Technema: Journal of Intelligent Engineering and Computing
Vol 1 No 2 June 2026, Hal 204-219
ISSN: 3163-6020 (Print) ISSN: 3163-5997 (Electronic)
Open Access: https://sovereignresearch.org/technema

Redesigning the Facility Layout Using the Systematic Layout Planning (SLP) and Blocplan Methods to Minimize Material Transport Distances and Material Handling Costs at CV. Sidomulyo Perkasa

Ariq Maulana[1*], Andre Sugiyono[2]
[1-2] Universitas Islam Sultan Agung Semarang, Indonesia
email: 31602200029@std.unissula.ac.id[1]

Article Info :
Received:
12-06-2026
Revised:
21-06-2026
Accepted:
27-06-2026

Abstract

CV. Sidomulyo Perkasa is a company engaged in cotton production that faces production efficiency problems due to an ineffective facility layout arrangement. The existing production floor layout does not follow the production process flow, resulting in inefficient material movement, excessive transportation distances, and increased material handling costs. Several departments with close operational relationships are located far apart, causing potential bottlenecks and longer production cycles. This study aims to redesign the production facility layout to minimize material transportation distance and material handling costs using the Systematic Layout Planning (SLP) and Blocplan methods. This empirical study involved direct observation, interviews, material flow analysis, distance calculation, and evaluation of alternative layouts based on transportation distance and Material Handling Cost (OMH). The results indicate that the proposed SLP layout provides the best performance compared with the existing layout and Blocplan alternatives. The material transportation distance was reduced from 139.5 meters to 71.5 meters, representing a 48.74% improvement, while OMH decreased from Rp74,999.92 to Rp39,455.31, resulting in cost savings of Rp35,544.61 or 47.39% efficiency. The proposed layout provides a more effective material flow arrangement and can be recommended as an alternative solution for improving production efficiency at CV. Sidomulyo Perkasa.

Keywords: *Blocplan, Facility Layout, Material Flow, Material Handling Cost, Systematic Layout Planning (SLP).*

INTRODUCTION

In the contemporary manufacturing industry, facility layout design has become a strategic factor that determines operational efficiency, production flexibility, and the competitiveness of industrial systems amid increasing market demands and the need for resource optimization. Facility layout refers to the systematic arrangement of production facilities, machines, workers, storage areas, and supporting equipment to achieve an effective relationship among production elements while minimizing unnecessary movement and operational losses. Inefficient facility arrangements may create excessive material transportation distances, irregular workflow patterns, increased handling activities, and higher operational costs, which ultimately reduce overall productivity performance. Previous studies have emphasized that redesigning facility layouts through structured approaches such as Systematic Layout Planning (SLP) can improve production flow by optimizing relationships among workstations and reducing non-value-added activities within manufacturing processes (Adiasa et al., 2020). The increasing complexity of manufacturing activities has encouraged researchers and practitioners to adopt analytical-based layout design methods that integrate qualitative and quantitative considerations to achieve more efficient production systems (Singla, 2025). Facility layout improvement is no longer limited to physical rearrangement but has developed into an engineering decision-making process involving material flow analysis, relationship evaluation, and computational optimization.

The effectiveness of a production system is highly influenced by the capability of a facility layout to support smooth material movement from raw materials to finished products. Research conducted in various manufacturing sectors has demonstrated that inappropriate placement of departments and machines often causes backtracking patterns, longer transportation routes, and increased material handling expenditures. Nugeroho (2021) reported that an unstructured production floor layout generated irregular material flow and backtracking activities, while the proposed SLP approach successfully reduced material handling distance and cost. Similar findings were presented by Kholifah and Suhartini (2021), who showed that systematic layout improvement could minimize excessive material movement and provide a more efficient production arrangement. These findings indicate that layout redesign is not merely a spatial modification process but a critical intervention for improving operational performance through the optimization of material flow. However, differences in production characteristics, facility constraints, and decision-making approaches require continuous evaluation of appropriate layout design methods for specific industrial environments.

Previous studies have applied various combinations of SLP, Activity Relationship Chart (ARC), and Blocplan algorithms to overcome facility arrangement problems in different manufacturing contexts. Muharni et al. (2022) demonstrated that the integration of ARC and Blocplan could provide an improved warehouse layout by determining activity relationships and reducing unnecessary material movement. The application of Blocplan has also shown effectiveness in generating alternative layouts based on quantitative and qualitative relationship data, particularly in industries experiencing inefficient workstation positioning (Faiz, 2021). Several studies have compared SLP and Blocplan approaches, revealing that both methods are capable of producing improved layouts, although their effectiveness depends on the characteristics of the production system and evaluation criteria used (Efendi et al., 2023). Saffanah et al. (2023) found that combining SLP and Blocplan could address cross movement problems and optimize production floor arrangements by considering material flow relationships. Despite these developments, many previous studies have focused on large-scale manufacturing industries, while optimization problems in small and medium manufacturing enterprises remain less explored, particularly those involving traditional production processes with limited facility space.

CV. Sidomulyo Perkasa, located in Tlogoayu Village, Gabus District, Pati Regency, is a manufacturing company engaged in kapok production, where kapok serves as an essential raw material for pillows, mattresses, and similar products. The increasing market demand for kapok-based products requires the company to maintain an efficient production process, particularly in managing material movement and workstation arrangements. The current production facility layout shows several operational limitations, including irregular facility placement, ineffective production flow, and excessive movement between interconnected departments. These conditions cause operators to travel longer distances, increase non-value-added activities, and potentially reduce production efficiency. Similar facility layout problems have been identified in other manufacturing companies, where improper workstation positioning resulted in increased transportation distances and higher material handling costs (Andriyanto & Cahyana, 2024). Previous research also confirmed that facility redesign using SLP and Blocplan methods could significantly reduce material movement distance and improve production efficiency in manufacturing environments (Febriyanto & Setiafindari, 2025). The existing condition at CV. Sidomulyo Perkasa indicates the necessity of a systematic evaluation to identify the most suitable alternative layout that can support smoother production activities.

Although numerous studies have investigated facility layout optimization, several limitations remain regarding the implementation of integrated approaches for small-scale manufacturing enterprises with specific production characteristics. Existing studies generally evaluate layout performance based on distance reduction and cost efficiency, but limited attention has been given to the relationship between production flow constraints, facility limitations, and practical implementation requirements within small manufacturing companies. Some studies have applied SLP or Blocplan individually, while the combined utilization of both methods as complementary approaches still requires further investigation to achieve more reliable layout alternatives (Henni et al., 2024). Research by Bukhori et al. (2024) showed that Blocplan could significantly reduce material handling distance, yet the selection of an optimal layout requires consideration of activity relationships and production requirements. The gap indicates that an integrated evaluation framework combining SLP analysis and Blocplan optimization is needed to generate a facility layout design that is not only mathematically efficient but also applicable to actual industrial conditions. Addressing this gap is important because inefficient layouts in small manufacturing enterprises may continuously increase production costs and limit operational competitiveness.

