) because SLP uses a holistic planning approach that systematically considers qualitative and quantitative factors.

1. Qualitative (Functional) Proximity: SLP uses the Activity *Relationship Chart* (ARC) And *Activity Relationship Diagram* (HIGH)to determine how important it is for a station to be close together (e.g.,

relationship 'A' =*Absolutely Necessary*). This need for closeness is based on process flow and material flow.

2. Quantitative Proximity (Distance): These qualitative factors are then combined with quantitative data in the form of displacement distance (FTC).

Graphical Methods, on the other hand, tend to prioritize placement based solely greatest distance weight from the FTC. While a pure focus on distance can reduce the distance between high-frequency stations, this method may fail to accommodate the need for strong functional relationships driven by process sequences. This integration (qualitative and quantitative) in SLP ensures that the resulting design not only minimizes distance but also streamlines the process flow logically, resulting in a more optimal total displacement distance (178 m) compared to the Graphical Method.

Relationship with Facility Planning Theory

The finding that the total distance reduction reached 17.13% is very relevant to the basic principles of industrial engineering:

a. Material Handling Cost Theory (*Material Handling Cost Theory*): The primary objective of the layout design is to minimize material handling costs, which are a function of the moving distance and frequency of moving. By reducing the total moving distance from 214.8 m to 178 m, UKM GoatLeather Kompang fundamentally achieves minimization (distance), which directly reduces operational costs.
b. Richard Muther Framework (SLP): This study confirms the effectiveness of the SLP framework because it systematically considers activity relationship (R) before allocating space (S). By placing high-interaction departments in proximity (as defined by ARC/ARD), SLP effectively cuts transfer costs and transportation times.

Insights and Practical Implications

Implementation of the proposed SLP layout provides significant practical benefits:

a. Increased Flow and Reduced Waste: The flow of material will become more linear and orderly, eliminating unnecessary movements (*backtracking*), which is a form of waste (waste) in the production system. This is speeds up the production process and increases productivity.
b. Time and Labor Efficiency: Reducing the total distance moved by 36.8 meters means the time workers spend moving materials is reduced. This allows the workforce to focus more on value-added activities and improves human resource utilization.
c. Accident Risk Reduction: An organized layout, where activities with strong relationships are placed close together, minimizes the potential for cross-traffic and risky activity overlap. This will reduce the risk of work accidents in the production area.

Conclusion

This study aims to redesign the layout of facilities at the Medang Kampai Goat Leather IKM through a comparison of two methods, namely Systemic Layout Planning (SLP) and the Graph Method. Based on the research that has been carried out, the proposed layout that was selected was the one that successfully minimized the distance of material transfer between work stations. The results of the From to Chart (FTC) calculation show that the proposal using the SLP method achieved the smallest transfer distance, namely 178, which is lower than the proposal using the Graph method with a transfer distance of 184.8. In addition, the production area required for this proposed layout is 167.73 m2. Unlike previous studies, this study focuses on comparing the SLP method and the Graph method implemented at the Kompang Kulit Kambing Medang Kampai IKM. In practical terms, it is hoped that the application of an optimized layout will improve the efficiency and effectiveness of IKM operations. In turn, this will support competitiveness and the preservation of cultural heritage during the sustainable production process.

References

[1] R. Novison, Amnur Akhyan, And Agus Wijianto, “Rancang Bangun Dan Alat Bantu Pengepres Kulit Untuk Alat Musik Khas Riau (Kompang),” *J. Elektro Dan Mesin Terap.*, Vol. 9, No. 2, Pp.

170–180, 2023, Doi: 10.35143/Elementer.V9i2.5929.

[2] J. Hirvonen And M. Majuri, "Digital Capabilities In Manufacturing Smes," *Procedia Manuf.*, Vol. 51, No. 2019, Pp. 1283–1289, 2020, Doi: 10.1016/J.Promfg.2020.10.179.

