Facility Layout Design with Corelap Algorithm for Educational Tour

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Abstract. Yogyakarta has potential in the field of tourism. Many places can be chosen to be visited, including tourism education village. This village is interesting because not only a vacation spot, but we can also increase our knowledge there. Currently, Widodomartani villagers are planning to create a tourism education village inspired by the tourism education village in Kebumen. To make a tourism education village there must be good planning. The purpose of this study is to assist Widodomartani villagers in planning the facility layout of an educational village. The analysis that will be carried out includes making business processes, identifying facilities, and establish facility layouts that can be used to plan the layout of facilities. Layouting facilities are done by the Corelap algorithm based on the relationship between the facilities. Based on TCR (Total Closeness Rating) for each department, where TCR is the number of value calculated based on the rating of a systematic approach. Determination of the layout of facilities for 24 facilities is done using Activity Relationship Diagrams by considering the Total Closeness Rating between existing facilities as a basis for determining the layout of facilities. From the results of the closeness relationship, layout optimization is done using CORELAP (Computerized Relationship Layout Planning) software to get the optimal layout which is then actualized described in Widodomartani tourism education village land.

1. Introduction

Yogyakarta is one of the tourist destinations in Indonesia. The number of tourists visiting Yogyakarta has increased every year (Figure 1), in 2017 the number of tourists reached 5,229,298, with a proportion of 8% of foreign tourists and 92% of domestic tourists [1]. The high level of tourist visits has become an opportunity for the development of new tourist destinations, especially tourist destinations that offer uniqueness for tourists.

Figure 1. Tourist Visits in Yogyakarta
The tourism village is one of the developing tourist destinations because it offers uniqueness for tourists. Yogyakarta is a province that has a high level of success in developing tourist villages, where Sleman Regency has 19 Tourism Villages with a visit rate of 206,934 tourists in 2017 [1]. Each tourism village has its uniqueness, which distinguishes one village from another.

Widodomartani Village in 2015 formed a "Forum Kelompok Usaha Bersama (Kube)” which consisted of Kube representatives from each region. Furthermore, in 2018 "Forum Kube” Widodomartani Village, after visiting a tourist village in Kebumen, they decided to establish an educational destination in the form of “Tourism education” in Widodomartani Village. This idea requires well planning to be realized and requires collaboration with several agencies.

To initiate the idea, careful development planning is needed, one of which is planning the layout of facilities. It aims to maximize existing facilities seen from several aspects such as the distance between facilities, the closeness between facilities, etc. Because this is still an idea, a method of formation or commonly called Craft is used, which can be used to design a facility layout that has not yet been built. One of the supporting tools for the Craft method is to use the CORELAP application by adding activity relationship chart (ARC), activity relationship diagram (ARD), and area allocation diagram (AAD) based on field studies that will be conducted next. So by using the method of forming by using CORELAP, it is expected that the laying of the facilities to be built will be right with a long life span. Based on the background above, it can be formulated that the problem that will be resolved is how to design an optimal layout of integrated agricultural and farming facilities using the CORELAP method. The purpose of this study is to produce an optimal layout of agricultural and animal husbandry educational facilities using the CORELAP method. In this study, the results of the layout are used as a basis for the construction of integrated animal husbandry and agriculture tours.

2. Literature Review

2.1. Tourism education Village
Criteria for a village can be developed into a tourist village, if it has several supporting factors, including: (1) has product potential and attractiveness, (2) has the support of human resources (HR), (3) strong motivation from the community, (4) has adequate infrastructure and support, (5) has facilities to support tourism activities, (6) has institutions that regulate tourism activities and (7) availability of land/areas that are possible to be developed into tourist destinations [2].

The model of an educational village for sustainable rural development must be creative and can prioritize the characteristics of a village. The formation of an educational village can build the economy of the people who live and can help build knowledge for visitors who come.

2.2. Facility Layout Design
The facility layout design is a technique and steps to change or improve the layout of an industry to be able to obtain layout changes to handle facilities and material handling so that the process activities are more optimal.

