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Layout Redesign to Eliminate Stagnation Using Blocplan to Increase Production Efficiency

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ABSTRACT

The rapid growth of the automotive industry was also followed by growth in subsidiary companies. One of the subsidiary companies is a company that produces auto parts such as wheels. Based on the annual report by the automotive corporation that, sales volume in 2021 increased to more than 2 million products while for 2022 to April it was more than 1 million products. High demand is not accommodated due to inadequate production capacity, one of which is the machining area. This study aims to increase efficiency by redesigning the layout of the factory which is considered to increase production results in the machining area. The method used in this research is Block Layout Overview with Computerized Planning using Logic and Algorithm (Blocplan). The results showed that the redesign of the machining area could reduce stagnation by adding 1 unit of multi drill machine. Relayout in the machining area can reduce 93" time stagnation for the K2SA rear ABS type which can produce 2 outputs at once. The delay in the machining area can be reduced from 4,863 seconds to 0 seconds.

Keywords: *Block plan, efficiency, layout, machining*

1. INTRODUCTION

The growth of the automotive industry in Indonesia every year has increased significantly. This increase is proven by the emergence of new automotive products every year (Setiawan & Setiawan, 2020). This increase has an impact on the emergence of competition in the subsidiary company (Setiawan et al., 2021). In 2021, the growth in the automotive industry will be even stronger. Sales of the national automotive industry set a record exceeding one million units. This causes the competition between brands is getting tougher. The development of the middle class and the expansion of the economic base are cited as two driving forces alongside the expected rapid expansion of Indonesia's automotive industry (Zhang & Khan, 2017; Irwanto et al., 2020).

Auto part manufacturer is an industry that is engaged in the manufacture of automotive components / spare parts, namely wheel rims for four-wheeled vehicles and motorcycles. In addition, this industry also produces after market products with well-known trademarks that have spread in the automotive spare part market in Indonesia and even Europe. The products produced are used for the Indonesian Original Equipment for the Manufacturer (OEM) market and for exports to, among others, Malaysia, Japan, Italy, Hungary, and Thailand. This industry produces based on the amount of demand from customers. Based on the annual report by the automotive corporation that, sales volume in 2021 increased to more than 2 million products while for 2022 to April it was 1 million products. High demand is not accommodated due to inadequate production capacity (Gosende et al., 2021; Satriyo et al., 2017).

Based on the initial observations made by the kaizen team in the production line, it is known that the target to meet the number of requests for 4 consecutive months has not been achieved. One of them is caused by the existing stagnation in some production lines. Currently, stacking occurs on some production machines.

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This buildup on the machine occurs because the production capacity is not able to maximize its output. Production capacity is the number of products that must be made to maximize profits (Liu et al., 2020). Several factors that influence the determination of production capacity include the number of workers and working hours (Tranggono et al., 2021). Production capacity is not increased in line with increasing demand, so the target to meet the number of requests is not achieved. As one of the actions to overcome the problem is needed. Alternative layouts are proposed in order to increase production output (Adiyanto & Clistia, 2020).

Based on research Ulfiyatul & Suhartini (2021) that to increase production capacity using the Systematic Layout Planning (SLP) method. SLP planning is assisted by using Block Layout Overview with Computerized Planning using Logic and Algorithm (Blocplan) (Afifah et al., 2020). Blocplan is a facility layout design system that creates and evaluates layout types in response to input data (Al-Bayati & Al-Zubaidy, 2021). All data entered will generate a random layout where the location of the facilities is continuously exchanged until a better layout is achieved but the number is limited to a maximum of 20 (Gunanti et al., 2021). This method can increase production efficiency (Mebrat et al., 2020). This method can also reduce production costs (Kovács, 2019). According to research Kovács & Kot (2017) that in increasing production capacity by redesigning the layout of the factory. This method is often combined with Activity Relationship Diagram (ARC). ARC is a technique used to analyze the relationship between activities or all existing activities (Amalia et al., 2017). ARC is created to determine the degree of closeness (Lekan et al., 2017). The degree of closeness describes how close one part is to another, and is determined by the degree of relationship between the two parts (Gogi et al., 2014). Line balancing is an analysis that tries to balance the calculation of production output by dividing the load evenly between processes so that there are no idle processes due to waiting too long for the product to come out of the previous process (Mirzaei et al., 2021). This study aims to increase efficiency by redesigning the layout of the factory which is considered to increase production results in the machining area.