[3] 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)," *Performa Media Ilm. Tek. Ind.*, Vol. 19, No. 2, Pp. 151–158, 2020, Doi: 10.20961/Performa.19.2.43467.

[4] M. Y. Erdiansyah And J. A. Szs, "Redesign Of Production Floor Layout Using Systematic Layout Planning (Slp) Method."

[5] A. T. Haryanto, M. Hisjam, And W. K. Yew, "Redesign Of Facilities Layout Using Systematic Layout Planning (Slp) On Manufacturing Company: A Case Study," *Iop Conf. Ser. Mater. Sci. Eng.*, Vol. 1096, No. 1, P. 012026, 2021, Doi: 10.1088/1757-899x/1096/1/012026.

[6] F. Jarrin, Y. Koga, D. Thomas, And H. Kawasaki, "Virtual Reality-Based Site Layout Planning For Building Design," *Autom. Constr.*, Vol. 167, No. September 2023, P. 105690, 2024, Doi: 10.1016/J.Autcon.2024.105690.

[7] M. M. Abdurrahman, R. Kastaman, And T. Pudjianto, "Rancang Ulang Tata Letak Fasilitas Produksi Untuk Efisiensi Produksi Kopi Di Pt Sinar Mayang Lestari Menggunakan Metode Systematic Layout Planning Dan Software Blocplan," *Agrikultura*, Vol. 32, No. 2, P. 146, 2021, Doi: 10.24198/Agrikultura.V32i2.33610.

[8] M. J. D. Firmansyah And E. P. Putri, "Relayout Of Production Layout To Reduce Material Handling Costs," *J. La Multiapp*, Vol. 6, No. 1, Pp. 34–49, 2025, Doi: 10.37899/Journallamultiapp.V6i1.1818.

[9] 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. Number 1, Pp. 57–68, 2021, Doi: 10.32890/Jtom2021.16.1.5.

[10] L. Gozali, L. Widodo, S. R. Nasution, And N. Lim, "Planning The New Factory Layout Of Pt Hartekprima Listrindo Using Systematic Layout Planning (Slp) Method," *Iop Conf. Ser. Mater. Sci. Eng.*, Vol. 847, No. 1, 2020, Doi: 10.1088/1757-899x/847/1/012001.

[11] 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.

[12] F. Azima, Z. Arifin, And V. M. Afma, "Perancangan Ulang Tata Letak Pabrik Menggunakan Metode Systematic Layout Planning Guna Meningkatkan Output Produksi Pada Pt. Wahana Tirta Milenia Batam," *Profisiensi J. Progr. Stud. Tek. Ind.*, Vol. 8, No. 1, Pp. 23–35, 2020, Doi: 10.33373/Profis.V8i1.2563.

[13] F. Laoh, I. H. Lahay, And J. Darusalam, "Perancangan Ulang (Re-Layout) Tata Letak Fasilitas Menggunakan Metode Systematic Layout Planning (Slp) Dan Algoritma Blocplan," *Jutin J. Tek. Ind. Terintegrasi*, Vol. 8, No. 1, Pp. 1049–1059, 2024.

[14] 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.

[15] E. Badharinath, V. D. Reddy, P. S. Kumar, And A. K. Damodaram, "Optimization Of Manufacturing Plant Layout Using Systematic Layout Planning (Slp) Method," *Matec Web Conf.*, Vol. 393, P. 01005, 2024, Doi: 10.1051/Matecconf/202439301005.

[16] H. W. Ramadhan And R. I. Tekmapro, "Analisis Perancangan Ulang Tata Letak Fasilitas Lantai Produksi Menggunakan Metode Slp (Systematic Layout Planning) Di Pt. Rajawali Sumber Rejeki Mojokerto," *Tekmapro*, Vol. 19, No. 2, Pp. 181–193, 2024, Doi: 10.33005/Tekmapro.V19i2.420.

