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Redesign Facility Layout with a Kaizen Approach in Testing Laboratory at Balai Pengujian & Sertifikat Mutu Barang Makassar

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ARTICLE INFO

Article history

Received: 26 May 2022

Revised: 4 July 2022

Accepted: 6 September 2022

Published Online: 22 September 2022

Keywords:

Facilities layout

5S

Conventional layout planning

Laboratory layout

ABSTRACT

In trading activities, especially exports in the food commodities sector, several documents must be made and completed by exporters, such as Certificate of Quality, Test-Certificate, and Chemical Analysis. Balai Pengujian & Sertifikasi Mutu Barang Makassar is a government agency operating in South Celebes that tests the quality of various agricultural and plantation commodities. From year to year, demand for testing services has increased along with the number of exports. So, testing activities have changed in terms of facility layout requirements resulting in overwhelmed in carrying out the testing process. Test rooms are not connected based on the current testing flow causing the tester's ineffective work patterns. This study aims to redesign the layout of the facilities in the testing laboratory with the Kaizen approach to support the smooth testing process. The results of this study indicate that the proposed floor area uses a 150% allowance so the calculation requires a floor area of 42.52 m². After that, an analysis of the proximity of the facilities is carried out by making ARC (Activity Relationship Chart) and ARD (Activity Relationship Diagram). Based on ARD, a template is made for the layout of testing laboratory facilities. This study applies Kaizen theory with the 5S concept to obtain a neater design, namely Seiri and Seiton in the refreshment laboratory and weighing room, Seiso on testing equipment in all testing laboratory rooms, Seiketsu and Shitsuke applied to all rooms in the testing laboratory.

1. Introduction

The increase in export yields of agriculture and plantation commodities has resulted in Makassar Goods Quality Testing and Certification Center receiving many requests for quality testing but not being supported by the proper

arrangement of testing facilities^[1]. resulting in the examiner or analyst being overwhelmed in carrying out the testing process the arrangement of the testing rooms is not connected. Based on the flow of testing in the testing laboratory the analyst or examiner goes back and forth

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DOI: <https://doi.org/10.30564/jmser.v5i2.4749>

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from one room to another or does not have a regular work pattern [2].

The layout is an important decision that determines the efficiency of an operation in the long term [3]. The layout of the facilities in this testing laboratory needs attention so that the quality testing process can run smoothly [4]. In research, the layout is the procedure for setting up factory facilities to facilitate the production process [5].

In this study, the facility layout's redesign was supported by applying the Kaizen theory, namely the 5S method. According to Kaizen aims to tidy up all company activities although slowly but can provide useful progress and that includes the Kaizen process [6]. Determination of the redesign using the conventional method [7] which begins with the calculation of the proposed floor area using allowances for the operator given 150% of the machine area [8]. The layout of the room in the testing laboratory is based on the Activity Relationship Chart (ARC) and Activity Relationship Diagram (ARD) [9].

2. Materials and Methods

2.1 Research Time and Place

When this research was conducted from February 2021 until March 2021, this research was carried out at the UPTD Balai Pengujian & Sertifikasi Mutu Barang, the Industry and Trade Office of South Sulawesi Province on AP Pettarani Street, Makassar City, South Celebes.

2.2 Data Collection

2.2.1 Primary Data

Primary data in this study were obtained directly from the object of research through observation, namely as follows: (1) Laboratory Area; and (2) Size of Testing Machine/Equipment [7].

2.2.2 Secondary Data

Secondary data in this study were obtained from existing data such as company documentation data and other information related to research. Secondary data in this study are as follows: (1) Testing Laboratory Plan; and (2) Testing Tool Name [10].

2.3 Data Processing

The data processing used in this study uses the conventional facility layout redesign method which is added to the application of Kaizen 5S theory which consists of (1) Determining the required floor area; (2) Creating an Activity Relationship Chart (ARC); (3) Create Activity

Relationship Diagram (ARD); and (4) Make a layout of Proposed Testing Laboratory [11].

