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Risk-Based Waste Control in Warehouses using FMEA and FTA Methods
(Case Study on CV. Roda Lintas Equator Sidoarjo)

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***Abstract*-Companiesthat have good management are companies that can manage risks that can occur so that the level of risk that occurs can be reduced or even eliminated. The risks that may occur can be managed by tracing beforehand so that information is obtained about the causes of these risks, and the analysis of risk assessment in the company serves as loss mitigation which will later be able to find out about the risks that will occur, the causes of the risks, the impact of these risks. as well as repair solutions to reduce waste in the warehouse. The risk assessment or risk assessment is carried out by the management, especially the head of the warehouse. The data obtained were then analyzed using the Failure Mode and Effects Analysis (FMEA) method and the Fault Tree Analysis (FTA) method. The analysis generates the value of the risk level (TR), and Risk Priority Number (RPN) and details the causes of a Top Event to a root cause failure. The results of the analysis obtained 25 risks for the entire process failure with the largest RPN value, namely the damaged network connection with a value of 40.74 while the smallest RPN value, namely the risk of lack of light intensity with a value of 4.89, the risk of damage to hardware with a value of 4.89.**

Keywords: Minimization, Repair, Production Process, Waste

I. INTRODUCTION

Of course, there are differences in the risks experienced by each company. A good company can manage risks that may be experienced, thereby reducing and eliminating the level of risk that occurs. Possible risks can be managed by obtaining information that leads to these risks so that companies can use this information to evaluate and analyze risks that may occur in the future (Mellisa, 2013). Risk management is an effort made to manage risk so that there is no accidental loss or accident (Ramli, 2010). Therefore, risk management can be used as an instrument for companies to take provisions, risk management can occur at any time (Ayu, 2016).

Companies that have a high level of risk in their management, one of which is a company engaged in retail distribution, in which there are inbound and outbound processes. Inbound and outbound processes include receiving, storing, replenishment, picking, packing, and shipping. In general, companies have warehouses where goods are stored. An example is a CV. The Equator Wheel. In the process of carrying out its activities, CV. Roda Lintas Khatulistiwa stores goods on selective pallet racking with stacked pallets and on material handling activities using hand lifts and forklifts. This condition poses many risks. The risks that may arise can interfere with the activities of the operator and can create unwanted risks to the company.

So far, because the company has not provided information about the risks that may occur in the operational process, risk management is carried out without any preparation. So that it can disrupt the production process when the risk occurs. Therefore, it is necessary to carry out a risk assessment analysis for the company so that losses do not occur in the future, the company can understand the risks that will occur, the causes of the risks, the impact of these risks, and solutions to reduce waste in the logistics department.

The problem in this study is related to the conditions of the work environment that are not paid attention to by the warehouse operator and cause waste in the logistics department. Many studies discuss risk management, but this research focuses on risk management-based waste control to control it. The aim is to analyze the risks that occur in the logistics department at CV. Roda Lintas Khatulistiwa and determine solutions for risks that may occur in the CV packaging section. The Equator Wheel.

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II. METHOD

The research conducted is descriptive quantitative research using FMEA and FTA methods to perform data processing. The sample used in the study were employees in a warehouse, totaling 12 people. The sampling method used is purpose sampling where respondents are taken based on what is the purpose of the study. The instruments used in this study were interview guides, observation guides, and questions on the questionnaire.

The data collected in this research are: 1). Interviews were conducted with the risk owner, to find out the risks that may occur in the production process that may occur. 2). Observation, field observations to get actual data. 3). Questionnaire, get data that is relevant to the research objectives.

The data obtained is used to identify process failure problems using a combination of two methods, namely Failure Mode and Effect Analysis (FMEA) and Fault Tree Analysis (FTA).

A. Failure Mode and Effect Analysis (FMEA)

At this stage, measurements are made of all process activities in the warehouse. The stages of the work carried out include:

1. Identifying the risk of failure in the Warehouse
2. Identify the cause of failure.
3. Determine the severity, occurrence, detection, and RPN values on the risk of failure

Table 1. Sub Identification of the Risk of Failure in the Warehouse

Failure	Risk	Risk Code
Inventory Management	The number of goods from the supplier does not match	R01
	Defective goods from supplier	R02
	Coming goods piled up in the area	R03
	Delay in goods from suppliers	R04
	The number of inventory items does not match the system	R05
Warehouse Supervision	Dirty environment	R06
	Low light intensity	R07
	Poor air circulation	R08
	The tool is out of place	R09
	Garbage piled up	R10
Goods Flow	No description of the item	R11
	Production of goods is not accompanied by evidence of documents	R12
	Lack of storage space	R13
	Damage to goods due to the value of goods	R14
	Demand for goods does not match inventory	R15
Technology Development	Broken computer software system	R16
	Damage to hardware	R17
	Missing files in the database	R18
	Broken network connection	R19
	Error entering data in a database	R20
HR Management	Limited employee skills	R21
	Less meticulous employees	R22
	Lack of employees	R23
	Low employee performance	R24
	Employees do not work discipline	R25

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B. Fault Tree Analysis (FTA)

The steps involved in making an FTA are:

a. Identify the root cause of failure in the warehouse, and create a table that classifies the causes of failure.
b. Making a Fault Tree, defining the problems that cause product failure, then making a Fault Tree, which is a simple analysis that can be described as an analytical technique.

III. RESULTS AND DISCUSSION

This risk assessment is carried out by the risk owner in each division in the production section. The risk owner will provide an assessment of the level of frequency (occurrence), the level of severity (severity), and the level of detection (detection) for each risk. Next, a Failure Mode and Effect Table will be made to calculate the value of the risk level and risk priority number (RPN).

A. Risk Analysiswith Failure Mode Effect and Analysis (FMEA) method

FMEA analysis is done by making a Failure Mode and Effect Table to find out the causes and effects of each risk. Table 2 calculation results based on calculations from the observations of researchers and the assessment of the head of the Logistics Department.

The calculation results based on table 2 provide several Risk Priority Numbers (RPN). The overall results of the Risk Priority Number (RPN) can be seen in table 2.

Table 2. Result of Calculation of Risk Priority Number (RPN)

Failure	Risk	Risk Code	Average value			RPN
			S	***O***	***D***	
Inventory Management	The number of goods from the supplier does not match	R01	2.67	1.00	3.67	9.78
	Defective goods from supplier	R02	3.33	1.33	3.00	13.33
	Coming goods piled up in the area	R03	3.33	2.67	3.00	26.67
	Delay in goods from suppliers	R04	3.67	2.67	3.33	32.59
	The number of inventory items does not match the system	R05	3.67	1.33	2.00	9.78
Warehouse Supervision	Dirty environment	R06	3.00	3.67	1.67	18.33
	Low light intensity	R07	3.67	1.00	1.33	4.89
	Poor air circulation	R08	4.33	1.00	2.33	10.11
	The tool is out of place	R09	2.33	4.67	2.00	21.78
	Garbage piled up	R10	3.67	5.00	1.33	24.44
Goods Flow	No description of the item	R11	2.33	3.33	2.67	20.74
	Production of goods is not accompanied by evidence of documents	R12	5.00	1.00	1.33	6.67
	Lack of storage space	R13	3.33	3.67	2.33	28.52
	Damage to goods due to the value of goods	R14	4.00	2.00	1.67	13.33
	Demand for goods does not match inventory	R15	3.33	2.33	1.67	12.96
Technology Development	Broken computer software system	R16	3.33	1.67	1.33	7.41
	Damage to hardware	R17	3.67	1.00	1.33	4.89
	Missing files in a database	R18	4.67	1.67	1.33	10.37
	Broken network connection	R19	3.33	3.67	3.33	40.74
	Error entering data in a database	R20	2.67	3.00	1.67	13.33
HR Management	Limited employee skills	R21	3.33	1.00	1.67	5.56
	Less meticulous employees	R22	4.33	3.33	2.00	28.89
	Lack of employees	R23	4.00	2.33	2.00	18.67
	Low employee performance	R24	3.67	1.33	1.33	6.52
	Employees do not work discipline	R25	3.00	1.33	2.00	8.00

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Tabel 3. Total Value of Risk Priority Number (RPN)

NO	Risk Indicator	RPN
1	**Inventory Management**	**92.15**
2	**Warehouse Supervision**	**79.55**
3	**Goods Flow**	**82.22**
4	Technology Development	**76.74**
5	HR Management	**67.62**
	Total RPN	**398.29**
	Critical Value	**79.65**

Table 3. shows the RPN value of all operational risk indicators and the critical value obtained from the total RPN value divided by the number of indicators assessed. Critical risk is not only influenced by the number of failures in it but also by the Severity, Occurrence, and Detection values. It can be seen in the risk indicators of inventory management, warehouse supervision, and the flow of goods, which have risk indicators that are categorized as critical.

B. Critical Risk Analysis With Fault Tree Analysis (FTA)

Critical risk indicators are used as top events and sub-indicators as sub-events and basic events determined through expert opinion.

There are 3 critical risks from the FMEA results which will then be searched for the basic events of each of the top events. The FTA process also involves correspondents from the FMEA questionnaires.

1. FTA Inventory Management Indicator

Sub-indicators of problems in the inventory management process include the number of goods from suppliers not matching, defective goods from suppliers, goods arriving piled up in the area, delays in goods from suppliers, and the number of inventory items not according to the system. Delay in goods from suppliers has a high-risk value which then makes it a top event in the inventory management section.

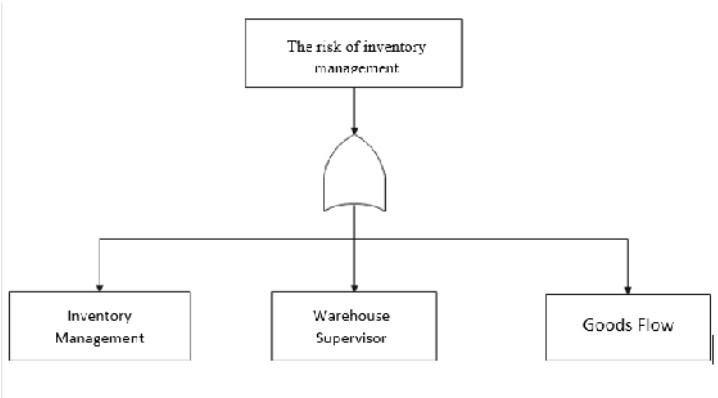

Figure 1. Department Critical Operational Risk

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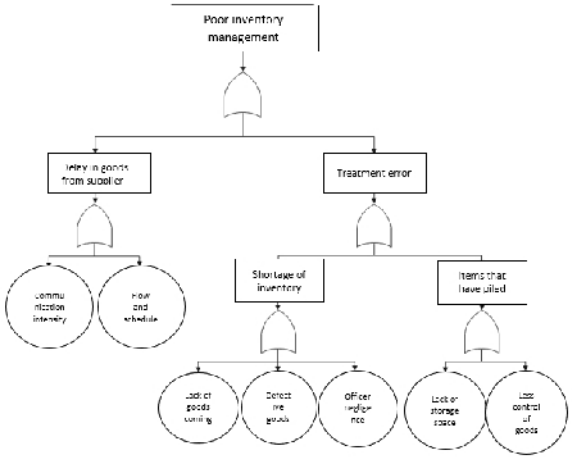

Figure 2. *InventoryFault tree*

The top event of the risk of inventory management indicators has 7 basic events, namely lack of quantity of goods, defective goods from suppliers, negligence of officers in counting goods, not preparing a place for goods to arrive, less control of incoming goods, less intensity of communication with suppliers, and inadequately planned schedule. applied. The solution for the handling is done by solving existing problems by collecting ideas from the heads of departments or experts.

2. FTA Warehouse Supervision Indicators

Sub-indicators of problems in Warehouse Supervision include a Dirty environment, Insufficient light intensity, Poor air circulation, Improper work tools, and Piled up the waste of goods. Garbage that has accumulated has a high-risk value which then makes it a top event in the warehouse supervision section.

Figure 3 shows some basic events from each of the existing top events. In the indicators of inventory management failure, there are 4 basic events, namely work accidents and lost items, disruption of the transfer and storage process, work tools that are not in place, and scattered cardboard waste. So that it can interfere with warehouse operational activities, this needs to be improved byincreasing supervision of employee performance and working environmental conditions.

3. FTA Goods Flow Indicator

Sub-indicators of problems in the flow of goods include: No description of the goods, Release of goods not accompanied by evidence documents, Lack of storage of goods, Damage to goods due to the value of goods, and Demand for goods does not match the inventory. The risk of lack of storage of goods has a high-risk value then makes it a top event in the flow of goods. Figure 3.3 is a Fault tree based on a predetermined flow of goods indicators

Figure 3.4 shows the top event results from the risk of goods flow indicators and 6 basic events from each existing top event. Some basic events from each top event are limited storage space, poor layout, inadequate warehouse service to customers,

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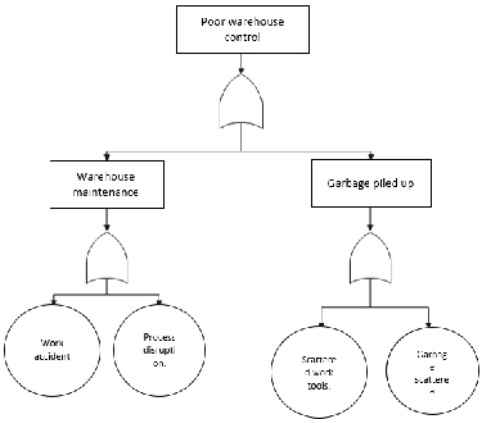

Figure 3. *Warehouse Monitoring Fault tree*

no label on goods, damage to goods, no field inspections. the process of flow of goods plays an important role.

From the basic critical risk events that exist, it is necessary to have a plan to overcome the identified risks and then create a plan at the Logistics Department in overcoming the risks that may occur, it can be concluded for the proposed improvement in table 4 as follows:

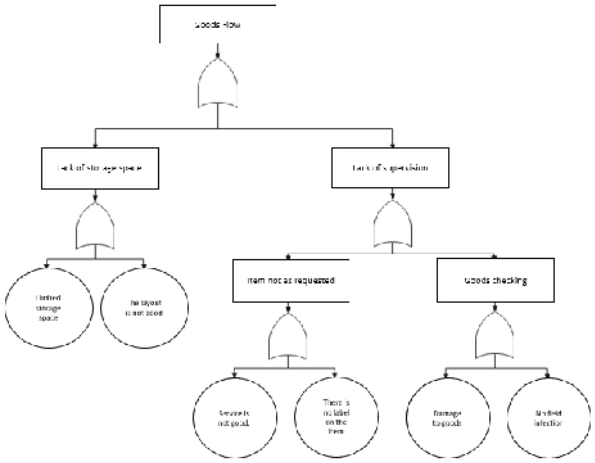

Figure 4 Item Flow Fault tree

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Table 4. Proposed Improvements

No	Failure	Possible Mode	The risk that occurs	Improvement Proposal
1	Inventory Management	Lack of amount of goods coming	The number of goods from the supplier does not match	Increase accuracy when measuring the weight of goods and checking random goods that come
		Product quality is decreasing	Defective goods from supplier	Carry out routine supervision and maintenance on incoming goods and immediately report if there are damaged goods
		Not preparing a place for goods to arrive	Coming goods piled up in the area	Controlling incoming goods by preparing a place for incoming goods and providing a maximum time limit on goods in the transit area
		Planned Flow and Schedule not applied	Delay in goods from suppliers	Increase the intensity of communication with suppliers and always maintain good relations
		The officer's negligence in counting the goods	The number of inventory items does not match the system	Calculating stock of goods periodically and making a schedule of stock-taking at a certain time
2	Warehouse Supervision	Lack of maintenance on warehouse	Dirty environment	Update the area picket schedule by creating a list of area responsibilities that did not previously exist
		The number of lights in the warehouse is less	Low light intensity	Arrangements on the layout so that the light is evenly distributed and replace the lamps with standard room lighting
		Improper air circulation in the warehouse	Poor air circulation	Ventilation settings and layout of raw materials because with an irregular layout will make the incoming air not optimal
		Limited tool storage space	The tool is out of place	Added space for tool storage and a dividing line for workers to place tools in an orderly manner
		Garbage leftover cardboard scattered	Garbage piled up	Require workers to clean the area according to a predetermined picket schedule and provide sanctions if they don't

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3	Goods Flow	No label on the item	No description of the item	Checking for items that don't have an article when the item arrives and sticking the barcode on the item before the packaging process
		The head of logistics does not know in writing	Production of goods is not accompanied by evidence of documents	Checking travel documents on each item to be issued more carefully
		Limited storage space	Lack of storage space	Arrangement of goods layout and addition of necessary goods shelves
		Release a new product while the old one is still stored in the warehouse	Damage to goods due to the value of goods	Making maintenance schedules on goods and prioritizing old stock
		Lack of synchronization of data on processed goods	Demand for goods does not match inventory	Correction of stock data of goods in and out of the warehouse based on actual conditions in the warehouse

IV. CONCLUSION

Based on the results of risk identification using the Failure Mode Effect and Analysis (FMEA) method, obtained 5 indicators of operational failure with 25 risks for the entire process failure with the largest RPN value, namely the damaged network

connection with a value of 40.74 while the smallest RPN value is the risk of light intensity that less with a value of 4.89 and the risk of damage to hardware with a value of 4.89. In risk analysis with (FMEA), the greatest risk does not become a critical risk because at that risk it has a high detection or control failure so it does not become a critical risk.

