Redesigning the Production Facility Layout Using the Systematic Layout Planning (SLP) Method: A Case Study at CV. Vyo Factory

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Article Info :	ABSTRACT
Article History : Received : 08-07-2024 Revised : 02-08-2024 Accepted : 06-08-2024 Available Online : 29-01-2025 **Keyword :** **Systematic Layout Planning (SLP), Manufacturing Efficiency, Production Flow Optimization**	*This research was conducted to design a facility layout using the SLP method, accompanied by a comparison of the efficient time between the initial layout and the proposal, as well as the results of direct observations of the production flow and activities in the CV production area. The Vyo factory has problems with irregular production flows, back-and-forth material movement (backtracking). This problem can have an impact on the enormous distances that material is moved irregularly due to relationships between departments that are far apart. Additionally, there is the issue of placing facilities that are not connected, as some facilities must be located near the production process. To overcome layout management problems, a method that can be employed is Systematic Layout Planning, which can be implemented using SketchUp software by redesigning the facility layout using this method. Based on the proposed alternative layout design using the SLP method, it can be seen that the best layout for shirt production on line 1 is starting with the storage warehouse, leading to the cutting for pattern cutting, after completion, it continues with a sewing process combining the front and back chest patterns, and sleeve sewing. The results of the design carried out using the SLP method, with SketchUp software, obtained a proposed layout to eliminate backtracking. The results of the analysis of effectiveness and efficiency during the production process can optimize the production process to be more orderly and utilize space more efficiently, allowing for a more streamlined workflow from incoming raw materials to finished products. Implementing this proposed layout can resolve layout issues in the production area, thereby eliminating backtracking.*

1. INTRODUCTION

Vyo Factory is one of the convection in Kebakkramat, Kemiri, Karanganyar Regency. This company has around 40 employees, and the products produced are various kinds of clothing, ranging from children's clothing to adult sizes, such as t-shirts, shirts, and polos—the machines owned by CV. Vyo Factory features a range of sewing machines, including single-needle and double-needle models, as well as overlock machines, cutting machines, steam ironing machines, electric irons, buttonhole machines, and button-attaching machines.

Results from direct observations of production flows, activities in the CV Convection production area. Vyo Factory has problems with irregular production flows, back-and-forth material movement (backtracking). This problem can have an impact on the enormous distances that material is moved irregularly due to relationships between departments that are far apart. This is in line with Muslim and Ilmaniati (2018), who state that unplanned layout design, which involves uneven material movement distances and department distances, can lead to a decrease in production and an increase in costs. Additionally, there is the issue of placing facilities that are not related to each other,

ISSN Print : 1979-7141
ISSN Online : 2541-1942

as some facilities should be located near the production process. Improvements are needed to meet consumer demand (Diansari et al., 2024). This arrangement results in production process activities carried out by operators becoming less effective and efficient.

Based on the observations made, initial observations in the field were obtained, that in the production process, the layout of the facilities was not by the flow of materials, resulting in an alternating current from the sewing machine to the overlock machine, and cutting movements in the trimming (thread cutting) section to the serger. Additionally, there is a buildup of semi-finished goods in the cutting area. Based on these problems, it results in irregular flow, which slows down the production process.

To overcome the above problems, it is necessary to redesign and improve the layout of facilities in the CV production area. Vyo Factory aims to optimize facility placement, reduce back-and-forth material movement (backtracking) and crosstracking. This can solve the problem of large material movement distances in the CV production area. Vyo Factory. To overcome layout management problems, a method that can be used is Systematic Layout Planning, implemented using SketchUp software. By redesigning the facility layout using the Systematic Layout Planning method, proposals for improving the production area layout at CV can be generated. Vyo Factory. The hope is that the company can optimize the production area so that the production flow runs smoothly and eliminates problems associated with backtracking or rework. The urgency or reason for the research is not yet visible in the background.

It is best to write the background with at least the following flow: Research Problem, Proposed Solution, and Reasons for the proposal.

2. METHOD

The method employed in this research utilizes the Systematic Layout Planning technique, incorporating schematic and graphic analysis for material flow (Sihombing, 2021). The research object of this thesis proposal is the CV production layout section. Vyo Factory is located in Kemiri Village, Kebakkramat District, Karanganyar Regency, Central Java Province, Indonesia. In this case, the process involves arranging incoming goods, cutting threads until the finished product is produced, and creating a production layout model at CV. Vyo Factory is also implementing additional improvements to its production flow.