3. Results and Discussion

3.1 Floor Area

In the design stage, the layout of the testing laboratory facility has 6 test rooms it consisting of a refresher laboratory, microbiology laboratory, weighing room, sample receiving room, fertilizer lab, and warehouse. The floor area calculation is based on the dimensions of the machine that has floors in 6 test rooms and an allowance of 150% is added. The followings are the results of the identification of the testing machine based on the calculation of the floor area requirement:

3.2 Activity Relationship Chart (ARC)

Activity Relationship Chart (ARC) is a description of the degree of closeness of each facility on the production floor, along with a description of the degree of proximity of each facility [12]. An activity relationship chart (ARC) is a tabular means of displaying the closeness rating among all activities or departments. In general, there are 6 closeness rating are used. This rating is named as "A, E, I, O, U, and X". This rating has a specific meaning attached to it. Following is the rating symbols with the meaning, (1) A is Absolutely necessary, (2) E is especially Important, (3) I am Important, (4) O is Ordinary, (5) U is unimportant, (6) X Absolutely Important.

In this study, the Activity Relationship Chart (ARC) is used to analyze the level of relationship between one facility and another by conducting interviews and discussions by testing analysts supported by the workflow sequence of the existing testing process. The Activity Relationship Chart is depicted in Figure 1 as follows:

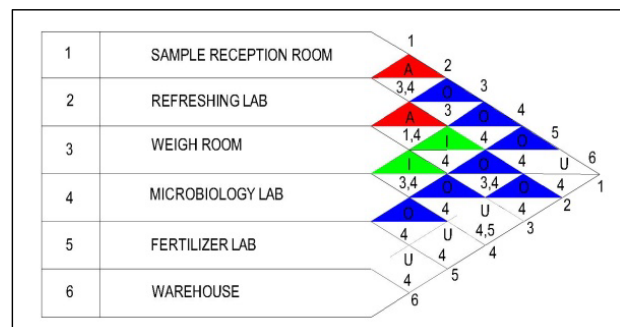


Figure 1. Activity Relationship Chart (ARC)

From the chart, it is summarized into an activity linkage worksheet where for the relationship level A will be the 1st priority, E is the 2nd priority, I is the 3rd priority, O is the 4th priority, and U is the 5th priority.

Table 1. The Floor Area of Testing Laboratory Facilities

No.	Work Station	Tool's Name	Tool Dimensions (m)		Operator Dimensions (m)		Total Area (m)	Allowance (150%)	Final Total Area (m)
			P	L	P	L			
1	Refreshing Lab	Kjelhdal Digital	0.4	0.4	0.4	0.5	0.34	0.51	0.86
2	Refreshing Lab	Electro Thermal	0.3	0.2	0.3	0.5	0.18	0.27	0.44
3	Refreshing Lab	Thermostatic Waterbath	0.3	0.3	0.3	0.5	0.24	0.36	0.60
4	Refreshing Lab	Hot Plat Stirrer	0.2	0.1	0.2	0.5	0.12	0.19	0.31
5	Refreshing Lab	Cocoa Oven	0.6	0.5	0.6	0.5	0.55	0.82	1.37
6	Refreshing Lab	Coffee Oven	0.6	0.5	0.6	0.5	0.55	0.82	1.37
7	Refreshing Lab	Incubator	0.4	0.3	0.4	0.5	0.33	0.49	0.82
8	Refreshing Lab	Top Loading Balance	0.3	0.2	0.3	0.5	0.20	0.30	0.51
9	Microbiology Lab	Stomatcher Lab Blender	0.4	0.2	0.4	0.5	0.31	0.46	0.77
10	Microbiology Lab	Centrifuge	0.2	0.3	0.2	0.5	0.16	0.24	0.40
11	Microbiology Lab	UV Cabinet II	0.5	0.4	0.5	0.5	0.41	0.62	1.03
12	Microbiology Lab	Coloni Counter	0.2	0.3	0.2	0.5	0.18	0.27	0.45
13	Microbiology Lab	High Performance Liquid Chromatography	0.6	0.3	0.6	0.5	0.54	0.81	1.34
14	Microbiology Lab	Auto Clave	0.4	0.4	0.4	0.5	0.39	0.58	0.97
15	Microbiology Lab	Optical Emission Spectrometer	0.8	0.7	0.8	0.5	0.87	1.31	2.19
16	Microbiology Lab	Biological Safety Cabinet	1.3	0.8	1.3	0.5	1.63	2.44	4.06
17	Weigh Room	Eksikator	0.3	0.3	0.3	0.5	0.24	0.36	0.60
18	Weigh Room	Analytical Balance	0.3	0.2	0.3	0.5	0.20	0.30	0.51
19	Weigh Room	Karl Fischer	0.3	0.3	0.3	0.5	0.19	0.28	0.47
20	Weigh Room	Spectroquant	0.4	0.3	0.4	0.5	0.32	0.49	0.81
21	Weigh Room	Mouisture Analyzer	0.5	0.4	0.5	0.5	0.42	0.63	1.05
22	Sample Reception Room	Scales	0.2	0.2	0.2	0.5	0.14	0.21	0.35
23	Sample Reception Room	Sampel Rack	1.0	2.5	1.0	0.5	3.00	4.50	7.50
24	Fertilizer Lab	Sample Storage Rack	3.0	1.5	3.0	0.0	4.50	6.75	11.25
25	Warehouse	Pallet	1.0	1.0	1.0	0.0	1.00	1.50	2.50
Total Area Requirement (m ²)									42.52
Available Area (m ²)									171.5

