

The Influence of Production Layout Strategy towards Productivity

N. Sutarni, C. Furqon, L. Noviyanto
Faculty of Economics and Business Education
Indonesia University of Education
nanisutarni@upi.edu

Abstract – From many sectors industries in Indonesia, automotive industry has a progressively growth. This industry also including into machines industry and Tools industry can saved our national industries from decline. Nowadays Toyota Astra Motor still dominated our national automotive market share, while PT. Mitsubishi Krama Yudha Motors and Manufacturing (PT MKM) was on the fifth grade. During the research time, the productivity of the company was decreased. Based on that problem, the company committed to enhance productivity by changing layout strategy. The research was conducted to described about layout strategy, productivity on Production Line Press D at PT MKM I, and to find out the influence of Production Layout Strategy towards Productivity of Production Line Press D at PT MKM I. This study used descriptive methods with explanatory survey, and regression analysis for data analysis. The result shows that productivity influenced by production layout strategy.

Keywords - Production Layout Strategy; Productivity

I. INTRODUCTION

In general, industry is certain business group that have the same techniques and methods which could generate surplus income. Industry term is also used for economic production that focusing to certain manufacturing process that has to have huge amount of capital, before it could gain surplus, and this commonly named as the big industry. In Indonesia, one of the industry that grow rapidly is automotive industry sector. This industry is one of important pillar in economic sector and society welfare, as its local product content set ideally could reach 80 to 85%. Thus other assembling industry in Indonesia could grow bigger and take more workforces. This latest development has caused tight competition in automotive industry, as companies try to increase their competitive advantages that could be reached by increasing its productivity. One of the company who try to do this is PT. Mitsubishi Krama Yudha Motors and Manufacturing (PT MKM), by changing its production layout strategy. This has high urgency if we could refer that PT MKM productivity within 10 years have decreased massively, whereas in 2006, PT MKM has second rank under Toyota Astra Motor, but in 2015 it has reached the fifth rank nationally. The reason to choose PT MKM I (as part of PT MKM), was because of its status as stamping factory that having lower productivity compared to PT. MKM II

(engine factory). Meanwhile, the choice of line production at Press D in PT. MKM I, was caused by the location of Press D that far away from the Material Stock and other production lines. Therefore, this Press D production line layout need to be adjusted optimally and will be expected to increase the overall productivity. Because of this reason, then this becomes the ground for this analysis about the influence of production layout strategy towards productivity in the the press D production line at PT MKM I.

II. LITERATURE REVIEW

There are two main term as a keyword in this research, lay out, and productivity. Both terms will be explained in this part. [1] Layout is one of the key decisions that determine the long run efficiency of operations. Layout has strategic implication because it establishes an organization's competitive priorities in regard to capacity, processes, flexibility, and cost, as well as quality of work life, customer contact, and image. An effective layout can help an organization or company achieve a strategy that supports differentiation, low cost, or response.

The objectives of layout design are:

- Higher utilization of space, equipment, and people.
- Improved flow of information, materials, or people
- Improved employee morale and safer working conditions.
- Improved customer/client interaction Flexibility (to be changed later) There are several types of lay out, which are:
 - a) Office layout
 - b) Retail layout
 - c) Warehouse layout
 - d) Fixed-position layout
 - e) Process-oriented layout
 - f) Work-cell layout
 - g) Product-oriented layout

A good Layout Requires Determining the Following:
Material handling equipment (manual hand trucks, conveyors, cranes, AGVs) Capacity and space

requirements. Environment and aesthetics (windows, height and walls of the offices to facilitate air flow, to reduce noise etc.) Flows of information (open offices versus dividers) Cost of moving material between work areas.

[2] An importance of material handling is the movement of materials at the minimum cost and also an effective material handling system reduces the manufacturing cost.

[3] The facility layout problem is to arrange facilities within a given area so as to minimize the total material- handling cost. An efficient arrangement of facilities plays an important part in the achievement of high productivity in a manufacturing system. [4] The continuous machine layout problem, and the more general continuous facility layout problem are important problems in manufacturing systems design. [5] Facility layout problems are related to the location of all facilities in a plant.

Based on the situation in the company (PT MKM I) as a locus for the research observation, the product oriented lay out type has relation to the research theme, because product oriented lay out seeks the best personnel and machine utilization in repetitive or continuous production.

In the product oriented lay out, there are two main type, fabrication line, and assembly line.

1) *Fabrication line: builds components on a series of machines; machine-paced; require mechanical or engineering changes to balance*

2) *Assembly line: puts fabricated parts together at a series of workstations; paced by work tasks; balanced by moving tasks*

Both types of lines must be balanced so that the time to perform the work at each station is the same.

