Improvement of Rubber Smoked Sheet Plant Using Arena Layout for Increasing Productivity

A. Watanapa, and W. Wiyaratn*

***Abstract*—The objective of this study is to improve the production process of rubber smoked sheets from. The layout used in the production of rubber sheet to reduce the steps required to submit to crossings using a Systematic Layout Planning (SLP) theory of plant layout and Arena simulation program. The rubber smoked sheet room has been improved such as air flow parameter. SLP has been found that by comparing the distance between the current factory layout and the improvement approach, we proposed three new approaches to the layout of the plant. The results of the study show that the three approaches are 1) total operating distance of 3.3 meters, 2) the total operating distance of 4.35 meters and 3) the operational distance of 2.6 meters. Then, the three models were used to model the scenarios using the Arena. It was found that the factory layout in the first model improvement was a plant layout that could reduce the time and distance used in this work. The most time was 0.54 minutes and 2.80 meters, respectively, it is appropriate to adopt a plan to improve plant layout as possible.**

***Index Terms*—productivity, arena, systematic layout planning**

I. Introduction

LAYOUT planning is defined as the work or the plan for the installation of machine, tools, devices or other objects required for the production process under the conditions of the structure and the existing building so that the production becomes safe and highly efficient. The layout planning must be conducted with care in order to meet the requirements for the production demands and the production process. Planning and controlling the productivity is usually aimed at maximizing the use of limited resources and at satisfying the customers. The resources in this context can be defined as all facilities for production such as machine, equipment, labor and raw materials for the production. To maximize the usefulness of the limited resources, the factory managers must be responsible for this and they could work with the department of planning and controlling the productivity to predict, plan, outline, analyze, control the goods in the warehouse, and control the production process.

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Plant layout has been started by Reed (1961) who devised a layout planning chart as the single most important phase of systematic planning in plant layout. Other approaches are Systematic Layout Planning (SLP) [1, 2, 3, 4], SLP is a method of plant layout design of project, which described step -by -step of method. The information of P, Q, R, S, T, is product, quantity, route, support and production timing as the given basic elements. Many of tables, graphs, as analytical tools, carry out the design through the layout methods. The researchers studied plant layout of manufacturing unit and improving it using the SLP for increased productivity [4]. In additional, many advanced algorithmic approaches have been used for solving the plant layout design e.g. a dynamic programming approach Rosenblatt (1986), genetic algorithm technique Lee et al. (2003) and El-Baz (2004), the ant colony optimization algorithm Bacykasogle et al. (2006) etc. [5]. Plant layout analysis and design for multi-products line production [6]. This work was carried out to investigate the suitable plant layout design for denture manufacturing. The appropriate 4 plant layout models were designed and compared the efficiency of each plant by adjacency-based scoring. Moreover, line balancing was done to allocate human resource using simulation programming (Arena 10) to find the increasing productivity of the new improvement layout. These reflect the importance of the plant layout design to bring about an increase in productivities. Arena simulation is another approach interested in improvement plant layout which helps in better all utilization such as man, material and machine in order to success the efficiency production [7-10]. For example, some researchers investigated layout planning in a pump manufacturing industry using arena [7]. This work delivers the evidence of valid advantage when the above given suggestions are applied in the industry. The proposed suggestions will overcome the drawbacks of the existing layout and thus the productivity can be improved. However, plat layout design is complicated due to many related factors such as employees, workflow, machine positions, and the relationship between machines and process. These factors result in plant layout improvement planning. Moreover, investment is required for machine positioning. Hence, the primary step for plant layout improvement should be started with identifying the problems of the current plant layout in order to maximize the productivities at the minimized investment, maximized and the working place becomes suitable for the efficiency and the productivity of the factory.

In this research studied the Rubber smoked sheet plant. The researcher proposed to design and improve rubber sheet

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plant. We investigated the discontinuous work flow in rubber smoked sheet plant. The Systematic Layout Planning Pattern (SLP) is an approach based on Analytical Hierarchy Process (AHP) and computer software called Arena. The temperature is constant between 35-70 °C, which can reduce the fungus. Therefore, the design and improvement of rubber sheet plant will save the long-term cost of the operator. Including entrepreneurs do not have to create new rubber plantations. But the improvement of the existing rubber plantation is better and more efficient, so the entrepreneur does not have to invest much.

