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LAY OUT AND PRODUCTIVITY ANALYSIS OF LEMURU CANNING INDUSTRY IN BANYUWANGI, EAST JAVA

Analisa Tata Letak Fasilitas Dan Produktivitas Pada Industri Pengalengan Ikan Lemuru Di Kabupaten Banyuwangi Jawa Timur

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ABSTRACT

Layout design can determine how efficient and effective a production process is. The decision to election desain layout will have an impact on optimizing the factory area, determining the production equipment used, operational costs and the number of workers used. The research aim is to find out the type of layout applied in the production process, to know the basic considerations for choosing the layout, to know the material flow pattern, and to know the productivity of fish canning factories in Banyuwangi Regency. Data collection was carried out by directly observing the production process at two fish canning companies in Muncar District, Banyuwangi Regency, East Java. Observations were made on the arrangement of production departments/sections, the location of production equipment, material handling flow, and factory productivity. The data was analyzed in a comparative descriptive manner between the two companies. The research results show that both fish canning companies use a type of product layout, which is indicated by the arrangement of machines and production facilities which are arranged according to the production process flow using the machine after machine principle. The choice of layout type aims to reduce material movement, reduce cost, and make it easier to monitor production activities. Productivity analysis at both companies shows values above the standards set by the company. Recomended further research is an analysis of the economic efficiency of the layout and selection patterns of the selected materials.

Keywords : Design Facility, Efficiency, Fish Processing Plant, Material Handling, Production Process.

ABSTRAK

Desain tata letak dapat menentukan seberapa efisien dan efektif suatu proses produksi. Keputusan penetapan tata letak akan berimbas pada optimalisasi area pabrik, penentuan alat produksi yang digunakan, biaya operasional, dan jumlah tenaga kerja yang digunakan. Tujuan dari penelitian ini adalah mengetahui jenis tata letak yang diterapkan pada proses produksi, mengetahui dasar pertimbangan pemilihan tata letak tersebut, mengetahui pola aliran bahan, dan mengetahui produktivitas pabrik pengalengan ikan di Kabupaten Banyuwangi**.** Pengambilan data dilakukan dengan mangamati secara langsung proses produksi pada dua perusahaan pengalengan ikan di Kecamatan Muncar, Kabupaten Banyuwangi, Jawa Timur. Pengamatan dilakukan pada pengaturan departemen/bagian-bagian produksi, letak alat-alat produksi, alur *material handling,* dan produktivitas pabrik . Data dianalisis secara deskpritif komparatif di antara dua perusahaan tersebut. Hasil penelitian menunjukkan bahwa kedua perusahaan pengalengan ikan menggunakan jenis *product lay out* atau tata letak produk, yang ditunjukkan dengan penyusunan mesin dan fasilitas produksi yang diatur sesuai aliran proses produksi dengan prinsip mesin *after* mesin. Pemilihan *lay out* tersebut dengan mempertimbangkan jenis produk, volume produksi, aktivitas pemindahan bahan, dan pemilihn mesin untuk pemindahan bahan. Kedua perusahaan menerpakan pola pemindahan bahan *straight line* yang sederhana dan pendek dengan alat pemindahan utama yaitu *conveyor belt.* milihan jenis tata letak bertujuan untuk mengurangi gerak perpindahan bahan, menekan biaya, dan memudahkan pengawasan aktivitas produksi. Analisis produktivitas pada kedua perusahaan menunjukkan nilai diatas standar yang ditetapkan oleh perusahaan. Penelitian lanjutan yang disarankan yaitu analisis efisiensi ekonomi dari *lay out* dan pola pemilihan bahan yang dipilih.

Kata kunci: Desain Fasilitas, Efisiensi, Pabrik Pengolahan Ikan, Pola Aliran Bahan, dan Proses produksi

INTRODUCTION

Factory layout or facility layout is a method of arranging facilities or machines in a factory as an effort to optimize the area of production, smooth material movement, permanent or temporary material storage, arrangement of the number of workers, and so on (Arif, 2017). Proper layout design can minimize the number and movement of workers (Rosyidi, 2018). Grouping production equipment into sections or departments is based on the analysis of equipment capacity and technology (Lan & Zao, 2010).

