INTERNATIONAL SEMINAR ON INDUSTRIAL ENGINEERING AND MANAGEMENT

Saturday, October 25th, 2008, Santika Hotel, Jakarta, Indonesia

Theme:
"The Quality of Supply Chain Management in Achieving World Class Industry"
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Following the successes of the first International Seminar on Industrial Engineering and Management (ISIEM 2007), we are glad to organize the second event (ISIEM 2008). The theme raise to this year is supply chain management. Supply chain management is a cross-functional approach to managing the movement of raw materials into an organization, certain aspects of the internal processing of materials into finished goods, and then the movement of finished goods out of the organization toward the end-consumer. Supply chain management become more important as the competition in the global market and networked economy more intense and open. Organizations increasingly find that they must rely on effective supply chains, or networks, to successfully compete in the market. At the other hand, as organizations strive to focus on core competencies and becoming more flexible, they have reduced their ownership of raw materials sources and distribution channels. These functions are increasingly being outsourced to other entities that can perform the activities better or more cost effectively. The effect is to increase the number of organizations involved in satisfying customer demand, while reducing management control of daily logistics operations. Less control and more supply chain partners led to the creation of supply chain management concepts.

We accepted abstracts about 60 titles from Indonesia and abroad. Abstracts were reviewed by peer reviewers, and finally we published 40 titles.

We want to thank all those individuals or group who submitted papers for review and those whose papers were chosen for presentation at the seminar and those who submitted manuscripts to be published in this proceeding. We’d like also thanks reviewers specially, for their commitment, effort and dedication in undertaking the task of reviewing all the abstract that were submitted. Without their help and dedication, it would not be possible to proceeding in such a short time frame. We highly appreciate all members of committee director, steering committee and organizing committee for mutual efforts and invaluable contributions for the success of the seminar. Last but not the least, our greatest gratitude to Gunadarma University, Trisakti University, and Indonusa Esa Unggul University rectors, for their support and contribution for this seminar.

It is always a pleasure to host our colleagues from regional industrial engineering community to build networks and links that are essential parts for the development of industrial engineering in the future. For this reason, we plan to host this seminar every year with varies theme in industrial engineering and management. In the blessing of Lord, we expect your continually contribution for the coming year.

Rina Fitriana, ST., MT.
Seminar Chairwoman
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LAYOUT EVALUATION AND REDESIGN USING SIMULATION
(Case study: Usaha Tahu Yudi)

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ABSTRACT

The purpose of this research is to redesign Usaha Tahu Yudi's layout in order to increase the productivity. Simulation of the model is used to observe, analyze, and optimize the plant layout. Observation and interview are used in data collecting phase. The process time, material flow, and current layout data is analyzed and transformed into information that used to built the model. System performance is measured based on material flow duration within the system. Result shows that existing layout still need to be improved. Improving was done by changes the plant layout, increase the capacity of casting table, alter the function of temporary table and casting table as cutting table, and move the position of frying pan closer to precedence operation. Having done the improvement, production time is decreased by 112.28 minutes.

Keywords: Layout, design, simulation, model, productivity.

1. INTRODUCTION

Designing layout is an important thing when we are trying to build a plant. The position of each facility on the layout will affect the material flows, determined the process flows, and at the end the facility position will affect the plant efficiencies and productivity rate.

The layout design is commonly designed in optimum state on factories or public services facility, where in both locations the equipments and facilities are designed to work with maximum efficiencies.

Beside the quality of the product, productivity is one of the many aspect in industries that need to improved continuously if want to compete with competitors in the long run. One way that can be applied to increase the productivity is with decrease the lead time, and the lead time can be decreased by redesign the facility layout.

Usaha Tahu Yudi is a small industry that works in tofu production. The main activity on the industries is production activity. On the production process, soy bean as raw material is processed to create tofu. The production process is work in consecutive flow and can not be conducted as random operation. Every operation has its own processing time and use different facility on the process.

However, based on preliminary observation, production layout design in Usaha Tahu Yudi shows inefficient performances. Bottleneck obviously seen in most facility, position and condition of the equipment is indicated that there must be something wrong with the layout.

Redesign of layout then must be considered to improve the performance. Instead of experiment with existing system, using simulation is preferred to evaluate and redesign layout. With simulation, system experiment allowed to be performed without interrupted production process.