Table 2. Activity Linkage Worksheet

No.	Hub	Degree Proximity					
		A	E	I	O	U	X
1	Sample Reception Room	2			3,4,5	6	
2	Refreshing Lab	3		4	5,6	6	
3	Weigh Room			4	5	6	
4	Microbiology Lab				1,2,3,5	6	
5	Fertilizer Lab				1,2,3,4	6	
6	Warehouse			2		1,3,4,5	

3.3 Activity Relationship Diagram (ARD)

Activity Diagram is a diagram that describes the various flow of activities in the system that is being designed, how each data flow begins, the decisions that may occur and how they end [13]. Activity diagrams are special state diagrams, where most of the states are actions and most of the transitions are triggered by the completion of the previous state of internal processing [14,15]. Therefore, the activity diagram does not describe the internal behavior of a system exactly, but rather describes the processes and activity paths from the top level in general. An activity can be realized by one or more use cases. The activity describes the running process, while the use case describes how the actor uses the system to carry out activities. Ba-

sically this diagram explains the relationship between the material flow pattern and the location of each supporting department to the production department.

Activity Relationship Diagram (ARD) is a block diagram that shows the relationship of one room to another based on the previous activity linkage worksheet. Facilities that are closely related will be approached. The ARD testing laboratory is as follows Figure 2:

Activity Template Block Diagram is a series of templates based on data obtained from Activity Relationship Diagrams and Activity Relationship Charts. In ATBD, the data that has been grouped in a worksheet is then entered into an activity template.

3.4 Proposed Layout

Based on the layout of the facilities in the mold testing laboratory, improvements need to be made to optimize and smooth the testing process by bringing closer and connecting test rooms that have close relationships. The layout of the proposed testing laboratory is as follows Figure 3:

3.5 Application of Kaizen Theory with the 5S Method

The application of Kaizen theory using the 5S method in the testing laboratory at Makassar Goods Quality Testing and Certification Center is as follows Figure 2:

