

Proposed Improvements to Production Facility Layout Using ARC and ARD at Home Industry Aurora Official

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Article Information	ABSTRACT
Article History Received : December 19, 2024 Revised : January 18, 2025 Published : January 24, 2025	Home Industry Aurora Official, which is engaged in the manufacture of pillows and baby mattresses, faces problems related to inefficient facility layouts in the workflow. Suboptimal layouts result in excessive waste of distance, which affects production time and reduces operational efficiency. This study aims to design a more efficient facility layout by minimizing the distance between production processes. The methods used in this study are the ARC (Activity Relationship Chart) and ARD (Activity Relationship Diagram) methods, which can help design layouts based on the relationships between production activities and determine the relationships between activities based on their priority level of proximity. Based on the analysis results, the initial layout produces a total distance of 940 meters, while the two alternative proposed layouts produce distances of 310 meters and 405 meters respectively. Of the two proposed layouts, proposed layout 1 was chosen as the proposed layout for the company with a total distance of 310 meters, with a decrease of 67% from 100% of the total distance of the initial layout. The results of this study indicate that the application of proposed layout 1 can improve workflow efficiency and reduce waste time in the production process.
Keywords: <i>Initial and Proposed Layout; Activity Relationship Chart; Activity Relationship Diagram.</i>	

INTRODUCTION

Home industry businesses have a strategic role in driving the economic growth of the community, especially in the production sector of daily necessities. Every company faces new problems because the company is still newly established (Nugraha, et al., 2024). Over time the company experienced an increase in market demand so that there was a significant development that encouraged large-scale production (Rozak, 2021). While this allows for increased production capacity, spatial management is needed for optimal production (Amelia, et al., 2024). The production process flow used from the beginning was maintained without regard to changes in the scale and complexity of operations. As a result, the links between production flows became too far apart and inefficient. This problem impacted production activities and contributed to increased processing time, labor errors, and higher operating costs (Rachman, et al., 2023).

In addition, unplanned production layouts with poor displacement can lead to less production and higher costs. To overcome these problems, a systematic approach is needed to design a more effective and efficient facility layout (Wahyuni, 2024). To design a good facility layout, you must first know how the production floor is organized (Aristriyana & Salim, 2023).

Simulation can be used to determine the layout so that it is easier to understand in accordance with the production system and on target (Cahyono & Mohammad, 2022). The design can be used to determine the layout so that it is easier to understand according to the production system and is right on target (Halimsyah, et al., 2023). This action aims to find out how the system flows (Yulistio, et al., 2022). This design uses a 2D-based design program, namely Visio 2013.

Home Industry Aurora Official is a home industry that produces a variety of pillows, character baby mattresses, etc. This industry still does not understand the layout of facilities, which results in poor space placement in the production flow and work processes that are less effective and efficient. In the activities of workers, they still take or move manually which takes a lot of time. Not achieving the production target is another problem faced by this industry, which causes the completion time to be unresolved. Therefore, the facility layout must be redesigned using the ARC method with the determination of the degree of approach and ARD as a link between activities based on the priority level of proximity. This research aims to provide a proposed facility layout that can reduce area wastage, improve workflow efficiency, and support sustainable business growth. The proposed solution is expected to be able to answer the operational challenges faced by this home industry, while making a real contribution to the optimization of the production process in the home industry sector. The Activity Relationship Diagram (ARD) and Activity Relationship Chart (ARC) used in this study methods are applied to analyze the inter-activity relationships in the production process. ARC helps identify the required level of closeness between production activities, while ARD provides a visualization of the layout based on these relationships. This approach not only considers space efficiency, but also ensures smooth production flow.

RESEARCH METHODS

This research method uses interviews and observations of employees. The manufacturing flow, the distance between places, and the frequency of picking when going between spaces or facilities are among the data used. Finding the degree of proximity using the Activity Relationship Chart (ARC) to ascertain the relationship between facilities is the next stage. Next, use the Activity Relationship Diagram (ARD) to visually identify the layout by determining the relationship between the activities based on the priority degree of proximity. Comparing the initial distance with the proposal is the last step.

