

Optimizing Layout and Material Handling Cost: A Case Study of a Small and Medium-Sized Enterprise in the Food and Beverage Industry

**Hanif Rahman Arifin, Muhammad Daffa Farras, Muhammad Fawwaz Robbani,
Muhammad Habiburrahman and Nathaniel Dave Anggita Lumban Batu**

Department of Industrial Engineering
Universitas Indonesia
Depok, 16424, Indonesia

hanif.rahman@ui.ac.id, muhammad.daffa05@ui.ac.id, muhammad.fawwaz01@ui.ac.id,
m.habiburrahman@ui.ac.id, and nathaniel.dave@ui.ac.id

Abstract

Mahakam Restaurant is a company operating in the food industry field. In its operational, Mahakam Restaurant is still not efficient in its process. In its operations, Mahakam Restaurant is still experiencing problems in the form of an inefficient implementation process. This of course has an effect on increased operational costs due to the high cost of moving materials. In addition, Mahakam Restaurant is also experiencing concerns regarding the existing OHS procedures. In this study, researchers made observations and analyzed these problems using systematic layout planning to achieve efficiency in the processes in the restaurant. The existing data is then processed using food service layout performance indicator, time process, ARC, ARD, AAD, and MHC analysis. The process resulted in a layout recommendation with significant improvements, namely reducing the moving distance by 10.05% and reducing material handling costs by 40.06%.

Keywords

Material Handling, Facility Planning and Layout Improvement.

1. Introduction

1.1 Background

At present, very high industrial development has led to the emergence of very tight competition conditions. This is also experienced by companies that want to expand their business. Every company is increasingly required to improve its competitiveness in all aspects, including service to consumers. Services to consumers themselves can be done by fulfilling consumer satisfaction in terms of the comfort felt by consumers. Competition between restaurateurs is currently increasingly found in society. Therefore, besides requiring guaranteed product quality, physical facilities, physical layout, and a supportive physical environment are also needed. By analyzing these factors from the point of view of activities that are not effective and efficient, it is proposed to improve physical facilities, facility layout, and a better physical environment, so that this can increase customer service satisfaction and be able to compete with other restaurants.

The layout is one of the most obvious characteristics of a productive operation, as it determines the “shape” and appearance of its environment (Slack et al. 2002). In executing processes, among other factors, greater flexibility is sought in the use of resources to transform information, personnel, or materials into a final marketable product or service (Hronec 1994). Thus, changing the way these environments are organized directly affects the way processes flow (material flow), which proves the importance of a good layout for business performance (Bougoure and Lee 2009). In other words, layout, in general, is viewed from a production point of view, namely in the form of an arrangement of production facilities to obtain efficiency in production, besides that the layout of facilities is also useful in supporting the production process of an industry. The layout design includes setting up the layout of operating facilities by utilizing the available area for the placement of materials for operations, and all equipment used in the operation process. (Apple 1998).

Mahakam Restaurant is a restaurant that operates in the field of western food such as chicken nuggets, burgers, and others, and also serves Indonesian specialties, namely Pangek Ala Mahakam bananas, rib soup, Soto Surabaya, and many others. This restaurant is managed by Mr. Muhammad Arifin with a restaurant concept such as semi-fast food, so that consumers do not have to wait for their dishes too long and at the same time consumers can enjoy the place or facilities inside to chat and have fun.

This restaurant was established in 2016 and originally started as a street food place. Until now the Mahakam Restaurant has developed into a place to eat as well as a cafe which is located on Jl. Mahakam GOR H Agus Salim, Padang City, West Sumatra. Based on the results of observations and interviews with the owner of the Mahakam Restaurant, the problems experienced by this restaurant can be identified. Some of the problems obtained based on the results of observations are that consumers feel sore while waiting due to uncomfortable waiting chairs, discomfort at the dining table and dining chairs in the dining room, so that it feels cramped and not comfortable when eating, and the environment feels hot. This is caused by several weaknesses in restaurants, namely physical facilities, facility layout, and physical environment that are still not supported. Apart from the consumer perspective, there are also several problems experienced by workers, namely the lack of flexibility when doing activities and difficulties in preparing food and drinks due to the lack of physical facilities in the kitchen space such as material preparation tables, drink preparation tables, and stove preparation tables.