The root causes of each critical risk indicator include:

a. Inventory management the root of the problem is the intensity of communication with suppliers that are lacking, the planned flow and schedule are not applied, the lack of the number of goods arriving, defective goods from suppliers, negligence of officers counting goods, not preparing a place for goods to arrive, less control of incoming goods.
b. The root cause of warehouse supervision is work accidents and lost items, disruption of the transfer and storage process, work tools that are not in their place, and cardboard leftovers scattered.
c. The flow of goods at the root of the problem is limited storage space, poor layout, inadequate warehouse service to customers, no labels on goods, damage to goods, and no field inspections.

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Quality Control Analysis of Fireproof Stone with New Seven Tools Method at PT. Loca Refractories Wira Jatim

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***Abstract*— PT. Loka Refractories WiraJatim is a manufacturing company that produces refractory stones. In carrying out the production process, defective products are often found. In this study, an analysis of the quality control of refractory stone will be carried out using the New Seven Tools method. The purpose of this study was to determine the quality of the refractory stone, the factors that cause disability, and the impact. In addition, suggestions for improvements will be given to improve the quality of the refractory stone produced. The results showed that the most common types of defects were 50% in April 2021, while the types of defects that occurred the least were > 1 type of defects as much as 2% in October 2020. The factors causing the formation of defective products include human errors, old machines, undeveloped work methods, and poor quality raw materials. Improvement activities that can be carried out are improving operator performance, improving machine performance, making work methods, and tightening control of raw materials or QC.**

***Keywords*: Defective Products, Refractory Stone, Quality Control, New Seven Tools**

I. INTRODUCTION

Along with the rapid development of the industry, every company is competing to be able to survive in the market competition. Many industries are trying to maintain and increase the purchasing power of their consumers by increasing their production results in quality, a quantity of production, price, and consumer satisfaction. To achieve customer satisfaction, companies must pay attention to the quality of their products. Providing quality products will lead to trust from consumers to produce a good business relationship. Quality is a factor that greatly determines the success of a product in market competition, apart from related factors such as price and service. A quality product will have an important value in the hearts of consumers so that it becomes one of the benchmarks for the company's success. Quality is not only the responsibility of the production department but is the concern of all parties in the company (Devani, 2021).

PT. Loka Refractories WiraJatim is a company engaged in the production of refractory stone and cement. Especially for refractory stone products that are produced in several forms including blocks, cylinders with a hole in the middle, and half cylinders. Of all the products produced by PT. Loka Refractories WiraJatim, the largest percentage of defects is in refractory stone with the shape of a beam with an average percentage of defects from August 2020 to July 2021 is 2.03%. While the tolerance for defects in each production of refractory stone is 2%.

In this research, the method used is New Seven Tools. New Seven Tools is a tool to map problems in detail to assist decision-making and facilitate work coordination (Handika, 2017). This method is proven to be able to map the causes and effects of product defects which can then be proposed for repair activities. Previous studies that have applied this method are Aziza and Setiaji (2020) who use the new seven tools method to control the quality of furniture products, and Zakariya et al., (2020) who use the new seven tools method to control the quality of bottled drinking water products.

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II. METHODOLOGY

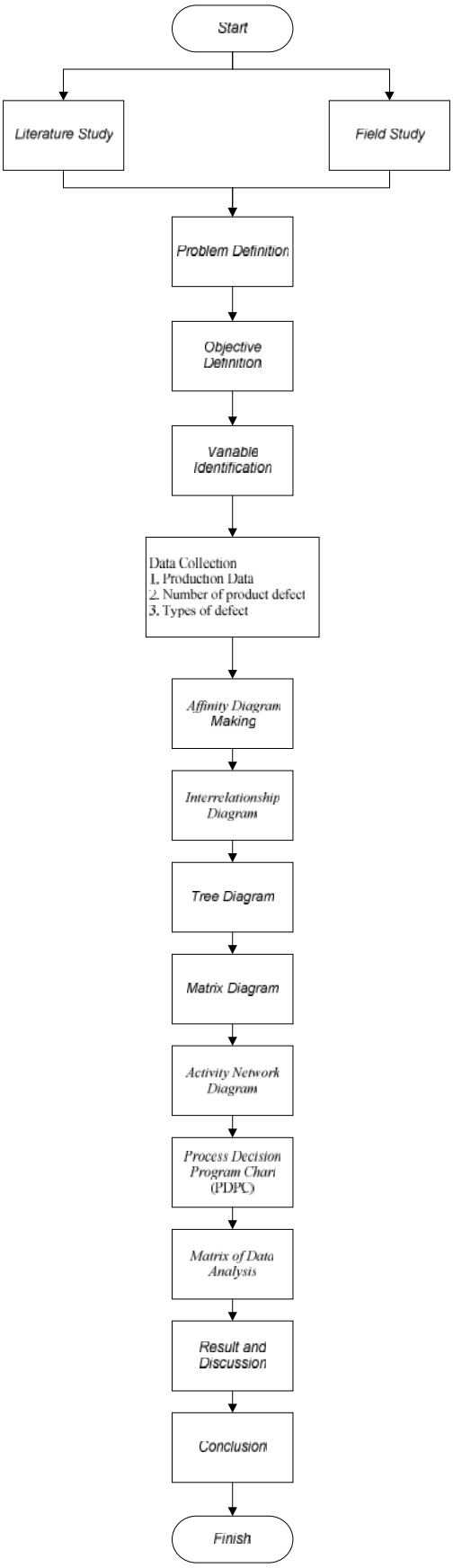

Figure 1. Research Methodology

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III. RESULT AND DISCUSSION

The following are the results obtained using the New Seven Tools method

A. Affinity diagram

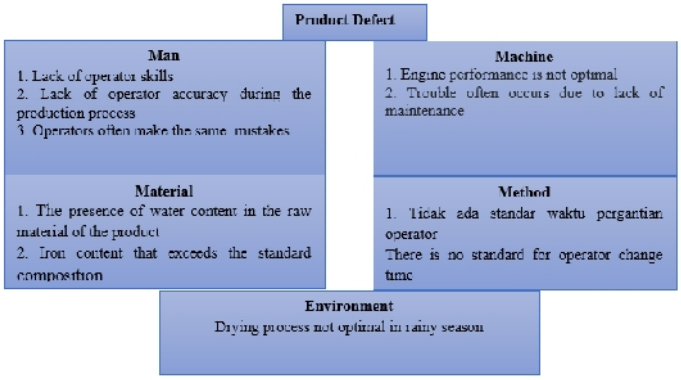

Figure 2. Affinity Diagram

Based on the affinity diagram in Figure 2 above, the factors that cause defects are humans, machines, materials, methods, and the environment. And in each factor has problems that can cause disability. The occurrence of defects is caused by human factors, namely lack of operator skills, operators often make the same mistakes, and lack of operator accuracy during the production process. On the machine factor, namely the age of the machine that is old, problems often occur due to lack of maintenance. On the material factor, namely the presence of water in the raw material of the product, iron content that exceeds the standard composition. In the method factor, namely the printing of certain shapes is still manual, there is no standard time for changing workers. And on environmental factors, namely the rainy season inhibits the dryer process so that it takes time to dry the products.

B. *Interrelationship Diagram*

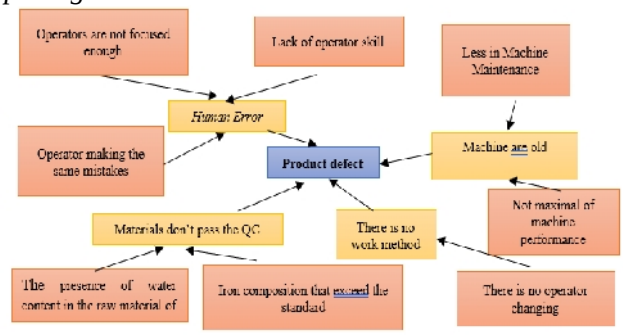

Figure 3. Interrelationship Diagram

Based on the interrelationship diagram in Figure 3 above, shows that the lack of operator skills, lack of operator accuracy during the production process, and operators often making the same mistakes are the result of human error. Then there are often problems due to lack of maintenance, not optimal engine performance is a result of the old age of the engine. Then there is no standard operator change time is the result of no working method. And the presence of water content in the raw material of the product, the iron content that exceeds the standard composition is the result of the raw material not passing QC.

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C. Tree Diagram

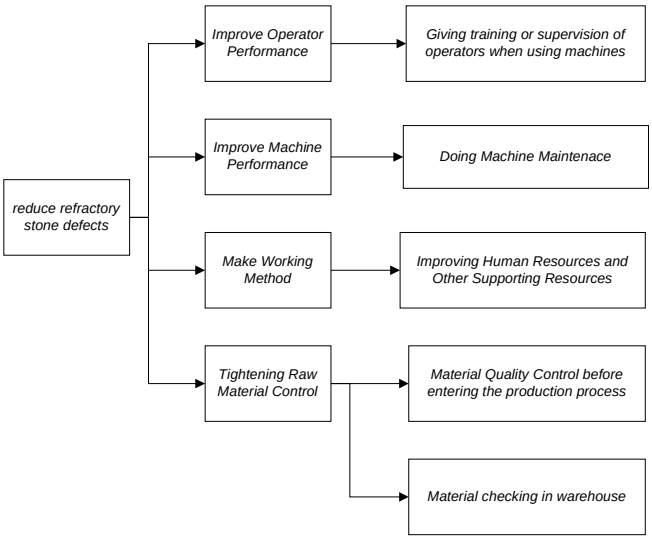

Figure 4. Tree Diagram

Based on the tree diagram or tree diagram above, it can be analyzed that to reduce refractory stone defects, can be minimized by:

1. Improve operator performance by training or supervising operators in using the machine.
2. Improve engine performance by checking and maintaining the engine.
3. Determine work methods by improving human resources and other supporting resources.
4. Tighten Raw Material Control or QC by checking the raw materials to be used, and checking the material in the storage.

D. Matrix Diagram

Human Error Old Machine	■ ●	● ■	▲ ●	▲ ●
There is no working method	▲	●	■	▲
Materials didn't pass QC	▲	●	▲	■
Cause / **Repair Activities** / **Specific Activity**	Improve Operator performance	Improve Machine performance	Making Working method	Tightening Raw Material Control
Giving training or supervision of operators when using machines	■	■	▲	●
Doing Machine Maintenace	■	■	▲	●
Improving Human Resources and Other Supporting Resources	■	■	■	■
Material Quality Control before entering the production process	▲	●	▲	■
Material checking in warehouse	▲	●	▲	■

Figure 5. Matrix Diagram

Based on the matrix diagram in Figure 5 above, the analysis can be carried out below:

1. Causes, repair activities, and specific activities that are closely related are human errors by improving operator performance, namely conducting training or supervision of operators in using machines, checking and maintaining machines, and improving human resources and

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other supporting resources. Then the age of the old machine by increasing the performance of the machine, namely conducting training or supervision of the operator in using the machine, checking and maintaining the machine, and improving human resources and other supporting resources. Then there is no working method by setting a work method, namely improving human resources and other supporting resources. And raw materials do not pass QC by tightening supervision of raw materials or QC, namely improving human resources and other supporting resources, checking raw materials to be used, and checking material storage so that it has a red square symbol.

symbol.

3. Causes, repair activities, and unrelated specific activities, namely human error by increasing machine performance. Then the age of the machine is old by improving operator performance, determining work methods, and tightening supervision of raw materials or QC, namely conducting training or supervision of

2. The causes, repair activities, and related specific activities are human error by establishing work methods and tightening supervision of raw materials or QC, namely conducting training or supervision of operators in using machines, checking and maintaining machines. Then there is no working method for improving operator performance, and tightening control of raw materials or QC, namely checking raw materials to be used, and checking material storage. And the raw materials do not pass QC by improving operator performance and establishing work methods, namely checking the raw materials to be used, and checking material storage so that they have a green triangle

operators in using machines, checking and maintaining machines. Then there is no working method for increasing engine performance. And the raw materials do not pass QC by increasing the machine's performance by checking the raw materials to be used, and checking the storage of materials so that they have a yellow circle symbol.

E. Activity Network Diagram

Table 1
Production Process and Duration

Types of process	Process code	Predecessor	Duration (Hour)
Material inspection	A	-	24
Material sorting	B	A	3
Milling process	C	B	4
Mixing	D	C	3
Making products using die	E	D	2
Dryer	F	E	7
Heating	G	F	36
Packaging	H	G	24

Based on the production information in Table 1 above activity network diagram can be made below in Figure 6.

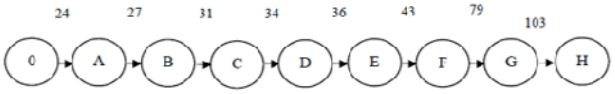

Figure 6. Activity network diagram

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F.*Process Decision Program Chart* (PDPC)

Figure 7 below is PDPC for a porous defect.

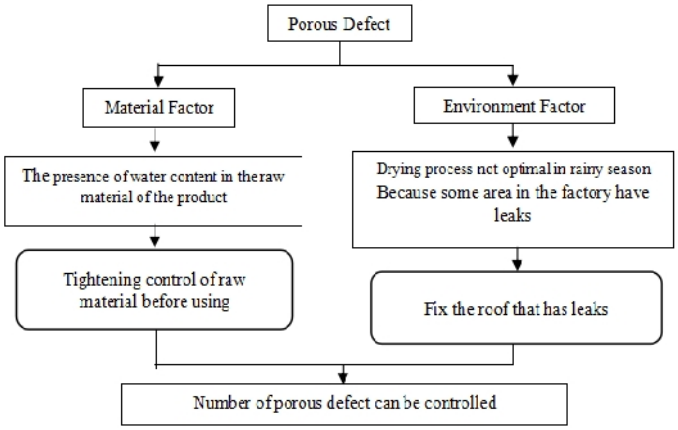

Figure 7. PDPC for Porous defect

G. Matrix Data Analysis
Table 2 below is a matrix data analysis obtained from this research.

Table 1
Production Process and Duration

Primary	***Secondary***	***Importance***	**PT. Loka**
Improve operator performance	Gicing training or supervision when operator is using machine	4	3
Improve machine performance	Doing Maintenance	4	2
Making work method	Improving human resource and other supporting resource	3	2
Tightening raw material control	1. Material quality control before entering the production process	4	3
	2. Material checking in WH	4	3

Explanation: 1 Un done; 2 Rarely; 3 Done; 4 Often

Based on the matrix data analysis, at PT. The WiraJatim Refractories Workshop improves operator performance by training or supervising operators in using the machine. Then to improve engine performance, checking and engine maintenance are still rarely carried out. Then determining work methods by improving human resources and other supporting resources is still rarely done. And tightening raw material supervision or QC by checking the raw materials to be used is still being carried out, and checking material storage is still rarely done.

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IV. CONCLUSION

Based on the graph obtained from data on the number of types of product defects for the period August 2020 to July 2021, it is known that the type of defect that occurs the most is gopil as much as 50% in April 2021, while the type of defect that occurs the least is >1 type of defect as much as 2 % in October 2020.

The factors that cause disability include human error, the old machine age, no working method, and raw materials that do not pass QC. Then the improvement activities that can be carried out are increasing operator performance, improving machine performance, determining work methods, and tightening control of raw materials or QC so that specific activities can be carried out, namely by training or supervising operators in using machines, checking and maintaining machines, improving human resources and other supporting resources, checking raw materials to be used, and checking material storage.