2. THEORETICAL BACKGROUND

2.1. The Purpose of Layout Design

Apple (1977) defines layout design as a first step to optimizing the connection between operators, operation, material flows, and information flow in order to create a plant with maximum productivity, economics annual cost, maximum efficiencies, and satisfying.

The problems that occur in the layout design is not only encountered on a
new plant, but also can meet in old factories. The problem can be merge as result of certain changes on the product design, demands, increasing plant capacity, new standardization of safety, or by replacing one or two equipments.

Nearly most of experts are agree that productivity can be achieved as a contribution from smooth material movement from one to another facility. This is an important aspect for factory, post office, hospital, or restaurant. In every case, the entities are enter, processed, and leave the system in different condition, so it was very important to make sure that every facility are arranged in right order.

System is defined as a collection of element that function together to achieve a desired goal (Blanchard 1991). Key points in this definition include the fact that (1) a system consists of multiple elements, (2) this elements are interrelated and work in cooperation, and (3) a system exists for the purpose of achieving specific objectives.

Examples of systems are traffic systems, political systems, economic systems, and service systems. Our main focus is will be on manufacturing and service systems that process materials, information, and people.

Both manufacturing and service system may be termed processing system, because they process materials through series of activities. In a manufacturing system, raw materials are transformed into finished product. For example, a bicycle manufacturer starts with tube stock that is then cut, welded, and painted to produce bicycle frames. Processing system are artificial (they are human-made), dynamic (elements interact over time), and usually stochastic (they exhibit random behavior).

A model is a simplified representation of reality, with emphasis on the word simplified. This means that the exact way in which an operation is performed is not so important as the way in which the operation impacts the rest of the system. An activity should always be viewed in terms of its effect on another system element rather than in terms of detailed way in which it is performed. Such detailed mechanics are inconsequential to the overall flow of entities and utilization of resource.

Most models, especially those built by beginner, tend to err on the side of being overly detailed rather than being too general. The tendency is to reproduce the precise way that the system operates. Not only is it difficult to create extremely detailed models, but it is difficult to debug and maintain them.

Furthermore, all of the detail may obscure the key issues being analyzed so that it actually weakens the model. The power of a model is more a function of its simplicity rather than its complexity. A point can be made more effectively when it is reduced to its simplest form rather than disguised in morass or detail.

The model that we will be using is a computer model. Simulation in this context can be defined as the imitation of a dynamic system using a computer model in order to evaluate and improve system performance. According to Schriber (1987), simulation is "the modeling of a process or system in such a way that the model mimics the response of the actual system to events that take place over time." By studying the behavior of the model, we can gain insights about the behavior of the actual system.

Rather than leave design decision to change, simulation provides a way to validate whether or not the best decisions are being made. Simulation avoids the expensive, time-consuming, and disruptive nature of traditional trial-and-error techniques.

3. RESEARCH METHOD

3.1. Tools

The software that used in this research is Microsoft Visio 2003 to draw layout, and Promodel 2001 Student version to simulate the model.
3.2. Simulation Step

This research was done following these steps:
1. Evaluation of existing system
2. Model conceptualization
3. Model logic development
4. Model simulation development
5. Model testing
6. Model implementation
   a. Data Collecting

Data collecting begins with measuring length and width of area, and followed with calculate the movement distance between operation, number of operators, and output production.

Predetermined of building model, it was important to understand how the current systems are works. It was also important to know what kind of machine and equipment that used on the production process. According to the observation on the location and interview with the owner, the process flow of the production process is illustrated on Figure 2.

![Figure 2. Process Flow](image)

The process time for each activities are showed in Table 1. The data is mean process time from 30 days measurement for one loop production per day.

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<td>5</td>
<td>Screening</td>
<td>7.1</td>
</tr>
<tr>
<td>6</td>
<td>Add additive substance</td>
<td>4.2</td>
</tr>
<tr>
<td>7</td>
<td>Mixing</td>
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<tr>
<td>8</td>
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<td>10</td>
<td>Casting</td>
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<td>11</td>
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<tr>
<td>12</td>
<td>Frying</td>
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The current layout is illustrated on Figure 3. Topographic condition slope to the river with 25° elevation. This condition force the owner to create the plant in three levels based on the soil surface beneath the foundation. The sizes of each facility are scaled from their actual size.
4. MODEL DEVELOPMENT

4.1. Status Variables

Status Variables show the change of the status on component facilities, operators, and materials. State variable consists of status of facilities, operators, and materials. Value 0 is assigned to each variables status when it's idle, and 1 when it's busy.