2. METHODS

This research was conducted in one of the automotive component industries in Indonesia. The purpose of this research is to increase efficiency by redesigning the factory layout which is considered to increase production results. The method used in this case study is Blocplan (Daya et al., 2019). The focus of this research is on the machining area. Data was collected in two ways, namely observation representing primary data and company and institutional report data representing secondary data (Sugiyono, 2017). This research uses 3 main stages which are systematic. Each stage has an important role in each problem solving. The framework of this research can be seen in Figure 1.

Based on Figure 1, the research framework can be described as follows:

1. The first stage, identifying problems and collecting data. Data collection is done by observing data on the production line
2. The second stage, analyzing the layout with the Blocplan application.
3. The third stage, analyze the results and evaluate the achievement.

3. RESULT AND DISCUSSION

In this section, problem solving analysis is carried out which refers to the improvement method. The analysis in this section is divided into 3 stages. At the end of the section there is a discussion with comparisons of similar studies.

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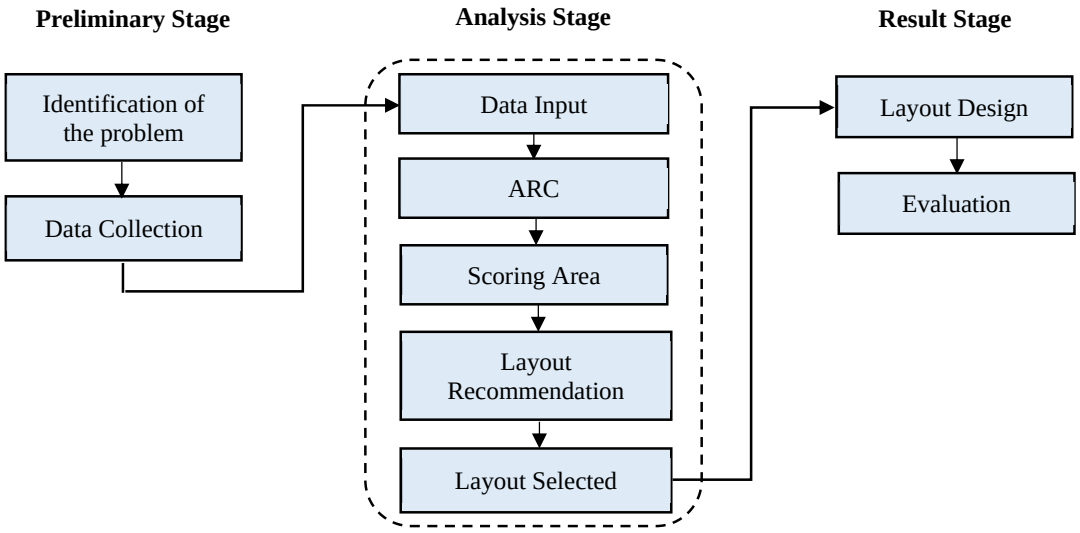

Figure 1. Research Framework

3.1 Preliminary Study

The following are the stages of the wheel production process: The first process is the melting process where the ingot and scrap material melts. The next process is sprue cut, which is the cutting of the sprue and wheel mold runners to remove unnecessary parts. The next process is heat treatment, to change the metal properties by changing the microstructure through the heating process and setting the cooling speed. The fourth process is shot blast which serves to provide a rough contour on the surface of the rim by firing sand onto the surface of the rim. The fifth machining process aims to produce components or technical objects that use ferrous and non-ferrous basic materials through a machining process. Machining is divided into several sections, namely Lines (OP 1 & OP 2), MD/ Broaching. The next process is painting, namely painting the colors on the wheels according to customer requests. The last process is final inspection, which is a thorough check carried out on finished goods and then the Shipping preparation area is a preparation area for shipping products to customers.

