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Overview of the Production Process Layout Through the Technology Group at PT. Kayu Mebel Indonesia Semarang

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KEYWORDS
Rang Order Cluster Algorithm (ROCA), Similarity Coefficient (SC), From to chart, layout.

ABSTRACT
This research was carried out at PT. Kayu Mebel Indonesia, Semarang. The company in this wood processing area has a production form that is elongated to the factory shape so that production is less than optimal. So it is necessary to revise the production layout by applying the Rank Order Cluster Algorithm (ROCA) and Similarity Coefficient (SC) methods, both of which are used to obtain a factory layout scheme that produces maximum production in order to achieve minimum back trafficking values. In order to know the forward and backward scores obtained through analysis from to chart. The results of the study obtained forward results which were originally 70.4% to 83.1% or an increase in the forward value of 12.7% from the initial layout. As for the backtracking value which was originally 29.6% to 16.9% or a decrease in the backtracking value of 12.7% from the initial layout. The results of the initial spacing of 1562.83 meters became 1466.37 meters or experienced a 7% savings from the previous layout. As for material handling costs, which were originally Rp. 760,280, - to Rp. 690,314, - or experienced a 7% savings from the previous layout.

Introduction

Every industry in the manufacturing sector must be faced with factory layout problems, especially in the production process. The most crucial issue is how a layout is able to bridge the optimal production system. Namely when the process of moving between production parts can be carried out sequentially and close together with the total distance of moving material efficiently, not too long and time-consuming. Among the characteristics of layouts that are ineffective and can hamper the production process include spatial layout that is not systematic so that the distance between successive production fields becomes too long, delays in fulfilling orders according to deadlines, low ability to complete orders and other obstacles (IRAWAN, 2018).

PT. Kayu Mebel Indonesia Semarang is a wood processing industry company that has problems in the field of production floor layouts. The factory has many machines that are not neatly arranged and are still moving around without having a standard production scheme. This certainly affects the production process which is less than optimal because a lot of time is wasted for long material movement activities between successive production fields. This means that the influence of a good layout is very large in determining the effectiveness and efficiency of a production scheme (Pratiwi & Astuti, 2018).

Currently, the company's production process depends on product structure, so the machines are only modeled on the product being made. This causes the total material hauling distance to be very large, namely 1562.83 m and the percentage of material hauling time is 29.6% of the total working hours of 8 hours/day. This shows that the conversion time in production is too large. The problem that often occurs in a production department is the large number of orders for certain product components so that products that are not successfully produced on one production line are processed on other lines that are still empty (Purwanggono & Sugiyono, 2006).

From there it can be understood that a comprehensive and well-planned layout will be able to create a solid and optimal production atmosphere. Companies in this case need to act actively in working out layout problems through the application of various reliable methods such as the technology group method. In this case similar components are identified and grouped together to gain advantages in the manufacturing process and component design (Rodliyah et al., 2014).

Technology group (GT) is a concept in the world of manufacturing that uses similarities in manufacturing processes to identify similar parts and group them into component groups (family parts). GT operation uses a sequential clustering algorithm. This reduces setup time, material handling steps, production time, product inventory, facility requirements, machine downtime and control complexity. The GT function is nothing but to identify machine cells and part families regularly and allocate family parts to machine cells with the aim of minimizing the movement of parts between cells. GT-based production floor layouts are easy to implement in an industry whose production process is based on a product (Permana, 2010). This is as implemented in the production process at PT. Kayu Mebel Indonesia Semarang, which produces processed wood.

Layout is the layout on a number of production machines in the factory. The layout itself is an activity that is correlated with the mechanism of a production with a scheme that makes it easy for each employee to get clear information so that performance becomes optimal. The layout is done by evaluating the arrangement of facilities or machines with an organized production function and is based on the effective and efficient movement of materials (Arifin, 2016). Layout is a way of arranging machines and their component tools needed to produce an item. among several types of factory layouts, among others: (1) production flow-based layout; (2) fixed material location-based layouts; (3) process function based layout; (4) product flow-based layout. Group Technology is a philosophy of manufacturing activity. In this case similar components are identified and grouped together to gain advantages in the manufacturing process and component design (Heragu, 1997).

Cellular Manufacturing is the application of a technology group that includes grouping machines based on the parts they compose. Manufacturing cell is a layout concept that is widely used by the manufacturing industry and can be relied upon in actively optimizing production (Indrianti et al., 2016). The main function of the manufacturing cell is to identify machine cells and part families in order to minimize the movement of parts between cells so as to minimize inter- and intra-cell material handling costs. (Assauri, 1980).

