Facilities layout design for vise manufacturing using Blocplan

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Abstract. Production floor requires several supporting facilities such as warehouse, office, labor locker and shipping/receiving area. These facilities are used to do activities other than production such as storing raw materials, rest for labor and other administration works. These facilities must be designed around the production floor. Design facilities layout becomes important for production since it can influence the material and human flow between facilities and production floor. As the result the arrangement of supporting facilities is necessary to make production activities run smoothly. Mistake in arrangement of supporting facilities might increase material and human movements which in turn increase material handling costs. Vise manufacturing requires supporting facilities to support the production of vise. The purpose of this study is to demonstrate the use of Blocplan in arranging supporting facilities for vise manufacturing.

1. Introduction

In the industrial world, company productivity is influenced by the arrangement of production and supporting facilities. Material and human flow within the company is mainly depend on the arrangements of production and supporting facilities. As the result, to achieve good productivity, the company should have good production and supporting facilities layout. Different factors are required to consider in designing facilities layout such as interrelationship between facilities such as material flow and human flow between facilities, as well as hazard produced by the facilities such as noise and bad smells.

To consider these factors in designing supporting facilities layout, several approaches are required. BlocPlan is one approach available in literature to support the design of facilities layout. Block plan use qualitative and quantitative data in designing facilities layout [1][2]. Qualitative data is obtained from the opinion of expert about the importance of facilities to be brought near or far. Then, quantitative approach is used to convert the closeness opinion into facilities layout with minimum movements.

Vise is a support tool for many manufacturing processes mainly for finishing process such as cutting, drilling and grinding. Vise consists of several parts that are made from different types of materials and are needed different manufacturing processes. Similar with other manufacturing, to produce vise, several supporting facilities are required. Production floor requires several supporting facilities such as warehouse, office, labor locker and shipping/receiving area. These facilities are used to do activities other than production storing raw materials, rest for labor and other administration works. These facilities must be designed around the production floor. Design facilities layout becomes important for production since it can influence the material and human flow between facilities and production floor [3]. For example, warehouse facility is used to store raw material and finished goods.
from production. The size of warehouse mainly depends on the quantity of inventory. This quantity is affected by several factors such as holding cost, ordering cost and delivery time [4]. As the result the arrangement of supporting facilities is necessary to make production activities run smoothly. Mistake in arrangement of supporting facilities might increase material and human movements which in turn increase material handling costs [5]. This paper focuses to design facilities layout for vise manufacturing by using BlocPlan.

2. Methodology
This research uses experiment as research methodology. Experiment is good to use when the investigation focuses to evaluate the impact of alternatives into system performance. In this research, the impact of facilities layout design on material flow is evaluated. The experiment was conducted at Laboratory of Facility Layout and Material Handling, Faculty of Engineering, Universitas Sumatera Utara.

2.1. Research Process
This research is divided into three stages including identification facilities required to support vise manufacturing, identification the degree of closeness between facilities and arrangement the facilities position in the layout. In the first stage, the research focuses to identify the facilities required to support vise manufacturing. Literature review is used to identify essential facilities for vise manufacturing. Then, this is continued by identification the degree of closeness between facilities. Activity Relationship Chart (ARC) is used to identify the degree of closeness. ARC identify the closeness between facilities based on relationship between facilities such as material flow or human flow and based on the hazard triggered by facilities such as noise and bad smells. In the third stage, the research focuses to arrange the facilities in the layout by using the degree of closeness from stage 2. In this stage, Blocplan is used as tools to support facilities layout design. The research process can be observed in figure 1.

![Figure 1. Research process](image)

3. Result and Discussion

3.1. Facilities and degree of closeness between facilities
There are five types of facilities identified including production area, production service, personal service, general service and physical plant service [4]. Production service means that the facilities
required to support the production process. There are 4 facilities identified under production service including raw material warehouse, finished good warehouse, receiving area and shipping area. Personal service means that the facilities required to support the labor/employee activities. There 4 facilities recognized under personal service including locker room/toilet for employee, common room/canteen/rest area, Emergency room, and prayer room. General service is the facilities required for general purposes. There facilities have been identified under general service including office for administrative work, parking and security post. Furthermore, physical plant service is the facilities to support energy and maintenance for building and production. Two facilities have been identified under physical plant service including generator room and maintenance room.