ARC is a technique for planning the layout of a facility or department based on the degree of activity relations of each facility or department. ARC Qualitative, using letter codes indicating the degree of activity relations and also numbers to explain the reasons for determining the letter code [3].

There are three main parts to the relationship between layout design activities that can be broken down as follows [4]:

- Identifying activities that have been defined as factory facilities.
- Prepare the ARC sheet and fill it in with the names of the facilities specified in step 1.
- Formulate reasons that can be used as a basis that facilities can be brought closer or must be kept away.
2.3. CORELAP

The CORELAP algorithm uses the proximity relationship rating stated in TCR in the selection of work station placement. This algorithm is a development algorithm (construction algorithm), which is an algorithm used to produce a new layout design that does not depend or does not require an initial layout. Based on TCR for each department, where TCR is the number of value calculated based on the rating of a systematic approach. [5].

CORELAP algorithm is a construction algorithm that can change qualitative data into quantitative data [6]. To determine the initial facilities that can be placed in a layout, data related to the activity relationship is needed. In research at PT. X also uses CORELAP algorithm and the results of the proposed layout are better as well as saving electricity [7]. CORELAP algorithm reduces the total distance difference on the production floor and reduces the total cost of moving material compared to the initial layout [8]. The application of the CORELAP algorithm is also used in the design of facility layouts at an oven manufacturing plant and an area savings of 8.83% is obtained [9].

According to (Tompkins, et al., 1996) there are CORELAP algorithm steps as follows:

- Calculate the TCR for each department.
  
  To calculate the TCR value, add up the weighting of the proximity values for each department, where the proximity values for each department are obtained from the ARC, and the FTC. From the ARC and FTC above, we can calculate TCR for each department from the TCR.

- Select one of the departments with maximum TCR, then place it first in the layout center.

- If there is the same TCR, first select the area that has a larger area then if the area is the same, then choose the department with the smallest number.

- Place the department with the link A, with the one chosen, then the linkages E, I, O, U, and X. If there are several of the same, the criteria are used the same as the previous step.

- If a department has been selected, determine its placement based on the Placing Rating, if the number of Weighted Closeness Ratings between departments that have entered with who will enter. If the Placing Rating is the same, then the length of the boundary or the number of square units adjacent to adjacent ones is compared.

- Layout evaluation through layout score:
  
  \[ \sum_{n} \text{Closeness Rating Numeric} \times \text{Shortest Track Length} \]

  \[ n = \text{all the department} \]

2.4. State of The Art

Based on the previous research [10], to obtain the layout of production facilities that have a minimum total transfer moment. In this study, using the BLOCPLAN (Black Layout Overview with Layout Planning) and CORELAP (Computerized Relationship Layout Planning) analysis was performed by comparing the total moment of movement between the actual layout and the layout of the proposal. Moment of displacement in the initial layout is 7,593,352 meters displacement/year. The results of the study found that the layout using the CORELAP algorithm was chosen as the layout of the proposal because it has a material transfer efficiency of 19.52% and a total moment of material transfer of 6,111,172 meters per year. While the layout using the BLOCPLAN algorithm has a moment of displacement of 7,449,682 meters/year displacement with material handling efficiency of 89%.

Subsequent research [11] is a company that processes plastic bottles into plastic pellets ready for processing. This processing requires several processes using machines that have been prearranged without specific calculations. As a result, the production process is hampered by seeing the condition of the movement of goods that pass through the pedestrian path and the top of employees who are working on the production machine. There is a need to change the layout of the new production facility so that it is expected to reduce the distance of material handling. So it is processed by CORELAP algorithm. The results of his research in the form of CV. Robbani, there are 2 material transfer flows from the raw material warehouse which is far apart, namely raw material warehouse 1
and raw material warehouse 2. So the distance of material handling warehouse raw material 1 is 27.79 m and distance of material handling warehouse raw material 2 is 31.57, so that the total length of material handling distance in the initial conditions is 59.36 m. Based on the Corelap Algorithm method, the Proposed Layout obtained with a distance of material transfer as far as 30.27 meters from the Initial Layout with a material transfer distance of 59.36 meters, the difference saves Material Handling distance by 49%.

