

# **Facility Layout Planning Optimization in Local Retail Store Using Systematic Layout Planning**

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## **Abstract**

Al Hikam Mart is a two-floored local retail store in Indonesia that provides relatively inexpensive daily necessities. Nowadays, the presence of retail stores is increasing, thereby tightening competition between retail stores. Therefore, Al Hikam Mart needs to improve the quality of its store layout planning so that customers get a better shopping experience. The study aims to assess current layout or facility arrangement of Al Hikam Mart, to tackle the problem encountered with the use of existing layout which had products that were placed a bit spread out. Identification of Al Hikam Mart's problem was conducted by in-depth interviews with the owner and observation. Afterwards, analysis using systematic layout planning is done by implementing ARC, ARD, AAD. Finally, appropriate layout, facilities, and product arrangement for Al Hikam Mart is proposed to meet the optimization goals. Proposed layout for both the first and second floor are visualized in 2D and 3D using AutoCAD and Sketch Up where similar and frequently sought-after products are brought together.

## **Keywords**

Retail, Facility Layout, Product Allocation, Systematic Layout Planning and Optimization

## **1. Introduction**

Retail stores play an important role in their local communities, helping to ensure necessities availability for residents in areas that may not be served by dependent grocery stores. They also provide employment opportunities and generate tax revenue for these areas. According to Chung and Myers (1999); Block and Kouba (2006); Powell et al., (2007), independent grocery stores are establishments whose owners operate fewer than four outlets simultaneously. The rapid development of retail stores, such as minimarkets, in Indonesia is caused by several factors. These are population growth, increased per capita income, and shopping behavior in urban communities who want comfort, cleanliness, product variety, and locations close to where they live. The rapid growth of outlets coupled with the locations of outlets that are close to each other has resulted in increasingly fierce competition between minimarkets. The retail store layout is based on the idea that sales and profits vary depending on which product appeals to the customer. Research shows that the greater the product can be seen by customers, the sales will increase, and the return on investment will also be higher (Heizer and Reinder 2012). Thus, we are motivated to conduct research on improvements to the layout of Al Hikam Mart, one of the retail minimarkets in Depok, West Java, Indonesia.

Al Hikam Mart was founded on October 22, 2015, on the idea of the founder of the Al Hikam Islamic boarding school, namely to help provide for the needs of the surrounding community and teach all students to be prepared for life, one of which is by trading. Currently, Al Hikam Mart has a problem where the manager of Al Hikam Mart has

no experience on how to manage a retail store. Therefore, the layout of products in stores is currently only based on benchmarking against other retail stores. From the assessment that has been done, Al Hikam Mart has a value of 65 - 70 which shows that there is still room to improve the quality of Al Hikam Mart.

### 1.1 Objectives

The purpose of this paper is to determine layout suggestions for retail stores using Systematic Layout Planning, especially Al Hikam Mart, to meet the needs of the company to improve the quality of its store layout and help customers to get a better shopping experience.

## 2. Literature Review

### 2.1 Facility layout planning

Facility layout planning (FLP) involves a set of design problems related to the arrangement of the elements that shape industrial production systems in a physical space (Pablo Alberto et al. 2021). As part of business operational strategies, FLP is considered one of the most important design decisions (Ghassemi Tari and Neghabi 2015; Kheirkhah et al. 2015; Sun et al. 2018). It also significantly affects the efficiency of production systems and their productivity level (Altuntas and Selim 2012; Navidi et al. 2012; Ku et al. 2011).

### 2.2 Retail Store

A retail store is a place of business that sells merchandise in small quantities directly to customers (NAICS Association 2022). Retailers are divided into store retailers and non-store retailers. Store retailers operate fixed point of sale locations (i.e. retail stores) to display and sell merchandise directly to the general public.

### 2.3 Systematic Layout Planning (SLP)

Systematic Layout Planning (SLP) is a series of stages in planning a layout, starting from the pattern outline and placement to the final layout. The SLP method uses both quantitative and qualitative inputs. Quantitative inputs such as distance and frequency of displacement, while qualitative inputs include the degree of activity relationship. (Heragu 1997).