This research will redesign the physical facilities at the restaurant and the layout of the restaurant facilities. In addition, the author also tries to provide suggestions for the physical environment and K3 (Occupational Safety and Health) in restaurants, to provide maximum comfort to consumers and also workers at the Mahakam Restaurant.

1.2 Problem Identification

One of the ways to increase production productivity is to improve the arrangement of less organized production sites, causing activities that are not effective and efficient. Various kinds of waste can occur in the production process caused by inefficient facility layouts, for example, the distance between raw material storage warehouses that are too far from the frying station, so it takes time for the frying process and the distance between stations is too far so that a layout design proposal is needed. more effective facilities. At the Mahakam Restaurant, the layout arrangement is still not feasible because there is no warehouse for raw materials which makes it ineffective in serving food. In addition, this restaurant combines a raw material warehouse with a kitchen (raw material processing) which can endanger the safety of workers, therefore it is necessary to improve the layout of the facilities in the Mahakam Restaurant.

This is a problem in the layout of the existing facilities at the Mahakam Restaurant so it is not effective in placing raw materials for further production processes. The layout is said to be effective if it can help a company achieve a strategy that supports its business at a low cost and fast response. Meanwhile, Hadiguna in (Siska 2012) defines layout as a set of physical elements that have been arranged according to a certain logic. Material handling systems that are not systematic enough to be a big enough problem and disrupt the smooth production process so that it affects the overall production process system. Therefore, it is necessary to redesign the layout of the facility, so that the flow of the food production process, the placement of raw materials, and the serving of food to consumers can be effective. A good and appropriate facility layout will be able to minimize the time and costs incurred by the company.

1.3 Research Purpose

Researchers conducted research on the Mahakam Restaurant to fulfill several things, namely:

- Know and analyze the actual physical facilities at the Mahakam Restaurant.
- Knowing and analyzing the layout of the actual facilities at the Mahakam Restaurant.
- Knowing and analyzing the actual physical environment in the Mahakam Restaurant.
- Knowing and analyzing actual occupational safety and health at the Mahakam Restaurant.
- Provide suggestions for good physical facilities.
- Provide recommendations for effective and efficient facility layouts.

2. Literature Review

2.1 Facility Layout Planning

Facility layout planning is part of facility design that focuses more on the arrangement of physical elements. Physical elements can be in the form of machines, tools, tables, buildings, and so on. Rules or regulatory logic can be defined as objective functions such as the total distance or the total cost of moving materials. A facility layout is only as effective as the management and plans that a company executes. An effective quality management system strengthens and complements the physical aspects of a facility and aims to maximize returns on investment in an organization's physical assets such as production equipment.

Companies must develop, document, implement and maintain an effective quality management system. This system needs to outline important processes and records that must be maintained. A documented quality system needs to be controlled to ensure that the company is currently operating according to the correct standards and procedures. Companies must have top management commitment to produce quality products. The facility layout design was optimized using routing sheets, from to graphs, and Layout IQ software (Meyers 2013).

2.2 Systematic Layout Planning (SLP)

Systematic Layout Planning (SLP) is a procedure used to arrange the layout of workplaces in factories by taking into account the logical relationship between high-frequency workplaces that are placed close to one another (Suhardini et al. 2017). In addition, SLP has detailed procedures for designing layouts and can bring up more than one alternative layout (Wignjosobroto 2009). SLP designed the layout with consideration of the distance between stations so as to produce minimum material flow and distance displacement. In its application, SLP is made based on the proximity relationship of the room which will later be analyzed through the Activity Relationship Chart (ARC).

2.3 Food Service Layout Performance Indicators

Food service layout performance indicators are useful for helping companies regarding management and controlling aspects related to operational efficiency, such as ergonomic, financial, and production factors (Baraban and Durocher 2010). Based on this, key operational performance indicators for the restaurant sector are divided into 4 dimensions as proposed by Pavani and Scucuglia (2012): people, processes, financial, and market.

In addition to the process indicators above, several studies (Huan and Qiang 2011) say that the financial aspect includes the operating cost impact. Meanwhile, in the "people" dimension, the indicator that has been tested the most is the indicator "work-related accidents" (Horng et al. 2013). Finally, on the "market" dimension, customer satisfaction is the most frequently used indicator in the layout planning of the food industry (Baraban and Durocher 2010).