This study is positioned within the field of industrial engineering and intelligent manufacturing systems by proposing a systematic facility redesign approach that integrates Systematic Layout

Planning (SLP) and Blocplan methods to improve production efficiency at CV. Sidomulyo Perkasa. The research aims to analyze the existing facility layout, identify problems related to material transportation distance and material handling costs, and develop an alternative layout that provides better operational performance. The contribution of this study lies in providing an empirical framework for applying combined SLP and Blocplan approaches in a kapok manufacturing environment, where facility limitations and manual material movement remain significant challenges. Methodologically, this research contributes by integrating qualitative relationship analysis through SLP with computational layout optimization through Blocplan to obtain a more comprehensive redesign process. Practically, the proposed layout is expected to support reduced material movement, lower handling costs, improve workflow continuity, and provide a reference for similar manufacturing enterprises seeking efficiency improvements through facility layout optimization.

RESEARCH METHODS

This research is categorized as an empirical study because it involves direct observation, primary data collection, and the application of facility layout redesign methods in an actual manufacturing environment at CV. Sidomulyo Perkasa, located in Tlogoayu Village, Gabus District, Pati Regency. The research was conducted on the kapok production facility with the main objective of redesigning the production layout to minimize material transportation distance and material handling costs through the integration of Systematic Layout Planning (SLP) and Blocplan methods. The research stages consisted of field observation, literature study, problem identification, data collection, data processing, layout redesign, and evaluation of the proposed layout performance. Primary data were collected through direct observation and interviews with company owners and production operators, including production process sequences, facility dimensions, workstation locations, material flow patterns, and frequency of material movement, while secondary data were obtained from scientific literature and previous studies related to facility layout optimization. Facility layout redesign requires a systematic evaluation of material flow, activity relationships, and spatial requirements to achieve an efficient production system (Adiasa et al., 2020). The initial layout condition was analyzed to identify inefficient material movement patterns, excessive transportation distances, and unnecessary handling activities. The redesign process was carried out by developing an Activity Relationship Chart (ARC), Activity Relationship Diagram (ARD), alternative layouts using Systematic Layout Planning, and optimization using the Blocplan algorithm to determine the most appropriate facility arrangement (Efendi et al., 2023).

The performance evaluation procedure was conducted by comparing the existing layout and the proposed layouts based on material transportation distance, material handling cost, and efficiency improvement percentage. The material flow analysis was performed by identifying the movement sequence of raw materials, semi-finished products, and finished products between workstations. Distance calculations were performed using the Rectilinear Distance method because the material movement pattern within the production facility follows horizontal and vertical pathways. The total material transportation distance was determined by considering both the distance between facilities and the frequency of movement between related workstations. Material handling cost analysis was performed by calculating operator-related transportation costs and comparing the total costs generated by the initial and proposed layouts. The Blocplan method was implemented by inputting department information, facility areas, and activity relationship values obtained from ARC to generate alternative layout configurations based on layout performance scores. Previous studies have shown that the combination of SLP and Blocplan can improve facility efficiency by reducing material movement distance and optimizing workstation relationships (Andriyanto & Cahyana, 2024). The validation process was conducted through comparative analysis between the initial layout and the selected alternative layout using performance indicators including total material transportation distance, total material handling cost, and percentage of improvement achieved.

Material Transportation Distance Calculation

The distance between facilities was calculated using the Rectilinear Distance method, which measures movement distance based on horizontal and vertical pathways.

$$d_{ij} = | X_i - X_j | + | Y_i - Y_j |$$

Keterangan:
d_{ij} : jarak perpindahan antara fasilitas $i$dan fasilitas j
X_i : koordinat $x$pada pusat fasilitas i
X_j : koordinat $x$pada pusat fasilitas j
Y_i : koordinat $y$pada pusat fasilitas i
Y_j : koordinat $y$pada pusat fasilitas j

Perhitungan Total Material Transportation Distance
Total jarak perpindahan material dihitung dengan mempertimbangkan frekuensi perpindahan antar fasilitas.

$$D_{total} = \sum d_{ij} \times F_{ij}$$

Keterangan:
D_{total} : total jarak perpindahan material
d_{ij} : jarak perpindahan antara fasilitas $i$dan fasilitas j
F_{ij} : frekuensi perpindahan material antara fasilitas $i$dan fasilitas j

Perhitungan Ongkos Material Handling (OMH)
Nilai OMH digunakan untuk mengetahui biaya perpindahan material berdasarkan biaya tenaga kerja dan waktu kerja operator.

$$OMH = \frac{\text{Upah Operator}}{\text{Waktu Kerja Operator}}$$

Keterangan:
OMH : ongkos material handling
Upah Operator : biaya tenaga kerja yang digunakan dalam aktivitas material handling
Waktu Kerja Operator : waktu efektif operator dalam melakukan pekerjaan

Perhitungan Total Ongkos Material Handling
Setelah nilai OMH per satuan perpindahan diperoleh, total ongkos material handling dihitung berdasarkan total jarak perpindahan material.

$$Total\ OMH = OMH/meter \times D_{total}$$

Keterangan:
Total OMH : total biaya material handling
OMH/meter : biaya perpindahan material setiap meter
D_{total} : total jarak perpindahan material

Perhitungan Efisiensi Layout
Efisiensi layout digunakan untuk mengetahui persentase peningkatan kinerja antara layout awal dan layout usulan.

$$Efficiency = \frac{Initial\ Value - Proposed\ Value}{Initial\ Value} \times 100\%$$

Keterangan:
Efficiency : persentase peningkatan efisiensi layout
Initial Value : nilai performa pada layout awal
Proposed Value : nilai performa pada layout usulan

RESULTS AND DISCUSSION

Data Collection and Identification of Initial Facility Layout Conditions

The initial identification of facility layout conditions was conducted through primary data collection obtained from direct observations of kapok production activities at CV. Sidomulyo Perkasa, interviews with the company owner and production operators, and measurements of facility dimensions in each production area. The collected data consisted of facility areas, number of machines, production process sequences, and material movement relationships between production departments. This data collection approach was required because facility layout redesign must consider actual production characteristics, material flow patterns, and spatial requirements to ensure that the proposed layout is aligned with operational conditions (Adiasa et al., 2020). The observation results indicated that the current production facility arrangement had not fully implemented a systematic material flow pattern, resulting in relatively long material transportation distances. Such conditions potentially increase material handling activities and contribute to higher transportation costs during the production process.