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Optimization of PT. Ciomas Adisatwa Distribution Routes to Minimize The Distribution Cost

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***Abstract*—Optimal distribution means that the process of sending goods from the company to agents has a basis for scheduling and determining routes appropriately, and products received by consumers are in a good and fresh condition by the specified time with low operating costs. PT CiomasAdisatwa is one of the Japfa group companies that produce processed chicken products that are fresh, hygienic, and of good quality but have a problem with the route that is passed in the distribution process. Based on the knowledge of the driver and assistant the distance traveled is uncertain which results in a longer delivery time. The distribution costs become expensive and erratic. The purpose of this study is to determine the optimal distance from each branch outlet and provide suggestions for route improvements to get a lower cost using the dynamic programming method. The Dynamic Program method provides distance savings of 1.0261 Km and costs savings of Rp. 1,426,433, with a percentage of cost savings of 4.7%, so that the Dynamic Program can be used for company distribution.**

Keywords*: *Dynamic Programming, Distribution, Short delivery time, Cost Minimization

I. INTRODUCTION

According to Yapanto and Musa (2018), distribution is a process of delivering goods or services from producers to consumers and users, whenever and wherever the goods or services are needed. While The distribution channel is an intermediary party between producers and consumers (Rao et al., 2021).Every big company usually has its distribution center (DC).

Distribution and transportation management generally perform some basic functions, namely segmenting and determining service level targets, determining the mode of transportation to be used, consolidating information and delivery, scheduling and determining delivery routes (Tsang et al., 2018), providing value-added services, store inventory, and handle returns (Grabińska et al., 2019). Some problems that occur due to inappropriate scheduling and route determination, namely delay (Cao et. Al., 2020) and waiting times (Smith et al., 2019) usually appear because of the estimated service time from the vehicle departing until the unloading of cargo at the consumer is not appropriate. Delays in the consumer will affect the service time to the next consumer if there is more than one consumer in a shipping route that is passed by a carrier vehicle.

Based on Dua et al. (2019), transportation is defined as the transfer of goods and resources from the place of origin to the destination. In the physical distribution process, a transportation process is needed to move one commodity from one place to another in a supply chain. Two parties involved in the transportation process in the supply chain are the shipper and the carrier. Routing and scheduling in distribution are seen as relatively complicated problems. This is due to many constraining factors that can arise and must be considered so that it causes different types of problems for each case. These types of problems can be categorized into 4 things, namely: (1) Strategy problems Refer to the long-term aspects of routing and scheduling, such as whether or not it is necessary to send a product in a fixed quantity regularly to some customers. This applies to the examples of the distribution of bread and grocery stores. Its main characteristic is that there is a fixed number of regular requests sent to the same location. So, vehicle scheduling can be done on a historical basis. (2) Operational problems This problem concerns the routes that must be arranged every day or every week. Generally, this problem occurs in the gift delivery company. An important factor to consider is the unpredictable number of requests and location changes. (3) Interactive Delivery

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operations are currently being planned on an interactive basis to allow a dispatcher to use a computer or digital device to determine the most effective route. In this interactive basis, actual demand data is used more than historical demand data, or it can be said as real-time data. This data becomes a reference for determining the route, and one of the advantages of this method is that the route can be changed as soon as possible if needed. The disadvantage of this method is the high cost of providing this kind of technology. (4) Planning To determine the route and delivery scheduling, route and schedule planning is carried out which is then simulated with a computer, then analyzed as a result of changes in demand or the addition of vehicles, the addition of vehicles with a larger capacity, or the possibility of policy changes.

PT CiomasAdisatwa, which is located at Jalan Tarik Km 2, is one of the Japfa group companies that produce fresh, hygienic, and quality processed chicken products to provide solutions to the needs of entrepreneurs, modern food providers, and household needs in East Java. To serve all consumers to remain loyal during intense trade competition, it is necessary to schedule and determine the right route so that the products received by consumers are in good condition and of good quality, and on time with low operating costs. The problem with this company is that the path taken in the distribution process is based on the knowledge of the driver and assistant so that the distance traveled is uncertain which results in long delivery times and results in the use of fuel that exceeds what it should be so that the costs incurred by the company increase and distribution costs become expensive and erratic

Dynamic Programming is a technique of solving a problem by decomposing or decomposing the solution into a set of stages so that the solution obtained is a series of interrelated decisions in which the decision-making determination maximizes its entire effectiveness (Liu et al., 2020). This method has been widely used in previous research on the same problem, such as Fachini et al. (2020), Lera-Romero et al. (2020), Şenaras et al. (2021), and Şahin et al. (2021) that use dynamic programming to solve the transportation problem. From those researches, the transportation problem at PT.CiomasAdisatwawould be solved using a dynamic program along with WinQsb software.

II. RESEARCH METHODOLOGY

A. Data Collection

Data collection is an activity carried out in research to collect information. This data will be input at the data processing stage. The data collection method used is secondary data using data that has been obtained from existing sources. The software used in this data processing is WinQsb software.

The data needed in this study are as follows:

1. Transportation cost data from the origin node to destination node
2. Maximum capacity data of conveyance
3. Distribution route data of PT. CiomasAdisatwa

B. Data Processing

The method used in this study is the Stagecoach Problem, which is a method to obtain optimal results from a mathematical model that compiles transportation costs. The data that has been collected will then be processed to determine the minimum transportation costs for instant noodle products that the company must spend to meet demand. Figure 1 below is a flowchart in this study.

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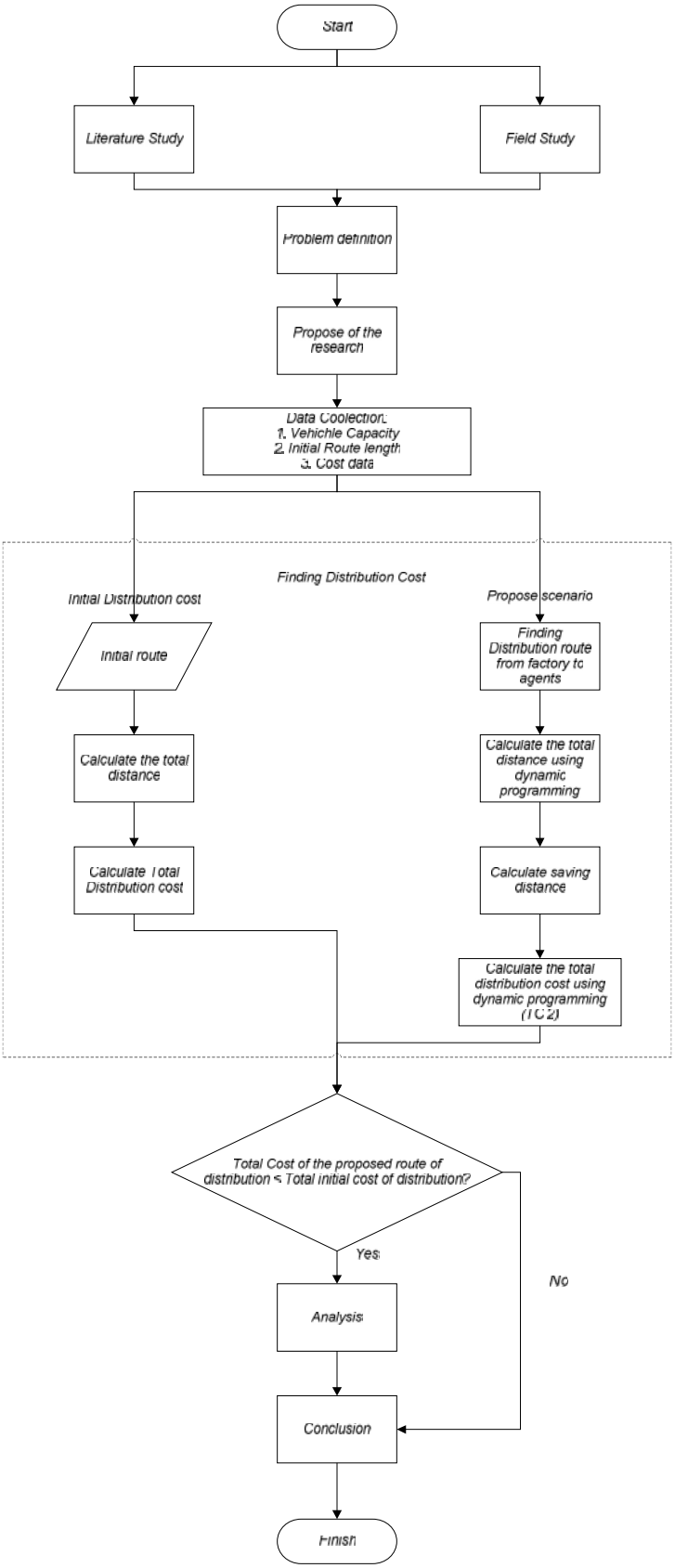

Figure 1. Research Methodology

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III. RESULT AND DISCUSSION

The type ofvehicle used todistribute the Chicken is a cooler box car with a capacity of 2000 kg with a fleet of 23 self-owned trucks.

A. Initial Scenario

The following Table 1 is the costs and routes that have been issued for the distribution of chicken pieces and Table 2 is initial route data from historical data.

Table 1. Distribution Cost from Company to Agents

Month	Agents	Distribution cost (Rp)
Agustus 2020	Mojopahit	2.726.731
	Kludan	2.707.704
	Majapahit	2.707.704
	Let. Suprapto	2.838.300
	Pasuruan	3.118.600
	Manukan	2.852.850
	Mulyosari	3.012.490
	Gresik	2.900.800
	Jombang	3.317.277
	Nganjuk	3.321.787
	Kediri	3.771.713
	Malang	3.786.227
Total		38.062.183

Table 2. Initial Route

Sub Route	Destination	Route	Distance (Km)
I	Sidoarjo, Jl. Raya Kludan No.12	Balongbendo – Tol manyar – Tol Sidoarjo – Pahlawan – Majapahit – Kludan	15 Km
II	Sidoarjo, Jl. Raya Majapahit No.89	Balongbendo – Tol manyar – Tol Sidoarjo - Pahlawan – Majapahit	15 Km
III	Mojokerto, Jl. Mojopahit No.36	Balongbendo – Tol Surabaya Porong – Tol Sumo – Raya Canggu – Raya Mlirip – Gajah Mada – Bhayangkara – Majapahit	17 Km
IV	Sidoarjo, Jl. Letjen Suprapto No. 27 c	Balongbendo – Tol manyar – Tol Juanda – Tol Berbek - Berbek Industri – Raya Berbek – Let.Suprapto	24 Km
V	Surabaya. Jl. Manukan Tama No. A3-26	Balongbendo – Tol manyar – Tol Margomulyo – Kyai Amir – Manukan Tama	25 Km
VI	Gresik, Jl. Kartini No.7	Balongbendo – Tol manyar – Tol Romokalisari – Veteran – Kartini	29 Km
VII	Surabaya. JL. Mulyosari No.69D	Balongbendo Joyoboyo Basuki Rahmat Gub.Suryo Prof Dr Moestopo – Mulyosari	36 Km
VIII	Pasuruan. Jl. Raya Bangil No. 10	Balongbendo – Jl. Raya Tarik – Jl Bulang- Tol Porong- Jl Beji- Sidowayah	44 Km
IX	Jombang, Jl. Brigjen Kretarto	Balongbendo – Tol Jombang – Jl pesantren – Jl. Jogoroto – Jl makam - Jl. Brigjen Kretarto	57 Km
X	Nganjuk, Jl. Bengawan Solo	Balongbendo – Tol Mojokerto – Jl. Bengawan solo – Jl. Ploso - Jl Barito	82 Km
XI	Kediri, Jl. Makmur selatan no. 14	Balongbendo – Tol Mojokerto – Jl Pahlawan – Jl. Kayen – Jl. Mojokarep – Jl. Cisadane – Jl. Makmur	89 Km
XII	Malang, Jl. Veteran No. 2	Balongbendo – Jl. Raya Prambon- Jl Bulang- Tol Pandaan- Jl. A. yani – jl. Soekarno Hatta- Jalan Besar Ijen- Jl. Veteran No. 2	90 Km

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B. Proposed Scenario

Figure 2 below is the proposed scenario obtained by using dynamic programming.

Kludan: Stagecoach-Shortest Route Problem

05-15-2022 17:55:49	Stage	From Input State	To Output State	Distance	Distance to Node10	Status
1	1	Node1	Node2	3	14	Optimal
2	2	Node2	Node4	5	11	Optimal
3	2	Node3	Node6	7	10	
4	3	Node4	Node7	5	6	Optimal
5	3	Node5	Node8	3,10	14,10	
6	3	Node6	Node9	2	3	
7	4	Node7	Node10	1	1	Optimal
8	4	Node8	Node10	11	11	
9	4	Node9	Node10	1	1	
	From Node1	To Node10	Minimum	Distance =	14	CPU = 0

Figure 2. Dynamic program output with WinQsb output Kludan

C. Cost Comparison

Table 3 below is a cost comparison based on those two scenarios.

Table 3
Comparison of the two scenarios

Scenario	Total Distance (Km)	Total Cost (Rp)
Initial	16.213 Km	38.062.183
Proposed	15.600 Km	36.635.750
Gap	592,1 Km	1.426.433

The initial distribution cost of the Mojopahit Outlet company is Rp. 2,726,731 for the cost of the Dynamic Program method of Rp. 2,712,200. The initial distribution cost of the Kludan Outlet company is Rp. 2,707,704 for the cost of the Dynamic Program method of Rp. 2,683,100. The initial distribution cost of the Majapahit Outlet company is Rp. 2,707,704 for the cost of the Dynamic Program method of Rp. 2.650.200. The initial distribution cost of the Pasuruan Outlet company is Rp. 3,118,600 for the Dynamic Program method of Rp. 3.118.600. The initial distribution cost of the Manukan Outlet company is Rp. 2.852.850for the cost of the Dynamic Program method of Rp. 2.819.800. The initial distribution cost of the Mulyosari Outlet company is Rp. 3,012.490for the cost of the Dynamic Program method of Rp. 2.141367. The initial distribution cost of the Kediri company is Rp. 3,771,713, the initial distribution cost of the Gresik Outlet company is Rp. 2.900,800 for the Dynamic Program method fee of Rp. 2,835,800. The initial distribution cost of the Jombang Outlet company is Rp. 3,317,277for the cost of the Dynamic Program method of Rp. 3,263,700. The initial distribution cost of the Nganjuk Outlet company is Rp. 3,321,787. The initial distribution cost of the Malang Outlet company is Rp.3.786.227 for the cost of the Dynamic Program method of Rp.3744.100.

IV. CONCLUSION

Based on the research, it can be concluded that the use of WinQSB optimization program, and can be used properly to overcome the problem of determining operational costs that can be used by companies to determine the distribution route with the lowest cost. Of the 12 distribution routes taken with a total distance of 15,600 Km, resulting in a total distribution cost of Rp. 36,635,750 while the results of the observation that the distribution route taken by the company's method now reaches 16,213 Km and requires a total distribution cost of Rp. 38,062.183. Thus, the Dynamic Program method provides a transportation distance savings of 592.1 Km and a cost savings of Rp. 1,426,433, with a cost-saving percentage of 4.7%, so that dynamic programs can be used for company distribution.

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Raw Material Planning and Control with MRP Method to Maintain Accurate Production Amounts in UKM Allwooden Woodworking

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***Abstract*—Allwooden Woodworking is a Micro and Small Enterprise (MSE) which is an entrepreneurship in the production of furniture, such as tables, chairs, and cupboards. These MSEs focus on the selection of good and quality raw materials. This study aims to find out when raw materials in MSE can be available at the right time with the amount according to the demand of suppliers. The method used in this research is Material Requirement Planning (MRP). The results obtained from this study are in the form of planning and controlling raw materials that contain scheduling material purchases and product manufacture regularly and determining the size of an economical order of raw materials to avoid product overstock.**

***Keywords*: Raw Materials; Entrepreneurship; Material Requirement Planning; MSE**

I. INTRODUCTION

The production process is largely determined by the availability of raw materials. If the company does not have enough raw materials, it will have difficulty meeting consumer needs. Production runs smoothly if the company's management can plan and control the inventory of raw materials properly. According to [1], inventory control is an activity that is a sequence of each other to plan time, quantity, quality, and costs. Inventories are deposits of materials in the form of raw materials, materials in process, and finished goods. From the company's point of view, inventory is an investment capital to store materials under certain conditions [2].