II. Research Methodology

A. Information about rubber smoked sheet coating was collected.

-- The researchers went into the site of Smoked sheet rubber factory to gather the data on the factory information as well as an old layout planning for a new layout planning. The data provided will be useful for the modification of the layout planning, the requirements for the size and the considerations for the limitations and work areas for the machine to be installed.

-- The process for product production has been used in analysis.

--The area of operation units such as machines/equipment was measured and space limitation of product layout has been studied.

-- The present plant layout was analyzed to identify the problem under material and operation flow.

B. Analytical data problem and improve process layout

When the relevant data were gathered, the next step was to analyze the problems which occurred to the layout planning and the production line. Afterwards, an approach to the layout planning would be adopted to solve. SLP has been used to improve present plant layout.

C. Assessment and summary

-- Evaluated by comparing the present plant and plant

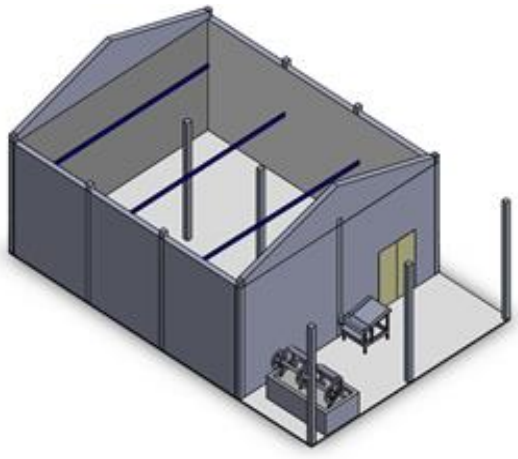

Fig. 1. Present Rubber Smoked Sheet plant layout

layout to improve with SLP and Arena

-- The suggestions were collected to write the report and were proposed to authorize to make decision for rearrangement the plant layout.

TABLE I
AREA SIZE OF EACH DEPARTMENT FOR RUBBER SMOKED SHEET

Symbol	Department	Conversion Area(m^2)
A	Mixing Latex	0.98
B	Latex Tray 1	1.2
C	Latex Tray 2	1.19
D	Make Rubber Sheets	2.3
E	Cleaning	0.9
F	Rubber Storage	2.4
G	Rubber Area before Rolling machine	0.78
H	Plan to adjust the tire	1.92
I	Printing	1.92
J	Tire Storage Area	1.26
K	Smokehouse - Dried	70.2
		85.05

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D. Simulation using Arena Program

The current layout of the factory was studied and analyzed. The current layout and alternative plant layout of the industry is created in ARENA program version 14 and distance evaluation of rubber smoked sheet document production was calculated.

III. Result and Discussion

A. Simulation using Arena Program

The rubber smoked sheet company usually produces the goods based on a make-to-order approach. For the production, the item would be passed from one machine to the others. Current plant layout of smoked sheet rubber as shown in Fig 1. The rubber smoked sheet with the size of 9x8x3.5 m3 is shown in Fig 1, with the rubber sheet area. In the area of production of smoked rubber sheets – dry, the work area can be divided into 4 areas as follows. The work area is shown in table1.

1. Rubber latex collection area;
2. Raw rubber sheet area;
3. Dry the rubber sheet to drain;
4. Smoking area.

The flow charts for production have been shown in Fig 2. Production process were smoked-drying fresh latex rubber grips and a mixed reception, latex, latex mixed with acid and water, and then wait until the rubber forming, after that sent the sample to the department to make the cubes into a sheet using a tire and then sent it to the department, cleaned and stored to wait for entering the rubber sheet rolling process. Then go to the department rolled rubber leveling by the rubber pad has gone into a tire rolled, thickness and forwarding to the Department printed on a rubber sheet. You will then be forwarded to the tire thoroughly, drain the area. Before delivery at smoked-dried and delivered to quality check to check and packing processes are finished.