Family part is a grouping of components, both in terms of shape and size as well as the sequence of stages of the manufacturing process. What matters is the grouping and coding itself among the machine cell designs. Where is the design of this machine cell that is the subject of discussion that is trying to be explained through the group technology method, so that an optimal layout design is obtained (Rodliyah et al., 2014b). The design of cell machines can be in the form of grouping components or machines, both on the basis of component classification and coding. (Hadiguna & Setiawan, 2008).

Methods for Solving Technology Group Problems (Tompkins, 1984): First, the classification method, in which the quiz has two variations as a problem solver namely: the visual method and the coding method.

Second, the cluster analysis method, namely the activity of finding and showing similar groups or clusters in a matrix of input data objects or attribute objects by rearranging the rows and columns of the input matrix of a pair matrix that determines whether a part is processed or not on a machine. certain. Such as grouping based on: (a) Rank Order Clustering Algorithm; (b) Bond Energy Algorithm; (c) Row and Column Masking Algorithm; (d) Similarity Coefficient Algorithm.

Third, From To Chart, is a conventional method that can be relied upon in planning factory layouts for the manufacturing industry. This method is very effective for material components or activities that move from one line to another, for example in factories, workshops, offices and other business units. From to Chart will display the recording of movement activities in an orderly and orderly manner, with a scheme of converting basic data into data that is ready to be used on a map or matrix according to the number of activities, then input data according to the activity. The matrix can contain records of various types of data, including (Purnomo, 2004): (a) The number of movements between activities; (b) Amount of material moved per time period; (c) Weight of material moved each period; (d) The combination of amount, time and weight per unit time; (e) Percentage of each activity against previous activities.

Research methods

The research method used at PT. Indonesian Furniture Wood, Semarang can be presented in the following scheme:

Data collection is the main foundation as part of finding answers to problems faced by PT. Kayu Mebel Indonesia Semarang. This company is engaged in the wood processing manufacturing industry which works on an order basis. So that production is carried out when the company gets orders according to the number and type of orders obtained. In this case PT. Kayu Mebel Indonesia Semarang. The primary data obtained here includes several things such as: (a) type of product; (b) data on production equipment/machinery and capacity; (c) the name of the production equipment and its area. Supporting data that complements the main data. The data were obtained by interviewing the company regarding the issues in this study.

From the data collection, some information is obtained:

(a) PT Kayu Mebel Indonesia product types include:

Table 1. Product Type

No	Types of products	Size (PxL) cm
1	A&Z	18x85
2	BLUES	18x85
3	RTL	85x275

(b) Production equipment and capacity used at PT. There are several parts of Indonesian Furniture Wood, namely:

Table 2. Machine production and capacity

No	Equipment	Capacity
1	Plans	6000
2	Cross Cut	3000
3	Joint	4000
4	Laminating	3000
5	Moulding	5000

(c) The name of the machine and the area owned by PT. Kayu Mebel Indonesia are as follows:

Table 3. Machine name and area

Code	Equipment	Area
P1	Plans	3x2m =6m2
P2	Cross Cut	12x1,5m=18m2
P3	Joint	12x1,5m=18m2
P4	Laminating	7 x 2m = 14m2
P5	Moulding	7,5 x 3m = 22,5m2