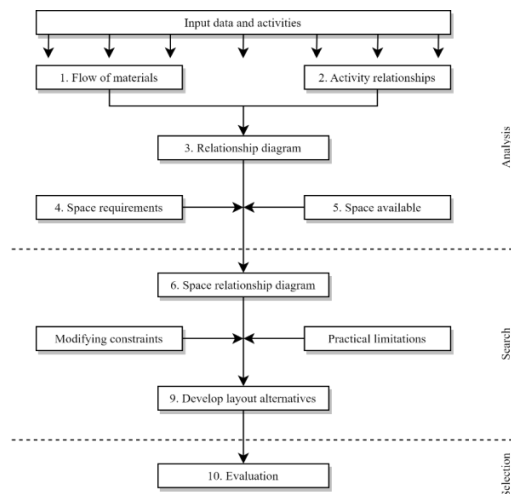


Figure 1. Systematic Layout Planning Flow Chart

Making the Activity Relationship Chart (ARC) is the first step in SLP. Activity Relationship Chart contains codes that determined how closely related each of the layout's parameters were to one another. 5-4-3-2-1 lines were used to represent these codes A-E-I-O-U-X in the Activity Relationship Diagram (ARD) section. The Activity Relationship Diagram is connected by lines that represent the closeness's strength as previously stated. This diagram makes it simple to visualize the relative importance of the characteristics in the space at hand. Afterwards, the Area Allocation Diagram (AAD) was created based on the Activity Relationship Diagram. The Area Allocation Diagram, which displayed the layout's floor plan, was the closest figure in the layout.

### 3. Methods

The method that has been done in this research can be seen in the flowchart in Figure 2.

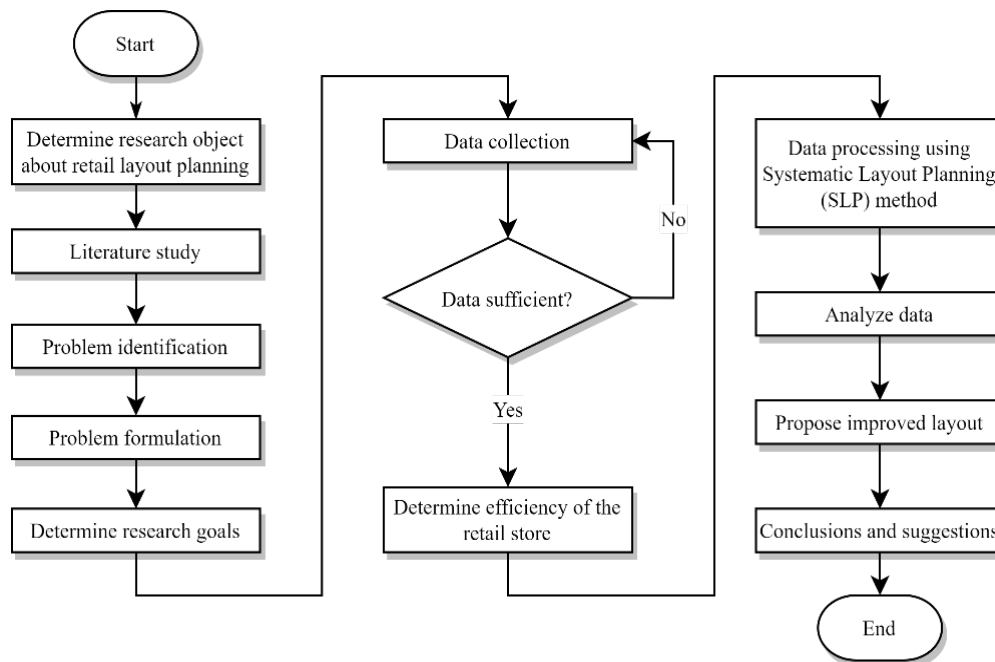


Figure 2. Methodology Flow Chart

### 4. Data Collection

#### 4.1 Research Location

Al Hikam Mart is a retail store located in Kukusan, Depok, West Java, Indonesia. It is a local retail store with two floors and operates from 7 AM to 10 PM. The hours of operation are divided into two shifts, namely the first shift from 7 AM to 1 PM and the second shift from 1 PM to 10 PM. Currently, Al Hikam Mart has eight employees who serve as salesclerks, cashiers, online shop managers, and delivery officers. For seven years running, Al Hikam Mart has helped the nearby community in providing relatively inexpensive daily necessities. Therefore, Al Hikam Mart became one of the intended targets for our research regarding factory layout and material handling.



Figure 3. Situation inside Al Hikam Mart

#### 4.2 Observation Data

Observation and measurement of the size of each component of the facility from Al Hikam Mart was carried out on Sunday, 6 November 2022. From the observation and calculation activities, data was obtained related to the types of components; length, width, and height of each component; as well as the amount of each component.