Rubber Smoked Sheet had a limited space but the number of orders has increased. Due to the increasing number of orders, the production could not meet the demands and the time required by the customers. The factory layout planning, therefore, seems to be a good solution so that the company

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could improve the production procedure and that the products could meet the demands and the deadline as required by the customers. The area and the plan need to be mapped out so that it is suitable to the production process. The flow of the production must be systematic and the delivery must be convenient. With the current area, however, it is impossible; hence, the need for a layout planning.

In additional, after the raw rubber sheet has been rolled. The raw rubber sheet is placed on the bamboo rails inside the factory (Fig 3). The heat from burning firewood spread in the rubber sheet storage. The heat generated by the combustion runs into the pile of rubber, the sheets are laid on the bamboo rails. In rubber sheet humidity generally takes about 72-96 hr/ session. The temperature in the range of 49-63 °C on the first day and then gradually increases in practice. The problem is that the rubber plant is not currently measuring the temperature. Unknown relative humidity resulting in time and temperature. Moreover, during high humidity rubber sheet is formed a lot of fungus.

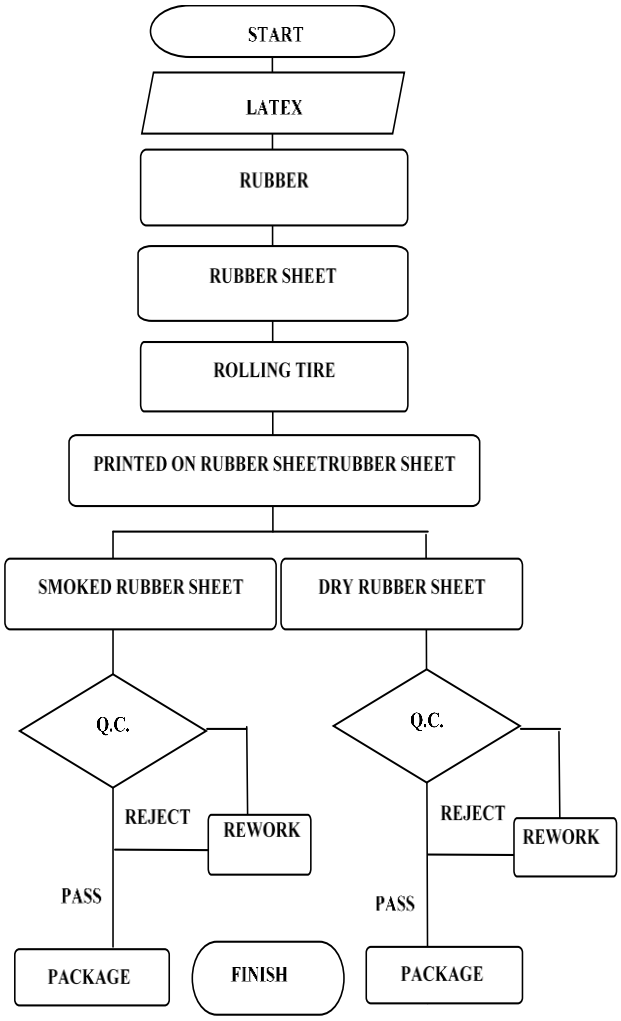

Fig. 2. Flow chart of the smoked sheet rubber production process

Fig 3. Drying of rubber sheets

B. Improvement Rubber Smoked Sheet Plant layout

Based on SLP method the modifying plant layout and practical limitations, a number of layouts were developed. The present plant layout displayed in Fig 4 A. The results of running an arena simulation of the current process from factory, the amount of 140 pieces, the average time of 10329.98 minutes (Fig 4 A-2) Alternative plant layout represents Fig 5 A-1, A-2, and A-3. In case of present plant layout, the transport distance for smoked rubber sheet plant of 6.10 meters. The A-1 proposed plant layout was greater than alternative plant layout represents A-2, A-3 i.e. distance for production, time as shown in table 2

About the air flow in rubber sheet smoked room, we used 12-inch fan. EX-30RHST four types of inlet and outlet air with a number of control devices and 4 machines to control the fan on and off at a certain temperature. The position of the fan is located at the side wall of the rubber plant. The fan on the right hand side of the entrance to the rubber **plantation. The distance from the building was 1.5 meters** high and the distance from each corner of the building was 1.5 meters and the left side of the rubber plantations.