Activity Relationship Chart (ARC)

It is the activities performed by each component that show the importance of its proximity to the space or workplace. In other words, the ARC is a map created to show the degree of connection between the events that take place in one area and one another (Jamalludin, et al., 2020). Based on the relationships between activities, ARC is used to design the layout of a department or facility (Azizah, 2023).

Activity Relationship Chart Symbol

Table 1. Activity Relationship Chart Symbol

Code	Color	Degree of Proximity
A	Red	Absolute
E	Orange	Very Important
I	Light Green	Important
O	Light Blue	Ordinary
X	Brown	Not Desirable
U	Yellow	Not Important

Determination of the degree of closeness on the Activity Relationship Chart.

Table 2. Degree of Proximity Activity Relationship Chart

Reason Code	Description
1	High Usage Frequency
2	Low Usage Frequency
3	Work Order
4	High Flow of Information
5	Information Flow Moderate
6	Supervisory Function
7	No Functional Relationship
8	Peace and Cleanliness
9	Safety and Security
10	Dangerous If Nearby
11	Convenience/Ease of Reach
12	Preventive Measures

Activity Relationship Diagram (ARD)

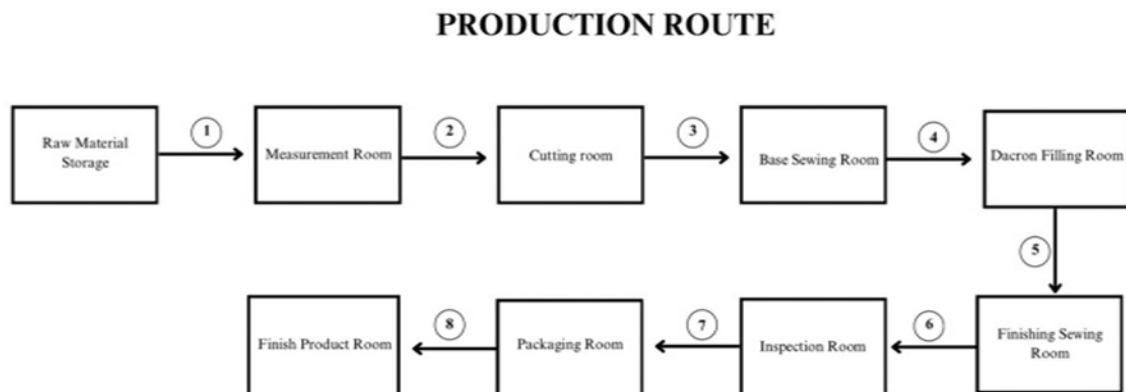
This diagram shows the relationship between various department/workstation activities based on the priority level of proximity (Panjaitan & Azizah, 2022). Starting from the department/station by prioritizing first and followed by the next, there is a possibility of errors. The purpose of this error is that each department/station cannot be near each other without any restrictions from other departments/stations (Panrelli, 2024). ARD is used to connect workstation operations and departments based on their proximity priority level (Warman & Mukhtar, 2024).

RESULTS AND DISCUSSION

Data Collection

Production Flow

Figure 1. shows an overview of the production flow that runs at Home Indutry Aurora Official.

**Figure 1.** Production Flow of Home Industry Aurora Official

(Source : Home Industry Aurora Official)

It is concluded that the production flow in the production process starts from the raw material storage room, measurement room, cutting room, sewing room, dacron filling room, inspection room, packing room, and finished goods storage room.

Initial Production Layout

Figure 2. shows the initial production layout. The initial design in the redesign should be done in stages.