No	Component	Length (cm)	Width (cm)	Height (cm)	Total (pcs)
<b>First Floor</b>					
1	Entire 1st floor	-	-	284	-
2	Ordinary shelf	90	30	150	35
3	Nugget Freezer	110	54	84	1
4	Yakult Freezer	50	55	138	1
5	Cadbury Shelf	45	49	150	1
6	Bread Shelf	55	42	150	4
7	Coca Cola Freezer	103	71	203	1
8	Yuzu Freezer	54	71	151	1
9	Zuzu Freezer	54	80	151	1
10	Nestle Freezer	54	80	157	1
11	Milk Freezer	54	56	157	1
12	Ayce Freezer	122	63	75	2
13	Snack Shelf	50	40	136	6
14	Ichitan Shelf	48	46	135	1
15	Shelf in front of the cashier	81	26	83	2
16	Cashier table	162	58	83	1
17	Bookcase by the entrance	58	33	200	1
18	Small Medicine Rack	100	40	112	2
19	Big Medicine Rack	100	40	150	1
20	Stairs	-	178	-	12
21	Stairs 2	-	167	-	5
22	Water gallon area	360	160	-	-

No	Component	Length (cm)	Width (cm)	Height (cm)	Total (pcs)
<b>Second Floor</b>					
1	Entire 2nd floor	-	-	322	-
2	Distance between shelves (aisle)	-	80	-	-
3	Ordinary shelf	90	30	150	52
4	Yuzu shelf	30	40	127	1
5	Piggy bank shelf	46	26	125	2
6	Cashier shelf	126	58	204	1
7	Nivea shelf	40	40	120	1
8	Mattress and bucket area	560	120	-	1
9	Sweep Area	320	120	-	1
10	Shelf Pins	45	45	160	1
11	Mask hanger	75	-	196	1
12	Razor shelf	40	23	150	1
13	Medicine shelf	100	40	112	4
<b>Storage</b>					
1	Small shelf	91	67	193	7
2	Big shelf	124	67	233	2

Figure 4. Al Hikam Mart Facility Component Data

### 4.3 Existing Layout

After making direct observations on Sunday, November 6, 2022, we studied the layout and arrangement of the products sold at the stores that were the object of our research. Afterwards, we sketched the existing layout of the first floor and the second floor at Al Hikam Mart in AutoCAD software. The following are figures of the existing layout on the first floor and second floor of Al Hikam Mart alongside descriptions.