The latest research [12] that is engaged in manufacturing rubber seal gripper manufacturers. This company has a problem with the layout of its production floor that is the occurrence of cross-movement and the distance at some stations is also too far which causes the flow of material disrupted. This problem can be solved by improving the layout of the production floor using the CORELAP and ALDEP methods then simulating it with Flexsim software. This study aims to design the layout of proposed facilities that can minimize material transfer distance by comparing the efficiency of the actual layout displacement moment with the proposed layout. The results of this study indicate a decrease in the total moment of displacement on the production floor of PT. Tourism education from 14,495.08 meters/month to 5930.19 meters/month using the CORELAP algorithm and 7,369.7 meters/month on the ALDEP algorithm. The distance efficiency in the proposed layout also increased from 53.67% to 93.74% in the CORELAP algorithm and 78.18% in the ALDEP algorithm. After doing a simulation to find the best method, the layout of the selected proposals is the layout of the results of the CORELAP algorithm with kilometers traveled per day 1.9 km/day.

3. Research Methodology
This research was conducted at the Widodo Martani tourism education located on Jalan Cangkringan, Umbul Martani village, Sleman, Yogyakarta Special Region. The implementation time was carried out in April 2020 until the beginning of May 2020. The formulation of the problem that was designed was the making of a good facility layout to turn Widodomartani Village into an educational village. Data collection is done by field study. Field studies were carried out in Widodomartani Village in the area where the Tourism education development was carried out. Observation of visitors flow and facility layout at similar Tourism education namely Sinatria Farm Tourism education Farm and Smesta Tourism education located in Pakem. Data processing is carried out to obtain business processes that will be applied to the Widodomartani Tourism education village and to search for secondary data to support research. After obtaining the right business processes, grouping the closeness of relations between each facility using the ARC (Activity Relationship Chart). After knowing the relationship between the facilities, layout planning is done with the CORELAP application. After processing the data, an analysis of the results has been obtained. The analysis is the distance between the buildings, the location of the building based on CORELAP, and the feasibility of the layout if applied to the place that has been prepared. Conclusions based on research that has been done. And provide suggestions for further development of subsequent research.

4. Result
4.1. Business Process
Widodomartani Tourism education Village is a newly developed tourism site that does not yet have a patent business process. So that researchers do business processes based on data obtained from surveys on tourism education sites that have been built and have business processes, that is Tourism education Sinatria and Tourism education Smesta. Convergent Validity
Based on the business process data above, the next step is to determine what facilities can support the business process. So the researchers determined 24 types of facilities that would be used in the Widodomartani education and the area and amount needed, the determination of this data based on the needs taken from the field survey. Determination of what facilities to be built are as follows:

### Table 1 Extensive Facilities

| Facilities         | Length | Width | Number of Facilities | Total Area |
|--------------------|--------|-------|----------------------|------------|
| Security           | 3      | 3     | 1                    | 9          |
| Parking Park       | 30     | 18    | 1                    | 540        |
| Ticket office      | 3      | 2     | 1                    | 6          |
| Playground         | 10     | 18    | 1                    | 180        |
| Office             | 12     | 7     | 1                    | 84         |
| Toilet             | 2      | 2     | 1                    | 4          |
| Library            | 8      | 8     | 1                    | 64         |
| Mushola            | 5      | 6     | 1                    | 30         |
| Goat Pen           | 2      | 1.5   | 2                    | 6          |