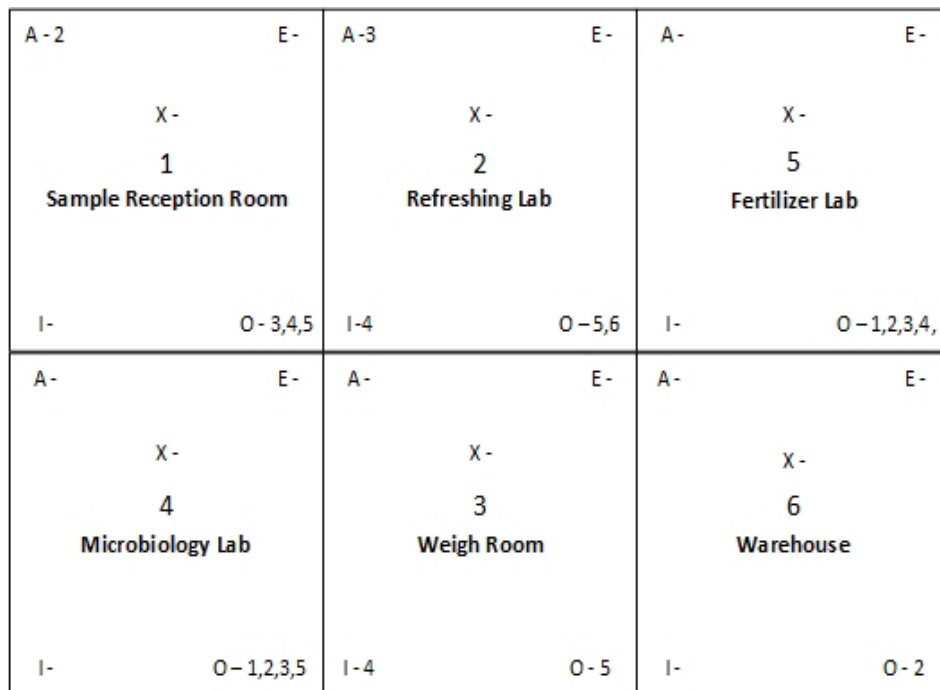


Figure 2. Activity Relationship Diagram

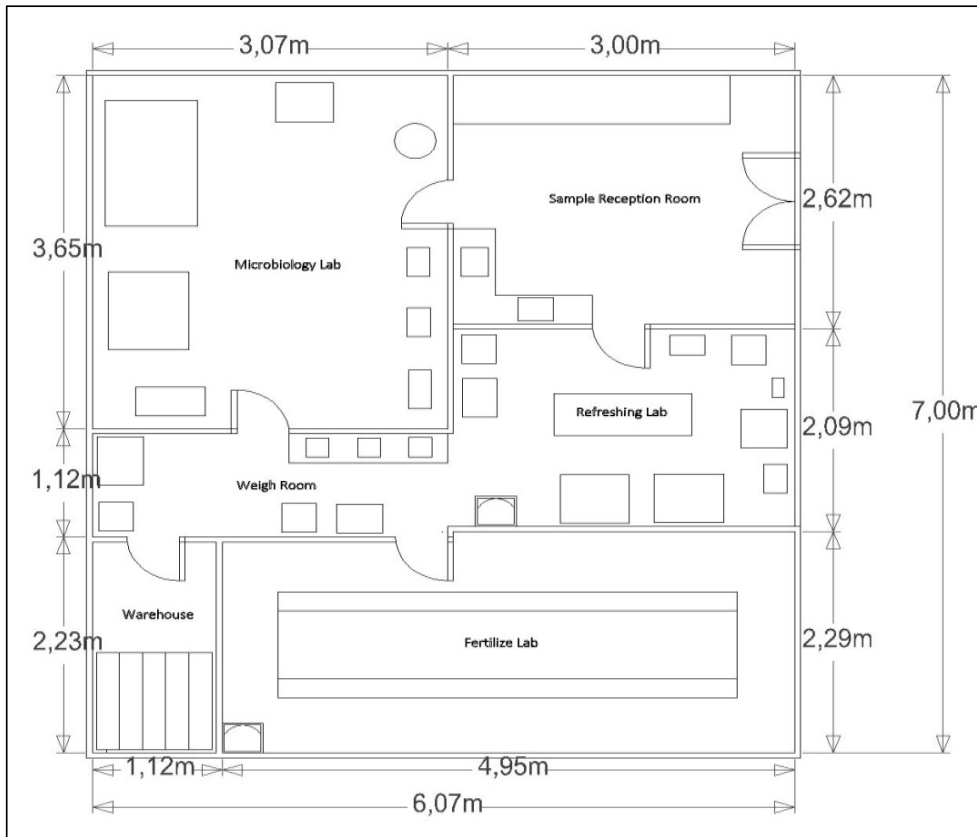


Figure 3. The Layout of the Proposed Testing Laboratory

a. Seiri

Seiri is the first step in implementing 5S, namely: sorting out useful and useless items; useful items are stored and useless items are thrown away. The Seiri method is applied to the refreshment laboratory room and the weighing room because a lot of testing equipment is not needed in this room, making the shelves or the area around this room full so that the place for analysts to do tests is narrow. Seeing this situation, Seiri was applied, namely putting the equipment in its place and setting aside the unnecessary so that the analyst did not need a long time to find the equipment needed in the testing process.