The data collected in this research details the problems faced by CV—Vyo Factory in the production section. The data used are initial primary data collected, including: production process, production time, initial layout, production area, and measurements of the number and size of machines. The respondent data collection in this research employed a purposive sampling technique. According to Sugiyono (2019), purposive sampling is a technique for selecting samples based on specific criteria, specifically employees of the CV production department. Vyo Factory with a minimum work period of three years. In the research, only four respondents were used, namely, three supervisors for each line, as well as the convection owner. This interview serves as an open-ended guide for designing the proposed layout.

3. RESULTS AND ANALYSIS

3.1. Production Process

a. Material Selection

The clothing production process begins with the selection of raw materials. The primary materials used in the garment industry, particularly for shirt production, are various types of fabrics such as American Drill, Nagata, Taipan, and others. The fabric selection is tailored to production specifications or based on specific customer requests. This stage plays a crucial role because the quality of the raw materials directly affects the final product.

b. Design, Pattern, and Size Development

The next stage involves developing the garment design, pattern, and size. At this stage, the pattern is designed based on the previously formulated design sketch. This pattern serves as the basis for the cutting and sewing process. If a repeat order is placed for the same product, the pattern can be reused unless substantial modifications are made to the design.

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c. Sample Production
Sample production is carried out by sewing the fabric according to the prepared pattern, as outlined in the established production worksheet. This sample is then submitted to the ordering party for evaluation. If the sample is deemed not to meet specifications or expectations, it will need to be revised or remade by the provided revisions. The approved sample will serve as the reference for mass production.

d. Cutting Process
After the sample has been approved, the process continues with cutting the fabric according to the pattern. This stage is a crucial step in garment production and consists of several sub-processes, as follows:

a) Spreading: the process of stretching the fabric in layers to prepare for cutting large quantities with high efficiency.
b) Marker Making: the process of optimally placing the pattern on the fabric to maximize material utilization and minimize waste.
c) Bundling: the process of identifying and grouping the marked pattern pieces ready for the cutting process.

e. Sewing
This stage involves joining the cut fabric pieces together using sewing techniques that comply with production standards. This process requires high precision to ensure dimensional conformity and product construction quality.

f. Finishing
Finishing is the final stage in the garment production process, encompassing activities such as final quality control, seam finishing, ironing, folding, and packaging. The purpose of this stage is to ensure that the final product meets quality standards before being distributed to customers.

This table explains the activities and time to complete making one shirt on each machine. The following explanation of the production process time is presented in the table 1.

Table 1. Activity and Time Production

Machines	***Activity***	***Time (Minutes)***
Cutting	Cut the fabric according to the pattern	1
Obras 1	Torn the sleeves	3
Obras 2	Bring your arms together with the front and back of your chest	3
Sewing 1	Unite the front and back chest	2
Obras 3	Torn all over	9
Sewing 2	Sew all over	5
Buttonhole	Making buttonhole	1
Install button	Install button	1
Trimming	Clean remaining threads on the fabric before finishing	3
Finishing	Ironing finished clothes and packing.	5
Amount		**33**

After obtaining the production process time, the distance between the production flow from the warehouse department to the final stage of production, namely the finishing department, is calculated. The following table calculates the distance and time for the production flow.

Table2. Distance and Production Flow Time

From	***To***	***Distance (Meters)***	***Time (Minutes)***
Werehouse	Cutting	6,97	0,38

ISSN Print : 1979-7141
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From	*To*	*Distance (Meters)*	*Time (Minutes)*
Cutting	Obras 1	9	0,50
Cutting	Obras 2	12,38	0,75
Cutting	Obras 3	5,61	0,33
Obras 1	Sewing 1	1,61	0,08
Obras 2	Sewing 1	17,36	0,97
Obras 3	Sewing 2	1,10	0,03
Sewing 2	Obras 3	1,10	0,03
Obras 3	Buttonhole	9,01	0,50
Buttonhole	Install button	1	0,03
Install button	Trimming	9,19	0,52
Trimming	Finishing	5,47	0,32
Finishing	Werehouse	27,42	1,55
Amount		**107,22**	**6**

3.2. Operation Process Chart

An operations process map is a diagram that depicts the sequence of steps raw materials undergo during a series of operations and inspections (Putri & Ismanto, 2019). This is the first stage in a sequence of steps for planning facility layout and material movement. The operations process map also contains information about the process description for each activity, the time required to complete each activity, and the equipment or machine.

