REDESIGN FACILITY LAYOUT WITH QUANTITATIVE AND QUALITATIVE METHOD ON PRINTING INDUSTRY

Trifenaus Prabu Hidayat[1], Andre Sugioko[2] and Gabriella Ratna Widiastuti[3]

Industrial Engineering Courses, Engineering Faculty, Atma Jaya Indonesia Catholic University,

Jl. Jenderal Sudirman Kav. 51, Jakarta Selatan, 12930, Jakarta

[1] trifenausprabuhidayat@gmail.com, [2] andresugioko@gmail.com

ABSTRAK

Performance and productivity production line system are very influenced by facility layout planning. Facilities composition if appropriate with flow of materials between departments, it will sustain the continuity of the system. PT. X engaged in the field of printing. Composition of the current layout facilities on the Plant has not fully optimized well and indeed has a potential possibility to be developed further in the future. This statement is supported from the result of existing MHPS which gives Rp 6.560.374,50 for total cost of material handling and 136329 metres for total distance. As for the purposes of this research are: evaluating the performance of current facility layout, designing the layout of the facility with qualitative and quantitative methods, comparing the current with proposed improvement layouts, as well as create a picture the new layout facility. The process of designing proposed layouts is done by using qualitative methods (CORELAP, BLOCPLAN & CRAFT) and quantitative methods (ABSMODEL & CRAFT) that both of the algorithms need same inputs, which are: current facility layout and the flow of material. Based from the results of calculation proposed layouts, show that layout from qualitative methods (CORELAP) gives maximal reduction to the total cost of material handling so that the amounts will be decreased to Rp 6.100.133,55 (reducing 7,02% from total cost of current layout), and 117264 metres for total distance (reducing 13,985%.).

Kata kunci : facility layout, quantitative methods, qualitative methods

I. Introduction

Material handling is a function rather than the movement of the right material to the right place, at the right time, the right amount and the right position to minimize costs. According El-baz (2004)[5]. "Material handling systems ensure that the delivery of raw materials in order to get to the goal".

Materials handling in addition to support production are also related to the layout of the facility. A change in the material handling causing changes in the layout as well. When dealing with issues related to material handling systems, the main thing to consider is preparing the facility and its vehicle. The vehicles (material handling) determine the pattern of future production floor layout [3]. Material handling requires some elements that need to be considered, the first is a project management system, which covers all activities relating to the sequence, average speed, layout, and routing [8].

Material Handling costs (OMH) are a cost that shows the amount of freight or material handling costs between departments that are interconnected. Material handling costs can be used as a basis for determining the layout of the facility. In terms of costs, a good layout is to have a small total material handling costs, although in this case the cost is not the only indicator to declare that the layout was good and there are many other factors that need to be considered.

PT. X is a company engaged in the field of printing. PT. X split its production floor into 2 parts, which is part of media and packaging. Laying the production facilities in the packaging known to less than ideal so as to make the material flow one facility to another facility to be disrupted with an indication of the distance of displacement is high enough and should still be minimized again. The farther the distance between facilities (d_{ij}), will slow the movement of the flow of production that leads to decreased levels of productivity and an increase in overall costs (C_{ij}).

Therefore, position arrangement for appropriate facilities and well-coordinated for all three units of the building owned by PT. X.PT. X currently has problems related to the layout of the facility tall three units of the building. This is evident from the amount of mileage material movements between work stations resulting in increased overall material handling costs. The purpose of this study are: to evaluate the layout of the current facilities at the Packaging PT. X, designing the layout of the facility with qualitative and quantitative methods, comparing the layout of the current facilities with a design layout of new facilities using qualitative and quantitative methods, create a picture of the layout of the new facility is based on the best method.

II. Methodology

1. Identification of Current Performance At this stage, the calculations of two criteria comparison to the current layout conditions (distance and cost). Some inputs are used:
   a.   Distance moved between work stations
   b.   The number and dimensions of the work station
   c.   Layout plan of the current facilities
   d.   Data related material handling

   As well as several other supporting data (production capacity, product structure, the reliability of the engine, and so on)
2. Design the layout by using a quantitative method ABSMODEL and continued using CRAFT method for optimized.
3. Design the layout by using a qualitative method with BLOCPLAN and CORELAP algorithms then continued using CRAFT method for optimized.