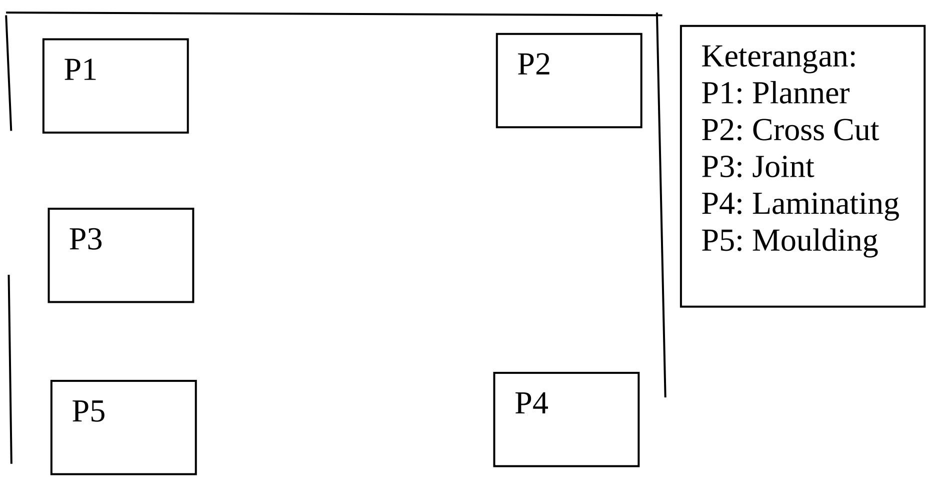
Data analysis

This study will apply two methods, namely the ROCA method and the SC method. The ROCA method is used for several functions such as: (1) determining binary weights; (2) determining the decimal equivalent; (3) equivalent decimal ranking; cell grouping. While the SC method is used to: (1) calculate the similarity coefficient; (2) making a dendrogram; (3) cell grouping. From there it will be reviewed how the old total layout through the old from-to-chart analysis is compared with the results of the new total distance of material movement using the new form-to-chart analysis.

Results and Discussion

The results of this study were carried out by analyzing the initial layout at PT Kayu Mebel Indonesia Semarang.

Figure 1 Initial layout of PT Kayu Mebel Indonesia's production process flow



Material movement distance is the length of the path traveled from one production line to another. Distance measurement can be obtained by setting the layout of the area that is too far by taking into account the length of the track and the costs spent by the company on that route. In order to know the distance of material movement in the initial layout, it must be drawn on coordinates with the X and Y axes. These coordinates are adjusted to the actual layout size of each production line in the factory. Then look for the center point on each production line with the following formula (Chang, 1995):

- Range Euclidean = $[(x-a)2 + (y-b)2]0.5$
- Range Rectilinier = $(x - a) + (y - x)$
- Range Squere Euclidean = $(x - a)2 + (y - b)2$

Then the researcher can reveal the conversion value of the supporting data as follows:

Table 4. Conversion Value

Product	Weight (Kg) A	Raw Material(M) B	Cost Per Unit C	Production flow	Conversion value
1	3	7	6000	P1-P3-P2-P4	126000
2	2	7	4000	P1-P3-P5	56000
3	4	6	7000	P1-P2-P4-P3	168000

The total conversion value transferred from P1 to P2 is part 3 with a capacity of 168000. The conversion value transferred from P1 to P3 is part 1 and 2 with a capacity of 126000 and 56000, the total transferred is 182000. The conversion value transferred from P2 to P4 is part 1 and 3 with a capacity of 126000 and 168000, the total transferred is 294000. The conversion value transferred from P3 to P5 is part 2 with a capacity of 56000. And the conversion value transferred from P4 to P3 is part 3 with a capacity of 168000.

Table 5. Form to chart layout before

When	From					Amount
	P1	P2	P3	P4	P5	
P1						0
P2	168000		126000			294000

P3	182000			168000		350000
P4		294000				294000
P5			56000			56000
P6						
Amount	350000	294000	182000	168000	0	994000

In Table 5 it can be seen for backward values layout Initially there were only 2 namely 126000 (from P3 to P2) and 168000 (P4 to P3). While the other values include forward.

Table 6. Backward and forward analysis

Backward	Forward
1) 126000 + 168000 = 294000 %= (294000/994000) x100%= 29,6%	1) 168000 2) 182000 3) 294000 4) 56000 Total = 700000 %=(700000/994000) x100%= 70,4%

Application of the ROCA Method

The rank order clustering algorithm (ROCA) method is a method of grouping equipment/machinery based on row and column sorting of the incident matrix of equipment/machine components. The concept carried by ROCA is to form diagonal blocks by re-allocating the columns and rows of the machine component matrix repeatedly which are expressed in binary values. The order of the production process can be seen in table 7. The matrix of the order of the components of the production process can be seen in table 8. Decimal values equivalents based on binary values can be seen in table 9. Results of weighting calculations 2^n on equipment/machines can be seen in table 10. While the weighting 2^n on the equipment/machine can be seen in table 11. Then the calculation of the equivalent decimal value of the column based on the binary system is as shown in table 12.