b. Seiton

Seiton means organizing and being ready. If we simply focus on putting things away, we can lose sight of why we put things away, which is to be able to retrieve. The Seiton method is a continuation of Seiri wherefrom the results of the sorting that has been done, will be continued with the process of arranging the equipment that has been sorted. In this case, the equipment in the refreshment laboratory and weighing room is neatly arranged, that is, it is placed in an equipment rack or equipment cabinet with the name attached according to the use of the tool in the testing process^[15]. The pictures of the equipment rack are as follows Figure 4:



Figure 4. Equipment Back

c. Seiso

Seiso is the third step of the 5S method. It means “to make everything shiny clean”^[16]. It is the only one-time step in the process. At this stage, the thing to do is the cleaning process. The cleaning carried out is cleaning dust and garbage on the testing laboratory floor, the equipment used for the testing process, and at this stage the addition of sanitation such as a sink as shown in the following Figure 5:

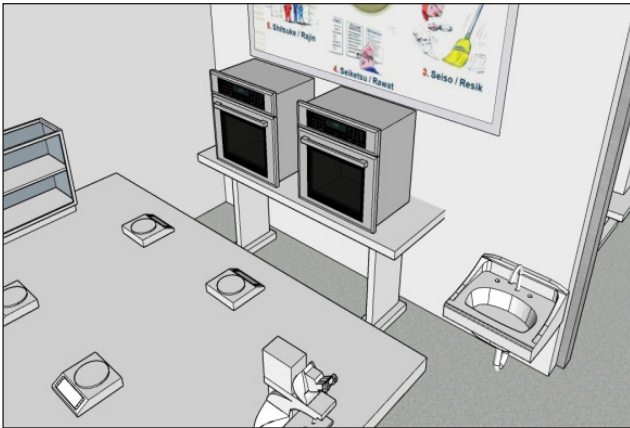


Figure 5. Sanitation in the Testing Laboratory

d. Seiketsu

Seiketsu is the next step after seiri, seiton, and seiso, namely: maintaining a neat and clean work environment becomes a work standard. The state achieved in the seiri, seiton, and seiso processes must be standardized^[17].

At this stage, an effort is made on how to apply the 5S method continuously by making attributes or posters that read the steps for applying the 5S principles. The 5S attribute images are as follows Figure 6:



Figure 6. 5S Attributes

e. Shitsuke

Shitsuke is the last step, which is self-awareness of work ethics: (1) Discipline against standards, (2) Mutual respect, (3) Shame to commit violations, and (4) Happy to make improvements.

This section focuses on how to familiarize yourself with the application of this 5S method. Awareness of the workers is needed to have a work pattern that is by the 5S method. Given the different nature of human beings, it is necessary to have someone who can control in this case the role of the leader is needed to care and be able to control workers so that they always maintain the work environment based on the 5S method that has been applied^[18].

4. Conclusions and Suggestion

4.1 Conclusions

Based on the results of the analysis and proposals that have been done, the conclusions of this study are as follows:

1) The redesign of the layout of the facilities carried out in the testing laboratory based on the existing testing process flow makes rooms that have a close relationship in the testing process connected to facilitate the existing testing process.

2) Implementing Kaizen theory as a supporting system in a testing laboratory, it can make it easier for testers or analysts to access testing tools so that testing operations are more organized and efficient.

4.2 Suggestion

From the conclusions that have been made, the suggestions that can be given are as follows:

1) Based on this research Makassar Goods Quality Testing and Certification Center pays attention to the layout of existing facilities, especially in the testing laboratory so that the examiner or analyst is more fluent and organized in testing product quality.

2) It is hoped that there will be further research with different methods and different perspectives in redesigning the layout of existing facilities.

Conflict of Interest

There is no conflict of interest.

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