Based on the initial observations made by the kaizen team in the production line, that production in the automotive component industry did not reach the target. Figure 2 is the target and actual finished goods, which shows that the number of requests for 4 consecutive months has not been achieved. One of them is caused by the existing stagnation in some production lines. Currently, alloy wheels that are finished in the machining area, namely in the line (OP-1, OP-2) cannot be processed directly. The wheels must be driven by human power using a dolly to go to the next process. The next process is multi drill (MD-12) which also cannot be processed directly because it can only work on product input from several production lines so that the results from other lines are delayed, causing stagnation. Here the actual layout in the machining area interpreted in Figure 2.

Figure 2. Actual Layout in the Machining Area

Currently the buildup that occurs on the MD-1 & MD-2 machine is for all types of products. This buildup on the machine occurs because the production capacity is not able to maximize its output. Production capacity is not increased in line with increasing demand, so the target to meet the number of requests is not achieved. Therefore, this research will provide

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alternative layout proposals to increase machining production output. The production process in this industry is a continuous production process. It is characterized by large production quantities. The flow pattern of raw materials that is always fixed starting from raw materials to finished products. The following production process in the machining area intepreted by Operation Process Chart (OPC) can be seen in Figure 3.

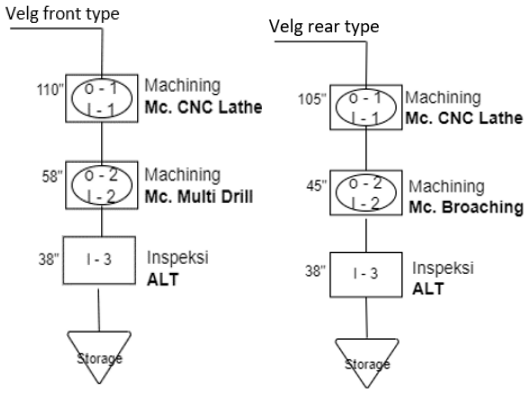

Figure 3. Process in the Machining Area

3.2 Analysis Stage

The design of the proposed layout of the machining area is carried out using the Blocplan method. There are 5 stages in determining the layout using the block plan method, which are as follows:

1. Input Data

The first step that needs to be done is to enter the data area to be changed. The data entered into the Blocplan are the number of areas, the name of the area and the area of the area. The area here is entered in meters. Table 1 is the data on the area of the machining area that is inputted into the Blocplan.

2. Activity Relationship Diagram (ARC)

The degree of proximity or ARC becomes Blocplan's consideration in determining the arrangement of the area other than the input area data. Determination of the degree of proximity using symbols in the form of letters, namely A, E, I, O, U, X. ARC in the machining area can be seen in Figure 4.

Table 1. Input Area Data on Blockplan

No	Process	Area				Total (m)
		Amount (unit)	Long (m)	Wide(m)	Square (m^2)	
1	CNC Lathe (Line Front)	4	6.20	5.8	35.96	143.84
2	CNC Lathe (Line Rear)	4	6.20	5.8	35.96	143.84
3	Broaching	1	3.45	3.6	12.42	12.42
4	MD HY	1	2.50	2.00	5.00	5.00
5	MD	3	3.10	3.00	9.30	27.90
6	ALT	2	2.8	2.4	6.72	13.44

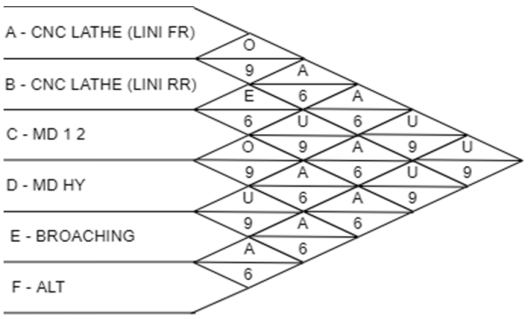

Figure 4. ARC in the Machining Area

Based on Figure 4, it is explained that Code A is given when the section absolutely needs to be brought closer because the process is sequential. Code U indicates that the area is not important to be close because it does not have a direct relationship in it, while code X indicates that the area is not desired to be close together.