The facility area and number of machines obtained from field measurements are presented in Table 1. Based on the table, CV. Sidomulyo Perkasa has a total production area of 433 m² consisting of six main departments, namely raw material storage, drying area, kapok separation area, semi-finished product storage, packing and finishing area, and finished product storage. The differences in department sizes indicate that each production area has different spatial requirements depending on its operational function. The finished product storage area has the largest space requirement of 250 m² because it functions as a temporary storage area before distribution, while the packing and finishing area has the smallest area of 1 m² due to its limited finishing activities. Determining appropriate facility requirements is an essential aspect of facility layout design because inappropriate space allocation may disrupt production flow and material movement efficiency (Sugiyono, 2018).

Table 1. Department Area and Number of Machines

No	Department Name	Length (m)	Width (m)	Department Area (m²)	Number of Machines
1	Raw Material Storage	10	4	40	-
2	Drying Area	10	10	100	-
3	Kapok Separation	1	2	2	1
4	Semi-Finished Product Storage	20	2	40	-
5	Packing and Finishing	1	1	1	1
6	Finished Product Storage	50	5	250	-
	Total			**433**	

The material movement flow in the kapok production process was analyzed based on the sequence of activities from raw material receiving to finished product storage. The observation results showed that the production process begins from raw material storage, followed by the drying process, kapok separation, semi-finished product storage, packing and finishing, and finally finished product storage. This flow pattern was used as the basis for evaluating the effectiveness of facility relationships because departments with high movement frequency require closer positioning to reduce unnecessary transportation activities. Activity relationship analysis is an important component of the Systematic Layout Planning (SLP) method because it determines the required proximity between departments based on material flow and operational relationships (Aristriyana & Salim, 2023).

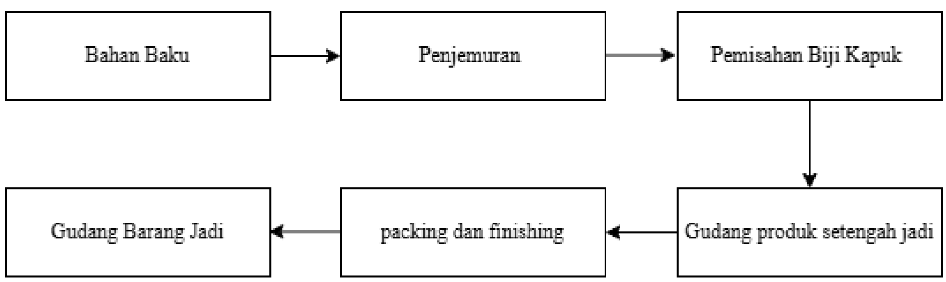

Figure 1. Kapok Production Process Flow

Evaluation of the existing layout condition revealed that several production facilities were not optimally positioned according to the production sequence. As illustrated in Figure 2, the initial layout showed relatively long transportation routes between several departments, particularly the movement from the packing and finishing area to the finished product storage area. This condition caused materials to travel through longer paths, increasing labor requirements and material handling costs. Previous studies have indicated that facility layouts that do not consider material flow characteristics may lead to inefficient transportation activities, ineffective space utilization, and reduced production system performance (Bisri & Cahyana, 2022). Therefore, the initial layout condition was used as a reference point for evaluating the effectiveness of the proposed layouts generated through SLP and Blocplan methods.

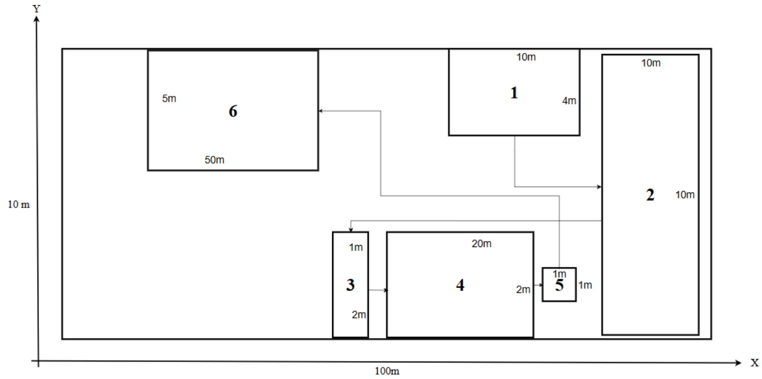

Figure 2. Initial Company Layout

Material transportation distance in the existing layout was calculated using the Rectilinear Distance method by considering the coordinates between production facilities. This method was selected because internal material movement within the production facility mainly follows horizontal and vertical pathways, making it appropriate for representing actual transportation routes. The calculation results showed that the total material transportation distance in the initial layout reached 139.5 meters per production cycle. This value indicates that the existing facility configuration still has improvement opportunities because transportation distance is one of the main factors affecting material handling costs. Coordinate-based distance measurement has been widely applied in facility redesign studies because it provides quantitative evaluation of layout performance before and after improvement (Efendi et al., 2023).

Table 2. Material Transportation Distance of the Initial Layout

No	Process	Distance (m)
1	Raw Material Storage–Drying Area	21
2	Drying Area–Kapok Separation	37.5
3	Kapok Separation–Semi-Finished Product Storage	10.5
4	Semi-Finished Product Storage–Packing and Finishing	11.5
5	Packing and Finishing–Finished Product Storage	59
	Total	**139.5**

Based on the initial identification results, the main problem at CV. Sidomulyo Perkasa was not only related to material transportation distance but also the arrangement of facilities that had not been designed according to production activity relationships. The longest transportation distance occurred between the packing and finishing area and finished product storage, reaching 59 meters, indicating that this relationship required improvement during the redesign process. This condition demonstrates that the existing facility arrangement had not fully supported the principle of minimizing material movement, which is one of the main objectives of facility layout planning. The integration of SLP and Blocplan methods was subsequently applied to develop alternative layouts capable of improving departmental relationships and reducing material handling costs through quantitative evaluation of layout performance (Andriyanto & Cahyana, 2024).

Initial Material Handling Cost Analysis and Activity Relationship Development

The evaluation of the initial facility performance was continued by analyzing the material handling cost generated from the existing production layout. The calculation was performed by considering the total transportation distance, movement frequency between departments, and material handling cost per meter. The material handling cost analysis is important because transportation activities that occur repeatedly during production can significantly influence operational efficiency and production expenses. The initial layout evaluation showed that inefficient facility positioning caused excessive material movement, particularly between departments with high production interaction frequencies. Previous research emphasized that minimizing material handling distance and cost is a primary objective in facility layout redesign because transportation activities do not directly increase product value but contribute significantly to production costs (Afdhilah & Rusindiyanto, 2026).

