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Blocplan Algorithm for Facility Layout Design in Various Industry in Indonesia

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ABSTRACT

Facility layout is an important aspect in planning and developing production facilities. A good layout can increase efficiency, productivity, and safety in the production process. The Blocplan algorithm is a layout design method that can produce an efficient layout. This method uses a heuristic algorithm to find layouts based on having the highest R-Score value. The Blocplan algorithm has been applied in various industries in Indonesia because of its advantages which can produce a more efficient layout compared to the initial layout. Based on this, it is necessary to study the use of the Blocplan algorithm in designing facility layouts in various industries in Indonesia. This review aims to determine the use of the Blocplan algorithm in designing facility layouts in various industries in Indonesia. The review results show that layout design using the Blocplan algorithm can produce a layout that is more efficient than the initial layout. It was found that several related industries in Indonesia can use the Blocplan algorithm in redesigning facility layouts, including the pharmaceutical industry, construction project implementation, food industry, steel or iron industry, spring bed production, PVC production, transformer production, valve production, production trolleys, corn milling, feed processing, plastic recycling, garment or convection industry, robotization industry, coffee production, paper production, brick production, and wood processing.

I. Introduction

Facility layout is an important aspect in planning and developing production facilities. A good layout can increase efficiency, productivity, and safety in the production process [1]. Shorter material movement distances or material flows can reduce the time and costs required to move materials from one place to another. In addition, good facility layout can improve safety by reducing the risk of work accidents, such as reducing the potential for collisions, falls and punctures [2].

Many methods or algorithms have been developed in planning and designing facility layouts. The Blocplan algorithm is a layout design method that can produce an efficient layout [3]. This method uses a heuristic algorithm to find layouts based on having the highest R-Score value. The R-Score value is a measure of the closeness of the relationship between facilities in the spatial layout [4]. The Blocplan algorithm consists of two main stages, namely the initialization stage (generating an initial layout) and the improvement stage (to increase the R-Score value of the initial layout) [5]. The working principle of the blocplan algorithm is to group facilities that are closely related. Facilities that have close relationships are facilities that frequently interact with each other [6]. To group facilities, the blocplan algorithm uses the R-Score value [7].

The Blocplan algorithm has been applied in various industries in Indonesia because of its advantages which can produce a layout that is more efficient than the initial layout. Based on this, it is necessary to study the use of the Blocplan algorithm in designing facility layouts in various industries in Indonesia. *Literature review is a method that can be used to carry out research activities and is a popular hierarchy of evidence* [8]. Literature reviews are carried out by approaching certain

problems using a scientific process to produce output in the form of articles intended for research or scientific research [9].

This review aims to determine the use of the Blocplan algorithm in designing facility layouts in various industries in Indonesia.

II. Method

This research uses a systematic literature review method to summarize and analyse existing literature regarding the use of the blocplan algorithm to design facility layouts in various industries in Indonesia. This research uses secondary data in the form of scientific articles published in journals and proceedings. The stages carried out in this research include:

a. Article search
   Article searches were carried out using the Google Scholar article search engine with the keywords "blocplan algorithm for facility layout design" and other keywords related to the blocplan algorithm in facility layout design. Search years were limited from 2018 to 2023.
b. Selection of articles
   Articles that were not related to the blocplan algorithm in facility layout design were then deleted.
c. Article summary
   Selected articles are then summarized based on the methods used and research results obtained.
d. Article grouping
   Articles are grouped by year of publication and use in the various fields or industries in which they are used.
e. Article analysis
   Articles are analyzed based on year of publication and their use in the various fields or industries in which they are used. Apart from that, we will also briefly discuss the use of the Blocplan algorithm used.

III. Results and Discussion

This section discusses the results and discussion of data collection, data processing and data analysis carried out in the research. Apart from that, this section also discusses articles resulting from the screening stage. In the initial stage of collecting articles, researchers used the keyword "blocplan algorithm for facility layout design" to search for relevant articles and the search was limited to the years 2018 to 2023. After going through the data collection stage, 100 articles were obtained. However, after going through the screening stage, only 25 articles were appropriate to the research topic. The results of the article collection are displayed in Table 1.