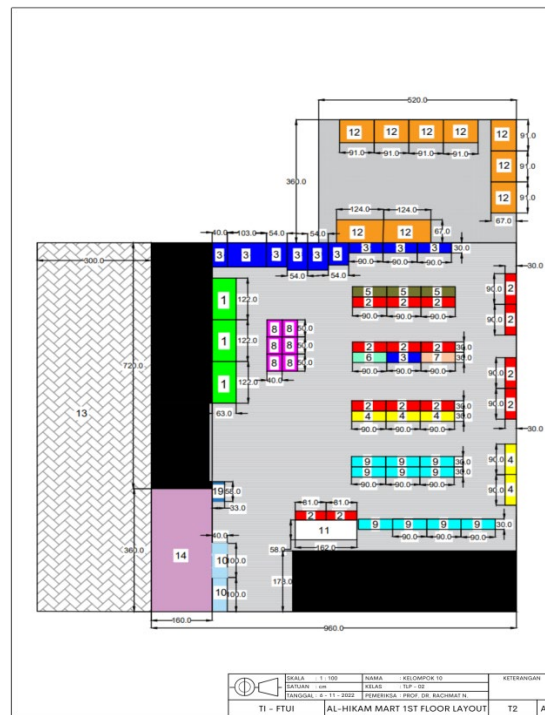


Figure 5. First floor layout of Al Hikam Mart

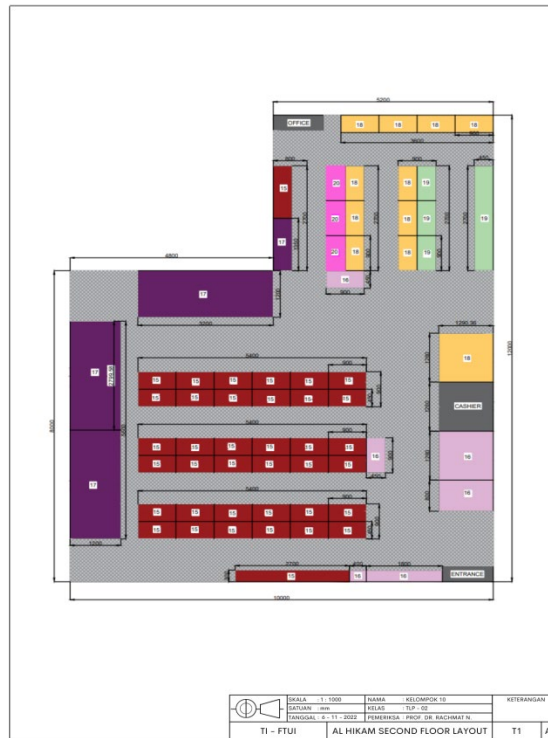


Figure 6. Second floor layout of Al Hikam Mart

No	Figure 6 Description
1	Ice Cream
2	Snacks
3	Cold Beverages
4	Instant Food
5	Beverages
6	Chocolate
7	Nugget freezer

8	Bread
No	Figure 6 Description
9	Food ingredients
10	Medicine
11	Cashier Counter
12	Warehouse
13	Parking Lot
14	Mineral Water Gallon
15	Body Care and Sanitary

16	Mask and Accessories
No	Figure 6 Description
17	Housekeeping Equipment
18	Stationery
19	Islamic Books
20	Clothing Apparel
21	Insect Repellent
22	Cashier Counter

#### 4.4 Material Handling

Material handling is the movement, protection, storage and control of materials and products throughout manufacturing, warehousing, distribution, consumption and disposal. As a process, materials handling incorporates a variety of manual, semi-automated and automated equipment and systems that support logistics and keep supply chains working. In this study, the authors observed the flow of the material itself and the material handling process at the Al-Hikam Mart retail store. Materials in the form of products that will be sold by Al-Hikam Mart. These products consist of several types of commodities, such as food and beverages, hygiene products, household appliances or furniture, medicines, and other commodities. The following is the material flow from Al-Hikam Mart, where the first material or product will be entered into the store through door, then the product will be stored in the Warehouse, and the product will be placed on the shelf when the previous display product has run out.

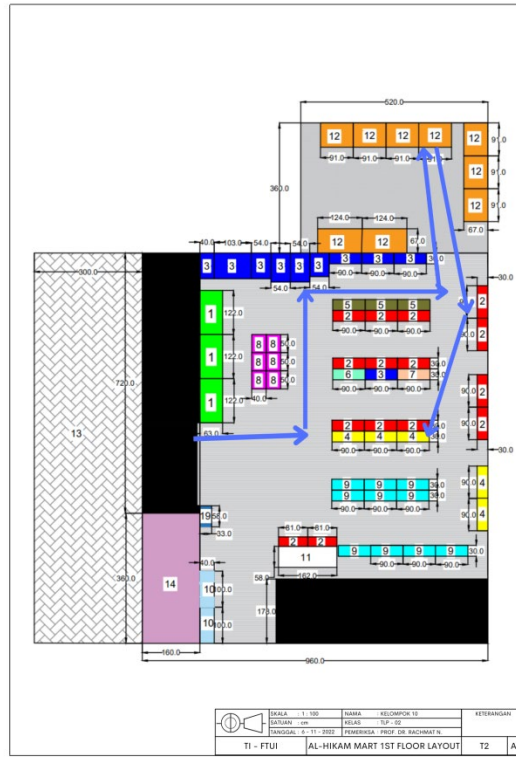


Figure 7. Material flow at Al Hikam Mart

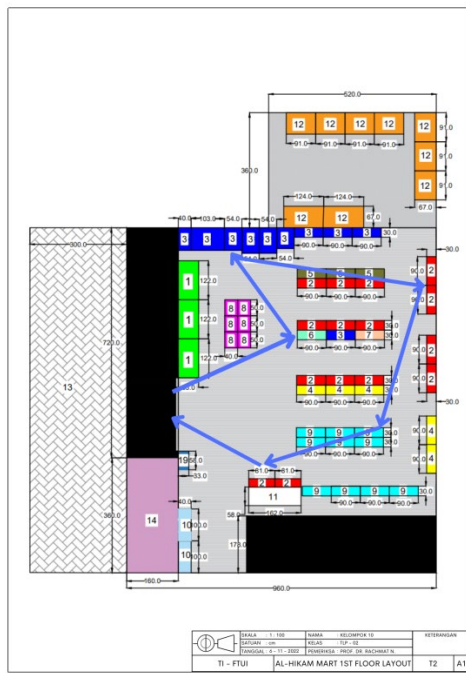


Figure 8. Flow of shoppers on the 1st floor of Al Hikam Mart



Figure 9. Flow of shoppers on the 2nd floor of Al Hikam Mart

The process of moving material to the warehouse is carried out by employees who are in the store. Materials or products that have just arrived will be transported manually or without assistance by employees from Al-Hikam Mart who are currently in the shop. Thus, Al-Hikam Mart does not require equipment costs in carrying out material handling. The following figures 8 and 9 are examples of the flow of buyers in Al Hikam Mart.