It is 2.5 meters from the floor and 1.5 meters from the corner of the building, and has a control over the installed fan.

TABLE II
COMPARE THE TIME AND DISTANCE USED BETWEEN EXISTING PLANT LAYOUT AND IMPROVEMENT APPROACH BY ARENA SIMULATION

Plant layout	Working Time (Min)	Distance (m)
Present	10329.98	6.10
Alternative1	10329.44	3.30
Alternative2	10329.74	4.35
Alternative3	10330.03	4.60

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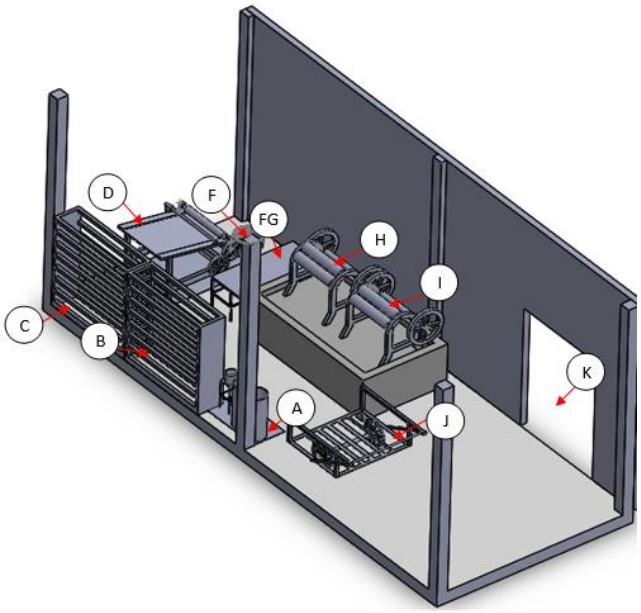
The relative humidity measured from the ground at 1 meter in rubber plantations from 13.00-17.00 hr. Relative humidity in the range of 53-78.2% at low level from the ceiling of 1 meter with relative humidity was in the range of 56.7-66.3% with an average relative humidity of 61.55%. The average temperature in the plant at a height of 1 meters 23-24.5 °C for a day. A less fungus is observed in rubber smoked sheet which the worker could use the brush to clean the fugues on the product. After that decreasing fungus on surface of smoked rubber sheet is observed.