All wooden Woodworking is a Small and Micro Enterprise (SME) that is an entrepreneurship in the production of table furniture, chairs, and cupboards. These SMEs focus on the selection of good and quality raw materials. Due to the high market demand, these SMEs produce furniture in various forms according to the wishes of consumers. Availability of raw materials in SMEs is often a problem due to not doing the planning properly. This happens because these SMEs do the recording and scheduling of production manually. The problem that often arises is the difference in the recording which results in a shortage or excess of the ordered raw materials.
The purpose of this research is to find out when raw materials in Allwooden Woodworking SMEs can be available at the right time with the amount requested to the supplier through the application of the Material Requirement Planning (MRP) Method.

II. LITERATURE REVIEW

Planning is an attempt to set goals. Production planning aims to carry out special planning in the field of production [3]. According to [4], planning has an important meaning for all activities carried out by the company, using methods to achieve these goals.

Control is supervision which at the same time can take some action for the necessary improvement. The control function is to carry out supervision of workers in the company including data collection as useful input to determine follow-up actions in future improvement efforts [4].

Inventory is an activity that includes goods belonging to the company with the intent to sell in a certain period as well as material supplies that are still there [5]. According to [6], inventory is one of the important things for an entity for both manufacturing and services.

Inventory control is an activity from a sequence that is closely related according to what has been planned in terms of time, quantity, quality, or cost [1]. The purpose of inventory control, among others, is so that the company does not run out of raw materials which can result in the cessation of production activities, to

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maintain the availability of raw materials in quantities that are not excessive, and to control ordering costs.

A. Production Planning and Inventory Control (PPIC)

Production Planning and Inventory Control (PPIC) is the process of entering and leaving materials in a working system to meet market demand and proper distribution to minimize production costs. Production planning and control are carried out at the beginning of the process before carrying out production activities, aiming to determine what must be done from beginning to end. Planning and control activities should not stop until the process is complete so that the results are as expected. According to [7], PPIC is the part that has the general task of receiving orders from the marketing department and ensuring that the orders have been completed and delivered to consumers on time.

B. Demand Forecasting

Forecasting is the art and science of predicting future events. To overcome demand forecasting problems, it is necessary to use enhanced data to anticipate potential declines orincrease sales shortly and develop strategies that companies must take to overcome certain conditions [8]. According to [39], forecasting is one of the activities that are considered capable of being used as the basis for making a company's product strategy. Forecasting is a form of business by applies various approaches, both qualitative and quantitative. Forecasting drives decisions so managers need immediate and accurate information about actual demand. Accurate forecast result has several important criteria, namely: The accuracy of a forecasting result is measured by the results of the habit and the consistency of the forecast. [10]

C. Material Requirement Planning

Material Requirement Planning or MRP is a technique or tool for determining the right material requirements by using several input data such as a list of raw material requirements, inventory data, receiving schedules, and master production schedules. Meanwhile, according to [10], MRP is one of the concepts for planning the requirements of the right goods in the production process. The purpose of MRP is to reduce inventory, reduce lead times, deliver on time, and improve production system efficiency. In addition, the purpose of using the MRP method is to find the right way to regulate product requirements in the production process according to needs so that the required products can be fulfilled on time [10]. So, it can be concluded that MRP is a technique for planning and scheduling raw materials used for the production process according to material requirements, inventories, estimated receipts, and production schedules. The use of MRP can provide information about how much and when a required raw material will be ordered. So that it can always be available when needed when production is running.

III. METHODOLOGY

The planning and control of raw materials in this study uses the Material Requirement Planning (MRP) method. In the MRP system, the costs used can be minimized every month to save production costs. With this MRP system, the direct impact that can be felt is to expedite the production process and increase efficiency because at the same time more results will be obtained. In addition, MRP helps to schedule raw material inventory to make it easier to operate and increase product delivery commitments to consumers.

Demand for items is divided into two types, namely independent and dependent requests. Independent demand is the demand for items that are not influenced by market factors. While dependent demand occurs if the demand for the item is influenced by demand for other items (Kusuma, 2017). MRP is a method designed to schedule production into a net requirement of all items. MRP was developed to assist companies in addressing item requirements effectively and efficiently.

IV. RESULT

A. Bill of Material

The planning and control of raw materials in this study uses the Material Requirement Planning (MRP) method. In the MRP system, the costs used can be minimized every month to save production costs. With this MRP system, the direct impact that can be felt is to expedite the production process and increase efficiency because at the same time more results will be obtained. In addition, MRP helps to schedule raw material inventory to make it easier to operate

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and increase product delivery commitments to consumers.

B. Demand Forecasting

Demand forecasting is done by projecting historical data from product demand. Historical data is obtained from recap data or databases from companies. By processing historical data, it is hoped that the pattern of demand for a product can be read and accurately predicted. The methods used in predicting demand patterns include the moving average method, simple exponential smoothing, and holts.Of those three methods, the better method was chosen among the others. The choice of method is done by calculating the forecast error of each method. forecast error that is used as a parameter for choosing the method, among others, is MSE, MAD, and MAPE.

Table 1. Bill of Material

Item	Material	Quantity	Dimensions	Decision
Frame	Slimar Wood	1	680 x 5 x 5 = 17000 cm^3 = 0,017 m^3	Make
Cushion	Pallet	1	5 pcs	Make
Back support	Pallet	1	1 pcs	Make
Sending Sealer	Solvent Based	1	200 ml	Buy
Melamine	Pernis	1	200 ml	Buy
Paint	-	1	250 ml	Buy
Hardener	Epoxy	1	20 ml	Buy
Thinner	-	1	750 ml	Buy
Glue	PVAC	1	100 ml	Buy
Nail Gun	Annular Ring Nail	1	24 pcs	Buy
Putty	Sunpolac	1	100 gr	Buy

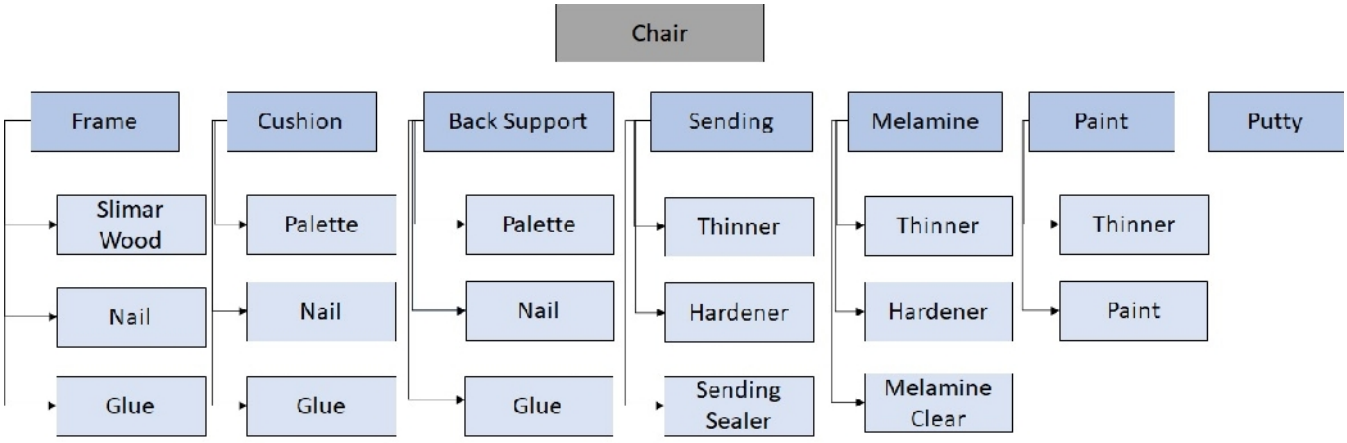

Figure 1. Bill of Material

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Table 2 : Demand Forecast Moving Average

Period (n)	Demand (Dt)	Lt	Ft	Et	$(Et)^2$	At	(Et/Dt)	
1	40							
2	48							
3	40	42.7						
4	44	44.0	43	-1.33	1.78	1.33	-0.03030303	0.030303
5	48	44.0	44	-4	16	4	-0.08333333	0.083333
6	40	44.0	44	4	16	4	0.1	0.1
7	40	42.7	44	4	16	4	0.1	0.1
8	56	45.3	43	-13.3333	177.8	13.33333	-0.23809523	0.238095
9	52	49.3	45	-6.66667	44.44	6.666667	-0.12820512	0.128205
10	42	50.0	49	7.333333	53.78	7.333333	0.17460317	0.174603
11			50					

Table 3: Demand Forecast Simple Exponential Smoothing

Period (n)	Demand (Dt)	Lt	Ft	Et	$(Et)^2$	At	(Et/Dt)	
0		45						
1	40	44.5	45	5	25	5	0.125	0.125
2	48	44.85	44.5	-3.5	12.25	3.5	-0.07292	0.072917
3	40	44.365	44.85	4.85	23.5225	4.85	0.12125	0.12125
4	44	44.3285	44.365	0.365	0.133225	0.365	0.008295	0.008295
5	48	44.69565	44.3285	-3.6715	13.47991	3.6715	-0.07649	0.07649
6	40	44.22609	44.69565	4.69565	22.04913	4.69565	0.117391	0.117391
7	40	43.80348	44.22609	4.226085	17.85979	4.226085	0.105652	0.105652
8	56	45.02313	43.80348	-12.1965	148.7552	12.19652	-0.2178	0.217795
9	52	45.72082	45.02313	-6.97687	48.67673	6.976871	-0.13417	0.134171
10	42	45.34873	45.72082	3.720816	13.84447	3.720816	0.088591	0.088591
11			45.34873					

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Table 4: Demand Forecast Holts

Period (n)	Demand (Dt)	Lt	Tt	Ft	Et	$(Et)^2$	At	(Et/Dt)	
0		41.46667	0.642424						
1	40	41.89818	0.600242	42.10909	2.109091	4.448264	2.109091	0.052727	0.052727
2	48	43.04858	0.710274	42.49842	-5.50158	30.26734	5.501576	-0.11462	0.114616
3	40	43.38297	0.635097	43.75886	3.758856	14.129	3.758856	0.093971	0.093971
4	44	44.01626	0.634735	44.01807	0.018067	0.000326	0.018067	0.000411	0.000411
5	48	44.9859	0.701716	44.651	-3.349	11.21583	3.349004	-0.06977	0.069771
6	40	45.11885	0.587963	45.68761	5.687612	32.34893	5.687612	0.14219	0.14219
7	40	45.13613	0.473827	45.70681	5.706814	32.56773	5.706814	0.14267	0.14267
8	56	46.64896	0.681628	45.60996	-10.39	107.9529	10.39004	-0.18554	0.185536
9	52	47.79753	0.775016	47.33059	-4.66941	21.80338	4.669409	-0.0898	0.089796
10	42	47.91529	0.643565	48.57255	6.572548	43.19839	6.572548	0.156489	0.156489
11				48.55886					
12				49.20242					
13				49.84599					

Table 5 : Forecast Error Comparison

Error	MA	SES	HOLTS
MSE	47	32.46	29.79
MAD	5.81	4.92	4.77
MAPE	12.20	10.68	10.48

Table 6 : Master Production Scheduling

Month	Weekly Needs (Upper Approximation)				TOTAL
	1	2	3	4	
1	13	13	13	13	49
2	13	13	13	13	50
3	13	13	13	13	50

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Table 7: On Hand Value, Lead Time, Lot Size

Level	Item	On Hand	Lead Time (Period)	Lot Size
0	Chair	0	1	1
1	Frame	0	1	1
2	Slimar Wood (m3)	0.03	1	0.005
2	Nail (pcs)	60	1	30
1	Cushion	0	1	1
2	Palette (pcs)	0	1	1000
2	Nail (pcs)	24	1	30
2	Glue (pcs)	4580	1	5000
1	Back Support	0	1	1
2	Palette (pcs)	310	1	1000
2	Nail (pcs)	24	1	30
2	Glue (pcs)	0	2	5000
1	Sending	0	1	1
2	Thinner (ml)	5000	1	5000
2	Hardener (ml)	5000	1	5000
2	Sending Sealer (ml)	5000	1	5000
1	Melamine	0	1	1
2	Thinner (ml)	3600	1	5000
2	Hardener (ml)	2240	1	5000
2	Sending Sealer (ml)	5000	1	5000
1	Paint	0	1	5000
2	Thinner (ml)	4100	1	5000
2	Paint (ml)	5000	1	5000
1	Putty (gr)	5000	1	5000

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Table 8: Material Purchase Planning

Month	Week	Item	Quantity	Decision
1	0	Slimar Wood	0,055 m^3	Buy
		Nail (540+480+90) (pcs)	1.110 pcs	Buy
		Palette (pcs)	1.000 pcs	Buy
		Thinner (10.000+15.000+15.000) (ml)	40.000 ml	Buy
		Sending Sealer (ml)	5.000 ml	Buy
		Glue (ml)	5.000 ml	Buy
		Melamine Clear (ml)	5.000 ml	Buy
		Paint (ml)	10.000 ml	Buy
	1	Frame (pcs)	49 pcs	Make
		Cushion (pcs)	49 pcs	Make
		Back support (pcs)	49 pcs	Make
		Sending (ml)	5.000 ml	Buy
	2	Melamine (ml)	5.000 ml	Buy
2	0	Chair (pcs)	49 pcs	Make
		Slimar Wood	0,085 m^3	Buy
		Nail (600+510+90) (pcs)	1.200 pcs	Buy
		Thinner (15.000+10.000+15.000) (ml)	40.000 ml	Buy
		Sending Sealer (ml)	10.000 ml	Buy
		Melamine Clear (ml)	10.000 ml	Buy
		Paint (ml)	10.000 ml	Buy
	1	Frame (pcs)	50 pcs	Make
		Cushion (pcs)	50 pcs	Make
		Back Support (pcs)	50 pcs	Make
		Sending (ml)	10.000 ml	Buy
		Melamine (ml)	10.000 ml	Buy

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	2	Putty (gr)	5.000 gr	Buy
3	0	Chair (pcs)	50 pcs	Make
		Slimar wood	0,085 m^3	Buy
		Nail (600+510+120) (pcs)	1.230 pcs	Buy
		Glue (5.000+5.000) (ml)	10.000 ml	Buy
		Thinner (15.000+15.000+15.000) (ml)	45.000 ml	Buy
		Sending Sealer (ml)	10.000 ml	Buy
		Melamine Clear (ml)	10.000 ml	Buy
		Paint (ml)	15.000 ml	Buy
	1	Frame (pcs)	50 pcs	Make
		Cushion (pcs)	50 pcs	Make
		Back support (pcs)	50 pcs	Make
		Sending (ml)	10.000 ml	Buy
		Melamine (ml)	10.000 ml	Buy
		Putty (gr)	5.000 gr	Buy
	2	Chair (pcs)	50 pcs	Make

Table 9: Material Purchase Cost

Month	Week	Item	Quantity	Unit Price (Rp)	Total (Rp)
1	0	Slimar wood	0,055 m^3	15.000	825.000
		Nail	1.110 pcs	550	610.500
		Palette	1.000 pcs	6.000	6.000.000
		Thinner	40.000 ml	75.000	600.000
		Sending Sealer	5.000 ml	330.000	330.000
		Glue	5.000 ml	165.000	165.000
		Melamine Clear	5.000 ml	330.000	330.000
		Paint	10.000 ml	270.000	270.000

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2	0	Slimar wood	0,085 m^3	15.000	1.275.000
		Nail	1.200 pcs	550	660.000
		Thinner	40.000 ml	75.000	600.000
		Sending Sealer	10.000 ml	330.000	660.000
		Melamine Clear	10.000 ml	330.000	660.000
		Paint	10.000 ml	270.000	810.000
	1	Putty	5.000 gr	65.000	65.000
3	0	Slimar wood	0,085 m^3	15.000	1.275.000
		Nail	1.230 pcs	550	676.500
		Glue	10.000 ml	165.000	330.000
		Thinner	45.000 ml	75.000	600.000
		Sending Sealer	10.000 ml	330.000	660.000
		Melamine Clear	10.000 ml	330.000	660.000
		Paint	15.000 ml	270.000	810.000
	1	Putty	5.000 gr	65.000	65.000

C. Forecast Error Comparation

From Table 5, the HOLTS method has the smallest Mean Absolute Deviation (MAD) value of 4.77. This shows that forecasting is done using the HOLTS method to get more accurate results.