**Figure 2. Research flow**
Facilities

| Facilities          | Length | Width | Number of Facilities | Total Area |
|---------------------|--------|-------|----------------------|------------|
| Cowshed             | 2      | 2     | 2                    | 8          |
| Cow Field           | 6      | 6     | 1                    | 36         |
| Goat Field          | 5      | 5     | 1                    | 25         |
| Feed Warehouse      | 2      | 2     | 1                    | 4          |
| Feed Land           | 4      | 4     | 1                    | 16         |
| Chili Farm          | 2      | 2     | 3                    | 12         |
| Fish Farm Pond      | 2      | 3     | 1                    | 6          |
| Biogas Processing   | 2      | 2     | 1                    | 4          |
| Gazebo              | 4      | 4     | 1                    | 16         |
| Canteen and Souvenir| 4      | 3     | 1                    | 12         |
| Store               | 3      | 3     | 1                    | 9          |
| Fertilizer Processing| 1      | 1     | 1                    | 1          |
| Water Tower         | 1      | 1     | 1                    | 1          |
| Garbage Bank        | 2      | 2     | 1                    | 4          |
| Draw Well           | 1      | 1     | 1                    | 1          |
| Laboratory          | 3      | 4     | 1                    | 12         |

Total Area 1089

4.2. Proposed Layout

Based on the research method described earlier, the initial data processing is by making an ARC, after which a numerical value is given for each proximity of the facility so that the TCR is obtained and continued with the allocation of TCR values to form a layout the new one.

4.2.1. ARC is based on existing facilities.

ARC application is obtained from facility data that will be linked in pairs to find out how close the two facilities are to be paired. Determination of the level of closeness between the facilities in terms of several aspects among them is the interrelationships between the production process, material flow, equipment used, humans, and others. In this study, the facilities used are based on table 1 above.

ARC is a map of the relationship of activities in the form of a rhombus, consisting of 2 parts. The upper part shows the symbol of the degree of interrelation between two departments/rooms, while the lower part is the reason used to measure the degree of interrelation [13]. Based on the degree of relationship between activities and their reasons, the ARC for 24 facilities at the Widodamartani Tourism education can be found in Figure 3. In the ARC it has been described the relationship between the pairs of facilities that are equipped with the degree of closeness A, E, I, O, U, and X along with the reasons for their closeness. The results of making this ARC are used to calculate the TCR. The following is an ARC for the entire production process and its supporting facilities, can be seen in Figure 3:
4.2.2. TCR

The establishment of ARC is the basis for calculating TCR which will be used in allocating facilities. TCR calculation is done by converting each degree of closeness into a rating value as follows A = 5, E = 4, I = 3, O = 2, U = 1 and X = 0.

As for determining the awarding of value in each facility by looking at the interests of the paired facilities. The higher the level of closeness, the TCR value will be higher. Facilities that have a high TCR value will be used as the main reference placed in the layout allocation when computed using the next CORELAP application.

Based on table 2, the facility that has the largest TCR value is the Goat Umbaran facility, because the facility is a source of biogas processing. Followed by cow slap. After doing TCR calculations, it can be seen which facilities have the highest proximity value with other facilities and will be the main area for further analysis.

| Facilities     | A | E | I | O | U | X | Total | TCR |
|----------------|---|---|---|---|---|---|-------|-----|
| Security       | 1 | 1 | 3 | 3 | 14| 1 | 23    | 38  |
### Table 1. TCR