#### 4.5 Operation Process Chart

The following Figure 10 is a diagram of the operating process at the Al-Hikam minimarket. The process begins with the transportation of the customer to the minimarket. The customer can take the shopping basket provided near the cashier to put the items to be purchased. After that, the customer will go towards the shelf of the desired item. Suppose a customer wants to buy a snack, he will walk towards the shelves with the snack category. The customer will repeat the process according to the wishes of each customer. Then, the customer walks to the queue at the cashier to proceed with payment. Customers can choose a payment method in advance, whether they want cash or transfer. After the payment is complete, the customer will walk towards the exit.

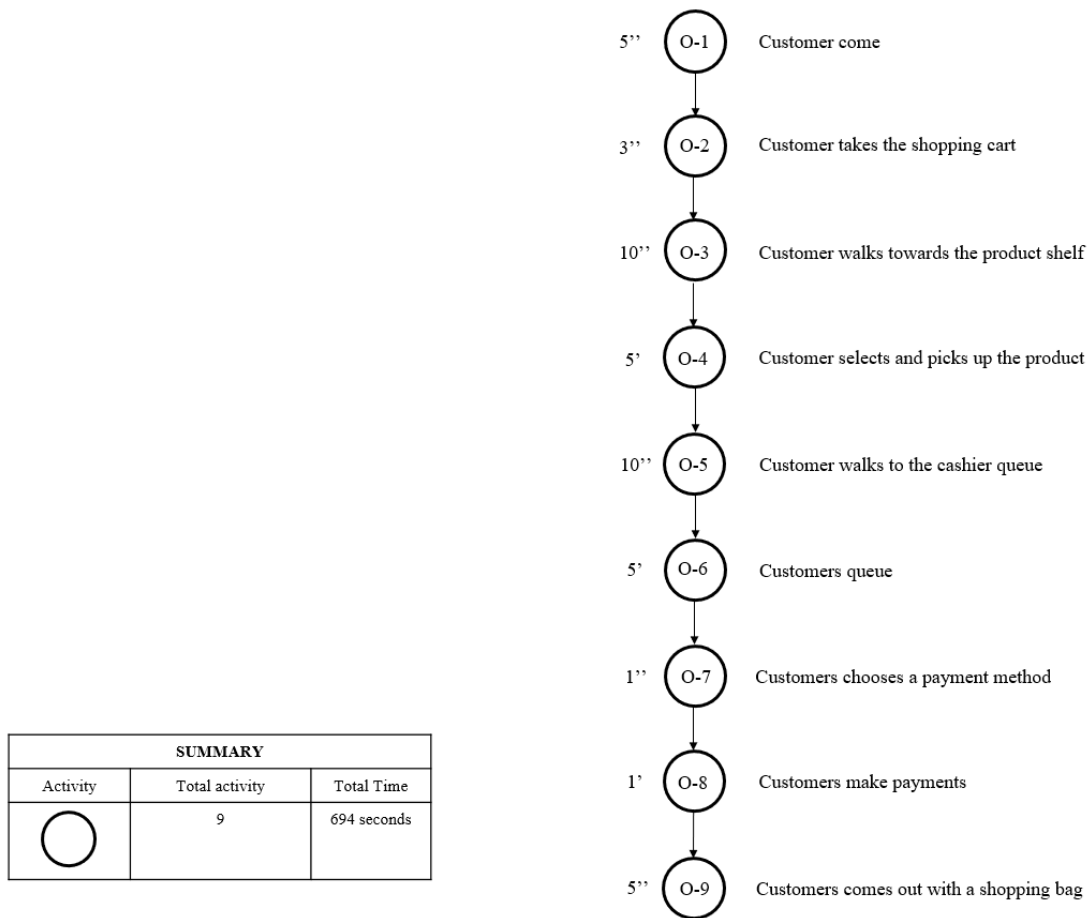


Figure 10. Operation Process Chart of Al Hikam Mart

## 5. Results and Discussion

### 5.1 Activity Relationship Chart (ARC)

Based on the ARC on the first floor, it can be seen the degree of proximity between the 14 locations. There are two relationships that must be adjacent. The first is cold drinks because usually when someone wants to buy a drink, they will look for a refrigerator. If someone is looking for something cold, they will look around if they want something

not cold too. Secondly, snacks need to be close to the cashier counter because when someone is waiting in line or making payments while waiting, they will look at the food around the cashier and be interested in buying it. The following Figure 11 is the ARC of Al Hikam Marton the first floor.