2.4 Operation Process Chart (OPC)

According to (Hakim 2020) Operation Process Chart is a diagram that describes the process steps to be experienced raw materials regarding the sequence of operations and inspections from the initial stage to the final product or component, and contains the information needed for further analysis such as time, materials, space, tools, and machines used. It can be known, the Operation Process Chart (OPC) of the assembly system and identify the product structure of the resulting assembly.

2.5 Time Process

Standard time is defined as "The time required to produce a product at a workstation under the following three conditions: (1) qualified and trained operators; (2) working at a normal pace; and (3) performing a specific task." These three conditions are essential to an understanding of the study of time. The process of setting time standards is time study (Meyer, 2013). Qualified and trained operators are required. Experience is usually what makes for a qualified, trained operator and time on the job is the best indication of experience.

The time it takes to become qualified varies with the job and the person. For example, sewing machine operators, welders, upholsterers, machinists, and many other high-tech jobs require a long time to learn. The biggest mistake made by new time study personnel is to time one's study too quickly. A good rule of thumb is to start with a qualified, fully trained person and give that person 2 weeks on the job before study time. In a new job or task, the

standard system predetermined time is used. These standards may seem difficult to achieve at first as time is set for qualified and well-trained operators (Meyers 2013).

2.6 Activity Relationship Chart (ARC)

Activity relationship chart (ARC) is a method that is quite easy to do in making facility layouts based on the level of activity relationships which are expressed qualitatively with subjective considerations from each work station. ARC will provide consideration regarding the degree of proximity between work stations with: absolute or not absolute, must be close together, important enough to be placed close together and others (Wignjoesobroto 2009).

In determining activities at a work station, guidelines have been made in classifying the degree of proximity by using symbols at each level of proximity. This has been arranged by Muther as follows:

A = Absolutely necessary, these activities must coincide with one another.

E = Very important, the activities are close together.

I = It is important that the activities are close together.

O = Ordinary, wherever it is placed there will be no problem.

U = No need for placement linkages.

X = Should be kept away from each other.

The values indicating the degree of relationship are recorded together with the underlying reasons in an Activity Relationship Chart which has been developed by Richard Muther (1973) in Wignjoesobroto (1999).

2.7 Activity Relationship Diagram (ARD)

Activity Relationship Chart (ARC) aims to plan and analyze linkages of activities, the information generated will be useful if it is further processed into one diagram. This is the purpose of the Activity Relationship Diagram (ARD), which is a diagram of the linkage of activities that forms the basis for planning the linkages between the pattern of the flow of goods and the location of service activities linked to product activities (Meyer 2013).

ARD serves to determine layout proximity between activities/facilities/departments. The function of ARD is the same as ARC, only the difference is that ARD is in the form of a flow diagram and its proximity is denoted by a line code. The input from ARD is a priority scale table (TSP) based on data from ARC. ARD was created with the aim of:

- To determine the location of one facility/department to another facility/department.
- A tool in planning the relationship of all activities/facilities/departments appropriately.
- Provides a description of the level of relationship between activities/facilities/departments.

2.8 Area Allocation Diagram (AAD)

Area Allocation Diagram (AAD) is an advanced process in ARC which processes the level of importance between activities. This means that there will be some activities that 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. The proximity of the activity layout can be seen in AAD. The Area Allocation Diagram (AAD) is a global template, the information that can be seen is only the utilization of the area, while the visualization image can be seen in the template which is the final result of analyzing and planning the layout of facilities and material transfer. ARC and AAD are types of maps that describe the relationship between rooms due to certain reasons that must be met.

3. Methods

3.1 Research Stages

The method used in planning changes to production facilities at the Mahakam Restaurant, Padang consists of several steps including:

- a) Results of Data Collection and Facility Identification
- b) Interfacility Data
- c) Calculation of Transportation Costs Between Workstations (Existing)
- d) Calculation of Material Transfer Costs (Existing)
- e) Determination of Activity Relationship Chart (ARC)
- f) Determination of Activity Relationship Diagram (ARD)
- g) Determination of Area Allocation Diagram (AAD)
- h) Re-Layout Analysis

- i) Distance Between Facilities (Proposed)
- j) Calculation of Transportation Costs Between Workstations (Proposed)
- k) Calculation of Material Transfer Costs (Proposed)

3.2 Stages of the Research

In planning a facility change layout, several stages are used to ensure that there is a harmonious relationship in each aspect. The following will describe the planning stages of the facility change layout.