An Operations Process Chart explains the entire production flow, from the beginning of the production process to the final stage. The operation process map functions to describe the work sequence by dividing the work into detailed operational elements in the manufacture of apparel, with each production line producing different products. Based on the interview results, the production process begins with cutting raw materials, as shown in Figure 1.

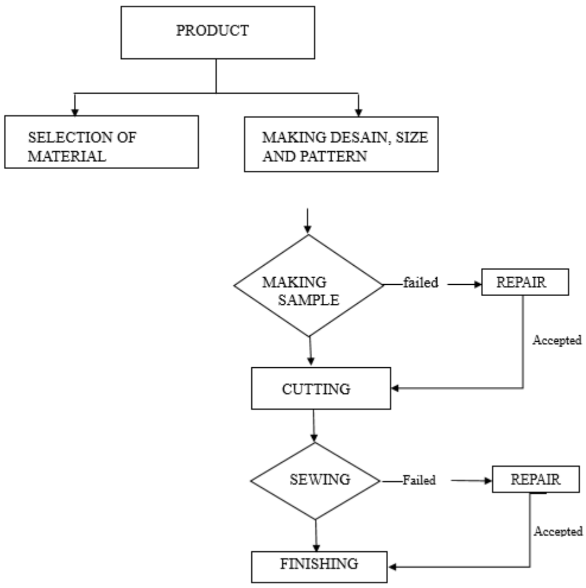

Figure 1. Production Process

3.3. Initial Layout

The ordering system at CV. Vyo Factory is a Pre-order, so this convention has various product variants. Therefore, the type of layout used is a production process-oriented layout. This company comprises five different departments: the warehouse department, cutting department, production department, trimming department, and finishing department. The size of each

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ISSN Online : 2541-1942

department is measured directly using a meter as a measuring tool—initial CV layout. Vyo Factory is shown in Figure 2.