The material handling cost calculation for the existing layout is presented in Table 3. Based on the calculation results, the total material transportation distance reached 3,663 meters considering the frequency of movement between departments, with a material handling cost per meter of Rp20.475. The highest material handling cost occurred in the movement from the packing and finishing area to the finished product storage area, reaching Rp36,240.75, due to the relatively long transportation distance combined with frequent movement activities. This condition indicates that the location relationship between these two departments requires improvement because departments with high movement intensity should be positioned closer to minimize unnecessary transportation costs. The application of SLP and Blocplan approaches has been reported to effectively improve facility relationships by reorganizing department positions based on activity requirements and material flow characteristics (Andriyanto & Cahyana, 2024).

Table 3. Material Handling Cost of the Initial Layout

No	From	To	Distance (m)	Frequency	Total Distance	OMH/meter (Rp)	Total OMH (Rp)
1	Raw Material Storage	Drying Area	21	30	630	20.475	12,899.25
2	Drying Area	Kapok Separation	37.5	15	562.5	20.475	11,517.18
3	Kapok Separation	Semi-Finished Product Storage	10.5	1	10.5	20.475	214.99
4	Semi-Finished Product Storage	Packing and Finishing	11.5	60	690	20.475	14,127.75
5	Packing and Finishing	Finished Product Storage	59	30	1,770	20.475	36,240.75
					3,663		**74,999.92**

The relationship between production departments was subsequently analyzed using the Activity Relationship Chart (ARC) to determine the degree of closeness required between facilities. The ARC development was based on production flow, frequency of material movement, and operational relationships among departments. The analysis identified that departments directly connected within the production sequence required stronger proximity relationships compared with departments having limited interaction. This approach supports the SLP framework, where facility arrangement decisions are determined not only by physical distance but also by qualitative relationships among activities (Adiasa et al., 2020). The ARC results were then translated into an Activity Relationship Diagram (ARD) to provide a visual representation of the preferred facility arrangement.

.

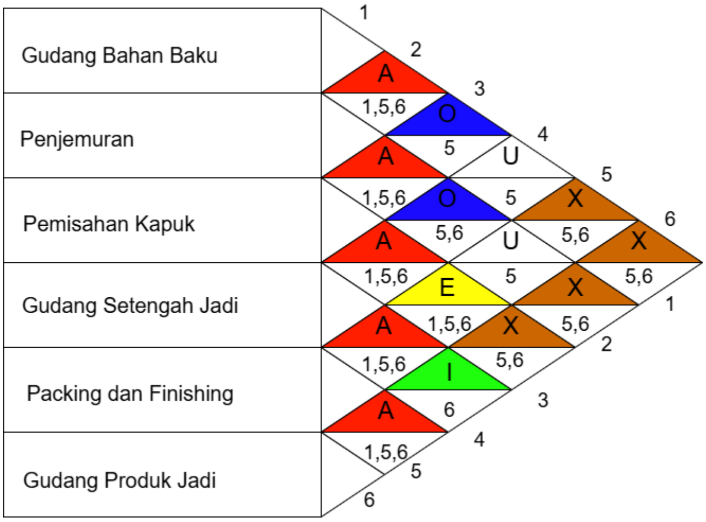

Figure 3. Activity Relationship Chart (ARC) of Production Facilities

The Activity Relationship Diagram (ARD) was developed to represent the recommended proximity pattern between departments before generating the proposed layout. The ARD provided a conceptual arrangement showing the preferred sequence of facility placement based on activity relationship values obtained from the ARC analysis. The diagram indicated that facilities with intensive material interactions should be positioned closer to reduce unnecessary movement and improve production continuity. The use of ARC and ARD as analytical tools in facility redesign studies has been widely applied because they provide a systematic approach for translating activity relationships into practical layout configurations (Muharni et al., 2022). Therefore, the ARD became the basis for developing alternative layouts using the Systematic Layout Planning method.

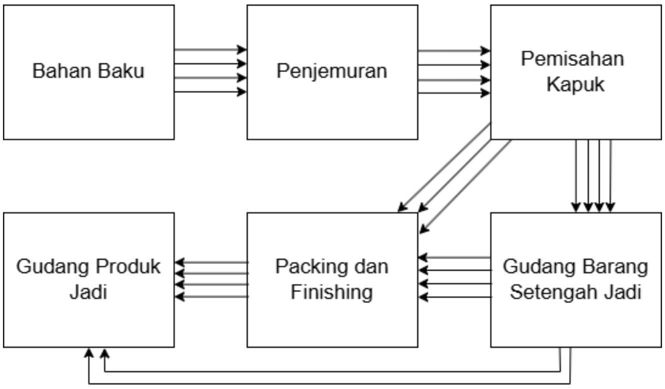

Figure 4. Activity Relationship Diagram (ARD) of Production Facilities

The proposed layout development using the Systematic Layout Planning method was conducted by integrating facility area requirements, material flow analysis, and activity relationship evaluation. The SLP approach generated a revised facility arrangement designed to shorten material movement paths while maintaining the operational requirements of each department. The resulting layout positioned facilities according to the production sequence, allowing smoother movement from raw material storage to finished product storage. The implementation of SLP in manufacturing environments has demonstrated its ability to reduce transportation distance and improve facility utilization through systematic arrangement of work areas (Haryanto et al., 2021). The proposed SLP layout was then evaluated through distance and material handling cost calculations to determine its performance improvement compared with the existing condition.

.

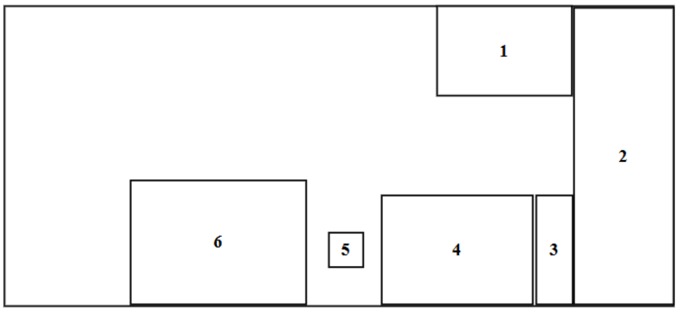

Figure 5. Proposed Layout Using Systematic Layout Planning (SLP) Method

The initial analysis confirmed that the existing layout condition at CV. Sidomulyo Perkasa generated relatively high transportation activities due to inappropriate facility positioning. The integration of ARC, ARD, and SLP provided a structured approach for redesigning the production layout based on quantitative and qualitative considerations. The results from this stage served as the foundation for comparison with alternative layouts generated using the Blocplan algorithm. Previous studies have demonstrated that combining SLP with computational layout optimization methods such as Blocplan can provide better alternatives by considering both activity relationships and layout efficiency indicators (Efendi et al., 2023). The following analysis evaluates the alternative layouts produced through Blocplan to determine the most effective facility configuration for reducing transportation distance and material handling costs.