- a) Identifying and formulating problems
- b) Looking for a theoretical basis where there is a formulation of the same problem and a solution to the problem
- c) Data collection
- d) Existing data processing
- e) Making layout change proposals
- f) The results of the analysis of alternative layout changes
- g) Formulation of conclusions regarding the best alternative that can be implemented

4. Results and Discussion

4.1 Existing Layout

Making the existing layout design in Figure 1 is done to analyze further what needs improvement in the facility layout design.

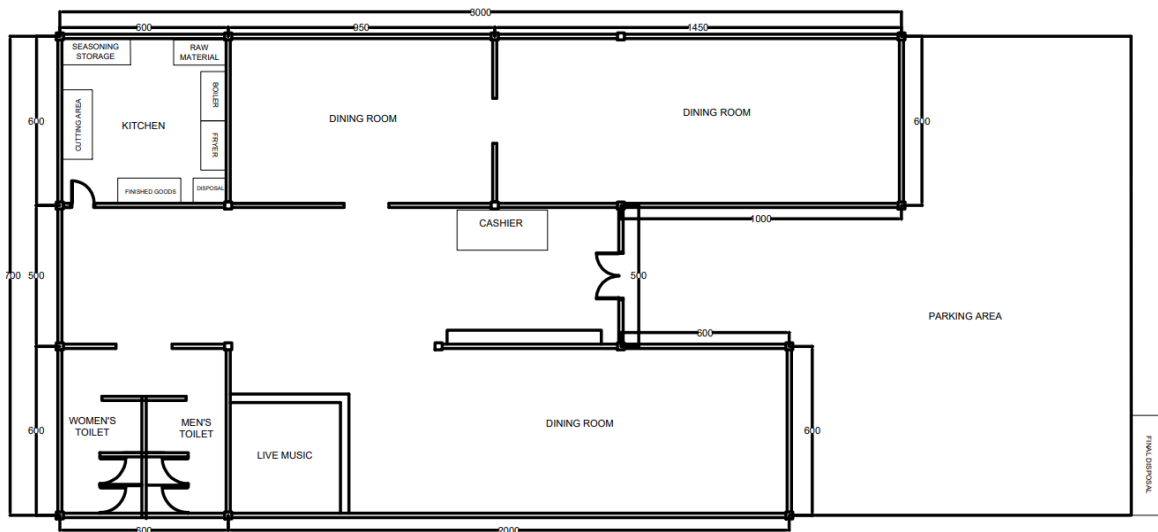


Figure 1. Existing Mahakam Restaurant Layout

4.2 Existing Layout Calculation for Area Size

Furthermore, the existing facilities in the project are identified to look for temporary facilities that will be used in the relocation scenario (Table 1).

Table 1. Area Calculation on Existing Layout

Code	Facility	Area (m ²)	Material Flow
A	Raw storage	2m ²	From A to B, C, D
B	Cutter	3m ²	From B to C, D

C	Fryer	1,5m ²	From C to G
D	Boiler	1,5m ²	From D to G
E	Dining area	255m ²	From E to J
F	Seasoning storage	4,5m ²	From F to G, C, D
G	Finished Goods	4,5m ²	From G to E
H	Cashier	3m ²	
I	Toilet	24m ²	
J	Disposal	1,5m ²	From J to L
K	Parking area	287m ²	
L	Final disposal	4,5m ²	
Total Area with Material Flow			273,5m ²

4.3 Existing Layout Calculation for Material Handling Cost

The frequency of material handling is the number of material handling from the initial station to the destination station per day (Table 2). This data is needed to calculate the total transportation costs during production. This calculation is carried out at each workstation by multiplying three variables: the distance to the existing layout, the frequency of moving material/day, and the cost of moving material under existing conditions (Rp. 5,-/meter).