D. Master Production Scheduling

Master production scheduling is a component of the production schedule obtained from the disaggregation of product requirements at a certain period. In this research, Master Production Schedule is derived from demand forecasting by leveling needs every week.

From table 6, the weekly needs approximation for production quantity is 13 each week.

E. Material Requirement Planning

In processing the material requirements planning data, it is necessary to make assumptions that are obtained by brainstorming with the owner of the company. The assumptions determined include assumptions about the lead time of material arrival, lot size, and the amount of existing stock owned by the company. Those assumptions are explained in Table 7. The output of the Material Requirement Planning model is material purchase planning, which includes the amount and when the material should be purchased. The materials purchase plan is shown in Table 8.After determining the amount of material to be purchased, then calculate the estimated cost to be incurred in purchasing the material for a

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certain period. The prediction of the material purchase cost is shown in Table 9.

V. CONCLUSION

By applying the Material Requirement Planning (MRP) method through the stages of making a Bill of Materials (BOM), demand forecasting, production planning using the Master Production Schedule (MPS), and scheduling material requirements for chair products, Allwooden Woodworking SMEs can find out when Raw materials in these SMEs can be available at the right time in the amount according to the supplier's request. This is very useful for maintaining the accuracy of the amount of production.

Raw materials at Allwooden Woodworking UKM canbe available at the right time and quantity, namely:

a) In the first month of week zero, it requires the procurement of materials in the form of Slimar Wood (0.055 m3), Nails (1,110 pcs), Pallets (1,000 pcs), Thinner (40,000 ml), Sending Sealer (5,000 ml), Melamine Clear (5,000 ml) , and Paint (10,000 ml).
b) In the first month of the first week, it requires the procurement of materials in the form of Frame (49 pcs), Sitting Mat (49 pcs), Backrest (49 pcs), Sending (5,000 ml), and Melamine (5,000 ml).
c) In the first month of the second week, it requires the procurement of materials in the form of Chairs (49 pcs).
d) In the second month of week zero, it requires the procurement of materials in the form of Slimar Wood (0.085 m3), Nails (1,200 pcs), Thinner (40,000 ml), Sending Sealer (10,000 ml), Melamine Clear (10,000 ml), and Paint (10,000 ml).).
e) In the second month of the first week, it requires the procurement of materials in the form of Frame (50 pcs), Sitting Mat (50 pcs), Backrest (50 pcs), Sending (10,000 ml), Melamine (10,000 ml), and Putty (5,000 gr).
f) In the second month of the second week, it requires the procurement of materials in the form of Chairs (50 pcs).
g) In the third month of week zero, it requires the procurement of materials in the form of: Slimar Wood (0.085 m3), Nails (1,230 pcs), Glue (10,000 ml), Thinner (45,000 ml), Sending Sealer (10,000 ml), and Melamine Clear (10,000 ml).).
h) In the third month of the first week, it requires the procurement of materials in the form of Frame (50 pcs), Sitting Mat (50 pcs), Backrest (50 pcs), Melamine (10,000 ml), and Putty (5,000 gr).
i) In the third month of the second week, it requires the procurement of materials in the form of Chairs (50 pcs).

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Implementation Of Business Strategies With SWOT For Food Traders At Bungkul Park, Surabaya

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***Abstract*—Small and Medium Enterprises (SMEs) are a group of one of the largest economic actors in the Indonesian economy and have proven to be a safeguard for the national economy in times of crisis and also create sizable job opportunities for domestic workers, thus greatly assisting efforts to reduce unemployment caused by difficulties looking for jobs. This research is classified into qualitative research. Respondents were taken using the purposive sampling technique. The method used is an analysis using SWOT (Strengths, Weaknesses, Opportunities, and Threats). The results of research with SWOT analysis show that in managing finances, they still use traditional records, in products they still use recipes for the taste and quality of food and beverages, in promotions they are passive in waiting for consumers, strategic locations, and neatly arranged.**

***Keywords* : Marketing, SMEs, Purposive sampling, SWOT analysis.**

I. INTRODUCTION

Small and Medium Enterprises (SMEs) is an organization aiming for a profit with minimal capital affordability and minimum skill (Khalique et al., 2020). Some characteristics of SMEs: First, most SMEs produce consumer goods, especially non-durable consumer goods. This group of goods is characterized if there is an increase in people's income, the demand for these goods does not increase much, and vice versa if people's income declines as a result of the crisis, the demand does not decrease much. Second, the majority of small businesses rely more on non-banking financing in terms of business funding. When the banking sector fell due to the crisis, core small businesses were not affected. Third, generally, small businesses carry out strict specialization, namely producing only certain goods or services (as opposed to conglomeration). SMEs tend to be flexible in owning and changing businesses (Phaphoom et al., 2018). Fourth, is the formation of new informal small businesses due to the many layoffs in times of crisis (Widyanti, 2021) and (Saarenketo et al., 2022). In addition, the resilience of SMEs is created because they do not have much dependence on external factors such as debt in foreign currencies and imported raw materials in carrying out their business activities after all SMEs generally use raw materials from local natural sources (Ratna, 2019).

Speaking of the trade sector, we cannot be separated from the community of traders as the perpetrators, one of whom is then better known as Street Vendors (PKL), namely by selling on the sidewalks or other public places. Street vendors are included in the SMEs sector but the majority of their businesses are not legally registered (Kriastianto et al., 2021).

The development of street vendors from time to time is very rapid in number because street vendors can be more easily found by consumers than official traders who are mostly permanent. So that consumers are facilitated to meet the needs for retail goods. Street vendors (PKL) always take advantage of places that are always considered profitable (nomaden) (Vegantara, 2021), for example, the city center, squares, crowded places to places that have the potential to become tourist attractions. They just think that what they are doing is to make a living regardless of other things. Behind the presence of these street vendors, it turns out that they can provide positive benefits and less profitable benefits. Positive benefits may be felt by people of low economic class because they can obtain goods at affordable prices. From the description above, it can be seen that the informal sector of street vendors has a major role in improving the

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economy, especially for the economically weak and this sector also absorbs workers who have relatively minimal expertise.

SWOT analysis can help business people so that in carrying out their business activities they can run according to the business plan and achieve their goals. Business people must dare to admit what are the strengths, weaknesses, opportunities, and threats that exist in their business activities to carry out strategies that are right on target in running their business which include production strategies, financial strategies, strategic MSDM, and marketing strategy.

In this study, swot analysis was used to generate the best marketing strategy. This method has been widely used before includingPaes et al. (2019) that used this method to analyze organic solid waste management, Wang and Wang (2020) that used that method to analyze China's strategy for Covid-19, Agyekum et al. (2020) that used the same method on Ghana's nuclear Agenda, and also Palomares et al. (2021) that used SWOT to obtain artificial intelligence in panoramic view to achieving sustainable development.

A. Purposive sampling

the Purposive sampling technique is a sampling technique of data sources with certain considerations (Leiwakabessya et al., 2021). This technique includes based on certain criteria made by researchers based on research objectives. The purposive technique is to determine the criteria, where the criteria must support the research objectives. In total there are 45 existing MSMEs and 7 of them are taken as samples. Indeep interview can be chosen because it produces a more accurate response (Handoko and Jannah, 2020).

B. SWOT Matrix

SWOT matrix is a matrix that describes the strengths, weaknesses, opportunities, and threads that can support the company's strategy Leiber et al. (2018).

C. EFAS and IFAS

IFAS and EFAS matrices are tools used to compile the strategic factors of a company (Devi and Triyuni, 2021).

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II. METHODOLOGY

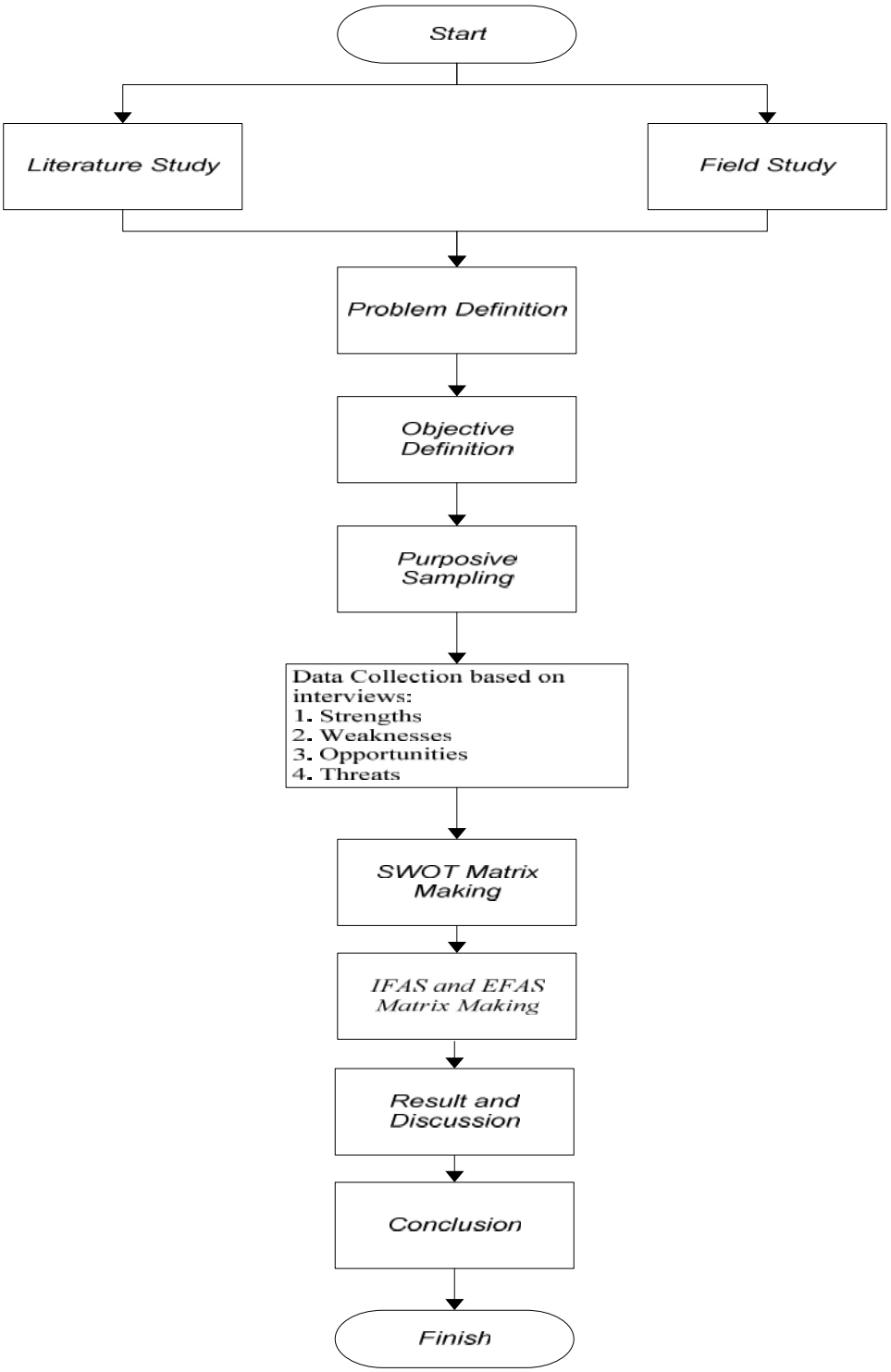

Figure 1: Flowchart methodology

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III. RESULT AND DISCUSSION

The following Table 1 is the results of the IFAS and EFAS Matrix analysis generated from the SMEs that have been surveyed.

Table 1. EFAS and IFAS Matrix

IFAS / EFAS	STRENGTHS - Availability of current capital in sufficient quantities. - -Availability of adequate human resources. - -Offering quite competitive products. - -Government support - The location is quite strategic	WEAKNESSES (W) - -Low quality of human resources. - -Access to the asset location is very congested and chaotic. - -Bound with a fairly long bureaucracy. - - Inappropriate pattern of market asset rejuvenation. - Traders as stakeholders are less cooperative.
OPORTUNE'S (O) - -Demographic factors - -Availability of third parties to utilize Bungkul Park. - -Regional autonomy. - -Economic growth. - A conducive investment climate.	S-O STRATEGY Increased marketing of street vendors in Bungkul Park, including development.	W-O STRATEGY Improving the quality of human resources, both human resources managers and traders.
TREATS - -Changes in people's lifestyles. - - Rules Bungkul park distance. - - The presence of street vendors. - -Changes to the regional layout.	S-T STRATEGY Improvement of facilities and infrastructure in the form of rejuvenation or revitalization of Bungkul Park.	W-T STRATEGY Cooperation in asset utilization with the private sector, both in the form of parking management and waste management.

The description of the four strategies in Table 1 is as follows:

a. S-O (Strength Opportunity) Strategy, a strategy that uses strength to take advantage of opportunities in street vendors in Taman Bungkul Surabaya, is carried out with the following actions:

1. Doing promotions by distributing brochures and word of mouth.
2. Conduct marketing cooperation with other street vendors.
3. Improve a clean, safe, and comfortable Bungkul Park.

b. W-O (Weaknesses-Opportunity) Strategy, a strategy that is carried out by minimizing weaknesses to take advantage of opportunities in street vendors in Taman Bungkul Surabaya, carried out with the following actions:

1. Recruitment of employees based on the needs of street vendors in Taman Bungkul.
2. Improvement of employee welfare.
3. Increasing the merchant cooperative empowerment program.
4. Improve supervision.

c. S-T Strategy (Strength-Threats), a strategy that uses strength to take advantage of long-term opportunities in street vendors in Bungkul Park, is carried out with the following actions:

1. Make physical repairs.
2. Waste management.
3. Arrangement of product display layout in Bungkul Park which is oriented to the convenience of Bungkul Park visitors.
4. Improve and supervise street vendors in Bungkul Park

d. W-T Strategy (Weakness-Threats), a strategy that is carried out by minimizing weaknesses and avoiding threats in street vendors in Bungkul Park, is carried out with the following actions:

1. Cooperation in the management of parking areas.
2. Cooperation in waste management.
3. Regional arrangement cooperation.
4. Environmental management cooperation.

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IV. CONCLUSION

These are the conclusions obtained from this research:

1.In managing finances, some street vendors in Bungkul Park, Surabaya still use traditional (manual) records.

2. Street vendors are still trying to maintain the production process and the recipes they use to maintain the taste and quality of food and beverages.

3. The street vendors are still passive in waiting for consumers and customers to come.

4. In Bungkul Park, Surabaya, the trade is more organized.

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Cash Information System Design Based on Website (Case Study on Café XYZ)

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***Abstract*—All human activities are very easy due to the rapid development of information technology. A Website is a product of information technology. Currently, the use of websites has mushroomed everywhere as a promotional medium for other uses. Cafe XYZ is one of the sellers of various processed coffee drinks in Surabaya. Before the research was conducted, the cafe cashier's transaction process was still carried out conventionally way only by relying on a notebook which was very inefficient. Not only that, but it is also very difficult in the process of managing the data recap, the possibility of the data being lost is very high. The researcher offers a website-based information system design with the Laravel framework supported by a development method, namely SDLC (System Development Life Cycle) which is connected online on the internet so that it can be accessed by anyone and anywhere. With the design of this cashier website, it is hoped that it can help and simplify the transaction process, process product data collection, and also recap transaction data to be more effective and efficient and can save time and costs.**

Keywords*: *Cashier based on a website, SDLC, Information System, Laravel framework

I. INTRODUCTION

Information technology is growing rapidly in this modern era, because of its many benefits. According to (Anwari et al., 2020) the use of information technology is very important which is useful for obtaining all information such as processing daily transactions, supporting managerial operations, and providing the necessary reports. The application of information technology in the industrial world is very broad. Information technology can be used to design process management within an organization (Hadeeba and Yusoff, 2022), in the banking world with the creation of internet banking (Musfira and Aboobucker, 2018), in education such as the creation of a self-education system (Bagrova et al. 2018), to develop countries through geographic information technology (Amade et al., 2018), in the world of marketing (Hosseini et al. 2018) and (Sukaris and Prestyadi, 2020), as well as the manufacture of cashier information systems (Wahdiniwaty and Taliasih, 2020).