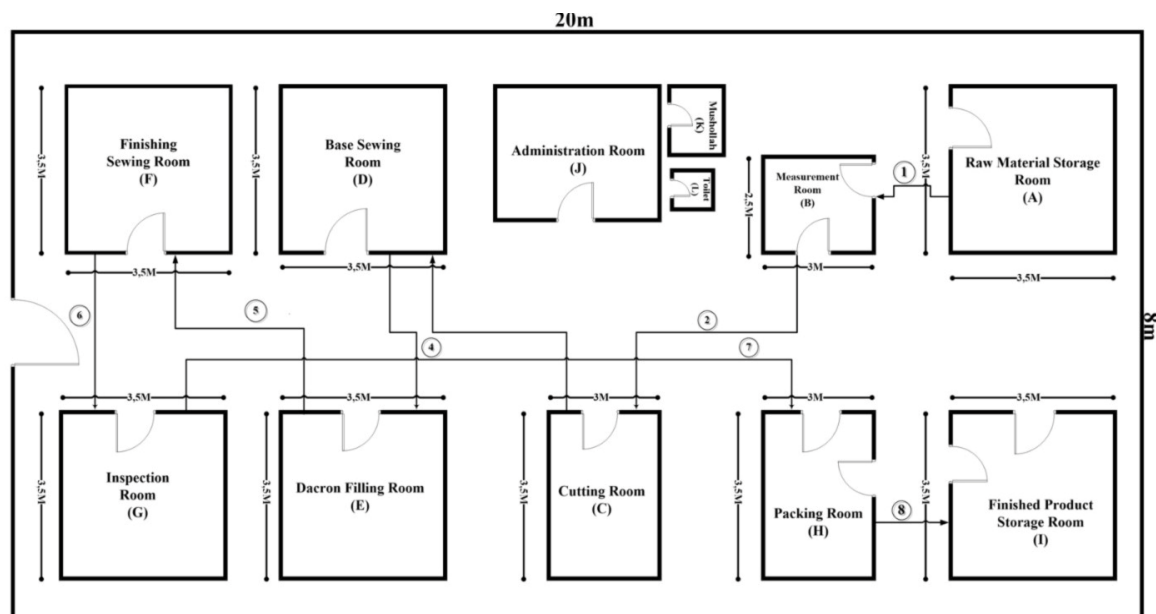


Figure 2. Initial Production Layout

(Source : Home Industry Aurora Official)

It is concluded that the distance between departments/workstations is quite far so that the time during production takes quite a lot of time and the time spent is not efficient. The flow of work processes involving facilities can be analyzed by looking at the initial production distance data for Home Industry Aurora Official in table 3.

Table 3. Production start distance

From	To	Tools	Frequency/ transit	Frequency/ day	Distance between rooms (m)	Total Distance between rooms (m)/day
A	B	People	2	5	1.5	15
B	C	People		5	3	30
C	D	People		5	2.5	25
D	E	People		10	1.5	30
E	F	People		30	2	120
F	G	People		30	1	60
G	H	People		30	9.5	570
H	I	People		30	1.5	90
Total			2	145	22.5	940

Table 3. Explaining that the means of movement use people, with the number of transit frequencies indicating that once the movement between spaces is done back and forth. While the frequency per day takes into account the movement between spaces is done several times. So that the existence of both frequencies can be known the total distance between spaces is 940m.

Data Processing

Activity Relationship Chart – Activity Relationship Diagram

The Activity Relationship Chart (ARC) is created with the purpose of indicating the level of connection between actions in various work areas. All these letter codes have a reason code, which will determine how close they are. A summary of the degree of connection between activities and ARC reason codes is given here.

