Eucalyptus Oil Plant Layout Desain in Timor Tengah Utara Regency Using Activity Relationship Chart (ARC) Method

Quido Kolo¹, Arif Budiman², Alva Edy Tantowi³, Wiku Larutama⁴
Magister of System Engineering, Faculty of Engineering, Gadjah Mada University
Jl. North Teknika No. 3 Barek UGM Yogyakarta 55281 Indonesia
Department of Chemical Engineering, Faculty of Engineering, Universitas Gadjah Mada
Department of Industrial Engineering, Faculty of Engineering, Universitas Gadjah Mada
Magister of System Engineering, Faculty of Engineering, Universitas Gadjah Mada
Jl. North Teknika No. 3 Barek UGM Yogyakarta 55281 Indonesia

quido.kolo@mail.ugm.ac.id; abudiman@ugm.ac.id; alvaedytontowi@ugm.ac.id; wiku.larutama@mail.ugm.ac.id

Abstract, The factory layout is an important role in improving the efficiency and viability of the industry. Designing the plant layout can use Activity Relationship Chart (ARC). The purpose of this research is to design the layout of eucalyptus plant facility in Timor Tengah Utara district. The results showed that the layout planning department Eucalyptus Oil production by Activity Relationship Chart (ARC) is largely influenced by the degree of sequence relationships between departments work flow and the degree of personal contact is often done. Based on the research that has been done in Timor Tengah Utara district, it can be concluded that the planning layout by Activity Relationship Chart (ARC) more efficient in Eucalyptus Oil refining process.

Keyword: Eucalyptus Oil; layout; production planning; Activity Relationship Chart

Introduction
Government's commitment to increase the production of essential national, stipulated in Government Regulation No. 14 Year 2015 concerning the National Industrial Development Master Plan 2015-2035 year [2]. National industrial development policy with a focus on the deployment and equity industry, the increase in value added in the country through the management of industry resources is sustainable, and improving the competitiveness and productivity of national industry.

Eucalyptus which is supposed to be a very promising commodity has not demonstrated its role in society yet [3]. Eucalyptus Oil national production in 2017 of about 650 tons per year, while the national pharmaceutical needs of 3,675 tons per year [4]. Ironically, demand of eucalyptus oil that increases not matched by supply is adequate. To cover the shortage of supply of eucalyptus oil as much as 3,025 tons per year is filled with eucalyptus oil imports from China.

White Wood Oil refining production, requiring a factory facility layout condition is good. In general, plant equipment layout carefully planned will also determine the efficiency and maintain the viability of the industry. So the need for research to design the layout of the plant eucalyptus in North Central Timor in order to support the productivity and production efficiency.
Eucalyptus Oil refining production, requiring a factory facility layout condition is good. In general, plant equipment layout carefully planned will also determine the efficiency and maintain the viability of the industry. So the need for research to design the layout of the plant eucalyptus in Timor Tengah Utara to support the productivity and production efficiency.

Based on data from the Department of Industry and Commerce of Timor Tengah Utara regency in 2018, it is known that the potential of eucalyptus plants with total area of 74 hectares has a number of plants estimated at 82,222 stems. The huge potential has not been used optimally, due to the unavailability of a large production facility. Eucalyptus plantation area which is extensive in Timor Tengah Utara has been able to make this area as one of the centers of essential plant eucalyptus. But the fact the field results eucalyptus oil produced in the Timor Tengah Utara only reached 0.72 tons per year, it is very small inversely proportional to the great potential of the raw materials.

The purpose of this study is to design the layout of eucalyptus plant facility in Timor Tengah Utara district.

Method
The design layout White Wood Oil mill can use Activity Relationship Chart (ARC) [5]. The flow of materials can be measured quantitatively using benchmarks the degree of closeness between the facilities (department) with each other. The values indicate the degree of relationship is recorded simultaneously with the underlying reasons in a map activity relationship (Relation Activity Chart) which has been developed by Richard Muther. An activity relationship map can be constructed with the following procedures:

1. Perform interviews or surveys of employees from each department are listed in the map and also with the management authorities.
2. Define the criteria of the relationship between departments will be set location based on the degree of tightly relationship and the reasons for each map. Furthermore, set the value of the
3. Discuss the results of assessment activities that have been mapped relationship with the basic reality of management. Freely give the opportunity fatherly evaluation or changes are more appropriate.