Table 1. Classification of articles based on research year, related industry, and research results

No.	Author and Year	Industry	Results
1	Saherdian et all, 2020. [10]	pharmaceutical	The proposed layout can reduce the distance of material movement in each area, including the WIP area with an R-score value of 0.96, the inspection area with an R-score value of 0.81, and the packaging area with an R-score value of 0.77.
2	Adiasa et all, 2023. [11]	construction project	The first proposed layout was chosen because it has the highest R-Score value, namely 0.73. The material handling movement distance in this layout is 80.76 meters, while the total area is 31.9 m2.
3	Daya et all, 2018. [12]	Food (bread)	20 alternative layouts were produced using the Blocplan method, the proposed layout chosen was the 13th layout. This layout has an R-Score value close to 1, namely 0.90. This layout is able to save material movement distance by 3.79% or 11.35 meters.

No.	Author and Year	Industry	Results
4	Muharni et all, 2022. [13]	Steel	The warehouse facility layout designed using the Blocplan method has the shortest material handling movement distance, namely 18,392 meters.
5	Pattiapon et all, 2021. [14]	Spring bed production	The Blocplan algorithm produces material handling costs of Rp. 51,267 with a total distance of 84.88 m.
6	Pramesti et all, 2019. [15]	Snack	The layout chosen was the first layout with an R-score of 0.97. This layout is able to reduce the distance by 16.45 meters and time by 299.9 seconds from the initial layout.
7	Budianto et all, 2021. [16]	PVC	The efficiency level of the Blocplan algorithm is 30%. The efficiency of changing the distance between departments in the initial layout with the proposed layout is 21%.
8	Harahap et all, 2019. [17]	Transformer production	From the results of 20 iterations, the alternative that can be implemented is the 13th iteration with the highest R-Score, namely 0.90. This layout shows a good level of efficiency with a layout score of 0.52.
9	Tarigan et all, 2022. [18]	Valve production	The total material handling costs for the initial layout were IDR 3,068,124.00 while for the new layout it was IDR 427,520.00.
10	Sholekhah et all, 2022. [19]	Food	Three proposed floor plans were produced which were selected by respondents (assumed group members) and had 1 selected floor plan.
11	Firdaus et all, 2019. [20]	Food	The proposed layout is more efficient than the initial layout because material handling costs are lower or 30% of material handling costs per month.
12	Rahayu et all, 2020. [21]	Troley production	The layout chosen is layout 2 with an ADJ Score of 0.65. The ADJ Score value is a value close to 1 so this layout is considered the most optimal.
13	Amal et all, 2022. [22]	Steel bar	The proposed layout can save material handling costs of IDR 439,782 per day. This savings is caused by reducing the transfer distance between facilities by 1305.7 meters.
14	Ginting et all, 2021. [23]	Corn milling	The resulting alternative layout has a higher score than the initial layout. This higher score indicates that the alternative layout is more efficient and can maximize production time on the corn milling machine.
15	Maulidah et all, 2022. [24]	Feed processing	The drying location and oven should be close together because they use the same equipment and require sunlight. The mixing, weighing and packing departments should be located close to the blending department to facilitate the production process.
16	Ningtyas et all, 2021. [25]	Plastic recycling	The proposed layout design has a material displacement moment that is 23% lower than the initial layout.
17	Kholifah et all, 2021 . [26]	Garment	The results of Rectilinear and Euclidean distance calculations in Blocplan show that the material transfer distance in the proposed layout is 30,920 meters and 26,942.5 meters. The resulting material handling costs average IDR 1,237,564.5.