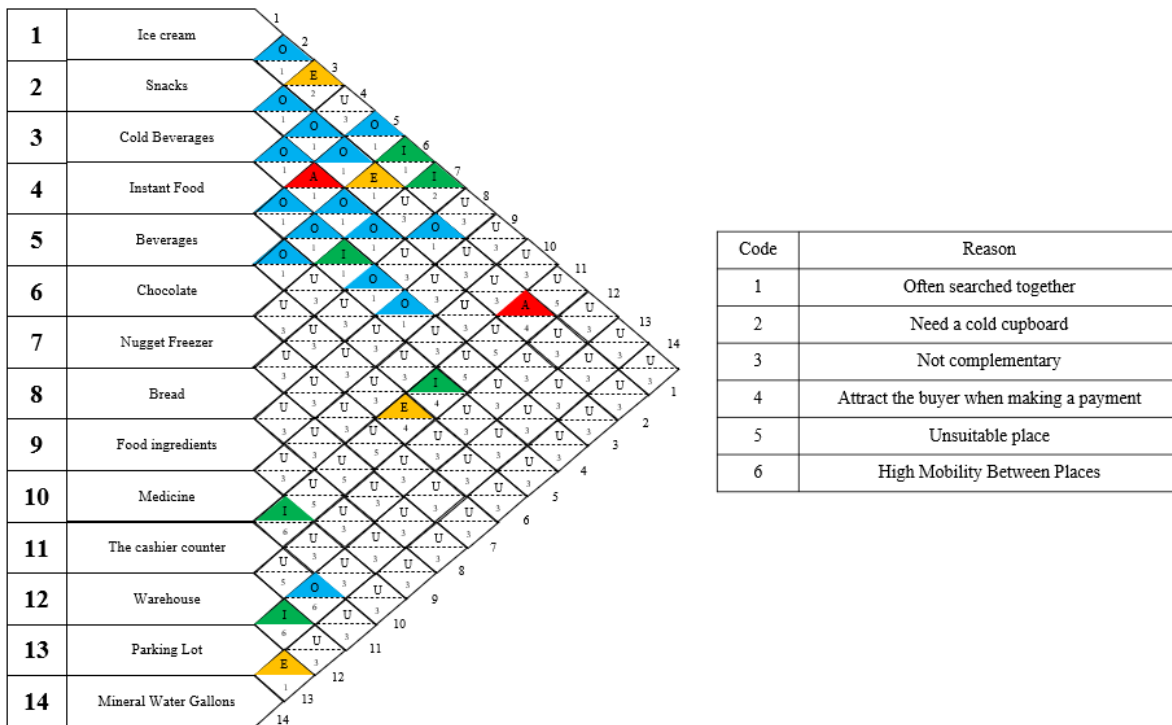


Figure 11. ARC of Al Hikam Mart First Floor

On the second floor of ARC, we can see the degree of closeness between the 8 locations. There is relationship that needs to be close together, namely masks and accessories with the cashier counter, because as we know during this pandemic, masks are a necessity and people will easily find them if placed near the cashier. Then there are also places that cannot be placed close together, namely masks and accessories with mosquito repellent, to avoid contamination. The following Figure 12 is the ARC of Al Hikam Mart on the second floor.