4.2. Discrete Events

Discrete events the tofu production system give a description of an event that changes the status of facility, workers, and materials. Discrete event that happens on the system are:

1. Soy bean as raw material enter the system, assign (M) with value 0, (O) value 0, and (F) value 1.
2. Soy bean are grouped per 10 Kilograms; assign (M) with value 1, (O) value 1, (F) value 1.
3. Soy bean placed on soy bean box. (M) with value 1, (O) value 1, (F) value 0.
4. Operator moves soy bean box to soaking area; (M) value 2, (O) value 1, (F) value 0.
5. Soaking process proceed. Assign (M) with value 1, (O) value 0, (F) value 1.
6. Soy bean box moved to juicing machine; (M) value 2, (O) value 1, (F) value 0.
7. Soy bean juiced into tofu extract. Assign (M) value with 1, (O) value 1, (F) value 1.
8. Tofu extract moved to boiling vessel. (M) value 2, (O) value 1, (F) value 0.
9. Boiling process proceed. (M) value 1, (O) value 1, (F) value 1.
10. Tofu extract poured to screening vessel. (M) value 2, (O) value 0, (F) value 1.
11. Screening process proceed. (M) value 1, (O) value 1, (F) value 1.
12. Tofu extract placed on the extruder. (M) value 1, (O) value 1, (F) value 0.
13. Tofu board moved to casting table; (M) value 2, (O) value 1, (F) value 0.
14. Casting process proceed. (M) value 1, (O) value 0, (F) value 1.
15. Tofu board moved to tofu table. (M) value 2, (O) value 1, (F) value 0.
16. Tofu board placed in tofu table. (M) value 1, (O) value 1, (F) value 1.
17. Tofu board moved to cutting table. (M) value 0, (O) value 1, (F) value 0.
18. Cutting process proceed. (M) value 1, (O) value 1, (F) value 1.
19. Tofu board moved to temporary table. (M) value 2, (O) value 1, (F) value 0.
20. Tofu board placed in temporary table. (M) value 0, (O) value 1, (F) value 1.
21. Tofu board moved to queue table. (M) value 0, (O) value 1, (F) value 0.
22. Tofu board moved to frying pan. (M) value 0, (O) value 1, (F) value 0.
23. Frying process proceed. (M) value 1, (O) value 1, (F) value 1.
24. Tofu placed on shipping area. (M) value 2, (O) value 1, (F) value 1.

Figure 4. Events Graf

4.3. Variables

Logics on the Tofu production system are linked by exogenous variables, endogenous variables, an simulation parameters. Exogenous variables consist of uncontrollable, and decision variables. Only one of uncontrollable variables, i.e. Delay time of material arrival (DM). Decision variables (Input factors) is differentiated into Number of material that enter the system (NM), Number of material that processed on the system (NPM), Number of Facility (NF), Facilities capacity (FC), Number of Operator (NP), Job description (JD), and Distance between Facilities (DBF).

Endogenous variables can be differentiated into state variables, and response variables. State variables such as facilities status (F), operator status (O), and Material status (M). Response variables consists of Time Scheduled (TSched ), Number of entities that enter the Facility (TotEntr_Facility), Number of maximum entities on facility (Nmax_Facility), Average time per entry (AVG_TmpEntr), Presentation of utilization on each, Facilities (PU_Fasilitas), Number of activities performed by operator (Nact_Operator), Presentation of utilization on each operator (PU_Operator), Presentation of idle time on each operator (P_idle_Operator), Number of entities that exits the system (Totexits_Entities), Average time of entities on the system (AVG_Tsys), and Average time blocked (AVG_Tblocked). Simulation parameters consists of Number of Entities on the System (NE), Process Time (PT), and The length of simulation time (TR).

5. RESULT AND DISCUSSION

Table 2. shows total time processing 100 Kilograms soy bean, i.e.814.55 minutes. Location with biggest utilization is screening vessel with utilization rate 58.39%.
Entity that has biggest blocked time is tofu board that spent 175.53 minutes blocked on the system. This happen because this entity is not handled by operator or waiting operation on next facility.