Proposed Layout Generation Using the Blocplan Method

The Blocplan method was applied as an optimization approach to generate alternative facility layouts based on the activity relationship data obtained from the Activity Relationship Chart (ARC). Unlike the SLP approach, which emphasizes a systematic qualitative arrangement process, Blocplan uses computational analysis by considering facility area requirements, department relationships, and closeness ratings to produce alternative layout configurations. The implementation of Blocplan in this study was conducted by inputting the production department data of CV. Sidomulyo Perkasa, including department names, facility areas, and relationship values between departments. The algorithm generated several alternative layouts that were evaluated based on material movement efficiency and layout performance scores, as the selection of an appropriate facility arrangement requires consideration of both spatial relationships and operational effectiveness (Efendi et al., 2023). The generated alternatives were further analyzed by comparing their material transportation distances and material handling costs with the initial production layout.

The Blocplan calculation produced several layout alternatives, including Layout 3, Layout 8, and Layout 10, which were selected for further evaluation because they provided feasible arrangements according to the production process flow. The visualization of Layout 3 generated by the Blocplan algorithm is presented in Figure 7, showing the rearrangement of production facilities based on relationship priorities between departments. The arrangement attempts to reduce unnecessary movement between related workstations, particularly between raw material storage, drying area, kapok separation, semi-finished product storage, packing, and finished product storage. Facility relationship analysis is an important factor in determining an efficient layout because inappropriate placement of departments may increase transportation activities and operational costs (Andriyanto & Cahyana, 2024). The proposed arrangement from Blocplan provides an alternative configuration that can be compared with the SLP-based layout to determine the most efficient facility design.

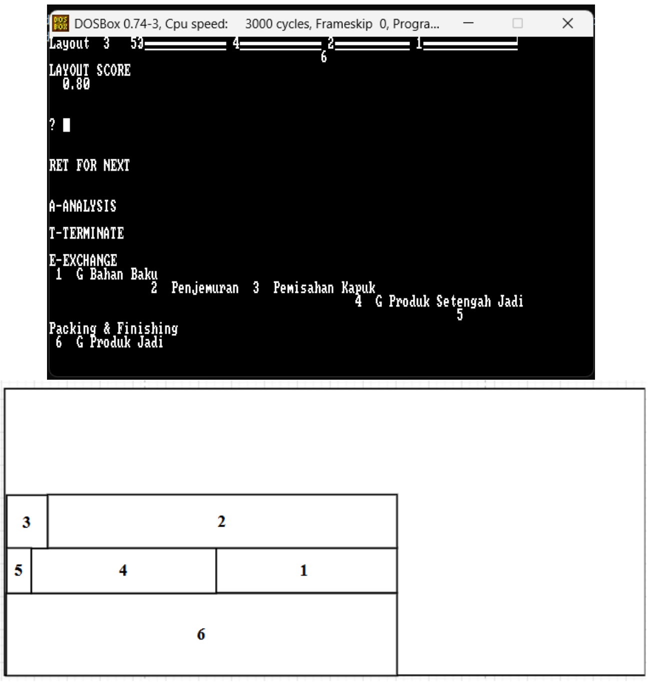

Figure 6. Blocplan Proposed Layout 3

The performance evaluation of the Blocplan alternatives was conducted by calculating the material transportation distance for each generated layout. Table 4 presents the distance calculation results for Blocplan Layout 3 based on the movement sequence between production departments and the frequency of material transfer activities. The calculation shows that Layout 3 resulted in a total material transportation distance of 119.77 meters, consisting of several movement paths from raw material storage to the finished product storage area. This value indicates that although Blocplan is capable of generating alternative layouts based on department relationships, the final performance is highly dependent on the suitability between the generated configuration and the actual production flow. Previous studies have demonstrated that Blocplan alternatives must be evaluated using quantitative indicators because the layout with the highest relationship score does not always produce the lowest material handling distance (Bisri & Cahyana, 2022).

Table 4. Material Transportation Distance of Blocplan Proposed Layout 3

No	Process	Distance (m)
1	Raw Material Warehouse – Drying Area	17.41
2	Drying Area – Kapok Separation	32.90
3	Kapok Separation – Semi-Finished Product Warehouse	17.81
4	Semi-Finished Product Warehouse – Packing and Finishing	16.65
5	Packing and Finishing – Finished Product Warehouse	35.00
	Total	**119.77**

The second alternative generated by Blocplan was Layout 8, which provided a different spatial arrangement compared with Layout 3. Figure 7 illustrates the proposed configuration of Layout 8, where several departments were repositioned to improve the proximity between activities with high material movement intensity. The evaluation of Layout 8 was performed using the same calculation approach by considering the distance between facilities and movement frequency. The result indicates that Layout 8 produced a total material transportation distance of 119.02 meters, which is slightly lower than Layout 3 but still higher than the SLP-based layout. This finding confirms that layout optimization requires not only relationship compatibility but also alignment with the actual production sequence to achieve minimum transportation requirements (Laoh et al., 2025).