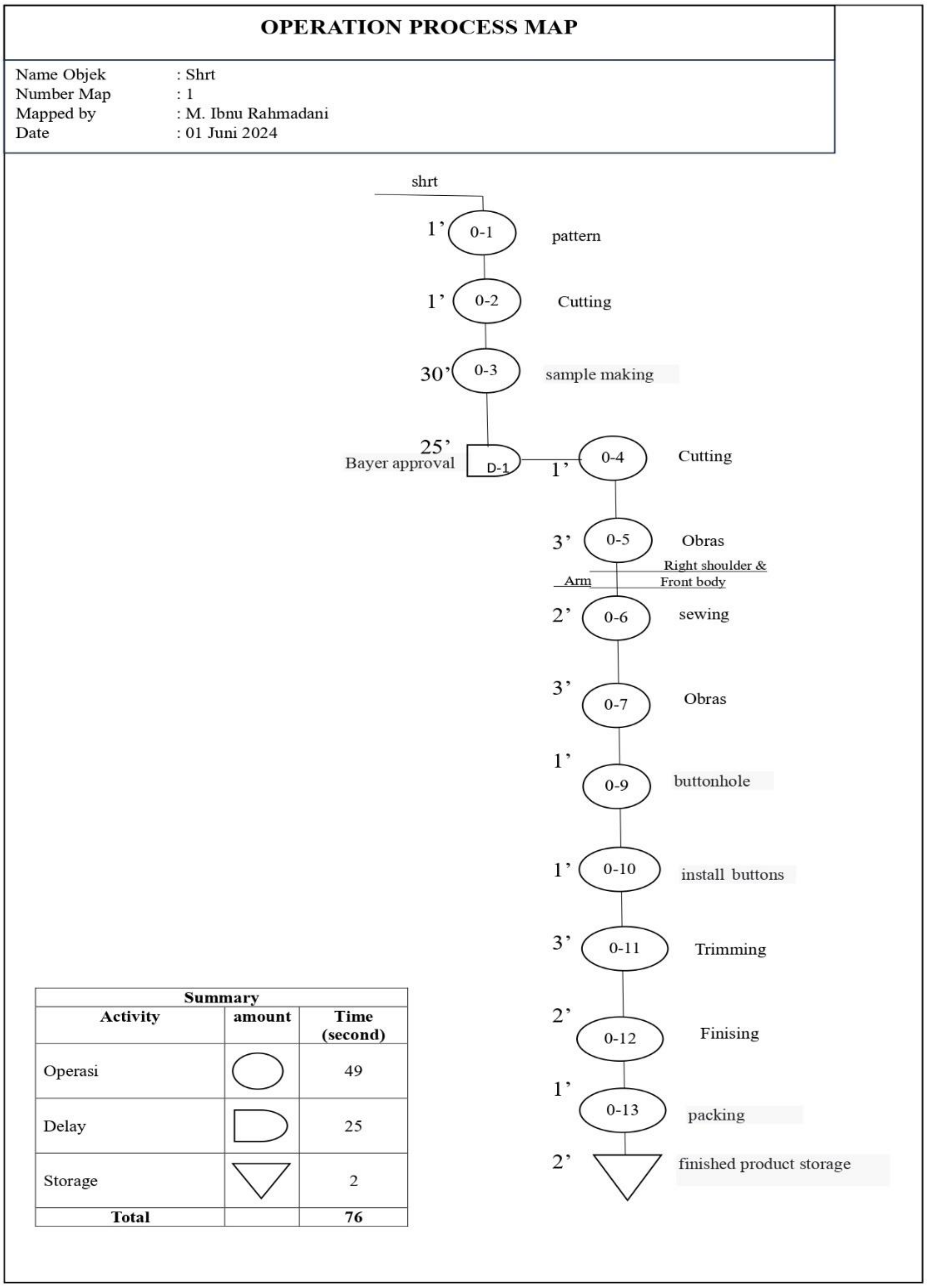

Figure 2. Operation Process Chart

3.4. Area Calculation

CV production area. Vyo Factory has an area of ±720 m². Area data between workstations is obtained by multiplying the length and width of the measured workstations. The size data are presented more clearly in Table 1.

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Table 3. Area Production

Kode	*Area*	*Size (m)*		*area (m2)*
		long (x)	*wide (y)*	
A	Werehouse	8	8	64
B	Sample	13	4	52
C	Cutting	12	13	156
D	Sewing	10	6	60
E	Button	6	2	12
F	Trimming	4	4	16
G	Finishing	4	4	16
H	Iron	2,40	1,60	3,84

3.5. Number *and Requirement of Machines*

In carrying out production, CV Vyo Factory has the equipment and machines shown in table 2

Table 4. Number and Requirement of Machines

No	**Name machines**	**Amount (Unit)**	**Size (m)**		**Area (m2)**
			Long (x)	**Wide (y)**	
1.	Cutting machines	1	5	2	10
2.	Sewing machines	2	0,8	0,8	0,64
3.	Obras machines	3	0,8	0,8	0,64
4.	Button attaching machine	1	0,8	0,8	0,64
5.	buttonhole machine	1	0,8	0,8	0,64
6.	iron	1	2	0,8	1,6

3.6. ARC (Activity Relationship Chart)

The preparation of the Activity Relationship Chart is influenced by material flow, relationships between activities and production processes. ARC is used as part of the data processing process which aims to produce a proposed layout that is in accordance with the material flow in the production process. Figure 3. depicts the ARC for each line 1 shirt production activity.