The purpose of arranging the factory layout is to reduce total costs such as construction and installation costs, machine building costs, material transfer costs, production costs, product storage costs, repair costs, security and others (Arif, 2017). Factory layout is divided into 4 types, namely function layout, product layout, process layout, and fixed material layout (Handoko, 2020). The selection of the layout type is related to factory location planning in placing production facilities and designing production facilities (Wignjosoebroto, 2009). Choosing the type of layout is important because it is related to production costs, which will indirectly be related to the profit or gain obtained by the company.

Layout design can be done with two classic approaches, namely block layout design, by placing facilities into departments and layout design based on material handling (Aiello *et al.*, 2002). Optimization of the facility layout scheme needs to consider the distance between machines, the distance of machines from transportation routes or construction elements of the production room (Kikolski & Ko, 2018). Layout design can be done using mathematical optimization models or expert knowledge, and the use of special software packages (Perez-Gosende *et al*., 2021). New developments in layout design using software provide new perspectives and make it easier to design factories (Meller & Gau, 1996).

So far, material handling has often been ignored because it is considered to only help the production process. In fact, in some factories, improper material handling can be a major obstacle that results in production disruptions, low efficiency, and low production system performance (Hao & Shen, 2008). If observed, the choice of layout will affect material handling, and can even affect production costs and company productivity.

In some cases, improper layout and material handling design can be evaluated. Re-designing the layout or layout is very possible, considerations in carrying out the rearrangement are changes in production volume, changes in production processes and technology, and changes in products (Monga & Khurana, 2015). In this case, a flexible layout can maintain low material handling costs even though the level of product demand fluctuates (Hillier, 1963; Monga & Khurana, 2015). The arrangement of production facilities also determines the pattern of moving or handling materials during the production process.

The selection of the type of layout and the pattern of moving materials is an important decision that needs to be considered carefully. Layout design should be done before the factory starts operating or can be rearranged if the layout type is not considered appropriate. An important condition for obtaining the expected impact is to identify and quantify the problems that arise properly, as well as selecting the right methods and tools to provide the best solution (Kikolski & Ko, 2018). The best solution will increase work productivity.

Measurement of work productivity can be seen through the quantity of work results by considering costs or other things related to the work completion process (Butar & Nuridin, 2022). Productivity is also interpreted as a comparison between the results achieved (output) with all the resources used (input) (Elbandiansyah, 2019). According to Ashar & Saleh (2015), productivity has two dimensions, namely: the effectiveness of maximum work achievement and the realization of the use or process of completing work. In this case, the layout of a factory has a contribution that can affect the work completion process.

Considering the importance of layout selection on costs, it is necessary to identify the layout and material flow patterns, as well as productivity in the factory. The purpose of this study is to determine the type of layout applied to the production process, to determine the basis for consideration of the selection of the layout, to determine the material flow pattern, and to determine productivity in the fish canning factory.

RESEARCH METHODS

The research was conducted in Muncar District, Banyuwangi Regency, East Java at two fish canning companies, namely PT. Sumber Yala Samudera and PT. Pasific Harvest. Data collection was carried out from October 2022 to May 2023 using field observation and interview methods. The observation method is a data collection technique by directly observing the activities or activities of the object of observation (Ahyar *et al*., 2020; Ramdhan, 2021). While the interview method is the process of collecting data by exploring research informants using a list of questions (Hardani *et al*., 2020; Abdussamad, 2022).

The data obtained will be grouped into primary data and secondary data. Primary data is the main information collected by researchers directly during the research process, while secondary data is data obtained through intermediary media or from other sources such as documents, literature, or data collected by other parties (Sulung & Muspawi, 2024). The tools and materials used in the research include tools and materials for data collection such as stationery, cameras/cellphones, and laptops.