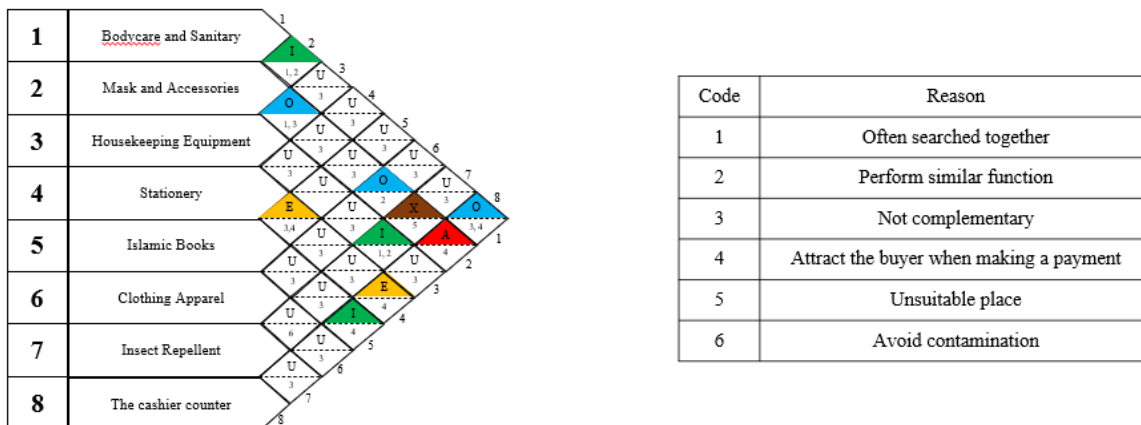


Figure 12. ARC of Al Hikam Mart Second Floor



### 5.2 Activity Relationship Diagram (ARD)

According to Tompkins (1990), Activity Relationship Diagram is a technique used to get an overview of the layout. This activity relationship diagram is formed by referring to ARC that was made previously. Based on Figure 11, it can be known that some activities must be close to other activities and vice versa. So, it can be said that the relationship between activities affects the level of closeness between the activity layouts in Al Hikam Mart. The following Figure 13 and Figure 14 is the Activity Relationship Diagram on the first floor and second floor of Al Hikam Mart.



Figure 13. First floor ARD of Al Hikam Mart

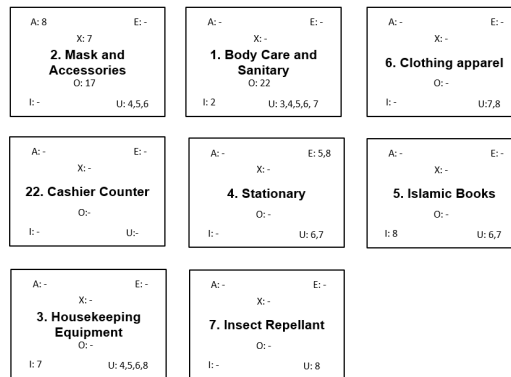


Figure 14. Second floor ARD of Al Hikam Mart

### 5.3 Area Allocation Diagram (AAD)

AAD is an interrelated process from ARD to determine the closeness of each department. It can be seen from Figure 14, the design of Area Allocation Diagram (AAD) of Al Hikam Mart is an initial description of the proposed facility layout, where this layout combines the ARD design for every department and ARC for the proximity between every department in the retail store.

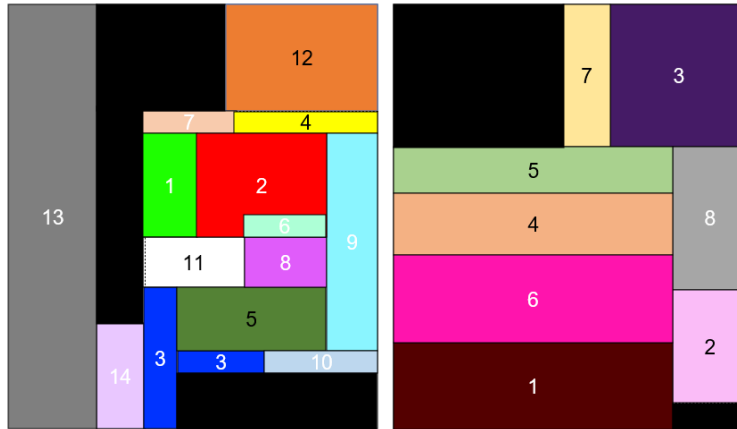


Figure 15. AAD of Al Hikam Mart

### 5.4 Proposed Layout Improvements

After implementing ARC, ARD, and AAD according to the flow of Systematic Layout Planning, we proposed the improvements that can be implemented by Al Hikam Mart to meet the optimization goals. Hereby attached in Figure 15, the proposed layout improvements for Al Hikam Mart in 2D drawings and 3D simulations.