Table 7. Sequence of the production process

Component	Process Order
1	P1-P3-P2-P4
2	P1-P3-P5
3	P1-P2-P4-P3

Table 8. Matrix of the sequence of production process components

Equipment/Machine	Component		
	1	2	3
P1	1	1	1
P2	1	-	1
P3	1	1	1
P4	1	-	1
P5	-	1	-

Table 9. The equivalent decimal value based on the binary value

Equipment/Machine	Component		
	1 (2nd)	2 (2nd)	3 (2nd)
P1	1	1	1
P2	1	-	1
P3	1	1	1
P4	1	-	1
P5	-	1	-

Add up the value of each equipment/machine based on the components arranged

P1 = $2^2 + 2^1 + 2^0$ = 6

P2 = $2^2 + 2^0$ = 4

P3 = $2^2 + 2^1 + 2^0$ = 6

P4 = $2^2 + 2^0$ = 4

P5 = 2^1 = 2

Table 10. Results of weighting calculations 2^0 on equipment/machines

Equipment	Component			Amount	Ranking
	1	2	3		
P1	1	1	1	6	1
P2	1	-	1	4	3
P3	1	1	1	6	2
P4	1	-	1	4	4
P5	-	1	-	2	5

Changes in the location of the machine based on the largest value as well as weighting 2^n on the machine (Starting from the machine with the largest value).

Table 11. Weighting 2^n on the machine (starting from the machine with the largest value)

Equipment	Component			Amount	Ranking
	1	2	3		
P1 (2^n)	1	1	1	6	1
P2 (2^n)	1	-	1	4	3
P3 (2^n)	1	1	1	6	2
P4 (2^n)	1	-	1	4	4
P5 (2^n)	-	1	-	2	5

Table 12. Column equivalent values

Equipment		Component		
		(1)	(2)	(3)
P1	2^n	1	1	1
P2	2^n	1	1	1
P3	2^n	1	-	1
P4	2^n	1	-	1
P5	2^n	-	1	-
Amount		30	24	30

Changing the placement of components based on the largest value:

Table 13 Placement of components based on the largest value

Equipment		Component		
		(1)	(2)	(3)
P1	2^n	1	1	1
P2	2^n	1	1	1
P3	2^n	1	1	-
P4	2^n	1	1	-
P5	2^n	-	-	1

Amount	30	30	24

Sel 1=P1, P3, P2, dan P4 Components 1, 3
Cell 2=P5 Component 2

Application of the SC Method

The cluster method is based on the coefficient of similarity (SC) between one piece of equipment and another in producing a product/component.

General formula:

$$Time = \frac{\Sigma\ Xijk}{\Sigma\ (Yik + Zjk + Xijk)}$$

Information:
Sij = coefficient of similarity between equipment i and j
Xijk = parts that pass through equipment i and equipment j
Yik = parts that only pass through equipment i
Zjk = parts that pass through device j only

Counting Similarity Coefficient (SC):

Table 14. Order of the Production Process

Component	Process Order
1	P1-P3-P2-P4
2	P1-P3-P5
3	P1-P2-P4-P3

Table 15 Matrix of the sequence of production process components

Equipment	Component		
	(1)	(2)	(3)
P1	1	1	1
P2	1	-	1
P3	1	1	1
P4	1	-	1
P5	-	1	-

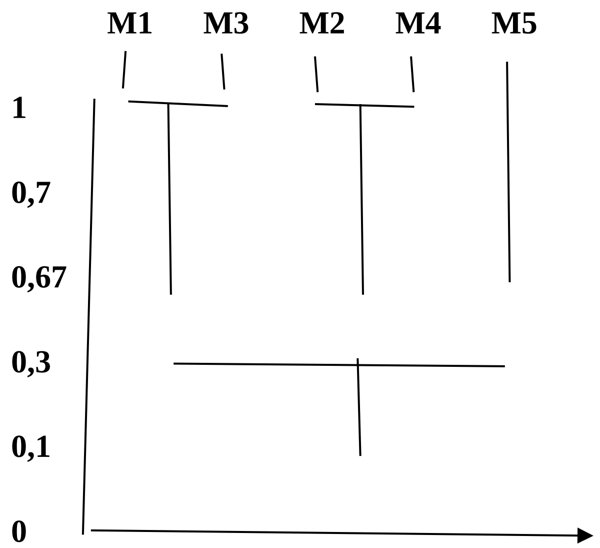
Calculating the coefficient of similarity between machines:

- S 1-2 = 2/ (3 + 3 – 2) = 0.5
- S 1-3 = 3/ (3 + 3 – 3) = 1
- S 1-4 = 2/ (3 + 2 – 2) = 0.67
- S 1-5 = 1/ (3 + 1 – 1) = 0.33
- S 2-3 = 2/ (3 + 2 – 2) = 0.67
- S 2-4 = 2/ (2 + 2 – 2) = 1
- S 2-5 = 0