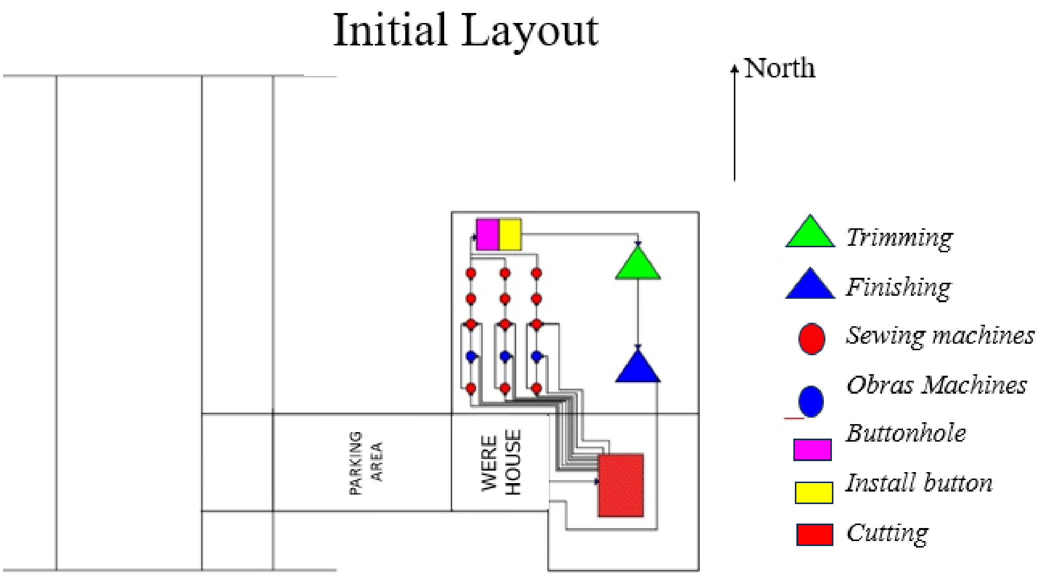

Figure 3. Initial Layout

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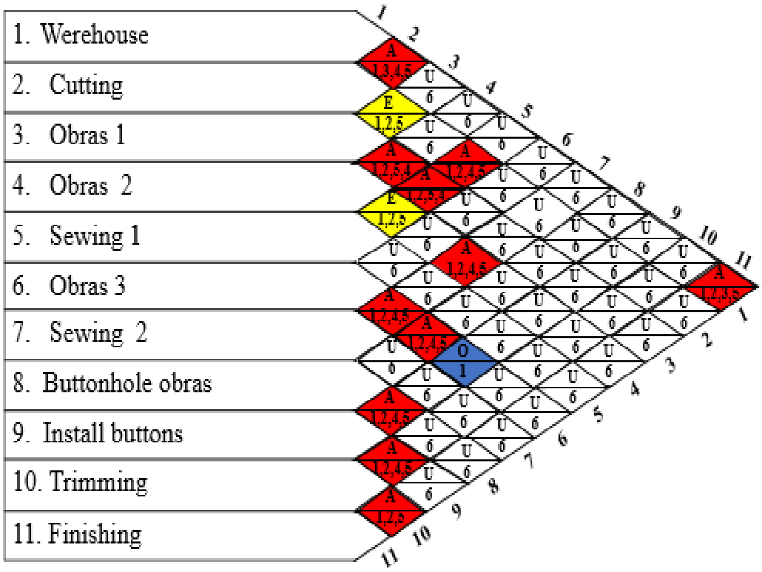

Figure 4. ARC

3.7. ARD (Activity Relationship Diagram)

The proposed Activity Relationship Diagram is created based on the degree of closeness obtained from the priority scale in the ARC that was created previously. The following table shows the degree of closeness of the Activity Relationship Diagram (ARD).

Table 5. Degree of closeness

No Dept	***Department***	***Degree of closeness***				
		A	***E***	***I***	***O***	***U***
1	Werehouse	2,11	-	-	-	3,4,5,6,7,8,9,10
2	Cutting	5,1	3	-	-	4,6,7,8,9,10,11
3	Obras 1	4,5	2	-	-	6,7,8,9,10,11
4	Obras 2	7,3	5	-	-	6,7,8,9,10,11,12
5	Sewing 1	2,3	3	-	-	1.6,7,8,9,10,11
6	Obras 3	7,8	-	-	9	2,3,4,5,10,11
7	Sewing 2	4,6	-	-	-	1,2,3,5,8,9,10,11
8	Buttonhole	9,6	-	-	-	1,2,3,4,5,7,10,11
9	Install Button	8,10	-	6	-	1,2,3,4,5,7
10	Trimming	11,9	-	-	-	1,2,3,4,5,6,7,8
11	Finishing	1,10	-	1	-	2,3,4,5,6,7,8,9

From the results of the table of degrees of closeness, a diagram is then made to visualize the closeness between departments.

3.8. Designing the proposed layout

After completing the stages above, the next step is to design an alternative layout drawing that is detailed and in accordance with existing needs and sizes, using sketch up software. The following is a proposed alternative layout design.