No.	Author and Year	Industry	Results
18	Faiz et all, 2022. [27]	Robotization industry	The first ranked proposed layout has a total displacement distance of 289.5 meters. This layout can save material handling costs of IDR 2,226,173.58.
19	Abdurrahman et all, 2021. [28]	Coffee production	20 alternative layouts were designed, then the most efficient alternative layout was selected based on the lowest material handling costs.
20	Revadi et all, 2022. [29]	Paper production	The new layout has a distance of 30 meters between the office, meeting room and prayer room and the production floor. The noise level on the production floor is 60 dBA.
21	Napitupulu et all, 2022. [30]	Brick production	The research results succeeded in designing a layout based on the Blocplan algorithm with five work areas, namely preparation, mixing, printing, drying and storage areas.
22	Rozak et all, 2021. [31]	Food	The first layout was chosen because it has the highest overall score, namely 0.68. This value consists of a REL-Distance value of 0.68 and a total distance of 80 meters.
23	Rahmadiansyah et all, 2021. [32]	Wood processing	The second layout alternative was chosen because it has the largest ADJ score, namely 0.67. This value indicates that the departments are close to each other.
24	Syarif et all, 2018. [33]	Food	The total displacement moment that occurs in the layout design and proposed facilities is 1178 meters displacement/day. This shows a decrease in the total displacement moment of 4088.4 meters displacement/day.
25	Salsabila et all, 2023. [34]	Convection	The results of the proposed layout design process can minimize material movement distance by 23.8%.

This article identifies several attributes contained in the literature review to provide a more comprehensive insight into the use of the Blocplan algorithm to design facility layouts in various industries in Indonesia. Articles were collected from 2018 to 2023 with specific topics related to the Blocplan algorithm for designing facility layouts in various industries in Indonesia. The distribution of articles by year and industry evaluated using the Blocplan algorithm is shown in Figure 1 and Figure 2.