[17] D. Ramadhan, L. Widodo, L. Gozali, W. Sukania, F. J. Daywin, And C. O. Doaly, "Redesigning The Facility Layout With Systematic Layout Planning Method And Lean Manufacturing Approach On The Production Floor At Pt. Baruna Trayindo Jaya."

[18] Anna Gustika Efendi, Muhammad Ihsan Hamdy, Fitriani Surayya Lubis, Muhammad Isnaini Hadiyul Umam, And Nazaruddin, "Perancangan_Tata_Letak_Fasilitas_Pabrik_Coco_Fiber," Vol. 5, Pp. 302–312, 2023.

[19] N. Candau, O. Oguz, N. León Albiter, G. Förster, And M. L. Maspoch, "Poly (Lactic Acid)/Ground Tire Rubber Blends Using Peroxide Vulcanization," *Polymers (Basel).*, Vol. 13, No. 9, Pp. 1–20, 2021, Doi: 10.3390/Polym13091496.

[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. 0240309-01-0240309–08, 2024, Doi: 10.26877/Asset.V6i3.628.

[21] T. Su, Y. Ma, B. Wang, X. Luan, H. Li, And X. Zhang, "Numerical Simulation Of Airflow Organization In Vulcanization Tanks For Waste Tires," *Polymers (Basel).*, Vol. 17, No. 2, 2025, Doi: 10.3390/Polym17020232.

[22] Y. Fitriani, S. Utami, And B. Junadi, "Perancangan Sistem Informasi Human Capital Management Berbasis Website," *J. Inf. Syst. Applied, Manag. Account. Res.*, Vol. 6, No. 4, Pp. 792–803, 2022, Doi: 10.52362/Jisamar.V6i4.919.

[23] A. N. Fitrian And D. Lestari, "Facility Layout Design Of Bag And Apparel Factory With Systematic Layout Planning And Computerized Relative Allocation Of Facilities Technique Method," *Opsi*, Vol. 17, No. 1, P. 146, 2024, Doi: 10.31315/Opsi.V17i1.11343.

[24] J. Adib, A. M. Subagyo, And R. P. Sari, "Perancangan Ulang Tata Letak Pabrik Industri Olahan Rotan Pt Xyz Di Kabupaten Cirebon Menggunakan Metode Systematic Layout Planning," *J. Serambi Eng.*, Vol. 8, No. 3, 2023, Doi: 10.32672/Jse.V8i3.6181.

[25] I. Prakoso, A. Y. Pratama, And M. Krisnawati, "Perancangan Tata Letak Fasilitas Dengan Metode Systematic Layout Planning (Slp) Pada Ikm Knalpot K4771ne Purbalingga," *Din. Rekayasa*, Vol. 18, No. 2, Pp. 193–199, 2022, [Online]. Available: Https://Dinarek.Unsoed.Ac.Id/Jurnal/Index.Php/Dinarek/Article/View/491

[26] M. A. Saputra, D. Rachmawaty, And H. Q. Karima, "Matrik Jurnal Manajemen Dan Teknik Industri-Produksi Perancangan Tata Letak Fasilitas Pada Umkm Sepatu ' Prohana ' Menggunakan Systematic Layout Planning," *J. Manaj. Tek. Ind. – Produksi*, Vol. 23, No. 1, 2022, Doi: 10.350587/Matrik.

[27] S. Pramija And M. Meipen, "Redesign Of Facility Layout At Pelangi Advertising Printing Using The Slp Method," *J. Ocean. Mech. Aerosp. -Science Eng.*, Vol. 65, No. 2, Pp. 77–81, 2021, Doi: 10.36842/Jomase.V65i2.252.

[28] F. L. Camerawati *Et Al.*, "Perancangan Ulang Tata Letak Fasilitas Gudang Bahan Baku Dengan Metode Systematic Layout Planning (Slp) Di Pt. Inka Multi Solusi," 2021.