3. Scoring Area

This score is based on the results of Blocplan processing with the previously inputted ARC data. The sum of all the values of the related symbols owned by each work station

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is the work station score. The following is the scoring of the Blocplan calculation results in Table 2.

Table 2. Scoring Area

No	Department/Area	Score
1	Line FR	21
2	Line RR	16
3	Broaching	36
4	MD HY	21
5	MD 1 2	30
6	ALT	30

4. Proposed Layouts Generated by Blocplan

The stages of the Blocplan process will produce a maximum of 20 alternative layouts in the form of a score table and the proposed layout. This study limits the number of layouts produced, namely 5 alternative layouts. The following is the alternative layout output score generated in Table 3.

Table 3. Alternative Layout Output Score

Layout	Adj. Score	R. Score	Rel-Dist Score
1	0,60 - 5	0,46 - 5	908 - 5
2	0,87 - 1	0,90 - 1	702 - 1
3	0,84 - 4	0,69 - 4	844 - 4
4	0,86 - 2	0,81 - 3	716 - 3
5	0,86 - 2	0,81 - 2	716 - 2

Table 3 shows that layout 2 has a high R-score with a value of 0.90 (close to a value of 1) and the lowest R-score is owned by a layout 1 of 0.46.

5. Selected Layout Proposal

Based on the results of data processing using Blocplan, the selected layout is layout 2. Layout 2 was chosen because it has the highest R. score of 0.90. The proposal is made by adding 1 machine in the multi drill area. The addition of multi drill machines is carried out based on Multi Product Process Chart (MPPC) calculations. Figure 5 is the selected layout 2. After the layout is selected based on the block plan, then it is described in real cases. The proposed alternative layout that has been made based on the data analysis above has been considered with the actual conditions on the production floor.

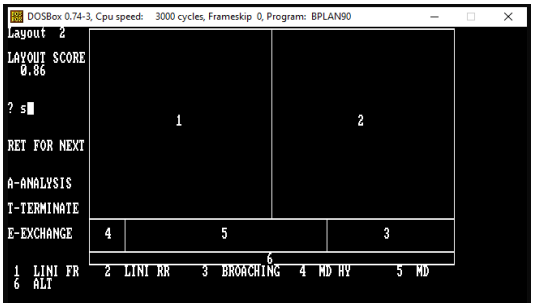

Figure 5. Layout 2 Selected by Blokplan

3.3. Result stage

Increasing production efficiency is an important concern for all sectors of the company. This can be seen from the company's ability to utilize the time, cost and capacity it has, so it is necessary to evaluate the ongoing production system. After obtaining the best layout (Figure 6), this study will evaluate the results obtained after improvement. The following is the production evaluation obtained after redesigning the machining area production line which can be seen in Table 4.

Figure 5. After Relayout in the Machining Area

Based on the evaluation, Table 4 shows that the output on the improved layout produces 2,964 pc. This increase provides relevant results due to the addition of I unit of multi drill machine. The difference in output before and after the layout improvement is 61 pc.

Table 4. Comparison Output Before and After Improvement.

Remark	Before *(pc)*	After *(pc)*
Line Prod.	1,198	1,198
Broaching	479	479
MD HY	705	705
MD 1	235	230

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MD 2	287	309
MD 3	0	43
Amount	2,903	2,964
Different	61	

3.4. Discussion and Implication

The results of this study are expected to provide benefits for similar industries in redesigning production lines so that companies can increase production with optimal efficiency. Based on the results of this study that production output has increased, this result is in line with research Daya et al. (2019). The results of this study are also in line with research Ulfiyatul & Suhartini (2021) that the addition of 1 machine unit is needed to support the production process in the machining area.

Based on the results of this study, information can be obtained regarding the factors that need to be considered, especially related to the effect of factory reset to eliminate process stagnation. The results of this study contribute to similar industries, especially the automotive component industry. The results of the study show that the production output has increased which has an effect on productivity and production efficiency. The results of this case study have had a significant impact on achieving a competitive company. This case study provides a reference to similar industries to achieve superior competition. In addition to reducing satgnan time, the implication of this case study is to increase productivity and gain benefits in the form of production costs.