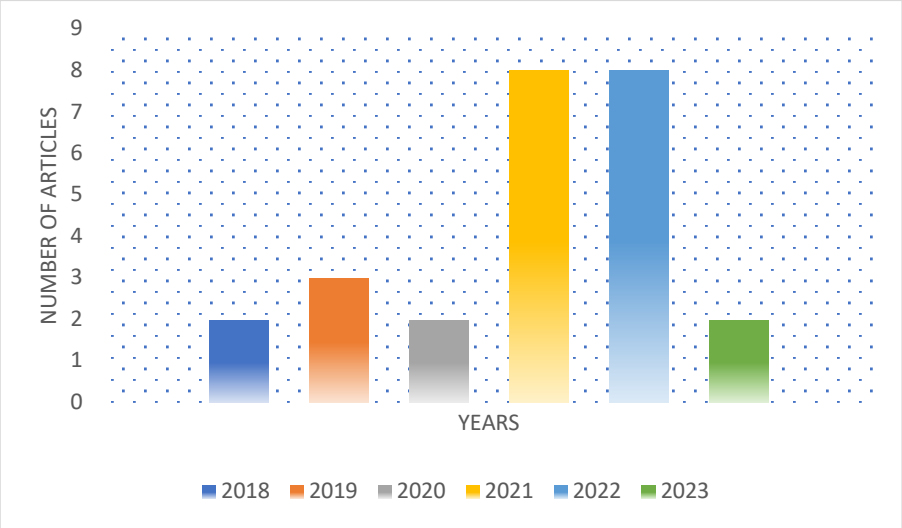

Fig 1. Articles based on year of publication

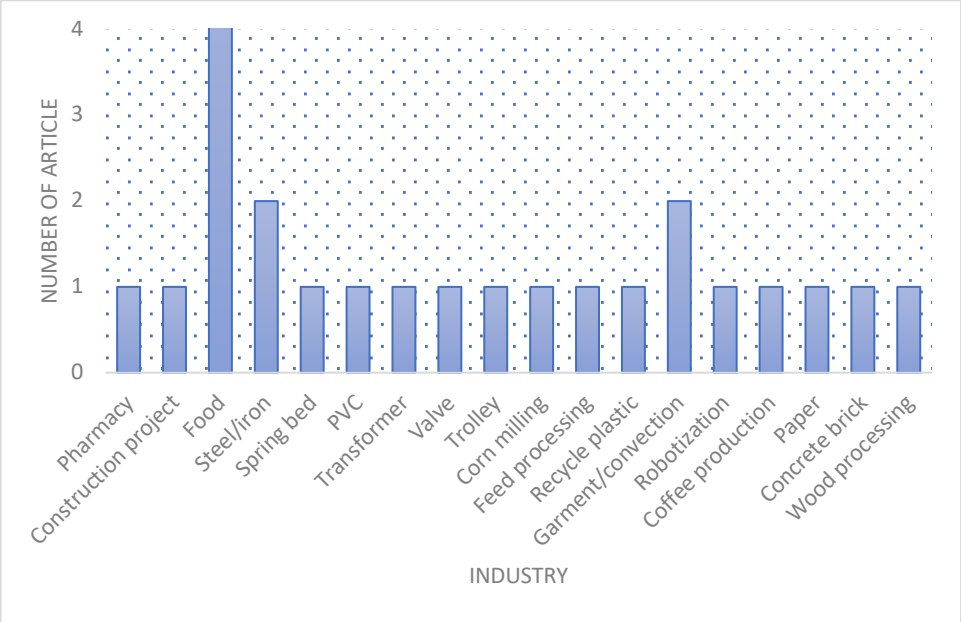

Fig 2. Articles by industry using the Blocplan algorithm

Based on Figure 1, the use of the Blocplan algorithm in designing the layout of facilities for various industries in Indonesia is quite common in 2021 and 2022 compared to the previous two years. Meanwhile, in 2023, two articles will still be found because 2023 is currently the current year. In addition, in 2018, 2019, and 2020 relatively few articles were found because they have not yet become an important concern for researchers or industry or companies.

Meanwhile, based on Figure 2, it is known that several related industries in Indonesia can use the Blocplan algorithm in redesigning facility layouts, including the pharmaceutical industry, construction project implementation, food industry, steel or iron industry, spring bed production, PVC production, transformer production, valve production, trolley production, corn milling, feed processing, plastic recycling, garment or convection industry, robotization industry, coffee production, paper production, brick production, and wood processing.

Layout design using the Blocplan algorithm can produce a layout that is more efficient than the initial layout. This efficiency can be seen from the reduction in material movement distance, material handling costs, and material movement moments. Here are some suggestions from the overall results of this literature review:

a. Use the Blocplan method for layout design. The Blocplan method is a layout design method that can produce an efficient layout. This method uses a heuristic algorithm to find the layout that has the highest R-Score value. The R-Score value is a measure of the closeness of the relationship between facilities in the spatial layout.

b. Use the R-Score value to choose the best layout. The layout with the highest R-Score value is the most efficient layout. The R-Score value can be calculated using the Blocplan method.

c. Layout design results. Based on the results of layout design using the Blocplan method, the following results were obtained:

    1. Material movement distance can be reduced
    2. Material handling costs can be reduced
    3. The moment of material movement can be reduced

d. Consider other factors in layout design. Apart from efficiency, layout design also needs to consider other factors, such as productivity, security, and comfort. Here are some other factors to consider in layout design:

1. Productivity. The layout should be designed in such a way that it can increase productivity. This can be done by reducing material movement distance, material movement time, and production time.
2. Security. The layout should be designed in a way that enhances worker safety. This can be done by reducing the risk of work accidents, such as impacts, falls, and punctures.
3. Convenience. The layout must be designed in such a way that it can increase worker comfort. This can be done by providing a fairly spacious work space, good lighting and a comfortable air temperature.

In general, layout design using the Blocplan method can produce a more efficient and optimal layout. However, layout design also needs to consider other factors such as productivity, security, and comfort in order to produce a better layout.

IV. Conclusion

The review results show that layout design using the Blocplan algorithm can produce a layout that is more efficient than the initial layout. It was found that several related industries in Indonesia can use the Blocplan algorithm in redesigning facility layouts, including the pharmaceutical industry, construction project implementation, food industry, steel or iron industry, spring bed production, PVC production, transformer production, valve production, production trolleys, corn milling, feed processing, plastic recycling, garment or convection industry, robotization industry, coffee production, paper production, brick production, and wood processing.

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