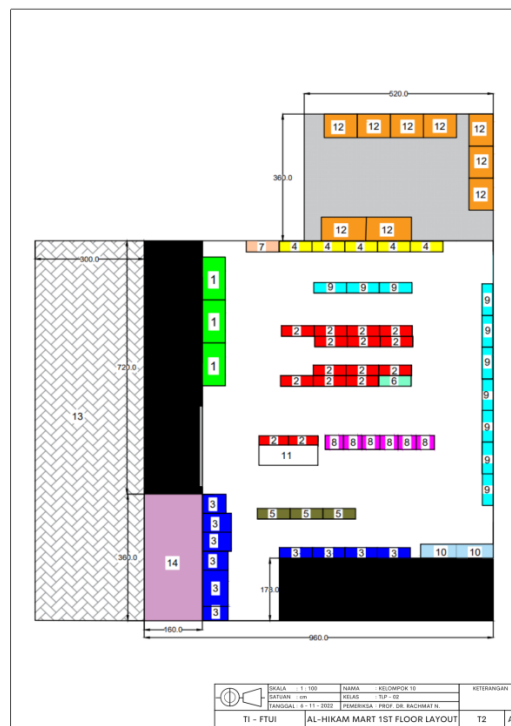


Figure 16. Proposed firstfloor layout improvements in 2D with AutoCAD

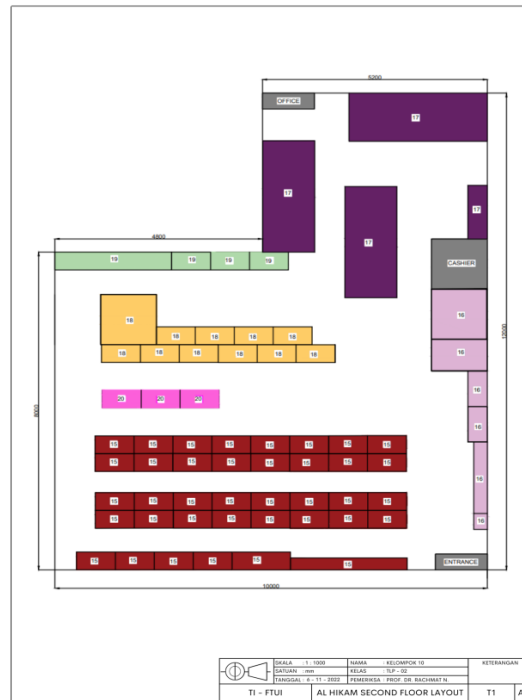


Figure 17. Proposed second floor layout improvements in 2D with AutoCAD



Figure 18. Proposed layout improvements in 3D with SketchUp

## 6. Conclusion

Overall, in accordance with the goal of AlHikamMart to meet the needs of the company to improve the quality of its store layout and help customers to get a better shopping experience, Al Hikam Mart can apply the scenarios to change the layout. Previously, Al HikamMart had products that were placed a bit spread out, for example snacks that were placed in various places. In our retail layout solutions, we bring similar and frequently sought-after products together. According to the proposed layout improvements for both the first and second floor, customers' experience will get better, and it may increase the profit margin of Al Hikam Mart. Customers will face a new experience of shopping and it will lead to an increase in customer satisfaction.

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## **Biographies**

**Abigail Naomi Ariela** is an Industrial Engineering undergraduate student from University of Indonesia who likes to explore new things. She is interested in learning about manufacturing systems and entrepreneurship. She is currently an intern in start-up business as a partnership. She also joined an organization in Industrial Engineering as a head division of entrepreneurship to develop leadership and management skills, and also joined a choir community.

**Arief Nurdini** is a junior lecturer at Gunadarma University. He earned Bachelor in Industrial Engineering Department, Gunadarma University Depok, Indonesia and he obtained his Master's Degree in Mechanical Engineering Department, Gunadarma University, Depok, Indonesia. Now he is carrying out his Doctoral study assignments in the Industrial Engineering Department, Universitas Indonesia.

**Fatimah Az-Zahra Qorib** is an Industrial Engineering undergraduate student from University of Indonesia who is eager to learn new things. She is currently a laboratory assistant in Statistics and Quality Engineering Laboratory. Zahra is an industrial engineering student interested in business cases, business plans, and content creation. Besides her studies, she takes on some leadership roles to strengthen her teamwork and collaboration skills, as well as joins some business competitions to improve her problem-solving skills and knowledge about the industry.

**Ruth Vanesa Hutagalung** is an Industrial Engineering undergraduate student from University of Indonesia who is eager to learn new things. She is currently a laboratory assistant in Management Information System and Decision Support Laboratory. Vanesa possesses a keen interest in data analytics, business development, and leadership through her experiences. She also eagerly contributes to organizations, competitions, projects, and courses to improve her hard and soft skills.

**Wynona Salsabila Hafiz** is an Industrial Engineering undergraduate student from University of Indonesia who is eager to learn new things. She is currently a research assistant in Ergonomics Centre Laboratory. Her research

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