Result and Discussion
The depiction of the degree of proximity of each department can be seen in Figure 1.

Figure 1. Relationship activity chart (Source: Sritomo, 1991)

| Degree of relationship                                      | Code | Color   |
|-------------------------------------------------------------|------|---------|
| Absolutely necessary approximated                           | A    | Red     |
| It is important to approximated                             | E    | Yellow  |
| It is important to approximated                             | I    | Green   |
| Enough / regular                                            | O    | Blue    |
| Not important                                               | U    | White   |
| Undesired adjacent                                          | X    | Chocolate |

The code letters such as A, E, I, O, and so show how the activity of each of these departments has a direct relationship with one another. To make it easier to analyse the degree of interest the letter codes
can be placed on top of the box. Furthermore, the code numbers 1, 2, 3, 4, 5, and so on are in place the bottom of the box, can explain the reasons for the selection or determination of the degree of relationship the activity of each of these departments. Letter code that describes the degree of correlation of activity of each of these departments in particular have been standardized, which is as follows:

| Code | Description of reasons |
|------|------------------------|
| 1.   | Usage notes together   |
| 2.   | Using the same labor   |
| 3.   | Using the same space area |
| 4.   | The degree of contact personnel who often do |
| 5.   | The degree of contact paper work is often done |
| 6.   | The sequence of work flow |
| 7.   | Conducting the same work |
| 8.   | Carry out the same work equipment |
| 9.   | The possibility of odors wear, crowded etc. |

![Table 2. Degrees relations activities](image)

**Figure 2.** Facility relationship chart of ecaliptus factory

Based on Figure 2 above, the relationship between the activity can be explained as follows:

a. Raw material warehouse layout with a) boilers or steam room pretty / plain adjacent to the grounds of work flow sequences; b) distilled boiler room absolutely necessary approximated by reason of use records, labor, and space the same area other than that facilitate the transfer of raw materials, auxiliary materials and production process control; c) where condenser, like coolers, separators, filters and inspection undesired sequences adjacent to the grounds of work; d) packaging and product storage space so important for approximated by reason of the order flow of work to facilitate the process of moving the finished product.

b. The layout of the boiler room with a) distilled and condensing boiler room is important for reasons brought closer to the work flow sequence of this is done to save piping installation so that drainage of steam from the boiler to kettle not too far; b) place like coolers, separators, filters and inspection, packaging, and storage of finished products is not desired flow sequence adjacent to the grounds of work, other than that this is done for reasons of safety and the finished product is not polluted water cooling bath.

c. Location of distilled with a boiler room) where condenser, like coolers, separators, filters and inspection, packaging, and storage of finished products essential to brought closer to the work
flow sequences reason this was done to facilitate the process piping and pipe purchase saves investment costs.

d. The layout of the place condenser with a) where absolutely necessary cooling bath approximated by reason of the order flow of work and conduct the same work, it is because this process has the same function and save the land; b) undesirable separator chamber adjacent to the reason for the order flow of work, this is done because the position of the separator can not be established outside the plant site; c) the filter chamber and inspection, packaging, and storage of finished products is important not adjacent to the grounds of work flow sequence.

e. The layout of the place with a cooling bath) room adjacent separator undesirable for reasons of work flow sequences; b) the filter chamber and inspection, packaging, and storage of finished products is important not adjacent to the grounds of work flow sequence.

f. The layout of the separator with a space) and the filter chamber is absolutely necessary inspection and packaging approximated by reason of the degree of contact personnel who often work done and the order flow in addition to effective ergonomics of movement of workers and thus reduce cycle time; b) the finished product warehouse adjacent to the reasons do not matter the order workflow.

g. The layout of the room with a strainer and inspection) packaging and warehouse space finished products need to be brought closer to the absolute degree of contact personnel reasons are often made and the order of work flow, this is to facilitate the transfer of the finished product.

h. The layout of the warehouse space with finished product packaging is absolutely necessary approximated by reason of the degree of contact personnel who often work done and the order flow

Based on the above, we can make plans eucalyptus oil refining plant in accordance with the criteria specified above. Recaps proximity between departments diagram is shown in Table 3.