After the facilities have been identified, the degree of closeness between these facilities are provided. Activity relationship chart were used to define the degree of closeness. This was identified based on the survey to students in Industrial Engineering Department, Faculty of Engineering, Universitas Sumatera Utara. Figure 2 shows the degree of closeness.

| SECTION           | NO. | ACTIVITY                  | DEGREE OF APPROACH |
|-------------------|-----|---------------------------|--------------------|
| PRODUCTION        | 1   | PRODUCTION SECTION        |                    |
|                   | 2   | MATERIAL WAREHOUSE        |                    |
|                   | 3   | PRODUCT WAREHOUSE         |                    |
|                   | 4   | RECEPTION                 |                    |
|                   | 5   | SHIPPING SECTION          |                    |
| PRODUCTION SERVICE| 6   | EMPLOYEE WC               |                    |
|                   | 7   | CANTEEN                   |                    |
|                   | 8   | POLYCLINIC                |                    |
|                   | 9   | ISLAMIC PRAYER ROOM       |                    |
| PERSONAL SERVICE  | 10  | PARKING                   |                    |
|                   | 11  | OFFICE                    |                    |
|                   | 12  | SECURITY POST             |                    |
| GENERAL SERVICE   | 13  | WORKSHOP AND EQUIPMENT    |                    |
|                   | 14  | GENERATOR ROOM            |                    |

3.2. Facilities Layout Design
Blocplan software is used to support facilities layout design. It started by inputting total area for every facility and degree of closeness between facilities. This is shown in Figure 3 (a) and (b). Then, Blocplan changes the degree of closeness into numerical value. For example, degree closeness A is valued with 10 points, degree closeness E is valued with 5 points, and degree closeness X is valued with -10 points. Blocplan gives opportunity to change the value for degree closeness. Based on these value, Blocplan calculates the total score for every facility. Total score is calculated from multiplying facility’s degree of closeness with the value. After this, Blocplan generates alternative layouts which
have adjacency score, R-score and R-dist. The best alternative layout is the layout with highest adjacency score, highest R-score and lowest R-dist [6]. Alternative layout 19 is selected due to having highest adjacency and R-score. The Blocplan result and analysis can be observed in Figure 4.

![Figure 3](image)  
**Figure 3.** (a) Total area for each facility, (b) Degree of closeness between facilities

![Figure 4](image)  
**Figure 4.** Facilities layout from Blocplan

The Blocplan software has certain limitations. Some of limitations are the layout produced by Blocplan is not reflected the real size of facilities and there is no space between facilities in the proposed layout. The final layout that follows the real size of facilities and bases on position produced by *BLOPLAN Software* is shown by Figure 5 and 6.
Figure 5. Area Allocation Diagram

Figure 6. Block Layout of facilities for vise manufacturing

| Legend                  |
|-------------------------|
| 1 | Production             |
| 2 | Raw Material Warehouse |
| 3 | Finished Goods Warehouse|
| 4 | Receiving area         |
| 5 | Shipping area          |
| 6 | Prayer room            |
| 7 | Restroom/canteen       |
| 8 | Emergency room/Clinic  |
| 9 | Locker room/Toilet     |
| 10| Office                 |
| 11| Parking                |
| 12| Security post          |
| 13| Generator room         |
| 14| Maintenance room       |

4. Conclusion
This paper demonstrates the use of Blocplan to design facilities layout for vise manufacturing. Based on the results of data processing using Blocplan software, there are 20 alternative facilities layouts,
Alternative 19 is selected as best layout due to the largest adjacency and r-score with a value of 0.74. The main limitation of Bocolan software lies on subjectivity in determining the degree of closeness. Further research can be focused on reducing the subjectivity by using different approach in determining the degree of closeness.

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