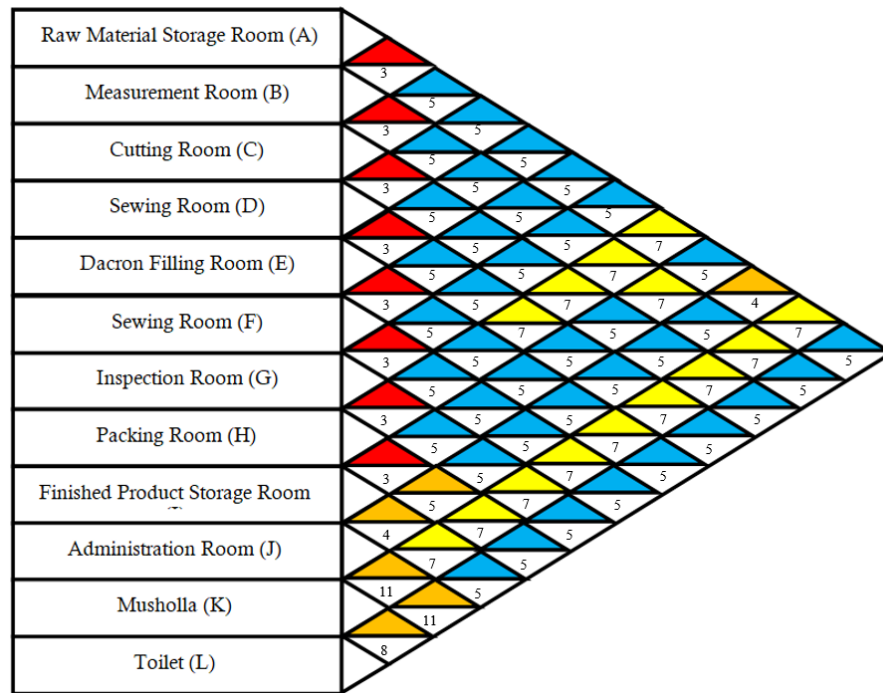


Figure 3. Degree of Proximity and ARC Code

Figure 3. shows the ARC for the location of production facilities. The rules for the degree of relationship between placements are shown in the figure caption. They are made based on the degree of proximity between work areas, such as table 4.

Table 4. Degree of Proximity between Spaces

Code	Facilities	Proximity Relationship					
		A	E	I	O	X	U
A	Raw Material Storage Room	B	J		C,D,E,F,G,I,L		H,K
B	Measurement Room	A,C			D,E,F,G,J,L		H,I,K
C	Cutting Room	B,D			A,E,F,G,I,J,L		H,K
D	Sewing Room	C,E			A,B,F,G,I,J,L		H,K
E	Dacron Filling Room	D,F			A,B,C,G,H,I,J,L		K
F	Sewing Room	E,G			A,B,C,D,H,I,J,L		K
G	Inspection Room	F,H			A,B,C,D,E,I,J,L		K
H	Packing Room	G,I	J		E,F,L		A,B,C,D,K
I	Finished Product Storage Room	H	J		A,C,D,E,F,G,L		B,K
J	Administration Room		A,H,I,K,L		B,C,D,E,F,G		
K	Musholla		J,L				A,B,C,D,E,F,G,H,I
L	Toilet		J,K		A,B,C,D,E,F,G,H,I		

ARD are created depending on the proximity level of ARC after being defined in table 4.

A-G,I E-J	A-H E-J	A- E-A,H,I,K,L	A- E-J,L	A-B E-J	A-A,C E-
Packing Room (H)	Finished Product Storage Room (I)	Administration Room (J)	Musholla (K)	Raw Material Storage Room (A)	Measurement Room (B)
O-E,F,L U-A,B,C,D,K	O-A,C,D,E,F,G,L U-B,K	O-B,C,D,E,F,G U-	O- U-A,B,C,D,E,F,G,H,I	O-C,D,E,F,G,I,L U-H,K	O-D,E,F,G,J,L U-H,I,K
A-F,H E-	A-E,G E-	A-D,F E-	A- E-J,K	A-C,E E-	A-B,D E-
Inspection Room (G)	Sewing Room (F)	Dacron Filling Room (E)	Toilet (L)	Sewing Room (D)	Cutting Room (C)
O-A,B,C,D,E,I,J,L U-K	O-A,B,C,D,H,I,J,L U-K	O-A,B,C,G,H,I,J,L U-K	O-A,B,C,D,E,F,G,H,I U-	O-A,B,F,G,I,J,L U-H,K	O-A,E,F,G,I,J,L U-H,K

Figure 4. ARD Determination Based on the Degree of Proximity of ARC

Proposed Production Layout

The proposed production layout is redesigned according to the production flow shown in Figure 5 as proposed layout 1 and Figure 6 as proposed layout 2.