| Facilities          | A | E | I | O | U | X | Total | TCR |
|---------------------|---|---|---|---|---|---|-------|-----|
| Parking Park        | 2 | 0 | 0 | 4 | 16| 1  | 23    | 34  |
| Ticket office       | 1 | 1 | 0 | 1 | 19| 1  | 23    | 30  |
| Playground          | 0 | 0 | 2 | 14| 6 | 1  | 23    | 40  |
| Office              | 0 | 1 | 2 | 12| 7 | 1  | 23    | 41  |
| Toilet              | 0 | 2 | 2 | 12| 6 | 1  | 23    | 44  |
| Library             | 0 | 0 | 2 | 12| 8 | 1  | 23    | 38  |
| Mushola             | 0 | 1 | 3 | 3 | 15| 1  | 23    | 34  |
| Goat Pen            | 4 | 2 | 3 | 8 | 5 | 1  | 23    | 58  |
| Cowshed             | 4 | 2 | 3 | 8 | 5 | 1  | 23    | 58  |
| Cow Field           | 4 | 2 | 3 | 7 | 6 | 1  | 23    | 57  |
| Goat Field          | 4 | 2 | 3 | 9 | 4 | 1  | 23    | 59  |
| Feed Warehouse      | 6 | 0 | 2 | 5 | 10| 0  | 23    | 56  |
| Feed Land           | 1 | 0 | 6 | 7 | 9 | 0  | 23    | 46  |
| Chili Farm          | 0 | 0 | 2 | 15| 5 | 1  | 23    | 41  |
| Fish Farm Pond      | 1 | 0 | 3 | 13| 5 | 1  | 23    | 45  |
| Biogas Processing   | 5 | 2 | 1 | 5 | 10| 0  | 23    | 56  |
| Gazebo              | 0 | 0 | 11| 6 | 5 | 1  | 23    | 50  |
| Canteen and Souvenir Store | 0 | 0 | 4 | 13| 5 | 1  | 23    | 43  |
| Fertilizer Processing | 4 | 2 | 0 | 4 | 12| 1  | 23    | 48  |
| Water Tower         | 1 | 0 | 3 | 3 | 15| 1  | 23    | 35  |
| Garbage Bank        | 0 | 0 | 0 | 0 | 3 | 20 | 23    | 3   |
| Draw Well           | 2 | 0 | 0 | 6 | 14| 1  | 23    | 36  |
| Laboratory          | 0 | 2 | 6 | 9 | 5 | 1  | 23    | 49  |

#### 4.2.3. Corelap Application

Data processing using the CORELAP method is done using the help of CORELAP 1.0 software. The input used is the area of the number of departments, the area of each department, and the ARC used to calculate TCR. In the use of the CORELAP method, only one proposal layout will be produced, which is the best layout. Here are departmental allocations using CORELAP Algorithm based on TCR values, Facility 1 would be the center of the place allocation.

- **Iteration 1**
  - Location 1 = 1 x 5 = 5
  - Location 2 = 0,5 x 5 = 2,5
  - Location 3 = 1 x 5 = 5
Location 1 showed the highest score in the earliest sequence, so we can conclude that location 1 is the best location for Facility II.

**Figure 4. Iteration 1**

- Iteration 2

Location 1 = 1 x 5 = 5
Location 2 = 0.5 x 5 = 2.5
Location 3 = (1 x 5) + (0.5 x 4) = 7

Location 3 showed the highest score in the earliest sequence, so we can conclude that Location 3 is the best location for Facility III. This calculation continues until all facilities have been allocated. After the calculation is done with CORELAP, the final layout result that is produced is like Figure 5.

**Figure 5. Iteration 2**

**Figure 6. CORELAP Results Layout**
4.3. Layout Overview

After getting the layout from the CORELAP method, the next step is to adjust the layout to the field conditions that will be used. On the Umbulmartani Tourism education land which has an area of 2,400 m², several facilities have been built before doing this research, namely the Office and the mosque. This, of course, makes the layout that has been produced requires adjustments to the buildings that have been built, so with the above problems, a map with a ratio of 1: 500 is made as follows:

![Figure 7. Layout Overview](image)

5. Conclusion and Recommendation

5.1. Conclusion

The construction of the Widodomartani Tourism education village requires 24 kinds of facilities, the determination of this amount was obtained from the needs of the Widodomartani Tourism education village as well as the benchmarking process in several tourism education villages that had been surveyed. Thus, the total land area needed for development is 1089 m², this area is the total facility area and does not include vacant land that can be used for other facilities. Determination of the layout of facilities for 24 facilities is done by considering the TCR between existing facilities as a basis for determining the layout of facilities. From the results of the closeness relationship, layout optimization is done using CORELAP software to get the optimal layout which is then actualized described in Widodomartani tourism education village land.

5.2. Acknowledge

The proposed layout generated in this study considers the level of closeness between facilities, to better describe the business processes that occur in the Widodomartani Tourism education village. Further business process analysis can be carried out which is then simulated to find out the effectiveness of the layout.

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