Table 2. Material Handling Cost on Existing Layout

No	From	To	Frequency	Total Cost	MHC
1	Raw storage	Cutting area	168	Rp22,00	Rp3.696,00
2	Raw storage	Fryer	84	Rp29,00	Rp2.436,00
3	Raw storage	Boiler	84	Rp1,00	Rp84,00
4	Cutting area	Fryer	56	Rp17,00	Rp952,00
5	Cutting area	Boiler	56	Rp20,00	Rp1.120,00
6	Fryer	Finished Goods	56	Rp9,25	Rp518,00

7	Boiler	Finished Goods	42	Rp15,00	Rp630,00
8	Seasoning storage	Fryer	168	Rp14,50	Rp2.436,00
9	Seasoning storage	Boiler	168	Rp30,00	Rp5.040,00
10	Seasoning storage	Finished Goods	168	Rp22,50	Rp3.780,00
11	Finished Goods	Dining area	56	Rp56,25	Rp3.150,00
12	Dining area	Disposal	84	Rp70,00	Rp5.880,00
13	Disposal	Final disposal	1	Rp222,50	Rp222,50
Total Cost					Rp29.944,50

4.4 Determination of Activity Relationship Chart (ARC)

The following is a picture of the Activity Relationship Chart (ARC) between facilities which involved the manager of the Mahakam Restaurant in its creation. The making of this ARC is based on the level of importance of the approach between facilities and the reasons for the need for these facilities to be nearby.

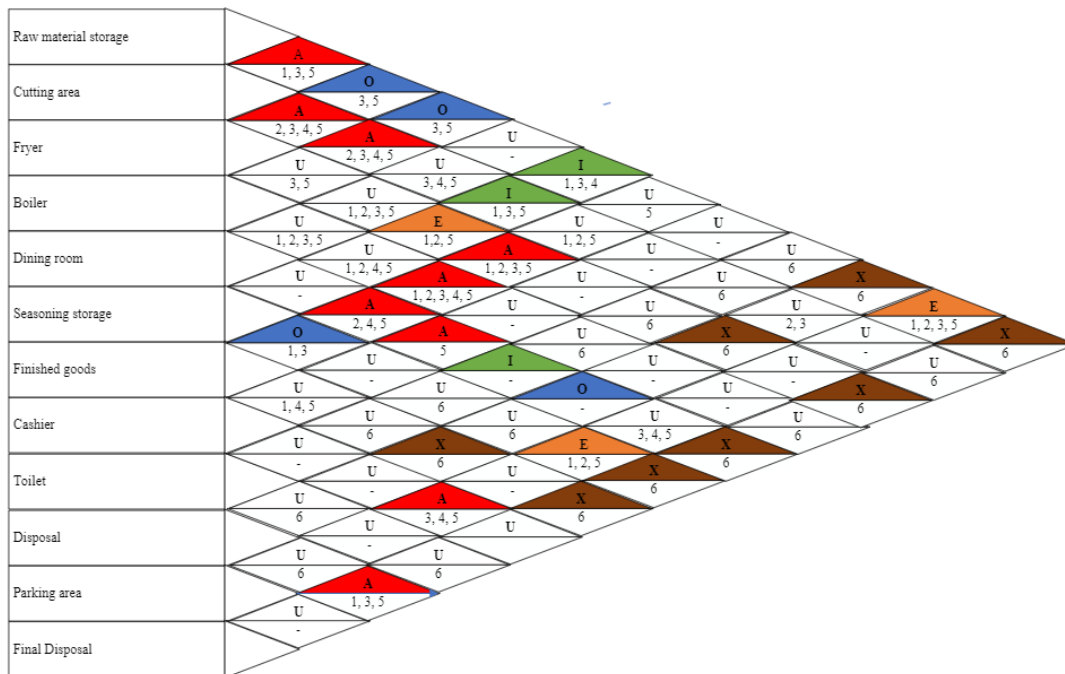


Figure 2. Mahakam Restaurant Activity Relationship Chart (ARC)

4.5 Determination of Activity Relationship Diagram (ARD)

ARD is used as supporting data for the location of the proximity of work stations which are depicted with colored lines in the existing Mahakam Restaurant Layout. Detailed Activity Relationship Diagram (ARD) can be seen in Figure 3. Where each symbol represents: I. Raw material storage, II. Cutting area, III. Fryer, IV. Boiler, V. Dining room, VI. Seasoning storage, VII. Finished goods, VIII. Cashier, IX. Toilet, X. Disposal, XI. Parking area, XII. Final disposal.