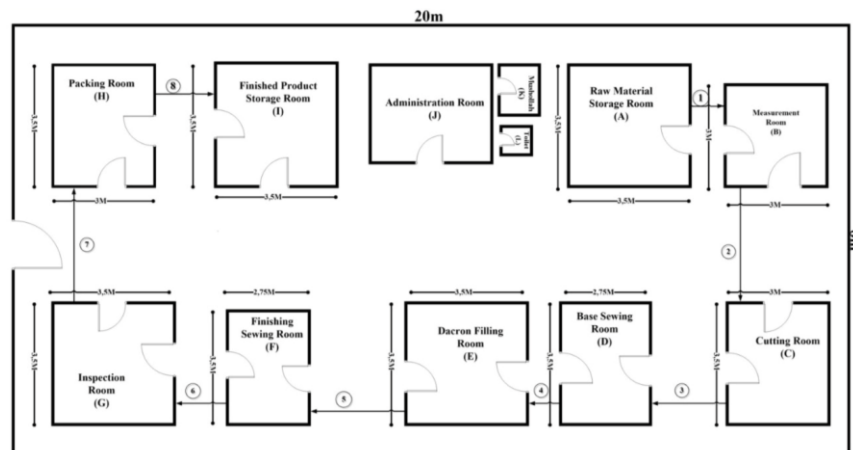


Figure 5. Proposed Production Layout 1

In the proposed layout, it can be seen that there was a previous change at the beginning of the layout, the production flow in proposed layout 1 is closer and does not take much time, so the time taken in the production flow is more efficient.

The following is table 5. the results of the comparison of determining the initial distance with the proposed distance.

Table 5. Proposed layout distance calculation 1

From	To	Tools	Frequency/ transit	Frequency/ day	Distance between rooms (m)	Total Distance between rooms (m)/day
A	B	People	2	5	1.5	15
B	C	People		5	1	10
C	D	People		5	1.5	15
D	E	People		10	1.5	30
E	F	People		30	1	60
F	G	People		30	1	60
G	H	People		30	1	60
H	I	People		30	1	60
Total			2	145	9.5	310

The comparison results in table 5 show that the total initial distance was 940m with the first proposed change being made with a total proposed distance of 310m.

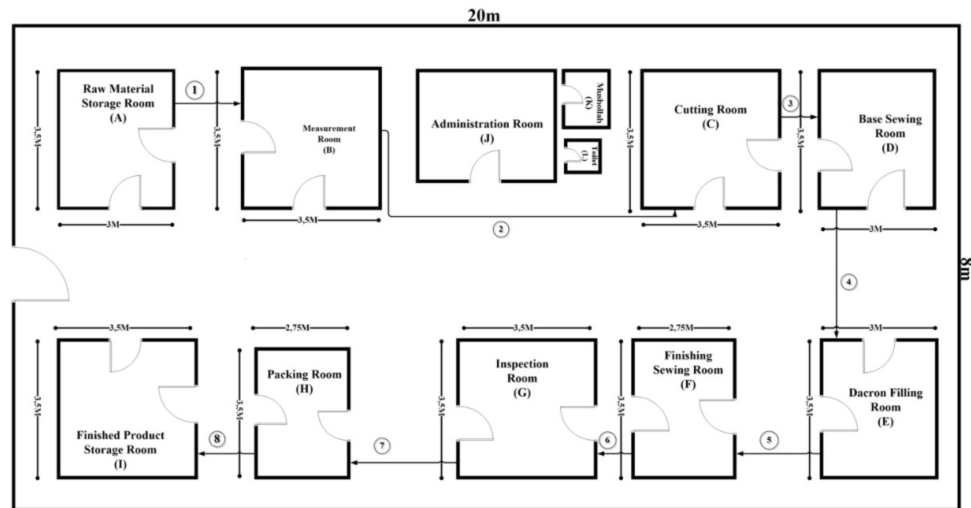


Figure 6. Proposed Production Layout 2

In the proposed layout, it can be seen that there are changes from the initial layout and differences in the proposed layout 1, the production flow in the proposed layout 2 has a workflow that starts from the main door so that the production flow route is different from the proposed layout 1 with the aim of facilitating the flow of raw materials in and out, and the location of the finished goods warehouse which also facilitates the flow of finished goods out.

The following is table 6. the results of the comparison determine the initial distance with the proposed distance 2.

Table 6 illustrates how the distance decreases as a result of comparing the original arrangement with the suggested one.