Net Quality Income is the net profit obtained from an improvement made. Reducing stagnation in the production line of plant 1 and increasing production output. This industry can benefit from this improvement of Rp. 70,919,700.16.

4. CONCLUSION

Based on the layout improvement using the Blokplan method, in the machining area a new layout is obtained. This layout gives the effect that the cause of stagnation in the machining area is due to the lack of a multi drill machine for the K2SA rear ABS type so that other types have to wait for processing in the multi drill machine. Relayout in the machining area can reduce 93” time stagnation for the K2SA rear ABS type which can produce 2 outputs at once. The delay in the machining area can be reduced from 4,863 seconds to 0 seconds. Reducing stagnation in the plant 1 production line can increase production output and increase production profits. This research does not involve time studies and lean manufacturing analysis so that it becomes a limitation of the research. Suggestions for further research can integrate the Blokplan method with Lean manufacturing to eliminate waste

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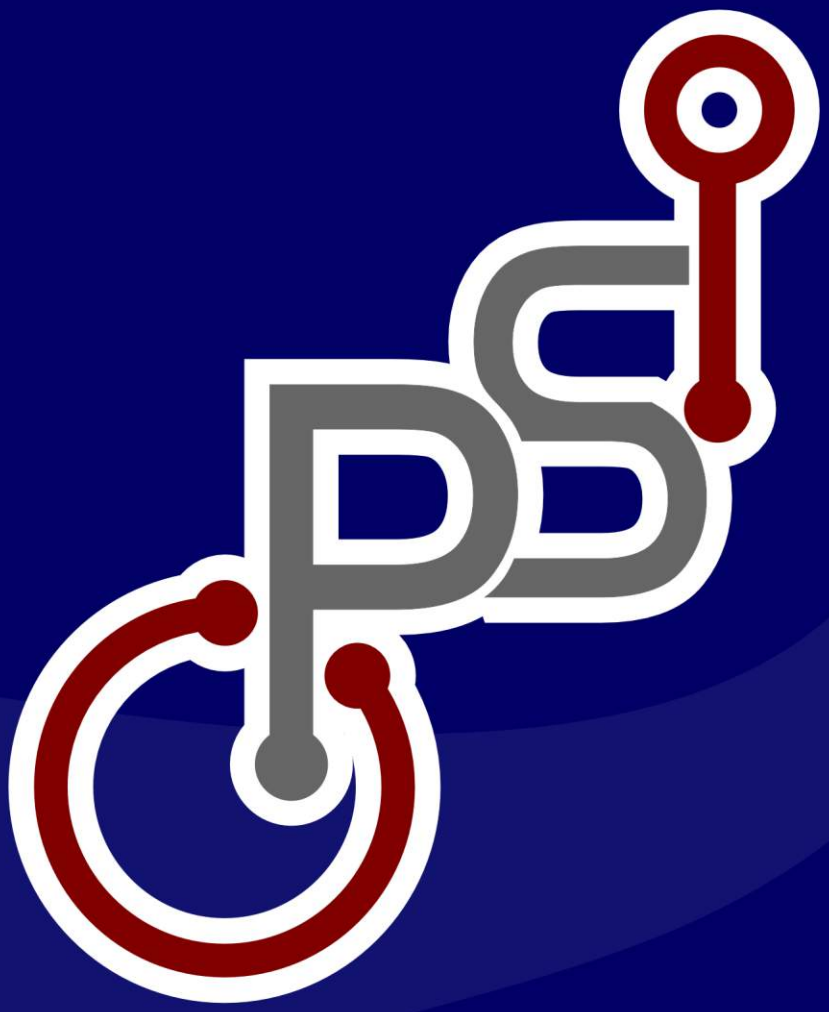

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Preface

All Praise belongs to Allah SWT who has bestowed infinite blessings and gifts on all of us. OPSI is an Industrial System Optimization Journal published by the Industrial Engineering Department of Universitas Pembangunan Nasional "Veteran" Yogyakarta to publish scientific works or technological engineering research related to Industrial Engineering, Industrial Systems, Industrial Management and Information Technology.

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