- S 3-4 = 2/ (3 + 2 – 2) = 0.67
- S 3-5 = 1/ (3 + 1 – 1) = 0.33
- S 4-5 = 0

Create a dendrogram, starting from the largest Sij value

Figure 2. Dendogram of similarities between equipment/machines



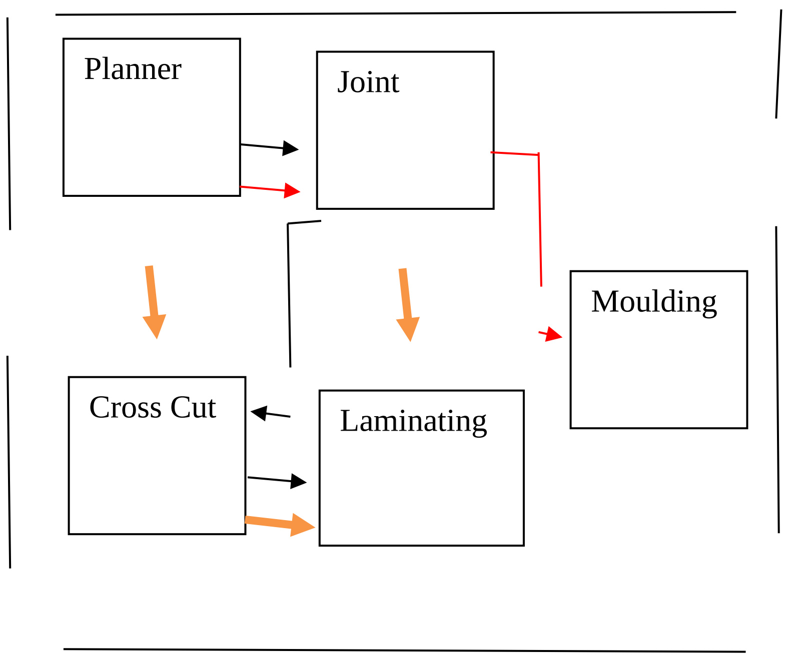
Proposed Layout Planning with ROCA and SC Methods

Re-planning is an activity to carry out an evaluation of the old layout that has been carried out by the previous company. This aims to hold a revision of the material transfer process flow. To plan a new alternative layout, the Rank Order Cluster Algorithm and Similiarity Coefficient methods are used here. The results of the proposed new layout planning from the two methods are as follows:

Create a manufacturing cell:

- Sel 1 : P1,P3
- Sel 2 : P2,P4
- Sel3: P5

Figure 3 the proposed layout along with the flow of the production process at PT. Kayu Mebel Indonesia Semarang



Information:

- The black arrow is the process flow for component 1
- For the direction of the red arrow is the process flow for component 2
- For the direction of the yellow arrow is the process flow for component 3

Analysis from to chart layout proposal:

Table 16 Conversion values and supporting data

Product	Weight (Kg) A	Raw Material(M) B	Cost Per Unit C	Production flow	Conversion value
1	3	7	6000	P1-P3-P2-P4	126000
2	2	7	4000	P1-P3-P5	56000
3	4	6	7000	P1-P2-P4-P3	168000

The conversion value transferred from P1 to P3 is part 1 and 2 with a capacity of 126000 and 56000 so that the total is 182000. The conversion value transferred from P1 to P2 is part 3 with a capacity of 168000. The conversion value transferred from P3 to P2 is part 1 with a capacity 126000. The conversion value transferred from P4 to P3 is part 3 with a capacity of 168000.

Table 17. From to chart layout suggestion

When	From					Amount
	P1	P3	P2	P4	P5	
P1						0
P3	182000			168000		350000
P2	168000	126000				294000
P4			294000			294000
P5		56000				56000
Amount	350000	182000	294000	168000	0	994000

For the proposed backward layout value, there is only 1, that is, see the value of 280000 from M4 to M3. And the other values include the forward.

Table 18. Backward and forward analysis

Backward	Forward
1) 168000 = 168000 Total = 168000 %= (168000/994000) x100%= 16,9%	1) 182000 2) 168000+126000 3) 294000 4) 56000 Total = 826000 %=(826000/994000) x100%= 83,1%

Conclusion

After conducting an evaluation with the technology group analysis, the material movement distance was reduced by 96.46 meters (7%) from the previous distance. Meanwhile, the cost of moving materials was also reduced by IDR 69966 / month/meter (7%) from the previous cost. In the calculation from to the initial layout chart and the proposed layout, there is a decrease in the backtracking value of 12.7%.

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