Table 6. Proposed layout distance calculation 2

From	To	Tools	Frequency/ transit	Frequency/ day	Distance between rooms (m)	Total Distance between rooms (m)/day
A	B	People	2	5	1	10
B	C	People		5	6	60
C	D	People		5	1.5	15
D	E	People		10	1	20
E	F	People		30	1.5	90
F	G	People		30	1.5	90
G	H	People		30	1	60
H	I	People		30	1	60
Total			2	145	14.5	405

As a result of the comparison between the initial layout and the 2 proposed layouts, the distance resulted in a decrease as shown in table 7.

Table 7. Percentage of Initial and Proposed Distance

Result	Distance (m)	Percentage (%)
<i>Initial layout</i>	940	100%
<i>Proposed layout 1</i>	310	33%
<i>Proposed layout 2</i>	405	43%

Based on the calculation of the distance on the initial layout which was previously 100% and after the proposed layout 1 was carried out it became 33%, so that the proposed layout 1 resulted in a decrease of 67%. And in the calculation of the initial layout with the proposed layout 2 it became 43% so that the proposed layout 2 resulted in a decrease of 57%.

Based on the existing results, it is better for the home industry to use the proposed layout 1 as a consideration in carrying out the facility layout, because the efficiency of the production flow distance is less than the initial layout and proposal 2. So it is possible to have a more optimal distance and does not take a lot of time.

CONCLUSION

According to the results of data processing and analysis, this study suggests a more efficient production layout than the initial layout using the ARC method with the determination of the degree of approach and ARD as a link between activities based on the level of priority of proximity, then the distance obtained is 310m which was previously at the initial distance of 940m. After the change from the initial layout to the proposed layout was selected, the resulting efficiency was 33% and a decrease of 67% from the initial distance of 100%.

Based on the conclusion above, the suggestion for Home Industry Aurora Official is to apply the proposed layout to the production flow so that the distance between picking and moving becomes more efficient.

ACKNOWLEDGEMENTS

Thank you to the Home Industry Aurora Official for accepting and helping me in conducting this research from start to finish so that this research can be achieved and successful.

REFERENCES

- Amelia, F., Manurung, A. H., Anggraeni, M., Nasution, N. M., & Ainun, T. N. (2024). Perancangan Ulang Tata Letak Fasilitas Melalui Metode Activity Relationship Chart (Arc) Dan Activity Relationship Diagram (Ard) (Studi Kasus : Ukm Tahu Baso Miwiti). *Jurnal Teknologi dan Manajemen Industri Terapan* , 3 (2), 171-180.
- Aristriyana, E., & Salim, M. I. (2023). Perancangan Ulang Tata Letak Fasilitas Menggunakan Metode Arc Guna Memaksimalkan Produktivitas Kerja Pada Ukm Sb Jaya Di Cisaga. *Jurnal Industrial Galuh* , 5 (1), 29-36.
- Azizah, N. F. (2023). Analisis Perancangan Tata Letak Menggunakan Metode Activity Relationship Chart (Arc) Dan Computerized Relationship Layout Planning (Corelap) Pada Cv. Tunas Karya. *Jurnal Teknik Industri* , 9 (1), 86-94.
- Baihaqi, A. (2023). Evaluasi Tata Letak Fasilitas Toko Retail Indomaret Dengan Menggunakan Metode Activity Relationship Chart (Arc). *Sains: Jurnal Manajemen Dan Bisnis* , XV (2), 209-222.