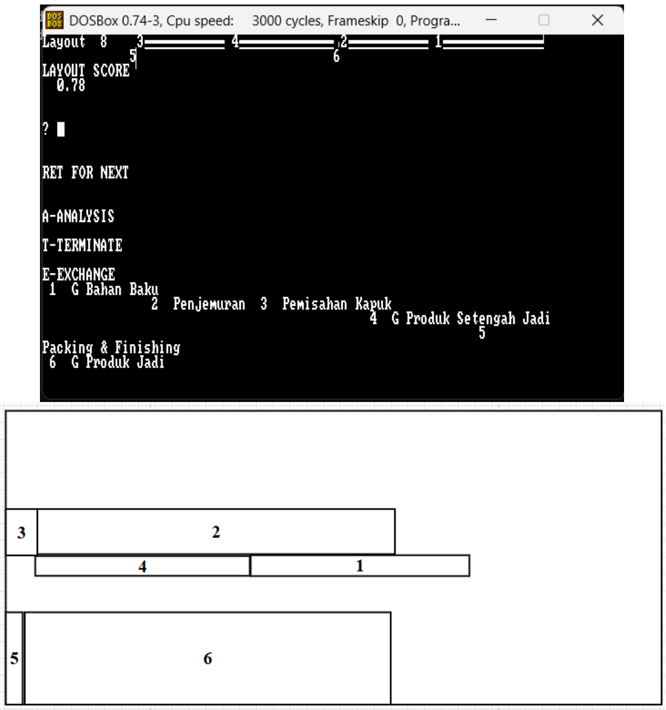

Figure 7. Blocplan Proposed Layout 8

The final Blocplan alternative analyzed in this study was Layout 10, which generated another possible facility arrangement for CV. Sidomulyo Perkasa. Figure 9 presents the spatial configuration of Layout 10, while the transportation distance calculation is summarized in Table 8. The evaluation results show that Layout 10 achieved a total material transportation distance of 107.14 meters, which is lower than Layout 3 and Layout 8 but remains higher than the SLP proposed layout. The difference in performance between Blocplan alternatives demonstrates that computational layout generation must be followed by quantitative evaluation because the effectiveness of a layout is determined by its ability to reduce material movement and handling costs. Similar findings were reported by studies applying combined SLP and Blocplan approaches, where the selected layout was determined through comparison of transportation distance and material handling cost indicators rather than relying only on algorithm output (Henni et al., 2024).

Figure 8. Blocplan Proposed Layout 10

Table 5. Material Transportation Distance of Blocplan Proposed Layout 8

No	Process	Distance (m)
1	Raw Material Warehouse – Drying Area	17.20
2	Drying Area – Kapok Separation	32.90
3	Kapok Separation – Semi-Finished Product Warehouse	17.19
4	Semi-Finished Product Warehouse – Packing and Finishing	18.83
5	Packing and Finishing – Finished Product Warehouse	32.90
	Total	**119.02**

Table 6. Material Transportation Distance of Blocplan Proposed Layout 10

No	Process	Distance (m)
1	Raw Material Warehouse – Drying Area	11.81
2	Drying Area – Kapok Separation	8.20
3	Kapok Separation – Semi-Finished Product Warehouse	32.14
4	Semi-Finished Product Warehouse – Packing and Finishing	31.37
5	Packing and Finishing – Finished Product Warehouse	23.62
	Total	**107.14**

The comparison of Blocplan-generated layouts indicates that Layout 10 provided better performance than Layout 3 and Layout 8 in terms of transportation distance reduction, but it was still less efficient compared with the SLP proposed layout. The Blocplan alternatives produced total distances ranging from 107.14 meters to 119.77 meters, while the SLP layout achieved a distance of 71.5 meters. This difference occurs because the SLP approach directly integrates material flow analysis, activity relationships, and production sequence evaluation during the layout development process, allowing the resulting arrangement to better represent operational requirements. Therefore, the Blocplan method functioned as an alternative optimization tool, while the final layout selection required additional evaluation using material handling performance indicators, consistent with previous facility redesign studies (Saffanah et al., 2023).

Evaluation of Material Transportation Distance and Material Handling Cost

The performance evaluation was conducted by comparing the initial facility layout with the proposed layouts generated from the SLP and Blocplan methods. The evaluation indicators consisted of total material transportation distance and material handling cost (OMH), which represent the operational efficiency level of a production facility. The initial layout condition at CV. Sidomulyo Perkasa showed inefficient material movement patterns because several departments with high activity relationships were positioned at relatively long distances. The proposed layouts were evaluated to determine the configuration capable of minimizing unnecessary transportation activities and reducing handling expenses. Facility layout improvement is generally measured through the ability to shorten material flow paths and optimize relationships between workstations, which directly affects production efficiency (Adiasa et al., 2020). The comparison results between the proposed layouts generated by SLP and Blocplan are presented in Table 7.

Table 7. Comparison of Proposed Layout Performance Based on Material Transportation Distance and Material Handling Cost

Layout Alternative	Material Transportation Distance (m)	Material Handling Cost (Rp/month)
SLP Proposed Layout	71.50	39,455.31
Blocplan Layout 3	119.77	63,116.42
Blocplan Layout 8	119.02	64,362.94
Blocplan Layout 10	107.14	63,468.89

Based on Table 7, the SLP proposed layout generated the lowest material transportation distance and material handling cost compared with the Blocplan alternatives. The SLP layout reduced the movement distance to 71.50 meters, while Blocplan alternatives produced distances above 100 meters, indicating that the arrangement developed through SLP was more compatible with the production flow characteristics of CV. Sidomulyo Perkasa. The difference occurred because SLP prioritizes the systematic analysis of activity relationships and material flow before determining facility positions, allowing departments with frequent interactions to be placed closer together. Previous research has confirmed that SLP implementation can significantly reduce material handling activities by improving the sequence and proximity of production facilities (Afdhilah & Rusindiyanto, 2026). Therefore, the SLP layout was selected as the most appropriate configuration for improving the production facility arrangement.

The reduction in transportation distance was further analyzed by comparing the initial layout and the selected proposed layout. The initial production layout required a material movement distance of 139.5 meters, while the SLP-based layout reduced the distance to 71.5 meters. The comparison result shown in Table 8 indicates a reduction of 68 meters or an efficiency improvement of 48.74%. This reduction reflects that the redesign process successfully eliminated unnecessary movement paths caused by the previous facility arrangement. A shorter transportation distance contributes to lower non-value-added activities because material handling represents one of the major sources of inefficiency in manufacturing operations (Febriyanto & Setiafindari, 2025).

Table 8. Comparison of Material Transportation Distance Between Initial and Proposed Layout

Layout Condition	Total Material Transportation Distance (m)	Distance Reduction (m)	Efficiency Improvement (%)
Initial Layout	139.50	-	-
Proposed SLP Layout	71.50	68.00	48.74

The improvement in facility arrangement can also be observed from the changes in material handling cost generated by the proposed layout. The initial layout produced a total OMH of Rp74,999.92 per month, whereas the SLP proposed layout reduced the cost to Rp39,455.31 per month. The detailed comparison presented in Table 9 shows that the implementation of the proposed layout decreased material handling expenditure by Rp35,544.61 or approximately 47.39%. The reduction in OMH occurred because the redesigned layout shortened the movement distance between production departments, reducing the accumulated handling workload. Similar research applying SLP and Blocplan methods reported that optimized facility positioning contributes to significant cost reduction through minimized material transfer activities (Andriyanto & Cahyana, 2024).