Table 3. shows us information time duration wasted on the system, and which entity that needed to improve material handling aspect. Based on entity activity from the output, we can verify that entities need improvement are soy bean box and tofu board.

Entity that has longest time on the system is soy bean box with 313.92 minutes on the system. This caused by insufficient capacity from soaking area. Increasing the capacity of soaking area may solve this problem.

It's identified, entities that blocked on the system are soy bean box, tofu extract, and tofu board. The capacity of soaking area is 6 boxes, move the location closer to juicing machine and arrange the box in pile can increase the capacity up to 16 boxes.

On current layout, position of receiving and soaking area are not matched with process flow. This condition make operators must walk in long distance to perform the operation. On material handling method, operation time can be reduced by shortened the distance. (Sritomo, 2003).

On the top level of the layout, material flow is set to "L" shape, where 3 short straight flows are grouped into one shape. This flow is used because the incapability to use another kind of material flow on this location. Beside that, there is a facility with permanent location that forces the using of this flow (Harahap, 2006).
Moved facilities and equipments that are not currently used on the operation give more space to arrange the position of other facilities. Altering the function of tofu table and temporary casting table to cutting table are increased the capacity of cutting table up to 3 times from the current capacity. These alterations put non productive facility to better use, and decreased the number of blocked material that caused by insufficient facility of cutting table.

The other changes on the layout is moved the position of tofu table from middle level to bottom level of the plant. This change increased the capacity of tofu table from 20 boards to 60 boards. As shown on Table 4, processing time is decreased from 814.55 minutes to 702.27 minutes. Aspect that gives biggest contribution in reducing process time is shaped the material flow into “L” shape on the top area of the plant.

Table 4. Location
Increasing the capacity of soaking area from 6 boxes to 16 boxes reduce the average time on the system of entity soy bean box from 313.92 minutes to 269.19 minutes. In conjunction, increasing the capacity of this location also reducing the number of item blocked on precedence operation.

The percentage of utilization is most increased on boiling vessel, where the utilization is increased from 17.27% to 33.78%. This caused by increasing the capacity of soaking area that performed as precedence operation before boiling process.

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The redesign process also increased the presentation utilization of operators. The most significant improvement made is in operator 3 where the utilization is increased by 9.15%.

However, average time that needed to move from one operation to others is decreased by 0.02 minutes. Idle time also reduced from 48.3% to 39.14%. The output also shown that even redesign process already performed, the percentages of utilization for each operator are still not even.

### Table 5. Resource

<table>
<thead>
<tr>
<th>Name</th>
<th>Scheduled Time (MIN)</th>
<th>Number Times Used</th>
<th>Avg Time Per Usage (MIN)</th>
<th>Avg Time For Use (MIN)</th>
<th>% Blocked In Travel</th>
<th>% Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pekerja 1</td>
<td>702.27</td>
<td>122.00</td>
<td>1.25</td>
<td>0.05</td>
<td>0.00</td>
<td>22.55</td>
</tr>
<tr>
<td>Pekerja 2</td>
<td>702.27</td>
<td>322.00</td>
<td>1.31</td>
<td>0.04</td>
<td>0.00</td>
<td>64.02</td>
</tr>
<tr>
<td>Pekerja 3</td>
<td>702.27</td>
<td>103.00</td>
<td>4.12</td>
<td>0.03</td>
<td>0.00</td>
<td>50.66</td>
</tr>
<tr>
<td>Pekerja 4</td>
<td>702.27</td>
<td>275.00</td>
<td>0.37</td>
<td>0.08</td>
<td>0.00</td>
<td>17.72</td>
</tr>
</tbody>
</table>

### 6. CONCLUSION

The modification of the layout is include changes the plant layout, increase the capacity of casting table, alter the function of temporary table and casting table as cutting table, and move the position of frying pan closer to precedence operation. Compared result of the simulation is show that the production time is decreased by 112.28 minutes.

This research shows that every operator has different presentation of utilization. To minimize the process time of the current system, besides redesigning the layout it was also important to do a research about how the most optimum job description for every operator on the system.

### 7. REFERENCES