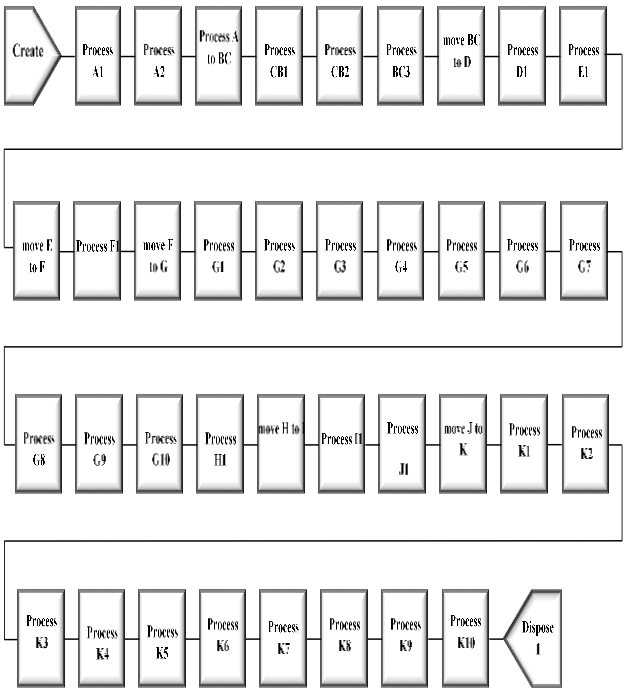
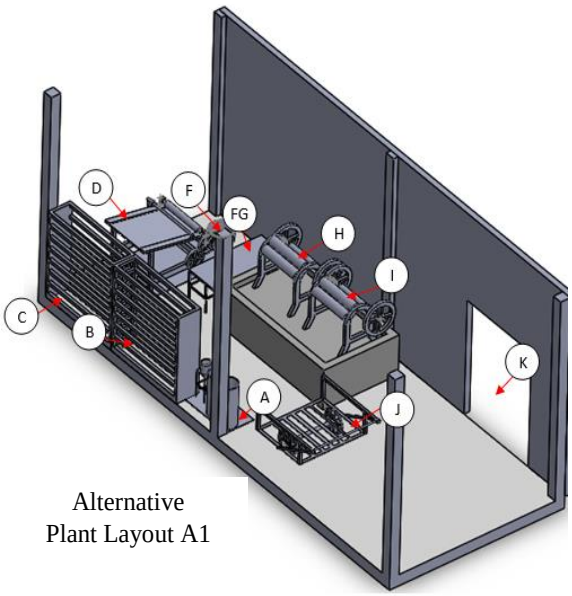
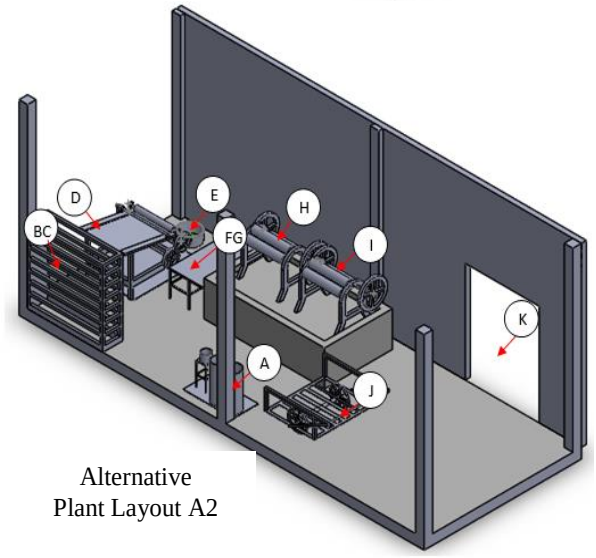


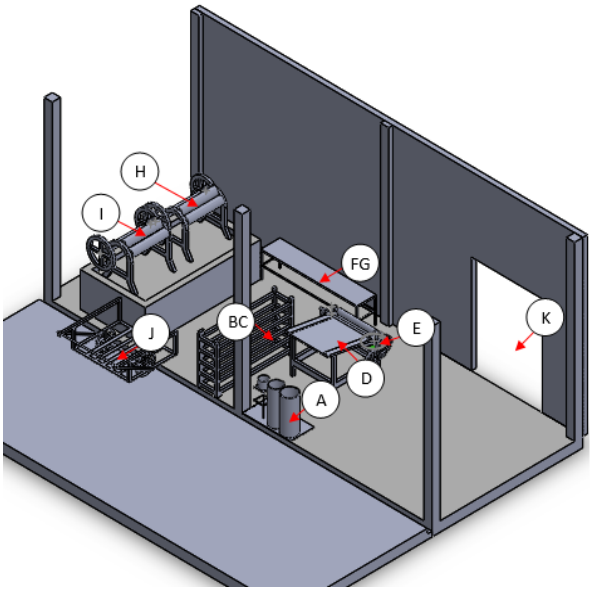
Fig 4 Present plant layout; 4 A-1 present plat layout, 4 A-2 Arena Simulation



Alternative
Plant Layout A1



Alternative
Plant Layout A2



Alternative plant layout A3

Fig 5 Alternative plant layout

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IV. Conclusion

After the layout planning for the factory had been done with 3 new models, it was found that Model A-1 could be operated within 10329.98 minutes for the length of 3.30 meters. Model A-2 could be operated within 10329.74 minute with the length of 4.38 meters. Model A-3 could be operated within 10330.03 minutes with the length of 4.60 meters. With the least time and the least distance model A-1 would be the most suitable model for the new layout planning of the factory because it could reduce the time and the length of the operation.

The air flow in the room is tire-smoke, 12-inch size and fan is used with device control 4 which controlled fans inside and outside the prescribed ambient temperature.

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