One of the most widely adopted uses of technology is the website. The website is easier to use by people in various regions by only using internet access (Hasugian, 2018). The website can also be used in making a cashier information system to make it easier to record buying and selling activities. Efficiency of time, energy, and cost, as well as many other conveniences for its users, are some of the conveniences offered by website creation (Driss et al., 2022).

Cafe Xyz Surabaya is a business that is engaged in food and beverage, with the main focus on coffee. Cafe Xyz has SOPs in handling incoming customers, including serving visitors, making and preparing visitor orders, and cleaning the cafe area. There are 4 employees owned by this cafe, and each employee has their respective duties at work. Cafe Xyz is a new cafe because it has not been around for too long, so there are still many things that need to be addressed. For example, the cashier transaction process is still carried out conventionally, namely by relying on a notebook or paper for recording orders, while

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visitors to this cafe can reach 50 customers every day, making the service less effective and efficient. Not only that but it is also very difficult in the process of managing data recap, both transaction data, and expenditure data and there is a possibility that these data are lost.

Based on the explanation described above, this is the reason for the author to create a website-based management information system, because the SIM can store fairly large information data in a fairly small space and is also easy to access. Making this information system using the System Development Life Cycle (SDLC) waterfall method. According to Ridwan and Benrahmah (2021) SDLC is a general methodology for developing systems. Compared to using the Fountain method which has been said by (Rizqi, 2019) where a stage of the design process can take precedence or skip stages it will result in confusion or inconsistency in designing information systems. Therefore SDLC is well suited for software products/programs with a clear need from the outset to reduce errors. So that it saves time and costs as well as is a solution to the problems that occur to cafe owners. The target of accessing the website are cafe employees and also cafe owners with the media devices that have been provided.

II. RESEARCH METHODOLOGY

The method used in this study is the System Development Life Cycle (SDLC) waterfall method. This method is widely used to develop a system (Wahid, 2020) and (Zenita and Fiati, 2019). Figure 1 below is a flowchart of this study.

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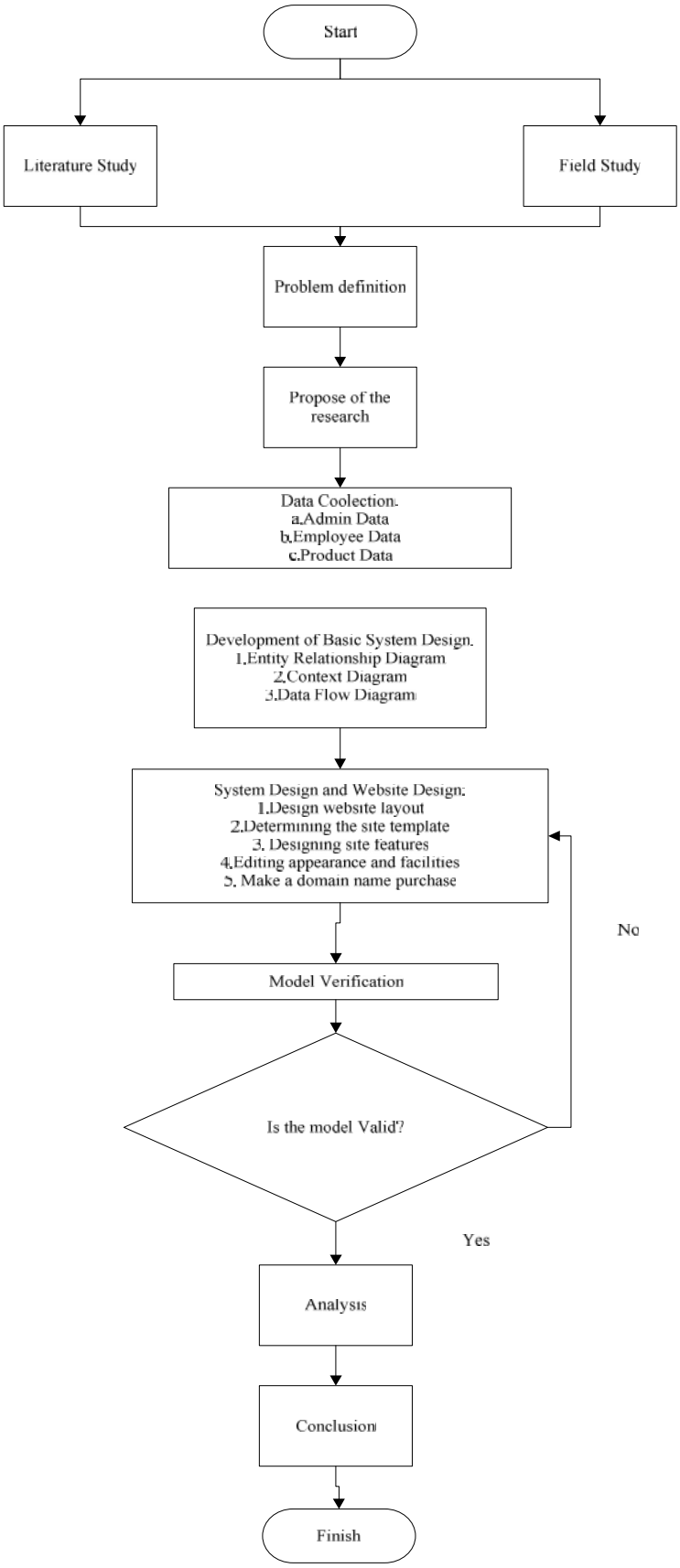

Figure 1. Research Methodology

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III. RESULT AND DISCUSSION

A. Entity Relationship Diagram (ERD)

The entity Relationship Diagram provides information on what entities are interrelated in a system that is built(Banjarnahor et al., 2021).

Figure 2 is ERD for this case.

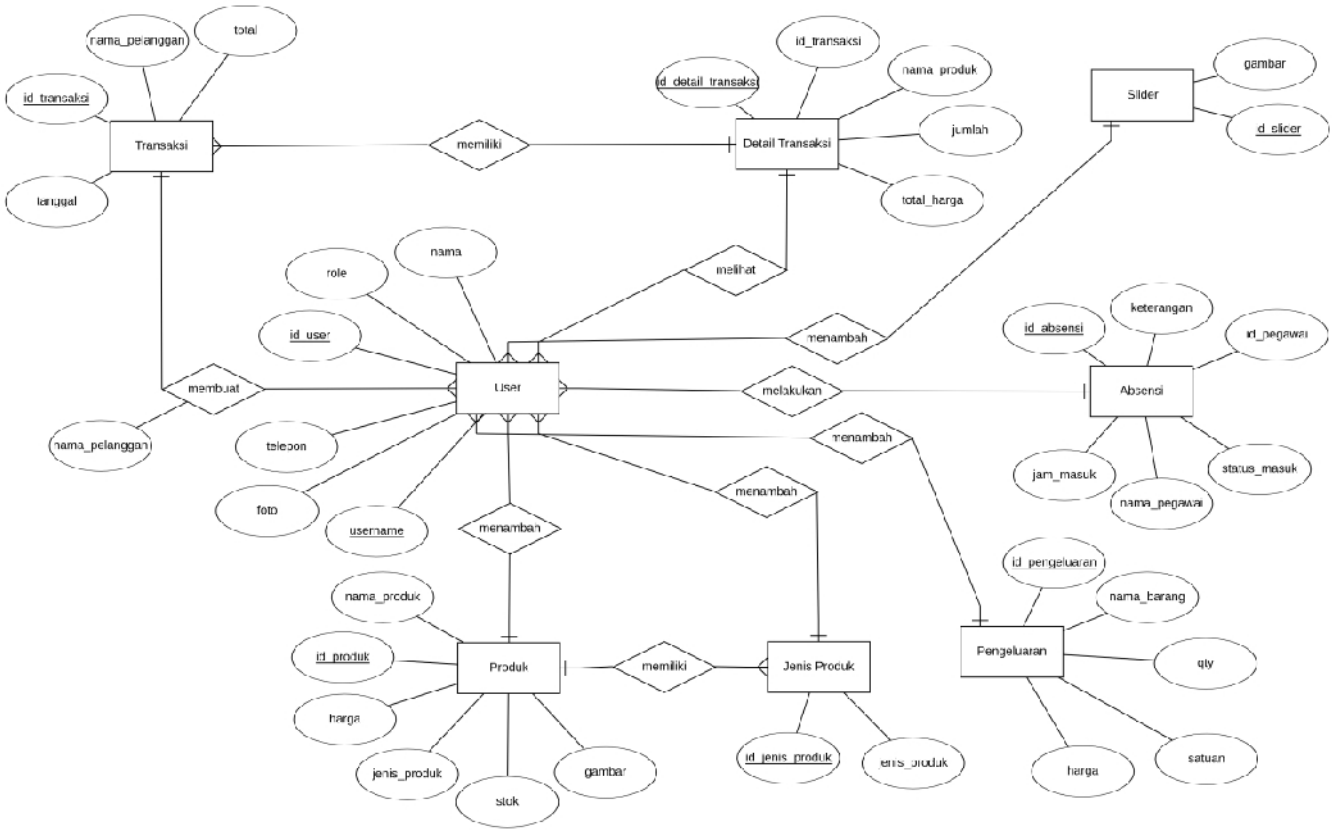

Figure 2. Entity Relationship Diagram

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B. Context Diagram

A Context Diagram (CD) is a diagram that consists of a process and describes the relationship between external and internal entities (Sylkin et al., 2019).

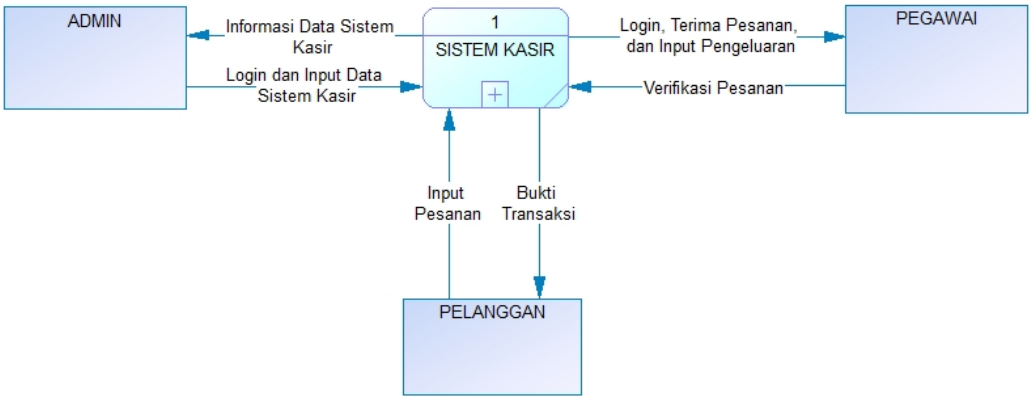

Figure 3. Context Diagram

C. Data Flow Diagram (DFD)

DFD is a tool that can be used to see the data flow of the system being created (Muliadi et al., 2020). Figure 3 below is the DFD made from the system in Café SYZ.

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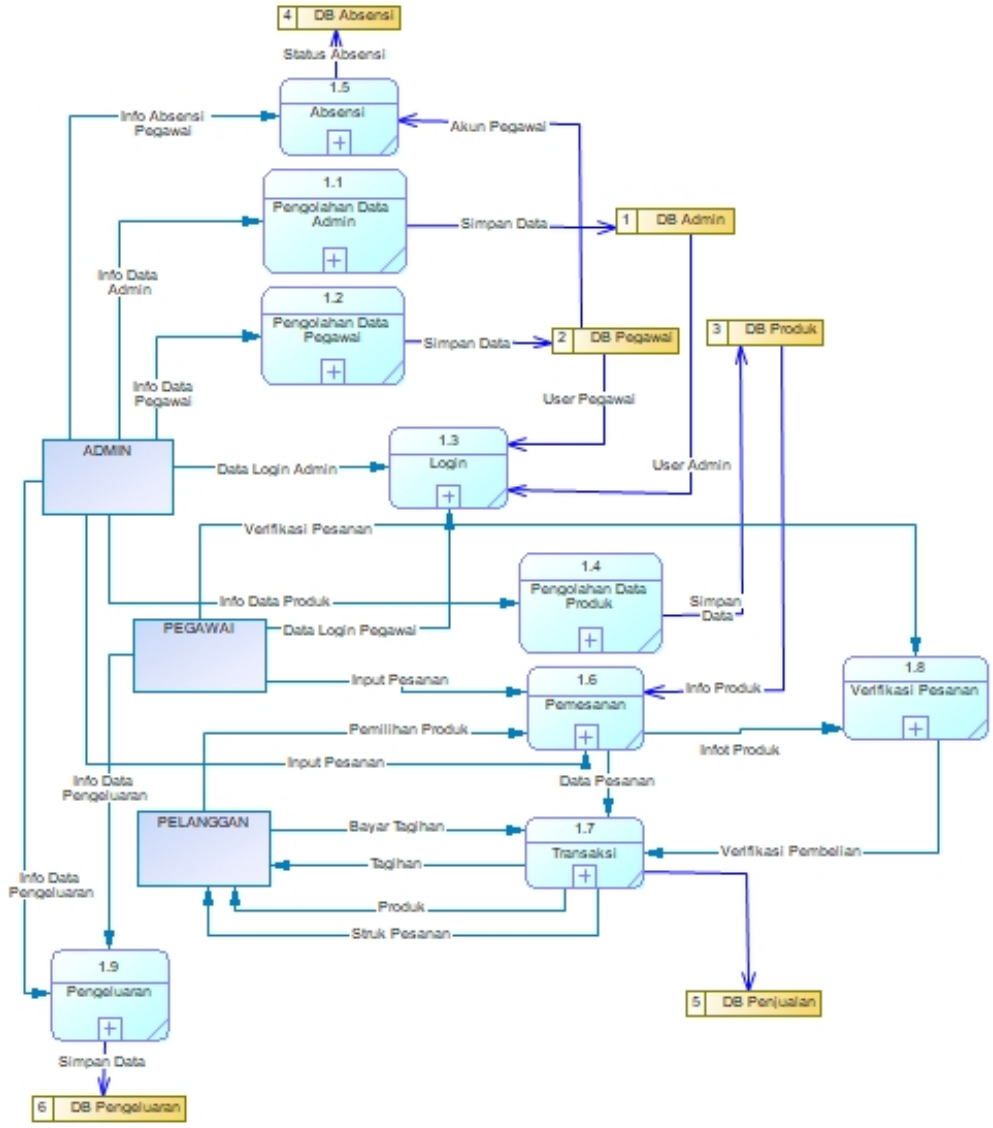

Figure 4. Data Flow Diagram (DFD)

From Figure 3, it can be seen that the Admin who already has the email and password from the admin database does the login process with the admin login data, if it matches the admin user in the admin database then it can enter into this system if it doesn't match then it cannot enter. The admin will make attendance to the attendance process, then the attendance data will be stored in the attendance database. The admin will create a new account by inputting admin data or employee data into the admin data processing or employee data processing, then the data will be stored in the admin database if it's for admins and the employee database if it's for employees. The admin will enter product info to be sold by inputting product data into the product data processing process and the data will be stored in the product database, then the output of this process is product info in the ordering process.

Employees who already have an email and password from the employee database do the login process with admin login data, if it matches the admin user in the employee database then they can enter this system, if it doesn't match then they can't enter. The employee will input expenses into the expense process, then the expense data will be stored in the expense database. The employee will also input the order into the ordering process for customers who have problems ordering orders on their device, after the employee inputs the order it will proceed to the transaction process, and after the transaction

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process is complete, the transaction data will be saved to the transaction database. Customers who have ordered their orders via the device will be verified by the employee in the order verification process and will proceed to the transaction process, after the transaction process is complete, the transaction data will be saved to the transaction database.

The customer does not need to log in and the customer will immediately select his order to the ordering process, it will proceed to the next process, namely the transaction process, this process will send a bill to the customer and when the customer has paid the bill, the customer will get a receipt and the results of this transaction will be stored in the transaction database.

D. Website Design

Figure 4 and 5 below is the front view of the website using mobile and PC.

Figure 4. Mobile Version

Figure 5. PC Version

IV. CONCLUSION

Based on the research, it can be concluded that this website-based ordering and sales information system has provided advantages regarding the transaction recap process. Where when compared to the old system, the reporting process still uses manual methods and is less effective in terms of storage, so a proposed system is made where the transaction recap process is carried out automatically according to existing customer transaction data. Then in the product ordering process, it will be easier for customers. Where this system produces an ordering system that is easy to use only requiring an internet connection. That way the proposed system can be said to have effectiveness in carrying out transaction activities on the website.