Table 9. Comparison of Material Handling Cost Between Initial and Proposed Layout

Layout Condition	Total Material Handling Cost (Rp/month)	Cost Reduction (Rp/month)	Efficiency Improvement (%)
Initial Layout	74,999.92	-	-
Proposed SLP Layout	39,455.31	35,544.61	47.39

The final proposed layout selected from the evaluation process is illustrated in Figure 9, representing the facility arrangement developed using the SLP approach. The layout positions the production departments according to their operational relationships, beginning from raw material storage, drying, kapok separation, semi-finished product storage, packing and finishing, until finished product storage. The arrangement provides a more continuous material flow compared with the initial condition, where several movement paths were relatively longer and less efficient. The improvement confirms that facility redesign based on systematic analysis can enhance production flow effectiveness without requiring changes to the production process itself. Previous studies have emphasized that integrating layout analysis with quantitative performance evaluation provides a reliable basis for selecting an optimal facility configuration (Haryanto et al., 2021).

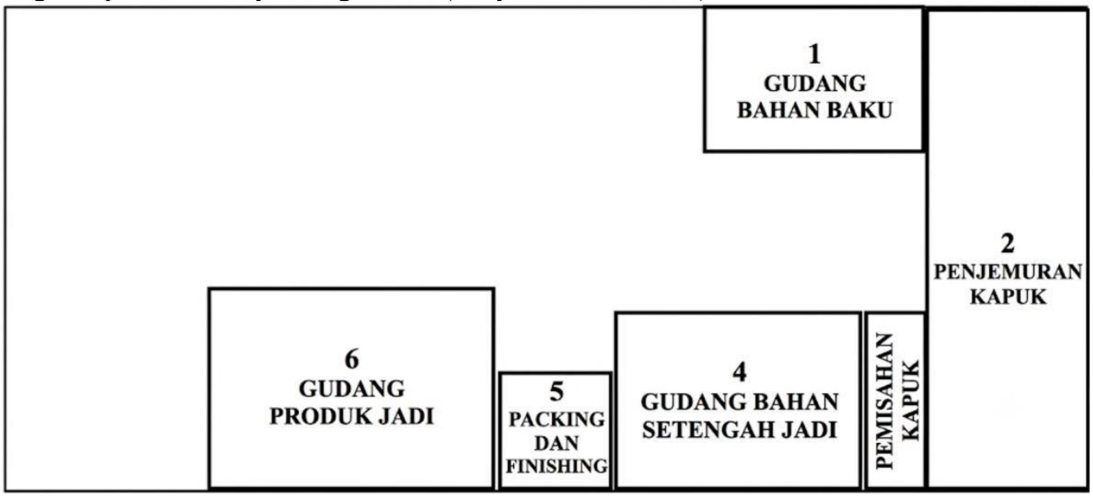

Figure 9. Selected Proposed Layout Based on Systematic Layout Planning (SLP) Method

The overall evaluation demonstrates that the integration of SLP and Blocplan methods successfully generated alternative facility arrangements for CV. Sidomulyo Perkasa, but the SLP-based layout provided the highest operational performance. The selected layout achieved the lowest material transportation distance and the lowest material handling cost among all evaluated alternatives. The results indicate that qualitative relationship analysis from SLP combined with quantitative evaluation using distance and cost metrics provides a comprehensive approach for facility redesign. This finding supports previous studies stating that facility layout optimization should consider both spatial relationships and measurable operational performance indicators to achieve sustainable production efficiency (Zaeni et al., 2025). The proposed layout is therefore considered the most suitable recommendation for improving material flow and reducing handling costs in the kapok production facility.

CONCLUSION

Based on the results of data processing and analysis, the facility layout redesign at CV. Sidomulyo Perkasa using the Systematic Layout Planning (SLP) and Blocplan methods successfully improved the efficiency of material movement and handling activities. The evaluation results showed that the initial layout generated a total material transportation distance of 139.5 meters, while the selected proposed layout reduced the distance to 71.5 meters. This reduction represents a decrease of 68 meters or an efficiency improvement of 48.74% compared with the existing layout condition. The comparison of alternative layouts generated by SLP and Blocplan indicated that the SLP proposed layout provided the best performance because it produced the shortest transportation distance and the lowest material handling cost. The improvement occurred due to a more appropriate arrangement of departments based on activity relationships, production flow sequence, and material movement requirements. The redesign process demonstrated that systematic evaluation of facility relationships can minimize unnecessary transportation activities in the kapok production process. These findings confirm that facility layout optimization plays an important role in increasing operational efficiency by reducing non-value-added material handling activities.

The analysis of Material Handling Cost (OMH) showed that the proposed layout also provided significant economic benefits for CV. Sidomulyo Perkasa. The initial layout produced a total OMH of Rp74,999.92, while the proposed SLP layout reduced the cost to Rp39,455.31, resulting in a cost reduction of Rp35,544.61 or 47.39%. The integration of SLP and Blocplan methods provided several alternative facility arrangements, where the final selection was determined based on quantitative performance indicators, including transportation distance and handling cost reduction. The proposed layout is considered the most suitable alternative because it improves the proximity between related departments while maintaining compatibility with the existing production process. The results indicate that the implementation of facility redesign can support more efficient production activities without requiring major changes to the production system. Therefore, the proposed layout can be recommended as an improvement alternative for CV. Sidomulyo Perkasa to optimize material flow and reduce operational costs. Future research may consider additional evaluation factors, such as production capacity, operator movement, and simulation-based analysis, to further validate the long-term performance of the redesigned facility layout.

REFERENCES

Adiasa, I., Suarantalla, R., Rafi, M. S., & Hermanto, K. (2020). Perancangan Ulang Tata Letak Fasilitas Pabrik Di CV. Apindo Brother Sukses Menggunakan Metode Systematic Layout Planning (SLP). *Performa: Media Ilmiah Teknik Industri*, *19*(2), 151-158. https://doi.org/10.20961/performa.19.2.43467

Afdhilah, S., & Rusindiyanto, R. (2026). Systematic Layout Planning Reduces Tofu Material Handling Distance: Pengurangan Jarak Material Handling pada Produksi Tahu Menggunakan Metode Systematic Layout Planning. *Academia Open*, *11*(1), 10-21070. https://doi.org/10.21070/acopen.11.2026.14319

Andriyanto, M., & Cahyana, A. S. (2024). Re-Layout Tata Letak Fasilitas Produksi Sepatu Menggunakan Metode Systematic Layout Planning dan Blocplan. *G-Tech: Jurnal Teknologi Terapan*, *8*(4), 2290-2300. https://doi.org/10.70609/gtech.v8i4.4973

Aristriyana, E., & Ibnu Faisal Salim, M. (2023). Perancangan Ulang Tata Letak Fasilitas Menggunakan Metode ARC Guna Memaksimalkan Produktivitas Kerja pada UKM SB Jaya di Cisaga. *Jurnal Industrial Galuh*, *5*(1), 29–36. https://doi.org/10.25157/jig.v5i1.3060