The data obtained were analyzed descriptively and comparatively to compare the layout and productivity of the research object. Labor productivity analysis is calculated from production or work results during a unit of time. This labor productivity can show productivity per person for each different company layout.

RESULT

Production Section Layout

Layout is the arrangement of factory facilities designed to support the smooth running of the production process. The results of observations in both canning companies show that the layout in the production section is arranged according to the flow of the production process. The placement of production facilities or machines is placed sequentially following the stages of the production process. The stages of the production process along with the completeness of the facilities and main machines used will be presented in Table 1 below:

Table 1. Stages of Fish Canning Production Process

No	PT. Sumber Yala Samudera		PT. Pasific Harvest	
	Stages	**Facilities and Machinery**	**Stages**	**Facilities and Machinery**
1.	Receiving Raw Materials	Tanks, tables, barrels and scales	Receiving Raw Materials	Tanks, baskets and scales
2.	Weeding and Sorting	Work tables and scissors	Thawing	Tampers and baskets
3.	Washing	Rotary drum machines	Weeding	Work tables and scissors
4.	Filling Fish into Cans	Tables, baskets and cans	Fish washing	Rotary drum machines
5.	Steaming (Pre-cooking)	Exhaust box machines and conveyor machines	Filling and weighing	Tables, pans, scales and cans
6.	Draining	Conveyor machines	Precooking	Exhaust box machines and conveyor machines
7.	Filling Sauce Media	Filling machines	Draining	Conveyor machines
8.	Can Closing	Seaming machines	Sauce filling	Filling machines
9.	Sterilization	Retort machines	Can closing	Seaming machines
10.	Cooling	Retort machines and water lines	Can washing	Conveyor machines
11.	Incubation	Packaging rooms and pallets	Sterilization	Retort machines
12.	Labeling	Labeling and coding machines	Cooling	Retort machines and water lines

13.	Packaging	Master cartons	Labeling	Ink jet printers and conveyor machines
14.	Storage and Distribution	Pallets, warehouses, truck containers	Incubation	Storage rooms and pallets
15.	-	-	Packing	Master cartons
16.	-	-	Storage	Pallets, warehouses
17.	-	-	Stuffing and distribution	Truck containers

The data in Table 1. shows that there is no significant difference in the process flow of the two companies. The difference in the thawing process is caused by the raw material used by PT. Pasific Harvest is frozen fish so that it requires a thawing process using water to melt the ice and soften the texture of the fish before being processed.

The results of the observations made show that both canning companies apply a product layout, namely the arrangement of facilities and production machines based on the sequence of work areas according to the sequence of the production process. In placing machines, the product layout type has the principle of machine after machine. Raw materials will run from one machine to the next following the stages of the process flow until they are finished as products.

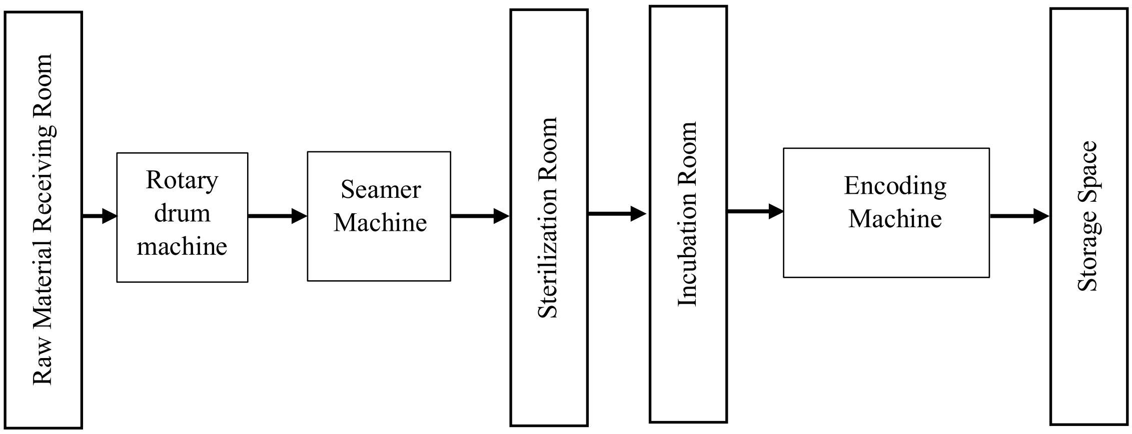

Figure 1. Lay Out Product

Basic Considerations for Layout Selection

Layout selection considerations are a big decision and are long-term in nature. There are several things that companies consider in making this decision, namely:

1. Both companies have one product produced, namely canned fish. Variations are only made in the differences in sauces used.
2. The daily production volume is very large. At PT. Pasific Harvest, the daily production process reaches 35,000 kg of frozen lemuru fish raw materials per day, while at PT. Sumber Yala Samudera it ranges from 20,000 to 45,000 kg of fresh lemuru fish raw materials per day.
3. With a large work volume, it requires automatic material transfer activities using a conveyor machine. This is to facilitate the production process.

4. The machines used in the production process are machines with special purposes or certain functions and do not require special operators.

. Based on these considerations, PT. Sumber Yala Samudera and PT. Pasifik Harvest chose to use the type of product layout that was considered the most appropriate.

Material Handling

Material handling is a non-productive activity but is closely related to production activities and the design of the layout of production facilities. This activity does not provide any additional material or products that are moved, but instead increases costs. In the study, only observing the activity of moving materials in a fish canning factory is classified as the movement of materials or products in and around the factory during the production process, while the movement of materials from their original source to the factory and the distribution of finished products (output) to the consumer location is not observed.

The results of the study showed that there was no difference in the pattern of moving materials or material handling at PT. Sumber Yala Samudera and PT. Pasific Harvest. Figure 2 will present the pattern of moving materials in a fish canning factory.

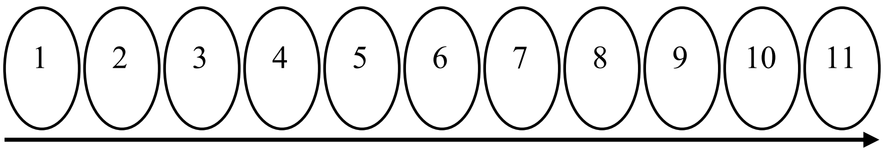

Figure 2. Fish Canning Factory Material Transfer Pattern

Information:

1. Raw material receiving area
2. Weeding area
3. Washing area
4. Fish filling area
5. Steaming area
6. Media loading area
7. Can closure area
8. Sterilization area
9. Incubation area
10. Coding area
11. Storage area

From Figure 2, it is known that the pattern of moving fish canning factory materials runs from one area to another following the production process flow. The selection of the product layout type results in raw materials or products being moved following the production process flow, from one area to another until the finished product.

The equipment used is chosen to be as effective and efficient as possible. The equipment used in moving materials in the fish canning factory can be seen in Table 2, namely:

Table 2. Canning Factory Material Transfer Activities

No	Area	Track Distance (meter)	Material Handling Activities	Equipment Used
1.	Raw material receiving area	3-5	Transfer	Trolley, Basket or Drum
2.	Weeding area	3-5	Transfer	Conveyor machine
3.	Washing area	3-5	Transfer	Conveyor machine
4.	Fish filling area	3-5	Transfer	Conveyor machine

5.	Steaming area	3-5	Transfer	Conveyor machine
6.	Media/sauce filling area	3-5	Transfer	Conveyor machine
7.	Can closing area	3-5	Transfer	Conveyor machine
8.	Sterilization area	10-15	Packaged materials	Pulley, big basket
9.	Incubation area	10-15	Packaged materials	Forklift, skid box or pallet
10.	Coding and packaging area	10-15	Unit loads	Conveyor machine
11.	Storage area	10-15	Unit loads	Forklift, skid box or pallet

Produktivity

Productivity observations are carried out in the production area, both using human power and machines. Table 3 will present the results of productivity calculations at the fish canning factory.