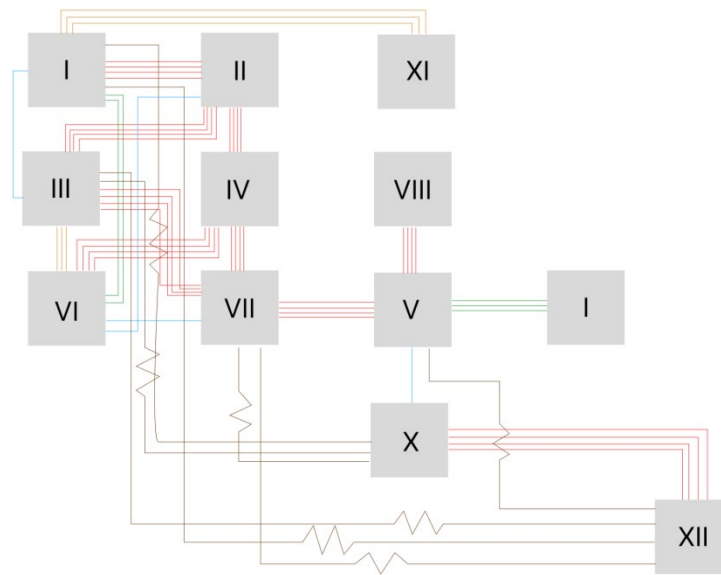


Figure 3. Mahakam Restaurant Activity Relationship Diagram (ARD)

4.6 Determination of Area Allocation Diagram (AAD)

Area Allocation Diagram (AAD) is a global layout illustration that illustrates the closeness relationship between departments with the actual floor area size scale. Detailed Area Allocation Diagram (AAD) can be seen in Figure 4.

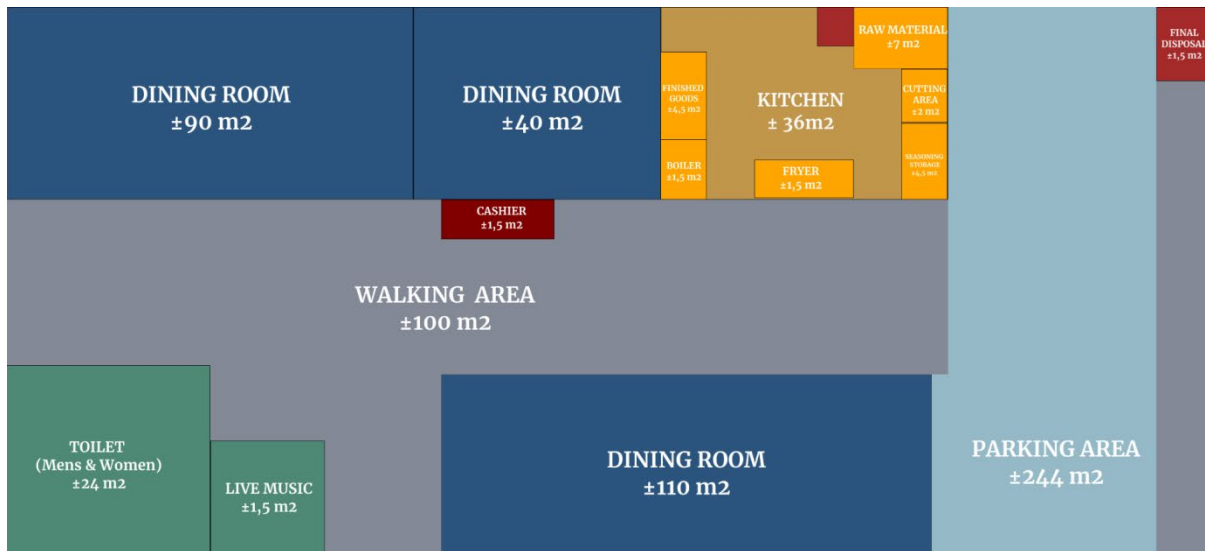


Figure 4. Mahakam Restaurant Area Allocation Diagram (AAD)

4.7 Recommendation Layout

After making ARC, ARD, and AAD, the researcher proposed a new layout based on these three components (Figure 5). Using these three components, researchers can find out how best to place the newly created layout based on employee activities and material movement.