The main advantages of product oriented layout are:

- Low variable cost per unit
- Low material handling costs
- Reduced work-in-process
- inventories Easier training and
- supervision Rapid through put

The disadvantages of product oriented layout are:

- High production volume is required to be justifiable
- Work stoppage at any point ties up the whole operation Lack of flexibility in product or production rates

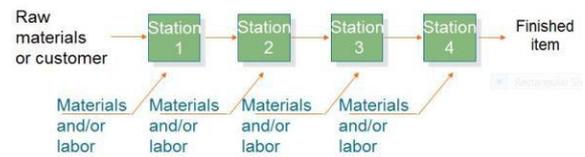


Fig. 1. Production/assembly line, for automobile manufacturing, etc.

The second main term, [6] Productivity is the the measure how good the resources are managed and used to achieve the expected result. The others define [7] Productivity as the comparison between output (result) with input. If productivity increases, this is only possible if there is any increased efficiency (time, material, manpower) and working system, production technical, and if there are any increased skills from its workforces. [8] To know the degree of successfulness in running operational strategy that already set up, we need to do the measurements for its productivity, efficiency, and effectivity of operational activity run. [9] Productivity is how to create or increase the goods and services as high as possible to take most advantages of resources usage efficiently. By that, productivity is frequently translated as the ratio between the output and the input in a certain period of time. Finally, we can define that [1] productivity is the ratio of outputs (good and services) divided by one or more inputs (such as material, labor, capital, and miscellaneous).

$$Pr\ oductivity = \frac{Units\ Produced}{InputUsed}$$

$$Pr\ oductivity = \frac{Output}{Labor + Material + Energy + Capital + Miscellaneous}$$

In general, productivity is stated as the ratio between output and input, or as the result ratio gained as the usage of resources. If in that ratio, the used input to result in the outputs are counted all, it is named as total productivity (*total-factor productivity, TFP*), but if it is counted as input for certain components, then it is called as *partial productivity* or *single-factor productivity*.

III. RESEARCHMETHOD

The objects of this research are: lay out strategy as an independent variable (*X variable*); and productivity as a dependent variable (*Y variable*). The descriptive research type used for the purpose of describing the *X* and *Y* variables, which are lay out production strategy, and productivity. Meanwhile for the purpose to measure the influence of lay out production strategy towards productivity, verification research type was used in this research, by regression analysis and hypothesis test. Data collection using survey method, interview, observation, and documentation study. The formula for regression analysis is:

$$y = a + bx$$

and for the hypothesis, t student test was used.

$$t = r_s \sqrt{\frac{n-2}{1-r_s^2}}$$

IV. RESULTS

A. Descriptive analysis results

Variables examined in this study were production layout strategy (independent variables) and productivity (dependent variable) in press production line D in the PT. Mitsubishi Motors and Manufacturing Kramayudha I. Here are descriptions for each of these variables:

[1] Layout strategy is one of the decisions on the restructuring of production facilities for efficient operation of the company in the long term. The layout of Press D production line is quite affecting the production of Press D itself or another production line. There are three indicators used to assess the efficiency of a layout strategy; raw materials, transport capacity, and handling time.

B. Raw material

The use of raw materials in general has always fluctuated, it depends on production orders by PT. Mitsubishi Krama Yudha Ratu Motor which is the company marketing department of Mitsubishi. At the PT. Mitsubishi Krama Yudha Ratu Motor done assemble all products that produced by PT. MKM before marketed to consumers. Orders from PT. Mitsubishi Krama Yudha Ratu Motor influenced by some external factors of government policy and the global economy, such as increases and decreases in fuel prices in Indonesia will affect the purchasing power of consumers. In general, consumers of PT. Mitsubishi Krama Yudha Ratu Motor are commercial enterprises that require a vehicle in running its business. Therefore, the product marketed by PT. Mitsubishi Krama Yudha Ratu Motor is required by these companies, and products produced sufficient quality in the market. The engine in Press D is Small Press because the capacity of machine power is quite small (110 Tonnage) compared to other machines in the Press production line, as well as the size. The power of the machine related to stamping or pressing a product. Not all products manufactured by PT. MKM I always through Press D. The point is that every production of a product must be tailored to the capacity of the machine Stamping. The production capacity of the machine in Press D average is 52 units/hour or 0.87 units/min, it's called machine hour to produce a product per machine. As for the maximum time for the engine capacity in Press D is 420 hours/month. By knowing the capacity of the machine, we can measure production time.

C. Transport Capacity

Transport capacity referred to the maximum capacity of the car transporter in bringing the product or raw materials. The car have a capacity of transporting about 50 sheet of Material Stock, whereas for work-in-process (WIP) about 30 units. Material stock transported is still in the form of steel sheet, meanwhile WIP are already visible form of a product to be made. WIP products

derived from the production line that requires machine power of Press D to complete a product.