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Implementation of Business Model Canvas Development (Case Study : Beauty Clinic dr.Reni.G)

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***Abstract*—As one of the business development strategies, dr. Reni. G made improvements by remodeling its business model. This study uses a descriptive analysis methodology on the case study of the Beauty Clinic of dr. Reni. G. After conducting the literature study, interview process, Focus Group Discussion, and observation, then a SWOT analysis was carried out to determine the uniqueness of dr. Reni. G to be in line with the capabilities of existing resources.**

The results of the SWOT analysis in quadrant I (1.662602; 1.777778), showed that the Beauty Clinic dr. Reni. G requires a progressive strategy. To be able to achieve the expected performance targets and profit, it is important to immediately implement improvements to the nine elements of the Business Model Canvas in the Beauty Clinic of dr. Reni. G

***Keywords*: Existing Business Model Canvas; SWOT Analysis; Business Model Canvas Improvement.**

I. INTRODUCTION

Maintaining appearance is the main thing for some people. The post-pandemic conditions have not discouraged society, both women and men, from always improving their appearance. This certainly encourages more promise for industry players in the beauty clinic business followed by increasingly fierce competition. Various innovations in beauty treatment methods along with supporting beauty care products are presented thoroughly in the beauty business industry, especially in beauty clinics.

In general, people in Indonesia like to visit beauty clinics with the aim of not only cleaning or brightening the skin but also perfecting some parts of the body so that they look more ideal and attractive, which can gain them more attention both in the real world and in cyberspace. For example, treatments for tightening and softening facial skin,
slimming the cheeks, removing wrinkles on the neck, slimming the chin, neck, and many others, which of course will increasingly encourage business opportunities for beauty clinics now and in the future.

Beauty clinic dr. Reni G has been established for more than 10 years on Jalan Kalimantan 34, Blitar City, East Java. As a shareholder as well as the main director dr. Reni Gresnawati and as a representative is dr. Gatut Wicaksono was assisted by some staff.

Statistical data shows that 2020 will be a challenging year for the beauty business. The categories of cosmetics, skincare, personal care, and fragrances experienced a very significant decline.

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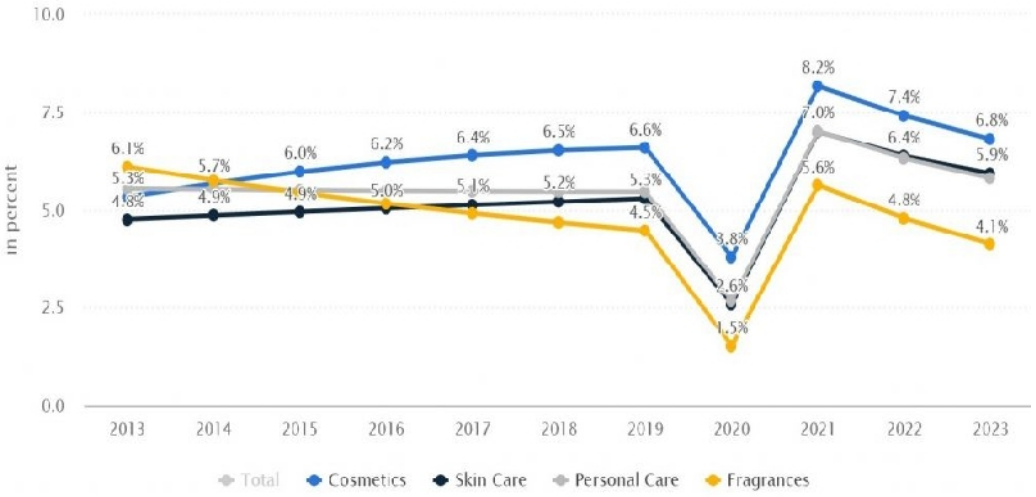

Figure 1. Revenue Growth of the Beauty & Personal Care at Indonesian Market in 2020 (Forecast adjusted for the expected impact of COVID-19)[1].

Statistics results of *Revenue Growth of the Beauty & Personal Care at Indonesian Market*in 2020 made businesspeople aware of the beauty industry that product innovation and related services, from upstream to downstream, must be more proactive and intensive. The pattern of changes in market behavior has encouraged dr. Reni. G to develop interesting and unique design concepts tosurvive and be able to compete well. Therefore, the owner of the Beauty Clinic, dr. Reni. G has a plan to carry out an appropriate and realistic business model to correct the existing deficiencies.

The Business Model Canvas as a working map that is flexible and easy to understand is the right choice to describe a business model. The approach through the Business Model Canvas is very easy to implement by a business organization engaged in the manufacturing product industry and the service industry as well as for periodic evaluations to obtain a new business model that is more appropriate to the organization's vision and mission.

Reviewing an existing form of a business model as a whole, and regularly is very important. Focus on every detail of its elements for improvement and innovation so that organizational performance becomes more productive [2], a more effective and solution method in this research is to combine SWOT analysis (*Strengths*, *Weaknesses*, *Opportunities*, *Threats*) on every element in the analysis of *the Business Model Canvas*.

The problem formulation of this research is "How to create better performance and profit at Reni Beauty Clinic. G through the SWOT Analysis approach and Business Model Canvas?". The purposeof this research is to identify the fundamental elements of the dr. Beauty Clinic business system. Reni. G and analyzing the strengths, weaknesses, opportunities, and threats in the Beauty Clinic business, dr. Reni. G along with the improvement factors in the Business Model Canvas.This research is expected to provide benefits to the company as an insight to improve the business performance of dr. Reni. G continuously and as for readers to get ideas about the business description of a beauty clinic.

The limitation of this research is the data comes from the existing conditions at clinic dr. Reni. G during the research timeline and this research was carried out only to the stage of improving the preparation of the model. There are several assumptions used in this research, the first assumption is the vision, mission, and strategy of dr. Clinic. Reni. G did not change in the research process. While the second assumption is the resource person is an expert in their field.

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II. LITERATURE REVIEW

A. Understanding Beauty Clinics

According to the Indonesian Dictionary [3]a clinic is a health organization that provides curative health services in the form of diagnosis and treatment in dealing with an illness. health problems. Meanwhile, a beauty clinic is a clinic that offers dermatology services. Dermatology (from Greek: derma which means skin) is a branch of medicine that studies the skin and parts related to the skin such as hair, nails, sweat glands, and so on. So it can be concluded that a beauty clinic is a form of the service industry that provides services in the form of health and beauty care for skin, hair, nails, and others that add value to the aesthetic aspect.

B. Business Model Canvas

According to Moris et al,[4] a business model is a brief representation of how a set of decision variables in the areas of business strategy, architecture, and economics are interrelated to create a sustainable competitive advantage in the marketplace.

Another opinion from Osterwarlder, Pigneur, and Clark (2010) business model describes thinking about how an organization creates, delivers, and captures its business values. Presenting concepts that are simple, relevant, easy to understand and can be implemented and evaluated as complex as any company condition. An effective step to assess the integrity of the overall business model is to combine a SWOT analysis (*Strengths*, *Weaknesses*, *Opportunities*, *Threats*) through the Business Model Canvas (BMC).

The Business Model Canvas describes the values that the company wants to offer to several customer segments and partners to create, market, and provide profitable and sustainable revenue streams[5].

Osterwarlder, Pigneur, and Clark[2] add that the Business Model Canvas is a business model consisting of 9 blocks of business activity areas that are outlined in 1 canvas sheet. The 9 blocks include Customer Segments, Value Propositions, Channels, Customer Relationships, Revenue Streams, Key Resources, Key Activities, Key Partnerships, and Cost Structures. These 9 blocks are the elaboration of the 4 main pillar designs that must exist in a business. The four pillars are offers, customers, infrastructure, and finance.

Meanwhile, Wallin, Chirumalla, and Thomson [6] stated that the Business Model Canvas is a promising tool to create and evaluate new business models easily and quickly.

Hong Y Ching, and Fauvel [7], underline the importance of implementing BMC and recommend it for use by business people and academia. BMC provides a more holistic understanding, so it is very helpful for users in their efforts to develop their business plans.

Business Model Canvas is a framework that functions to evaluate a company's business model and its use has contributed to the development of an organization. The Business Model Canvas focuses on implementing the basic ideas to create value in an organization[8]. Meanwhile, according to Herawati et al.[9], the Business Model Canvas is a business framework that is needed by every businessperson in running their business so that business processes take place according to the vision and mission that have been set.

The purpose of the Business Model Canvas is to introduce a standard way of assessing a business model run by a company. With the concept of a business model that must be easy to understand and can be easily communicated through good design, this is not talking about developing a business model but assessing a good business model[10].

Osterwalder and Pigneur [2] also state that it is used to visualize ideas, logical thinking, or frameworks of designers to make it easier for business actors in making decisions, including designing, evaluating, and managing their business models. The advantage of implementing the Business Model Canvas is that it can see more accurately how the form of business is being or will be run.

Through the Business Model Canvas, you can see the big picture of a business model, complete and detailed regarding the key elements of the business being run so that you can see the complete picture which is very helpful in answering questions about the movement of the business. By gradually evaluating each key element, it will provide convenience and practicality in analyzing and taking steps to things that are not appropriate for improvement.

Another advantage of the Business Model Canvas is that it can turn complex business model concepts into simple ones. In the book *Business Model Generation*, Alexander

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Osterwalder explains that a business model consists of 9 elements called 9 building blocks, namely Customer Segments, Value Propositions, Channels, Customer Relationships, Revenue Streams, Key Resources, Key Activities, Key Partnerships, and Cost Structure.

CustomerSegments
The core of a business model is that can provide profit (*profit*) for the company. Without customers, no company can survive long. Companies can group customers into different segments by common needs, common behaviors, or other attributes. A business model can determine large or small customer segments[2].

Value Propositions
A Variety of products and services will create value for certain customer segments[2]. Valueis the reason why customers choose the products and services of a company over other companies because the company is considered to have advantages in solving problems and meeting customer needs.

Channels
A medium for companies to communicate with their customers to convey a value proposition[2].

Customer Relationships
Explanation of how to maintain the relationship between the company and consumers. The company must describe the type of relationship each customer segment wants to build. Various types of relationships range from providing individual personal assistance to each consumer, utilizing the community, or even in the form of "*self-service*."

Revenue Streams
Income or income received by the company from its customers for the value proposition provided by the company to customers[2].

ResourcesKey
The most important assets needed to make a business model work. Every business model requires key resources, key resources enable companies to create and offer value propositions, reach markets, maintain customer relationships, and generate revenue[2].

Key Activities
The most important things a company must do to make its business model work[2].

Key Partnership
The network of suppliers and partners makes the business model work. Companies offer partnerships for a variety of reasons, and partnerships are the cornerstone of many business models. Companies create alliances to optimize their business models, reduce risk, or acquire resources[2].

Cost Structure
Describes all costs incurred to operate the business model. *cost structure* describes the most important costs incurred while operating in a particular business model. Creating and delivering value, maintaining customer relationships, and generating revenue all come at a cost[2].

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C. SWOT Analysis

The first step in developing a Business Model Canvas is to do a SWOT (Strength, Weakness, Opportunity, Threat) analysis. The results of the SWOT analysis are used to design improvements to the Business Model Canvas as a sustainable business model.

According to David[11], all organizations have strengths and weaknesses in business functional areas. No company is equally strong or weak in all areas of business. Internal strengths/weaknesses, combined with external opportunities/threats and a clear mission statement, form the basis for setting goals and strategies. Goals and strategies are set with the intent of exploiting internal strengths and overcoming weaknesses. Explanation of the SWOT analysis[11]:

1. Strengths are resources, skills, situations, conditions, or other advantages related to the company's competitors and market needs that can be served by the company.

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2. Weakness is a condition of limitations or deficiencies in resources, skills, and capabilities that effectively hinder the company's performance.
3. Opportunities are important conditions and situations that are favorable in the company's environment in achieving goals.
4. Threats are important unfavorable conditions or situations in the company environment so that they can pose a threat to the company.

According to Prentice Hall [12] SWOT analysis is: the swot analysis provides helpful information for matching resources and capabilities to the competition in which the organization operates. the model can be used as an instrument for devising and selecting strategy and is equally applicable in any decision-making situation, provided the desired objective has been clearly defined.

Richard L. Daft [13] asserts that “SWOT analysis includes efforts to identify the strengths, weaknesses, opportunities, and threats that determine the company's performance. Meanwhile, Pearce and Robinson argue that SWOT analysis is part of the company's strategic management process that aims to identify strengths, weaknesses, opportunities, and threats[14].

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III. RESEARCH METHODOLGY

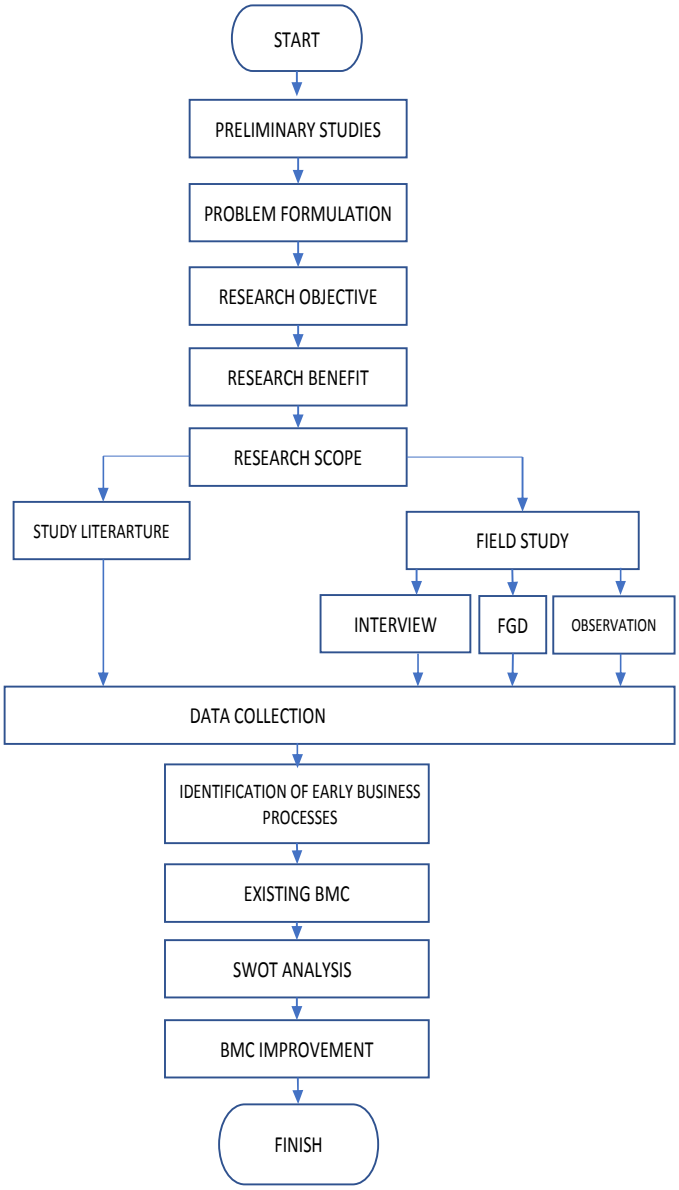

Figure 2.Research Flow Chart.