Table 3. Activity relationship diagram creation eucalyptus oil

| Number and name departmen | A  | E  | I  | O  | U  | X  |
|---------------------------|----|----|----|----|----|----|
| I. Row material warehouse | III| -  | VIII, IX | II | -  | IV, V, VI, VII |
| II. Boiler                | -  | -  | III, IV | -  | -  | V, VI, VII, VIII, IX |
| III. Distilled kettle     | -  | -  | IV, V, VI, VII, VIII, IX | -  | -  | -  |
| IV. Condenser             | -  | -  | -   | -  | VII, VIII, IX | VI |
| V. Cooler                 | -  | -  | -   | -  | VII, VIII, IX | VI |
| VI. Separator             | VII, VIII | -  | -  | -  | IX | -  |
| VII. Filter and Inspection| VIII, IX | -  | -  | -  | -  | -  |
| VIII. Packaging           | IX | -  | -   | -  | -  | -  |

Based on Table 3 can indicate the degree of proximity of each department. It can be seen that the raw materials warehouse has a degree of closeness with the department kettle A flute and grade I I with a strainer and inspection department and O with Boiler and X with other departments. For the depiction of any other degree of closeness that is shown in Table 3. After the depiction then made Activity Template Block Diagram Creation Eucalyptus Oil as in Figure 3.
Figure 3. Block diagram template preparation activity eucalyptus oil

Figure 3 is a block diagram templates activity prior to modification based on a diagram of its proximity, so there are some departments that do not correspond to the degree of proximity. As raw materials warehouse has a closeness with distilled kettle department but on an activity diagram the initial block is still located far apart. Therefore do realignments based on the degree of proximity of each department that can be seen in Figure 3. Activity relationship diagram is block diagram that using closeness of activity for every activity which is as single model [1].

Figure 4. Activity relationship diagram creation eucalyptus oil

After rearranging the department based on the degree of proximity, so he found the arrangement of all departments of production as shown in Figure 4. It can be seen that the raw material warehouse is located adjacent to the boiler pipe, according to the degree of proximity. In addition the department is located near boiler with distilled kettle. Overall flow of operation on the layout are made as U thus saving land using. After the design was carried out using the activity relationship diagram method, the final layout planning of the establishment of eucalyptus oil factories can be seen in Figure 5.
Conclusion

Based on the discussion above and direct observation at Eucalyptus Oil plant for approximately two months, the writer can draw conclusions including: design layout the production department of Eucalyptus Oil Plant with Activity Relationship Chart method (ARC) above is largely influenced by the degree of the relationship of work flow order between department. Other underlying factor layout redesign the production department of Eucalyptus Oil Plant with Activity Relationship Chart method (ARC) is the degree of contact of personnel which is often done. Activity Relationship Chart Basically very well used for analyse factory layout with pay attention to the factors which are qualitative, then this method it is suitable for setting layout department of an office, warehouse, waste disposal site, and etc.

References

[1] Apple, James M. 1977. Plant layout and material handling, third edition. Mardiono, Nurhayati M. T. (terjemahan) Tata Letak Pabrik dan Pemindahan Bahan (Edisi Ketiga), ITB, Bandung.
[2] Indonesia KSN. Peraturan Pemerintah Republik Indonesia Nomor 14 Tahun 2015 Tentang Rencana Induk Pembangunan Industri Nasional 2015-2035. Indonesia; 2015.
[3] Ghiffari RA. Development of Eucalyptus Oil Agro-industries in Kabupaten Buru. Procedia - Soc Behav Sci.2016;227(November2015):815-823. doi:10.1016/j.sbspro.2016.06.150
[4] Rimbawanto A, Kartikawati KN, Prastyono. Minyak Kayu Putih Dari Tanaman Asli Indonesia Untuk Masyarakat Indonesia. Yogyakarta: Kaliwangi; 2017
[5] Sritomo W. Tata Letak Pabrik Dan Pemindahan Bahan. (Gunarta IK, ed.). Jakarta: Guna Widya; 1991.