2.1 Designing the layout by ABSMODEL method

Notations used in ABSMODEL are:

n Number of facilities
c_{ij} Material costs of moving one unit of distance facilities i and j
f_{ij} Number of trips between the facilities i and j
l_i Length of the horizontal section of the facility i
b_i Length of the vertical section of the facility i
dh_{ij} Minimum horizontal distance between the facilities i and j
dv_{ij} Minimum vertical distance between the facilities i and j

Model Minimization $\sum_{i=1}^{n-1} \sum_{j=i+1}^{n} c_{ij} f_{ij} (|x_i - x_j| + |y_i - y_j| \dots (1)$

Constraints: $|x_i - x_j| + M z_{ij} \geq \frac{1}{2}(l_i - l_j) + dh_{ij}$, i = 1, 2, …, n-1, j = i+1, …, n … (2)

$|y_i - y_j| + M(1 - z_{ij}) \geq \frac{1}{2}(b_i - b_j) + dv_{ij}$, i = 1, 2, …, n-1, j = i+1, …, n … (3)

$z_{ij}(1 - z_{ij}) = 0$, i = 1, 2, …, n-1, j = i+1, …, n … (4)

This is the result of ABSMODEL alternative initial layout (early), which will be followed using methods CRAFT.

2.2 Designing the layout by CRAFT method

The method used to repair the current layout is to use the algorithm improvement CRAFT (with the help of software WinQSB). For the calculation using the software is done by entering the necessary data and the software will automatically perform iterations until the optimal.

Each iteration results obtained will be recalculated its coordinates, the displacement distance, up to the total cost calculation using MHPS (using the previous equation). The reason is because the use of algorithms CRAFT role as Improvement-type rather than as a Construction-type which means that the function is to improve and increase (improve) the condition of the current layout with the aim of reducing costs and distance moving material through spot exchange between departments.

2.3 Designing the layout by CORELAP Algorithm

Another method that is used as a comparison method CRAFT is CORELAP. CORELAP algorithm (Computerized Relationship Layout Planning) is an algorithm development (construction algorithm), which is an algorithm used to generate the new layout designs that do not rely or not require initial layout. CORELAP algorithm procedure is to calculate the activities of the busiest in the layout or who have the highest degree of relatedness. CORELAP algorithms require input data in the form of a map of the relationship (ARC), the area of each department, the number of departments, and value relationships. The output from CORELAP (early initiation) is used as input for the CRAFT method.

2.4 Designing the layout by BLOCPLAN method

BLOCPLAN is a hybrid algorithm (a mix between construction and improvement algorithm) which requires a degree of relationship closeness between facilities (relationship) as the primary input. This closeness degrees obtained from the ARC which is converted into the form of symbols relationship closeness degree (A, E, I, O, U, and X). For the results to be obtained from calculations with BLOCPLAN algorithm is done with the help of BLOCPLAN software for Windows which will produce a maximum of 20 randomly optimal layout by taking into account the degree of closeness input (relationship) which had been granted previously. Then from any existing alternative layout is evaluated using software WinQSB to determine which alternative has the smallest total material handling movement. After obtained the best alternative, optimization will be followed using CRAFT method.

III. Result

3.1 Routing Calculation Sheet (e.g.: for joint operations manual and QC inspection and packing to Fancy Carton Box Iron Philips HD 1172)

- Processing time = 80000s (known)
- Set up time = 300s (known)
- Operating hours = 8x3600seconds=28800seconds
- Theoretical machine capacity $= \dfrac{\text{Hours of operation}-\text{time setup}}{\text{processing time}} = 0.36$
- Scrap percentage = 1.5%
- The expected number = 10000sheets(known)
- Number of prepared $= \dfrac{\text{The expected number}}{(1-\%skrap)} = 10000/((100\% \text{ -1.5\%})) = 10150$ sheets
- Efficiency = 95% (known)
- Production with efficiency $\dfrac{\text{The expected number}}{(1-\%skrap)}$ 10150/(95%) =10684 sheets
- Reliability = 95% (known)
- Theoretical number of machines $= \dfrac{\text{production with\,efficiency}}{\text{Reliability}x \text{ engine capacity\,theoretically}}$: circulation =10684/(0.95 x0.36): 10000 = 3.1569 Machines