Bisri, M. H., & Cahyana, A. S. (2022). Production Facility Layout Redesign Using Systematic Layout Planning And Blocplan Methods: Perancangan Ulang Tata Letak Fasilitas Produksi Menggunakan Metode Systematic Layout Planning dan Blocplan. *Procedia of Engineering and Life Science*, *3*. https://doi.org/10.21070/pels.v3i0.1349

Efendi, A. G., Ihsan Hamdy, M., Surayya Lubis, F., Isnaini , M., & Nazaruddin, N. (2023). Facility Layout Design of Coco Fiber and Cocopeat Factory Using Systematic Layout Planning Method and Blocplan Algorithm. *JURNAL PERANGKAT LUNAK*, *5*(3), 302-312. https://doi.org/10.32520/jupel.v5i3.2754

Faiz, N. M. (2021). *Usulan Perbaikan Tata Letak Fasilitas PT. Promanufacture Indonesia dengan Menggunakan Aplikasi Blocplan* (Doctoral dissertation, Universitas Islam Sultan Agung Semarang). https://repository.unissula.ac.id/23117/

Febriyanto, B., & Setiafindari, W. (2025). Optimasi Tata Letak Fasilitas Produksi dengan Metode Systematic Layout Planning (SLP) untuk Meningkatkan Efisiensi Material Handling. *Jurnal Teknologi dan Manajemen Industri Terapan*, *4*(I), 10-19. https://doi.org/10.55826/jtmit.v4iI.522

Haryanto, A. T., Hisjam, M., & Yew, W. K. (2021, March). Redesign of facilities layout using Systematic Layout Planning (SLP) on manufacturing company: a case study. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1096, No. 1, p. 012026). IOP Publishing. https://doi.org/10.1088/1757-899X/1096/1/012026

Henni, H., Pramestari, D., Dinariana, D., Suryani, F., Sujatini, S., Dewi, E. P., & Nurjaman, H. N. (2024). Redesign the layout of production facilities at a garment company using the BLOCPLAN method to optimize material handling. In *Proceeding of the International Conference on Multidisciplinary Research for Sustainable Innovation* (Vol. 1, No. 1, pp. 358-368). https://doi.org/10.31098/icmrsi.v1i.818

Isharyanto, D., & Rifai, A. P. (2026, May). Redesign of Staging Area Layout at Marunda Port with Systematic Layout Planning (SLP) Method and Its Effect on Ship Loading and Unloading. In *8th Mechanical and Industrial Engineering Symposium (MIE 2025)* (pp. 132-144). Atlantis Press. https://doi.org/10.2991/978-94-6239-687-6_10

Khofiyah, N. A., Azizurrohman, A., Suhendra, S., Prasetya, D. I., & Mukhlisin, M. (2025). Optimizing Layout for Material Handling Cost Reduction Using Blocplan and FlexSim: A Case Study in Screen Printing Production. *Journal of Applied Informatics and Computing*, *9*(6), 3752-3762. https://doi.org/10.30871/jaic.v9i6.11698

Laoh, F., Lahay, I. H., & Darusalam, J. (2025). Perancangan ulang (Re-Layout) tata letak fasilitas menggunakan metode Systematic Layout Planning (SLP) dan Algoritma Blocplan. *Jurnal*

Teknik Industri Terintegrasi (JUTIN), *8*(1), 1049–1059. https://doi.org/10.31004/jutin.v8i1.41301

Muharni, F., Febianti, E., & Vahlevi, I. R. (2022). Perancangan tata letak fasilitas gudang pada Hot Strip Mill menggunakan metode activity relationship chart dan blocplan. *Jurnal Teknik Industri*, *8*(1), 44-51. https://doi.org/10.24014/jti.v7i2.11526

Nirvana, N. A. B., Mahardhika, G. I. I., Panjaitan, F. Y. D., Lapri, I. R. S., Romadhon, A. A., & Setiawan, I. (2025, December). Application of systematic layout planning at PT sinar aelas jaya abadi for layout efficiency. In *Proceedings ASTRAtech International Conference* (Vol. 2, No. October, pp. 38-48). https://doi.org/10.52453/aic.v2iOctober.487

Nugeroho, A. A. U. (2021). Usulan perbaikan tata letak fasilitas pabrik tahu dengan metode systematic layout planning. *Jurnal Optimasi Teknik Industri (JOTI)*, *3*(2), 65-69. http://dx.doi.org/10.30998/joti.v3i2.10452

Saffanah, S., Imral, R. A., & Sibarani, A. A. (2023). Usulan Perancangan Tata Letak Lantai Produksi Dengan Metode SLP Dan Blocplan Pada Produk Cutting Steel Pipe Di Cv. Abc Di Cileungsi. *Jurnal Rekayasa Sistem Industri*, *8*(2), 1-27. https://doi.org/10.33884/jrsi.v8i2.6625

Santoso, S., Heryanto, R. M., Kartawidjaja, M. A., & Sukwadi, R. (2024). Perancangan Ulang Tata Letak Fasilitas pada Industri Garmen dengan Metode BLOCPLAN. *Jurnal Optimalisasi*, *10*(1), 69-79. https://doi.org/10.35308/jopt.v10i01.9238

Singla, V. (2025). An integrated systematic layout planning, analytical hierarchy process and nonlinear programming approach to facility layout design. *International Journal of Operational Research*, *52*(1), 128-145. https://doi.org/10.1504/IJOR.2025.143960

Sugiyono, A. (2018). *BUKU AJAR PERENCANAAN TATA LETAK FASILITAS(PTLF)*.

Tarigan, U., Sembiring, M. T., Tarigan, I. R., & Syahpturi, K. (2025). Increasing Production Productivity by Improving Facility Layout Using the BLOCPLAN Method, Systematic Layout Planning, and Differential Evolution Algorithm. *Jurnal Sistem Teknik Industri*, *27*(3), 145-153. https://doi.org/10.32734/jsti.v27i3.19705

Theresia, S., Andrianti, I., & Sugeng, B. (2025). Usulan Perancangan Tata Letak Gudang III dengan Metode Systematic Layout Planning pada PT XYZ. *Jurnal Teknik Industri Terintegrasi (JUTIN)*, *8*(2), 1586–1594. https://doi.org/10.31004/jutin.v8i2.41667

Zaeni, Z. S., Juniani, A. I., & Zammi, K. A. F. Z. (2025). The Re-Layout Design of the Production Machine Through Blocplan and Systematic Layout Planning (SLP) Method. *MEIN: Journal of Mechanical, Electrical & Industrial Technology*, *2*(1), 17-24. https://doi.org/10.35991/mein.v2i1.20