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ISSN Online : 2541-1942

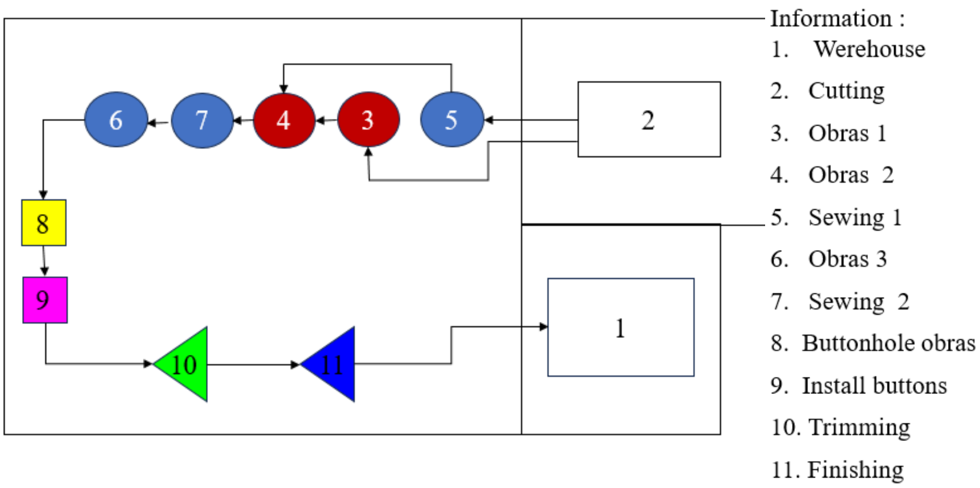

Figure 5. Layout

Based on the proposed alternative layout design using the SLP method, it can be seen that the best layout for shirt production on line 1 is starting from the storage warehouse leading to the cutting for pattern cutting, after completion it continues with the sewing process, uniting the front and back chest patterns, and cutting the sleeves.

3.9. Distance and Production Flow Time for Proposed Layout

Table 6. Activity and Time Production

Machines	Activity	Time (Minutes)
Cutting	Cut the fabric according to the pattern	1
Sewing 1	Unite the front and back chest	2
Obras 1	Torn the sleeves	1
Obras 2	Bring your arms together with the front and back of your chest	2
Sewing 2	Sew all over	3
Obras 3	Torn all over	3
Buttonhole	Making buttonhole	1
Install Button	Install button	1
Trimming	Clean remaining threads on the fabric before finishing	3
Finishing	Ironing finished clothes and packing.	5
Amount		**22**

After obtaining the production process time, the distance between the production flow from the warehouse department to the final stage of production, namely the finishing department, is calculated.

Table 7. Distance and Production Flow Time

From	To	Distance (Meters)	Time (Minutes)
Werehouse	Cutting	6,97	0,38
Cutting	Sewing 1	9,41	0,52
Cutting	Obras 1	11,32	0,87
Sewing 1	Obras 2	5,61	0,33

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Obras 1	Obras 2	1,10	0,03
Obras 2	Sewing 2	1,10	0,03
Sewing 2	Obras 3	1,10	0,03
Obras 3	Buttonhole	2,60	0,13
Buttonhole	Install button	1	0,03
Install Button	Trimming	9,2	0,50
Trimming	Finishing	5,47	0,32
Finishing	Werehouse	6,74	0,37
Total		**61,62**	**3,55**

3.40. Comparison of distance, initial layout time and proposed layout

After calculating the distance, production flow time for the initial and proposed layouts, the comparison of the efficiency percentages can be seen. The following is a comparison table of distance, production flow time for the initial layout and the proposal in the table.

Table 8. Comparison of Distance, Initial and Proposed Layout Time

Layout	**Time (Minutes)**	**Distance (Meters)**
Initial	33	107,22
Proposed	22	61
Eficiency	**67%**	**57%**

Based on the table above, the time efficiency percentage of the proposed layout is 67% with a time difference of 11 minutes faster than the initial layout. Furthermore, the proposed layout distance obtained a percentage of 57% with a distance difference of 46,22 meters compared to the initial layout.

4. CONCLUSION

Based on the design process that has been carried out, it produces a proposed layout for the CV. The results of the design carried out using the SLP method using SketchUp software obtained a proposed layout to eliminate backtracking. Based on the table above, the time efficiency percentage of the proposed layout is 67% with a time difference of 11 minutes faster than the initial layout. Furthermore, the proposed layout distance obtained a percentage of 57% with a distance difference of 46,22 meters compared to the initial layout. The results of the analysis of effectiveness and efficiency during the production process can optimize the production process to be more orderly and use space in the convection, allowing for a more efficient work flow from incoming raw materials to finished products coming out. Implementing this proposed layout can solve layout problems in the CV. production area to eliminate backtracking.

5. ACKNOWLEDGEMENTS

The author would like to express sincere gratitude to Allah SWT for the guidance and strength provided throughout the completion of this study. The author also extends appreciation to Assoc. Prof. Dr. Singgih Purnomo, M.M., Chancellor of Duta Bangsa Surakarta University, for his support. Special thanks are conveyed to Brillian Nur Diansari, S.T., M.T., as the first supervisor, and Garnet Filemon, S.T., M.T., as the second supervisor, for their invaluable guidance and constructive feedback. The author also gratefully acknowledges CV. Vyo Factory for the opportunity and support provided during the research process.

6. DECLARATION OF COMPETING INTEREST

We declare that we have no conflict of interest.

ISSN Print : 1979-7141
ISSN Online : 2541-1942

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