Table 3. Productivity of Fish Canning Factory Based on Production Stages

No	Production Stages	Produktivity	
		PT. Sumber Yala Samudera	PT. Pasifik Harvest
1.	Weeding	68.2 kg/hour/person	67.3 kg/hour/person
2.	Fish filling	340 cans/hour/person	300 cans/hour/person
3.	Can closing	12,000 cans/hour	12,000 cans/hour
4.	Sterilization	5,400 cans/hour	5,400 cans/hour
5.	Coding	16,000 cans/hour	15,000 cans/hour

The data in Table 3 shows the productivity calculation at five stages of production. The weeding and fish filling activities are carried out manually, while the other three stages are carried out using machines. The productivity value obtained has exceeded the productivity set by the factory.

DISCUSSION

The observation results show that the layout used is a product layout where the arrangement of production facilities and machines is adjusted based on the sequence of the production process. The advantages of the product layout include being able to use automatic machines and conveyor belts, making supervision easier, not requiring high skills to run the production process, the time required for the production process is relatively short, easy material movement at low cost, and making production scheduling easier.

During the observation process at both companies, the production schedule was carried out regularly with a regular process. Almost all workers in the production area do not require special skills with an education level of elementary school (SD) to high school (SMA). Some employees who have special skills are usually placed in certain areas/machines that require supervision.

However, the selection of the product layout type also has disadvantages, such as what happened during the study, namely when one of the machines was damaged/unable to function, the production process was immediately stopped or switched to using another similar machine.

In this case, high investment is needed to have a number of similar machines to support smooth production. In addition, delays in one production process can hamper the overall production process. The company also does not have the flexibility to make different products, because the machines/facilities owned are specifically for canned fish products. Product changes will increase investment.

The layout of the product layout type also affects the material transfer pattern. The material transfer pattern for me and the product in both companies follows the production process flow with the aim of minimizing material transfer. The material transfer pattern in the fish canning factory follows a straight line pattern or a simple straight line pattern. This pattern is very suitable for short and simple production processes, with short track distances. The selection of equipment used will also determine the material transfer pattern used. The advantages of the straight line material transfer pattern are that the transfer activity takes place smoothly, quickly, and at a low cost. The process of transferring materials from one production area to another is carried out using tools such as conveyor machines, trolleys, pulleys, forklifts, skid boxes, drums, and baskets. The use of tools or machines in the material transfer process can minimize the transfer time and the amount of labor used. The arrangement of production facilities (layout) and the selection of material transfer patterns will affect work productivity. In the research object, there are five stages of production that are observed. Of the five stages, the process is grouped into manual and automatic (mechanization). The manual production stage includes the process of cleaning fish and filling fish into cans. Meanwhile, the production stages using automatic machines include can closing, sterilization, and coding.

At the can closing, sterilization and coding stages between the two companies have relatively the same value. This happens because the equipment used in the two factories observed has the same or almost the same specifications. The same machine specifications will produce the same productivity. Machine performance must always be evaluated to see if the machine is still performing well according to the machine's operational standards. In the machine area, there are one or two operators whose job is to ensure that each machine runs well and according to the company's targets. In this case, work productivity in the mechanization area such as can closing, sterilization, and coding activities is determined by the specifications of the machine used and the age of the machine. Meanwhile, work productivity in the manual area is influenced by the workers. Weeding and fish filling activities require hand speed and accuracy from the workers. Hand speed is influenced by the worker's experience in doing the same task.

CONCLUSION

The lemuru fish canning company applies the product layout type/type, namely the arrangement of production facilities and machines based on the sequence of work areas according to the sequence of the production process. In machine placement, the product layout type has the principle of machine after machine. Considerations for selecting the layout are based on the type of product, production volume, material transfer activities, and the use of material transfer machines. The material transfer pattern in the fish canning factory follows a straight line pattern or a simple straight line pattern. This pattern is very suitable for short and simple production process types, with short track distances. Productivity analysis is determined by the speed of workers (in production activities that rely on manual work such as weeding and fish filling) and the specifications of the machines used (in can closing, sterilization, and coding activities).

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