J	Disposal	1m ²	From J to L
K	Parking area	210m ²	
L	Final disposal	3m ²	
Total Area with Material Flow			246m ²

Based on the recommended arrangement of facilities from the table above, the facility's total area with the material flow has decreased with the new layout formed, namely from 273.5m² to 246m². Here it can be concluded that there is a reduction in the total area of 10.05%.

4.9 Recommendation Layout Calculation for Material Handling Cost

The researcher recalculated the material handling cost used in the material movement. The calculation results can be seen in the following Table 4.

Table 4. Material Cost Handling on Recommendation Layout

No	From	To	Frequency	Total Cost	MHC
1	Raw storage	Cutting area	168	Rp10,00	Rp1.680,00
2	Raw storage	Fryer	84	Rp22,50	Rp1.890,00
3	Raw storage	Boiler	84	Rp9,00	Rp756,00
4	Cutting area	Fryer	56	Rp13,00	Rp728,00
5	Cutting area	Boiler	56	Rp21,00	Rp1.176,00
6	Fryer	Finished Goods	56	Rp14,25	Rp798,00
7	Boiler	Finished Goods	42	Rp9,50	Rp399,00
8	Seasoning storage	Fryer	168	Rp9,50	Rp1.596,00
9	Seasoning storage	Boiler	168	Rp22,50	Rp3.780,00
10	Seasoning storage	Finished Goods	168	Rp21,00	Rp3.528,00
11	Finished Goods	Dining area	56	Rp5,25	Rp294,00
12	Dining area	Disposal	84	Rp15,00	Rp1.260,00
13	Disposal	Final disposal	1	Rp61,00	Rp61,00
Total Cost					Rp17.946,00

Based on the calculation of the cost of moving materials recommended from the table above, the total cost has been reduced by the new layout formed, namely from a cost of IDR 29,944.50 to a cost of IDR 17,946.00. Thus, it was concluded that there was a total cost reduction of 40.06%.

5. Conclusion

This research uses the ARC, ARD, and AAD methods to improve the layout of the Mahakam Restaurant. This study also uses the area of material movement activity and material handling costs to compare the old layout with the proposed layout that the researchers provided. Our layout results show a decrease of 10.05% and a decrease in material handling costs of 40.06%. Thus, the proposed layout that we provide is a better layout than the layout currently being used. With this layout, the researcher hopes that the researcher can help business owners in advancing their businesses.