- Cahyono, A., & Mohammad. (2022). 5 Perencanaan Tata Letak Untuk Meningkatkan Efisiensi Pada Perusahaan Furniture Xyz Dengan Metode Arc(Activity Relationship Chart) Dan Ard(Activity Relationship Diagram). *Jurnal Riset Teknik* , 1 (3), 32-38.
- Farhan, A., Pratama, A. D., Hutasuhut, N., Anugrah, I., & Mubarok, R. (2023). Perancangan Ulang Tata Letak Fasilitas Dengan Menggunakan Activity Relationship Chart (Arc) Pada Ukm Andi Shoes. *Talenta Conference Series: Energy & Engineering* , 6 (1), 1206-1216.
- Halimsyah, Y., Nasution, R. S., & Nugroho, H. W. (2023). Evaluasi Layout Fasilitas Produksi Minyak Kelapa Sawit Di Pt. Abc Dengan Metode Activity Relationship Chart (Arc) Dan Activity Relationship Diagram (Ard). *Journal of Green Engineering for Sustainability* , 01 (01), 13-24.
- Jamalludin, Fauzi, A., & Ramadhan, H. (2020). Metode Activity Relationship Chart (Arc) Untuk Analisis Perancangan Tata Letak Fasilitas Pada Bengkel Nusantara Depok. *Bulletin of Applied Industrial Engineering Theory* , 1 (2), 20-22.
- Nasution, R. S., & Nugroho, H. W. (2024). Improvement Of The Layout Of Building Construction Factory Facilities Using Arc And Ard Approaches . *Kisra* , 1 (1), 1-11.
- Nugraha, D. A., Hidayat, & Negoro, Y. P. (2024). Usulan Perubahan Tata Letak Fasilitas Produksi Umkm Ibs Menggunakan. *G-Tech: Jurnal Teknologi Terapan* , 8 (4), 2578-2528.
- Panjaitan, F. Y., & Azizah, F. N. (2022). Perancangan Tata Letak Fasilitas Gudang Produk Jadi Menggunakan Metode Activity Relationship Diagram Pada Pt Jvc Electronics Indonesia. *Jurnal Ilmiah Wahana Pendidikan* , 8 (9), 30-38.
- Panrelli, S. (2024). Perancangan Ulang Tata Letak Fasilitas Menggunakan Metode Systematic Layout Planning Pada Umkm Xyz. *Jurnal Teknik Industri* , 27 (1), 76-85.
- Rachman, A., Widyaningrum, D., & Rizqi, A. W. (2023). Perancangan Tata Letak Fasilitas Untuk Meminimalkan Jarak Material Handling Pada Pabrik Pupuk Organik Pt. Petrokopindo Cipta Selaras Dengan Metode Arc Dan Ard. *Jurnal Teknik Industri* , 9 (1), 345-352.
- Rozak. (2021). Penerapan Arc Dan Ard Untuk Membuat Rancangan Layout Fasilitas Pada Pabrik Kerupuk Menggunakan Blocplan Di Cv Arto Moro. *Bulletin of Applied Industrial Engineering Theory* , 2 (2), 145-149.
- Septiani, T., & Syaichu, A. (2020). Perencanaan Ulang Tata Letak Fasilitas Menggunakan Metode Activity Relationship Chart (Arc). *Jurnal Ilmu Teknik Sistem* , 16 (2), 30-41.
- Syaichu, A., & Mala, R. N. (2022). Perancangan Ulang Tata Letak Fasilitas Produksi Beras Sehat Jawatan Pada Upt. Makarti Pomosda Menggunakan Metode Activity Relationship Chart (Arc). *Jurnal Ilmu – Ilmu Teknik - Sistem* , 18 (3), 1-8.
- Wahyuni, D. S. (2024). Analisis Perancangan Tata Letak Greenhouse Menggunakan Metode Arc Dan Ard Pada Cv Green Tropical Sukabumi. *Jurnal Maritim* , 6 (1), 65-74.
- Warman, F. O., & Mukhatar, M. A. (2024). Analisa Layout Facility Lantai Produksi Menggunakan Metode Activity Relationship Chart(Arc) Dan Activity Relationship Diagram Di Pt.Isumi. *Seminar Nasional Hasil Riset Dan Pengabdian* , 6, 958-964.
- Yulianto, R., & Cahyana, A. S. (2024). Relayout Tata Letak Fasilitas Menggunakan Metode Arc, Ard, Dan Blocplan Guna Mengoptimalkan Perpindahan Material Handling. *Umsida* , 1-13.
- Yulistio, A., Basuki, M., & Azhari. (2022). Perancangan Ulang Tata Letak Display Retail Fashion Menggunakan Activity Relationship Chart (Arc). *Jurnal Ilmiah Teknik Industri* , 10 (1), 21-30.