D. Handling time

Before the changes to the layout of the Press D, the distance between Press D to the production line associated with the production Press D quite far apart and can be said to be less efficient. Here is the data about the distance between Press D to production line which has a working relationship in its production:

- Material Stock toward Press D: 165 m, time 0.033m/h.
- Press A to Press D: 8 m, time 0.0016m/h.
- Press B to the Press D: 30 m, time 0.006m/h.
- Press C to the Press D: 60 m, time 0.012m/h.
- Press D to the hand work: 80 m, time 0.016m/h.
- Press D to the stamping part stock area: 5 m, 0.001m/h.

The total accumulated distance of transfer of goods to the Press D along 348 meters. As for the speed used by the car transporter is 5 km/h. For the latest data from the time of transfer of the goods at the latest Press D after the change of layout is as follows:

- Material Stock to Press D: 130 m, time 0.026m/h.
- Press A to Press D: 10 m, time 0.002m/h.
- Press B to Press D: 10 m, time 0.002m/h.
- Press C to Press D: 40 m, time 0.008m/h.
- Press D to hand work: 100 m, time 0.02m/h.
- Press D to stamping part stock area: 4 m, 0.0008m/h.

Total accumulated distance transfer of goods in Press D with the new layout is 244 meters. Judging from the total accumulated distance of diversion, Press experiencing the efficiency of distance by 30 % compared with the use of the old layout strategy on Press D.

The layout strategy Press D at PT. MKM I Layout system uses cellular manufacturing system which is a combination of product orientation with the orientation process. Cellular layout consists of several machines with different functions, which are placed adjacent to each other and dedicated to work on part-families it processes. Capabilities of the engine are grouped to match the flow of the production process. Various factors have closeness in the production process are placed close together.

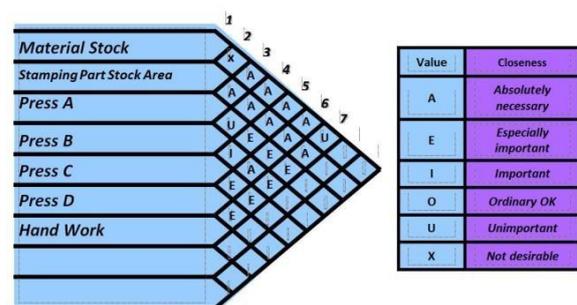


Fig. 2. Activity Relationship Chart of the Press D Production Line

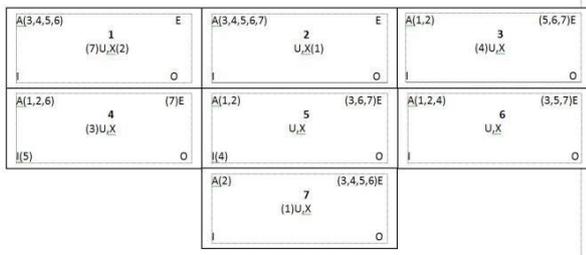


Fig. 3. Activity Relationship Diagram of the Press D Production Line

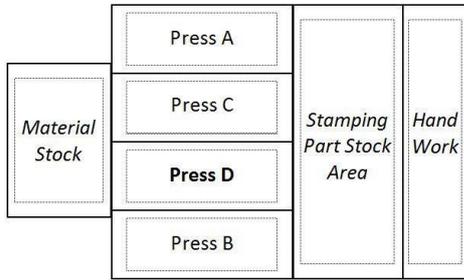


Fig. 4. Layout of the Press D Production Line base on Degree of Closeness

On the picture layout Material Stock is needed once the production line Press. As for Stamping Part Stock Area is needed proximity to Work Hand in comparison with production lines Press. Items will be heading to Hand Work previously stored beforehand in Stamping Part Stock Area, so Stamping Part Stock Area takes its proximity to the production lines Press. For more details about the layout of the actual picture in PT MKM I both before and after the change of strategy at Press D can be seen in the attached picture factory layout.

E. Productivity overview

Productivity implies the progress of the change. [1] Productivity is the ratio between output (goods and services) divided by inputs (resources). Productivity can be said to be increased if the resources are not used up and the resulting product rises. Therefore, a good company is if the company can manage resources used in order to increase productivity. With the increase of the productivity of the company will get significant profit.

Productivity at Press production line in a certain period during this research time has shown that there was a fluctuation at Press D productivity, and the value average of productivity has decreased. As production run, Press D productivity has increased with the value of 101.6% at the last period phase.