References

- Adzim, H., Standar OHSAS 18001:2007, Available: <https://sistemmanajemenkeselamatankerja.blogspot.com/2013/10/OHSAS-18001-Pdf-Download.html>, Accessed on November 25, 2022.
- Anam, C., and Pradana, B. I., Perancangan Ulang Tata Letak Untuk Mengurangi Jarak Material Handling Dengan Metode Systematic Layout Planning (Slp) (Studi Pada Perusahaan Konveksi CV. Damai Jaya), *Jurnal Ilmiah Mahasiswa FEB Universitas Brawijaya*, vol. 9, no. 2, 2021.
- Apple, M., *Plant Layout and Material Handling*, 3rd Edition, Ronald Press, 1977.
- Bougoure, U. and Lee, B., Service quality in Hong Kong: wet markets vs supermarkets, *British Food Journal*, Vol. 111 No. 1, pp. 70-79, 2009.
- Fajri, A., Perancangan Relokasi Tata Letak Gudang Dengan Metode Systematic Layout Planning Pada PT. MKM, *Jurnal Teknik Industri: Jurnal Hasil Penelitian Dan Karya Ilmiah Dalam Bidang Teknik Industri*, vol.7 no.1, 2021.
- Flessas, M., Tortorella, G. and Fetterman, D., Layout performance indicators and systematic planning: A case study in a southern Brazilian restaurant, *British Food Journal*, vol. 117 no. 8, 2015, pp. 2098-2111, 2011.
- Fransisco, M., Manuel, F. and Leoparti, M Identifying Muda in a fast food service process in Spain, *International Journal of Quality and Service Sciences*, vol. 2, no. 2, pp. 201-206, 2020.
- Hronec, S., Sinais Vitais: Usando Medidas De Desempenho Da Qualidade, Tempo E Custo Para Traçar A Rota Para O Futuro De Sua Empresa, Makron Books, São Paulo. 1994.
- Dharmayanti, I., Hardjomidjojo, H., Fauzi A. M. and Mulyadi, D., Aplikasi Metode Systematic Layout Planning (Slp) Dalam Penataan Klaster Industri Kelapa Sawit (Studi Kasus Kawasan Industri Sei Mangkei), *Journal of Industrial Research*, vol. 10, no.1, pp. 41-49, 2016.
- Ismail, D. and Derlini, Perbaikan Tata Letak Fasilitas Produksi pada Ud. Tahu Goreng Sky di Tebing Tinggi Dengan Metode Activity Relationship Chart, *Jurnal Umum Teknik Terapan Fakultas Teknik Universitas Samudra*, vol. 9, no. 2, pp 001-006, 2017.
- Muther, R. and Hales, L., *Systematic Layout Planning*, 4th Edition, Management & Industrial Research Publications, Marietta, GA, 2015.
- Pradana, E. and Nurcahyo, C., Analisis Tata Letak Fasilitas Proyek Menggunakan Activity Relationship Chart dan Multi-Objectives Function pada Proyek Pembangunan Apartemen De Papilio Surabaya, *Jurnal Teknik Pomits* vol. 3, no. 2, 2014.
- Pratiwi, P. and Fatah, A., Pengaruh Keselamatan Kerja dan Lingkungan Kerja Terhadap Kinerja Karyawan Bagian Kitchen Restoran Makanan, *Jurnal Inovasi Dan Kreativitas (JIKa)*, vol. 1, no. 1, pp. 15-24, 2021.
- Rivai, and Veithzal., *Manajemen Sumber Daya Manusia Untuk Perusahaan*. Raja Grafindo, Jakarta, 2004.
- Slack, N., Chambers, S. and Johnston, R., *Administração da Produção*, 2nd ed., Editora Atlas, São Paulo, 2002.
- Stehens, M., and Meyers, F., *Manufacturing Facilities Design and Material Handling*, 5th Edition, Purdue University Press West Lafayette, Indiana, 2013.
- Suhardini, D., Septiani, W. and Fauziah, S. Design and Simulation Plant Layout Using Systematic Layout Planning, *10th International Seminar on Industrial Engineering and Management "Sustainable Development In Industry and Management"*, Indonesia, Belitung, 7-9 November, 2017.
- Susanti, Yudiantyo, W., Halim, W., Analisis Dan Perancangan Fasilitas Fisik, Tata Letak Fasilitas, Lingkungan Fisik dan K3 Ditinjau Dari Segi Ergonomi (Studi Kasus Restoran "X" di Bandung), *Undergraduate thesis Jurusan Teknik Industri Universitas Kristen Maranatha Bandung*, 2015.

Wijayanti, A., Nova T., and Suroso, H., Perancangan Ulang Tata Letak Fasilitas (Re-Layout) pada Produksi Kerupuk di UD. Sekar, *Seminar Nasional Teknologi Industri Berkelanjutan I (SENASTITAN I)*, 2021.

Biographies

Hanif Rahman Arifin is an Industrial Engineering undergraduate student from Universitas Indonesia. He is currently a student. His research interests are Business Process Reengineering, Information System, Enterprise Resource Planning, Project Management, Industrial Feasibility Analysis, Project Management

Muhammad Daffa Farras is and Industrial Engineering undergraduate student form Universitas Indonesia. He is currently in third year of college. He has completed a research project with Lasita within the topic of optimizing software companies. His research interests include manufacturing, simulation, optimization, reliability, scheduling, manufacturing, and lean.

Muhammad Fawwaz Robbani is an Industrial Engineering undergraduate student from Universitas Indonesia. He is currently a student. His research interests are Business Process Reengineering, Information System, Enterprise Resource Planning, Project Management, Industrial Feasibility Analysis, Customer Relationship Management, Database Management System, and Decision Support System.

Muhammad Habiburrahman is doctoral student in Department of Industrial Engineering Universitas Indonesia.

Nathaniel Dave is Industrial Engineering undergraduate student at Universitas Indonesia. His research interests are System Quality Engineering, Industrial policy, Enterprise Resource Planning, and Data and Analytics.