3.2 Calculation Distance Displacement

Calculation of the displacement distance between work stations using rectilinear provisions. Existing layout described to be block diagram layout.
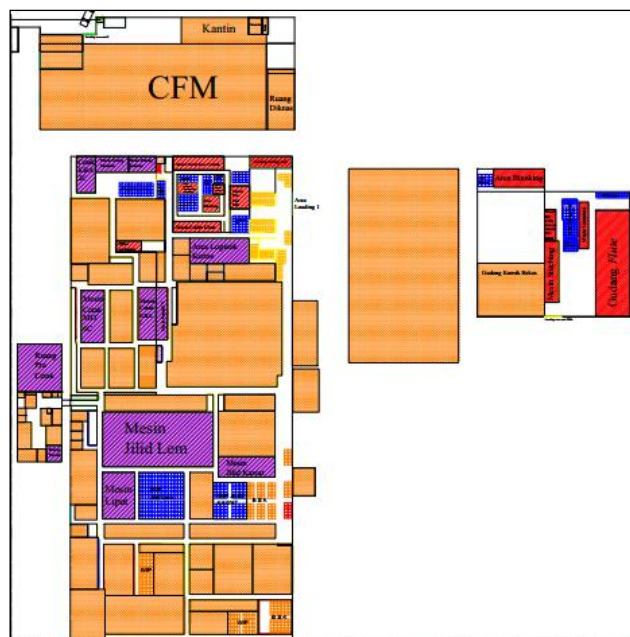

Figure-1. Block Diagram of Overall Layout

Once described, then searched the distance between each point of the center of the work station with rectilinear equation.

$d_{ij} = |\Delta x| + |\Delta y| \dots (5)$

- coordinates manual gluing area : Xa = 43,65 ; Ya = 211,1
- coordinates finished goods warehouse unit 2: Xb = 70 ; Yb = 211,22
- Then: dij= |Xa-Xb| + |Ya-Yb|
    = |43,65-70| + |211,1-211,22|
    = 26,35 + 0,12
    = 26,47 (meter)

3.3 Trip displacement calculation
Examples trip displacement HD1172 products
Pallet capacity:

Paper duplex 250 6287 = 6 Rim
Flute single face = 4 Rim
Assembly duplex & Flute = 3 Rim

The amount of raw materials:
Paper duplex 250 6287   = 10.646 Rim
Flute single face   = 20.71 Rim
Printing plates   = 6 Plat

Calculation:
Trip Paper duplex 250 6287 = (10.646 Rim) / (6 Rim) = 1.77 $\approx$ 2 times
Trip Flute single face = (20.71 Rim) / (4 Rim) = 5.18 $\approx$ 6 times

3.4 Calculation MHPS
Here the calculation condition existing layout (duplex paper materials 250 6287 (HD 1172)) from the logistics area paper to cutting machine:
- Distance (in rectilinear) = 67.4144 m
- The amount to be transferred = 5323 = 10.646 rim sheet
- For unit load is at 6 rim (using a hand pallet MH)
- Total trip = 2 (Trip Paper duplex 250 6287)
- Time displacement (known)

$$= \text{Load Unload} + \left[\left(\frac{1}{Average\ Speed}\right) \times \left(\frac{Distance}{\text{effectiveness}}\right)\right]$$

$$= 2 + \left[\left(\frac{1}{30}\right) \times \left(\frac{67,4144}{0,5}\right)\right] = 6,49 \text{ minutes.}$$

- Total time of use of equipment = $\sum$(The transportation time x $trip$) = ((6,49 x 2)+(5,976 x 2)+…) = 108,55minutes
- Transport costs (known)

$$= \left[\left(\frac{\text{Transport time}}{\text{Total time of use of equipment}}\right) \times (Qty \times Inv.cost/TU)\right] + \left[\text{Transport time} \times \frac{hourly\ FP\&M.Cost + Hour\ Labour\ Cost}{60}\right]$$
$$= \text{Rp } 2154,03$$

3.5

IV. Kesimpulan

Kesimpulan menggunakan Times New Roman 10 pt. Kesimpulan dari makalah/paper dapat diberikan dalam bentuk point-point ataupun paragraph.

Ucapan Terima Kasih

Ucapan terima kasih diberikan apabila ada pihak-pihak yang membantu atau penyandang dana.

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