F. Results of statistical analysis

Hypothesis testing results show that the strategy layout has a significant relationship with the productivity. The correlation value of 0.621 showing a strong degree of correlation. Based on the regression equation shows that the decline in the value of overall evaluation of the strategy will boost productivity in the layout Press D PT. MKM I. Therefore, changes in the layout of the new strategy can bring a strong influence on the increase in productivity.

TABLE I. REGRESSION ANALYSIS RESULTS

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta	B	Std. Error
1	(Constant)	103.180	1.428		72.244	.000
	Layout	.064	.025	.621	2.504	.031

Based on the data processing using linear regression, obtained equation $Y = 103.180 + 0.064X$. Constant at

103.180 states that if there is no increase in the value of the variable layout strategy (X) then the value of productivity (Y) will increase by 103 180. A regression coefficient of 0.064 states that each increase of one score or value on the layout strategy will provide increased productivity by at 0.064. To determine the contribution of layout strategy (X) to fluctuations in productivity (Y) is calculated with a coefficient of determination.

$$\begin{aligned}
 \text{coefficient of determination} &= r^2 \times 100\% \\
 &= (0,621)^2 \times 100\% \\
 &= 38,56\%
 \end{aligned}$$

Based on the above data processing showed that, the influence of the inventory management system by the supplier (X) to the cost of production amounted to 38.56

%, while the remaining 61.44 % influenced by other factors. Based on test results that show the correlation value of 0.621, which means strategy layout has a strong influence on the productivity of the Press D, so H_0 rejected. Based on the calculation results obtained $t =$

2.504. Due t value $>$ t table, namely $2.504 > 1.812$, it can be concluded reject H_0 , meaning that affect the productivity layout strategy.

V. CONCLUSION

Based on the research result about the effect of layout strategy to the productivity in the Press D production line at PT MKM I, we could conclude as follows:

PT. MKM I has done its production facility layout that all machines at Press D could run more efficiently. Press D's new layout strategy could give efficiency on distances between Press production line for 30% compared to the previous layout strategy. This change will cause the decreasing of value from layout strategy because of time efficiency. This new layout strategy is expected to give positive impact to Press D in running its production, because Press D is the production line that needed by other production lines. By this change, it is also expected to reduce problems that frequently happen in running the production, such as material handling, waiting time, smoothness in sending products / outputs.

Productivity at Press production line in a certain period during this research time, has shown that there was a fluctuation at Press D productivity, and the value average of productivity has decreased. As production run, Press D productivity has increased with the value of 101.6% at the last period phase.

Based on the statistical test, it can be concluded that layout strategy could give impact to the productivity on Press D production line. PT. MKM I has changed the layout strategy in order to increase its productivity. Press

D has increased its productivity, including for layout changed at Press D as an important production line in running the production process at PT MKM I. The hypothesis test result in this research has also concluded that there is an influence of Production Layout Strategy towards Productivity in the Press D Production Line at PT. Mitsubishi Krama Yudha Motors and Manufacturing I.

ACKNOWLEDGEMENT

We would like to express our deepest gratitude to PT. Mitsubishi Krama Yudha Motor and Manufacturing I who has helped the research from the beginning till its completion.

REFERENCES

- [1] Heizer, Jay, and Render, Barry. 2014. *Operations Management: Sustainability and Supply Chain Management*, 11th Edition. Pearson Education, Inc.
- [2] Arulkumar, P. V., Saravanan, M. Minimising material handling cost using relative factors for fixed area cell layout problem. *Applied Mechanics & Materials*, 2015, Vol. 786, p311-317.
- [3] Xiao, Yujie and other. A two-step heuristic algorithm for layout design of unequal-sized facilities with input/output points. *International Journal of Production Research*, Jul 2013, Vol. 51 Issue 14, p4200-4222.
- [4] Brunese, P.A. On implied within-building constraints for machine layout. *International Journal of Production Research*, Mar 2013, Vol. 51 Issue 6, p1937-1952.
- [5] Navidi, Hamidreza. A heuristic approach on the facility layout problem based on game theory. *International Journal of Production Research*, Mar 2012, Vol. 50 Issue 6, p1512-1527.
- [6] Herjanto, Eddy. 2006. *Manajemen Operasi. edisi ketiga*. Jakarta.GRASINDO.
- [7] Hasibuan, Malayu S.P. 2003. *Manajemen (Dasar, Pengertian Dan Masalah)*. Jakarta. PT. Bumi Aksara.
- [8] Murdifin Haming dan Mahfud Nurnajamuddin. 2007. *Manajemen Produksi Modern: Operasi Manufaktur dan Jasa*. Jakarta. Bumi Aksara.
- [9] Sedarmayanti. 2001. *Sumber Daya Manusia dan Produktivitas Kerja, Cetakan Kedua*, Bandung. Mandar Maju.