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IV. DISCUSSION

A. Existing Business Model Canvas

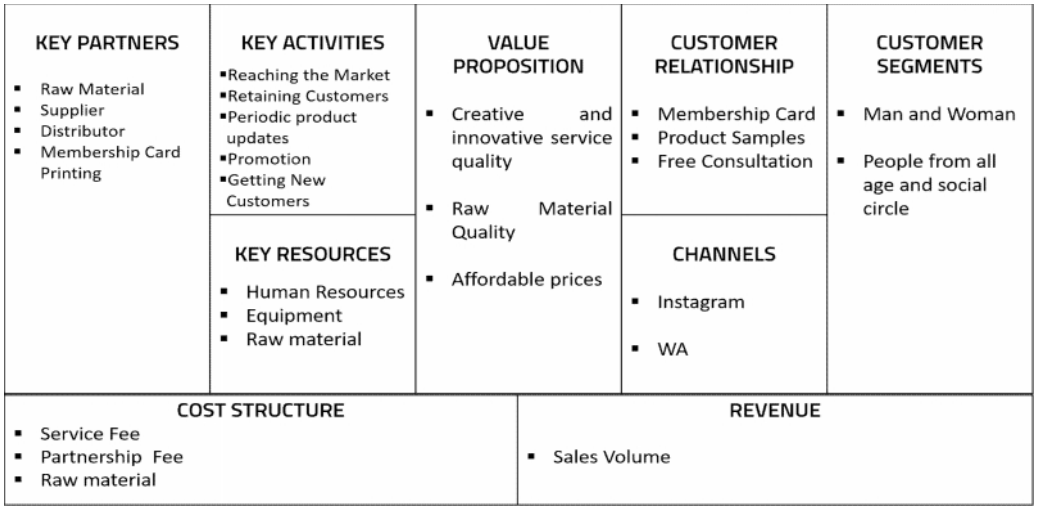

Figure 3. Existing BMC at dr. Reni. G Beauty Clinic

B. SWOT Analysis

	STRENGTH
CS	UNDERSTANDING THE NEEDS OF EVERY CUSTOMER
	SERVING BASED ON CUSTOMER COMPLAINTS
	SERVING MEN AND WOMEN CUSTOMERS
	SERVING CUSTOMERS WITH DIFFERENT AGES
VP	HYGIENIC TREATMENT DOCTOR DIRECTLY HANDLE
	CREATE PRODUCT INNOVATION
	CONVENIENCE AND CONVENIENCE BE THE ATTRACTION OF THE OWN ATTRACTION
	VALUE OFFERED ACCORDING TO CUSTOMER DESIRES
	WELL INTEGRATING PRODUCTS AND SERVICES
	HIGH LEVEL OF CUSTOMER LOYALTY
	PRODUCT VARIATIONS ACCORDING TO CUSTOMER NEEDS
Ch	USING SOCIAL MEDIA AS A PROMOTIONAL EVENT
	PROVIDING MEMBERS FOR EASY INFORMATION AND SERVICE CONVENIENCE
	MEMBERS OFTEN GET INTERESTING PROMOTIONS
CR	RELAXING FAMILY ATTITUDE AND THE FRIENDSHIP BETWEEN THERAPIST AND CUSTOMER
	SMILE, GREAT, FRIENDLY SERVICE SO ATTENTION CUSTOMERS
	FREE CONSULTATION FOR NEW CUSTOMERS AND MEMBERS
	ENOUGH ENOUGH REPUTATION
	CLINICAL RELATIONSHIP WITH CUSTOMER IS GOOD ESTABLISHED
RS	MONTHLY INCOME CAN BE PREDICTED
	AFFORDABLE PRICE ACCORDING TO CUSTOMER'S ECONOMIC CLASS
	PRICE SETTING IS APPROPRIATE
KR	VERY STRATEGIC LOCATION
	HAVE A VERY SPACIOUS LOCATION
	CAN PREDICTING RESOURCES WELL
	EASY TO GET RESOURCES
	HAVE ADEQUATE INFRASTRUCTURE TO DEVELOP A GRAND STRATEGY
	CONSULTATION AND TREATMENT DIRECTLY HANDLED BY DOCTOR
	TREATMENT USING MODERN TECHNOLOGY
	OFFERING COMPLETE TREATMENT
KA	ABLE TO RUN BUSINESS ACTIVITIES PROPERLY
KP	GOOD WORKING RELATIONSHIP WITH PARTNERS
Co.S	OPERATING COSTS AS REQUIRED

	WEAKNESS
CS	LIMITED NUMBER OF CUSTOMERS WHO HAVE RECOGNIZED THE IMPORTANT ROLE OF APPEARANCE
	LACK OF INFORMATION ON PRODUCT, INNOVATION AND PRICES KNOWN BY CUSTOMERS
VP	HAVE NOT MAXIMIZED THE ROLE OF SOCIAL MEDIA IN BUSINESS
	HAVE NOT PROVIDED MAXIMUM PRODUCT INFORMATION OR INNOVATION
	DOES NOT HAVE SMOKING AREA AVAILABLE
	TYPE OF TREATMENT IS NOT COMPREHENSIVE ENOUGH
Ch	LOCATION IS STILL LIMITED TO ONE CITY
	HAVE NOT OPEN ANOTHER BRANCH
	THERE IS NO CAFE / CANTINE
	THERE IS NO CHILDREN'S PLAY AREA
CR	WEAK BRAND IMAGE, HAVEN'T ABLE TO AFFECT CUSTOMERS
	CUSTOMER SURVEY FOR QUALITY IMPROVEMENT IS STILL NOT EFFECTIVE AND EFFICIENT
RS	FINANCIAL MANAGEMENT PERFORMANCE IS NOT ENOUGH EFFECTIVE AND EFFICIENT
KR	MAIN RESOURCES IS EASY TO IMITATE BY THE COMPETITORS
	THE POTENTIAL OF HUMAN RESOURCES HAVE NOT BEEN EMPOWERED OPTIMALLY
	HR MARKETING IS NOT WORKING EFFECTIVE AND EFFICIENT ENOUGH
KA	MAIN ACTIVITIES ARE EASY TO IMITATE BY THE COMPETITORS
KP	LOW NUMBER ON PARTNERS
Co.S	MONTHLY COST CANNOT BE PREDICTED CORRECTLY
	THERE ARE OVERHEAD COSTS THAT STILL HARD TO CONTROL

	OPPORTUNITY
CS	HUMAN NATURE TO WANT TO LOOK ATTRACTIVE WHICH IS AN OPPORTUNITIES TO GET NEW CUSTOMERS
	PROVIDE FREE WEBINARS TO ATTRACT NEW CUSTOMERS
	INSTALLING BANNERS THAT ATTRACT NEW CUSTOMERS
	UPDATE LEADING PRODUCTS TO ATTRACT NEW CUSTOMERS
VP	PRODUCT AND SERVICE INNOVATION TO INCREASE REVENUE
	GIVES INSIGHTS OF THE IMPORTANCE OF TREATMENT AND APPEARANCE
	ADDITIONAL PAYMENT FACILITIES
	PROVIDE CARE PRODUCTS ACCORDING TO RECOMMENDATIONS AND HAVE BPOM
Ch	ADDING NEW TOOLS FOLLOWING TECHNOLOGY DEVELOPMENT
	OPEN NEW BRANCH TO REACH CUSTOMERS IN STRATEGIC AREA
CR	THERE IS THE POTENTIAL TO IMPROVE RELATHIONSHIP WITH CUSTOMERS
RS	THERE ARE OPPORTUNITIES TO ADD OTHER INCOME FLOWS
	PRICE CAN INCREASE ACCORDING TO ECONOMIC CONDITIONS
KR	OPPORTUNITY TO USE CHEAPER RESOURCES
	NEW PRODUCT INNOVATION WITH ALTERNATIVE RAW MATERIALS
	OPPORTUNITY TO USE THE AVAILABLE LAND TO OPEN A CAFÉ, SUCH AS IN PARKING AREA OR ANOTHER AREA
	HAVE A STRATEGIC BANNER INSTALLATION LOCATION
	BUILD A CHILDREN'S PLAY AREA, TO IMPROVE CUSTOMER COMFORT THAT BRINGS CHILDREN TO THE CLINIC
KA	STANDARDIZE KEY ACTIVITIES
KP	EXPANDING PARTNERSHIPS BOTH FOR THE SUPPLY OF RAW MATERIALS AND ITS DISTRIBUTION CHANNELS
	CREATE NEW JOBS FOR THE NEIGHBORHOOD COMMUNITY
	OPENING NEW BUSINESS OPPORTUNITIES FOR BEAUTY AND HEALTH PRODUCTS
	OPENING NEW BUSINESS OPPORTUNITIES FOR CAFE PROVIDERS
	OPENING CHILDREN'S PLAY AREA BUSINESS OPPORTUNITIES
Co.S	EFFICIENING EXPENDITURES THAT ARE NOT TOO IMPORTANT

	THREATH
CS	DECREASED ON CUSTOMERS NUMBER DUE TO STRONG BUSINESS COMPETITION
	CUSTOMERS ARE MORE CRITICAL AND SELECTIVE
VP	COMPETITORS HAVE BETTER NETWORKS AND PARTNERS
Ch	COMPETITORS HAVE BETTER DISTRIBUTION CHANNELS
	BUSINESS COMPETITORS WHO ARE MORE KNOWN AND KNOW THE MARKET
CR	RELATIONSHIP WITH CUSTOMERS BECOME BAD IF SERVICE DOESN'T MEET CUSTOMER EXPECTATIONS
RS	DEPENDENT ONLY ON ONE INCOME STREAM
KR	THERE ARE CONSTRAINTS IN THE SUPPLY OF CERTAIN RAW MATERIALS
	THREATS TO THE QUALITY OF RAW MATERIALS
	INCREASE COST ON RAW MATERIAL
	THE EMERGENCE OF PRODUCTS/TOOLS THAT ARE MORE ADVANCED AND FOLLOWING TECHNOLOGY TREND
KA	LESS PROFESSIONAL PARTNERS BECOME A THREAT IN SOP DETERMINATION
KP	PARTNERS THAT ALSO COOPERATE WITH COMPETITORS
Co.S	HIGH TAX COST
	ELECTRICITY AND OTHER COSTS THAT SUDDENLY INCREASED

Figure 4. SWOT Analysis

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Strength Analysis

Table 1. Strength Analysis

STRATEGIC FACTOR		WEIGHT	RATING	SCORE
STRENGTH				
CS	Understanding the needs of every customer	0,045455	5	0,227273
	Serving based on customer complaints	0,015152	5	0,075758
	Serving men and women customers	0,015152	5	0,075758
	Serving customers of different ages	0,030303	4	0,121212
VP	Hygienic treatment is directly handled by the doctor	0,030303	4	0,121212
	Create product innovation	0,030303	3	0,090909
	Convenience and convenience be the attraction of the own attraction	0,045455	5	0,227273
	The Value offered according to customer desires	0,045455	5	0,227273
	Well integrating products and services	0,030303	3	0,090909
	High level of customer loyalty	0,030303	3	0,090909
	Product variations according to customer needs	0,045455	4	0,181818
Ch	Using social media as a promotional event	0,045455	4	0,181818
	Providing members with easy information and service convenience	0,045455	5	0,227273
	Members often get interesting promotions	0,045455	5	0,227273
CR	Relaxing family attitude and the friendship between therapist and customer	0,045455	5	0,227273
	Smile, great, friendly service so attention customers	0,045455	5	0,227273
	Free consultation for new customers and members	0,030303	5	0,151515
	Enough reputation	0,030303	4	0,121212
	Clinical relationship with the customer is well established	0,030303	5	0,151515
RS	Monthly income can be predicted	0,015152	3	0,045455
	Affordable price according to customer's economic class	0,015152	4	0,060606
	Price setting is appropriate	0,030303	4	0,121212
KR	Very strategic location	0,015152	5	0,075758
	Have a very spacious location	0,045455	5	0,227273
	Can predicting resources well	0,015152	4	0,060606
	Easy to get resources	0,015152	3	0,045455
	Have adequate infrastructure to develop a grand strategy	0,015152	3	0,045455
	Consultation and treatment are directly handled by the doctor	0,045455	5	0,227273
	Treatment using modern technology	0,015152	3	0,045455
	Offering complete treatment	0,015152	3	0,045455
KA	Able to run business activities properly	0,030303	4	0,121212
KP	Good working relationship with partners	0,030303	4	0,121212
Co.S	Operating costs as required	0,015152	3	0,045455
		1		4,333333

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Weakness Analysis

Table 2. Weakness Analysis

	STRATEGIC FACTOR	WEIGHT	RATING	SCORE
	WEAKNESS			
CS	A limited number of customers who have recognized the important role of appearance	0,02439	1	0,02439
	Lack of information on products, innovation, and prices known by customers	0,04878	2	0,097561
VP	Have not maximized the role of social media in business	0,073171	4	0,292683
	Have not provided maximum product information or innovation	0,02439	3	0,073171
	Does not have a smoking area available	0,04878	2	0,097561
	The type of treatment is not comprehensive enough	0,02439	2,5	0,060976
Ch	Location is still limited to one city	0,073171	3	0,219512
	Have not to open another branch	0,073171	3	0,219512
	There is no cafe / canteen	0,073171	5	0,365854
	There is no children's play area	0,04878	4	0,195122
CR	Weak brand image, haven't able to affect customers	0,02439	2	0,04878
	Customer survey for quality improvement is still not effective and efficient	0,02439	2	0,04878
RS	Financial management performance is not enough effective and efficient	0,02439	1	0,02439
KR	Main resources are easy to imitate by the competitors	0,073171	1	0,073171
	The potential of human resources has not been empowered optimally	0,02439	3	0,073171
	Hr marketing is not working effective and efficient enough	0,073171	4	0,292683
KA	Main activities are easy to imitate by the competitors	0,073171	1	0,073171
KP	The Low number of partners	0,073171	4	0,292683
Co.S	The Monthly costs cannot be predicted correctly	0,04878	1	0,04878
	There are overhead costs that are still hard to control	0,04878	1	0,04878
		1		2,670732

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Opportunity Analysis

Table 3. Opportunity Analysis

	STRATEGIC FACTOR	WEIGHT	RATING	SCORE
	OPPORTUNITY			
CS	Human nature to want to look attractive which is an opportunity to get new customers	0,047619	5	0,238095
	Provide free webinars to attract new customers	0,047619	5	0,238095
	Installing banners that attract new customers	0,047619	5	0,238095
	Update leading products to attract new customers	0,047619	5	0,238095
VP	Product and service innovation to increase revenue	0,047619	5	0,238095
	Gives insights into the importance of treatment and appearance	0,047619	5	0,238095
	Additional payment facilities	0,031746	4	0,126984
	Provide care products according to recommendations and have BPOM	0,047619	5	0,238095
Ch	Adding new tools following technology development	0,047619	5	0,238095
	Open a new branch to reach customers in a strategic area	0,015873	3	0,047619
CR	There is the potential to improve the relationship with customers	0,031746	4	0,126984
RS	There are opportunities to add other income flows	0,031746	4	0,126984
	Price can increase according to economic conditions	0,015873	3	0,047619
KR	Opportunity to use cheaper resources	0,031746	3	0,095238
	New product innovation with alternative raw materials	0,031746	4	0,126984
	Opportunity to use the available land to open a café, such as in a parking area or another area	0,047619	5	0,238095
	Have a strategic banner installation location	0,047619	5	0,238095
	Build a children's play area, to improve customer comfort that brings children to the clinic	0,047619	5	0,238095
KA	Standardize key activities	0,015873	4	0,063492
KP	Expanding partnerships both for the supply of raw materials and its distribution channels	0,047619	5	0,238095
	Create new jobs for the neighborhood community	0,047619	5	0,238095
	Opening new business opportunities for beauty and health products	0,047619	5	0,238095
	Opening new business opportunities for cafe providers	0,047619	5	0,238095
	Opening children's play area business opportunities	0,047619	5	0,238095
Co.S	Efficiency on expenditures that are not too important	0,031746	3	0,095238
		1		4,666667

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Threat Analysis

Table 4. Threat Analysis

	STRATEGIC FACTOR	WEIGHT	RATING	SCORE
	THREAT			
CS	Decreased in customers number due to strong business competition	0,055556	1	0,055556
	Customers are more critical and selective	0,055556	1	0,055556
VP	Competitors have better networks and partners	0,083333	2,5	0,208333
Ch	Competitors have better distribution channels	0,083333	3,5	0,291667
	Business competitors who are more known and know the market	0,055556	1,5	0,083333
CR	Relationships with customers become bad if service doesn't meet customer expectations	0,083333	2	0,166667
RS	Dependent only on one income stream	0,027778	2	0,055556
KR	There are constraints in the supply of certain raw materials	0,055556	2	0,111111
	Threats to the quality of raw materials	0,083333	3	0,25
	Increase cost of raw material	0,083333	5	0,416667
	The emergence of products/tools that are more advanced and follow technology trend	0,055556	3,5	0,194444
KA	Less professional partners become a threat in sop determination	0,055556	2	0,111111
KP	Partners that also cooperate with competitors	0,055556	1	0,055556
Co. S	High tax cost	0,083333	5	0,416667
	Electricity and other costs that suddenly increased	0,083333	5	0,416667
		1		2,888889

SWOT Analysis Graph

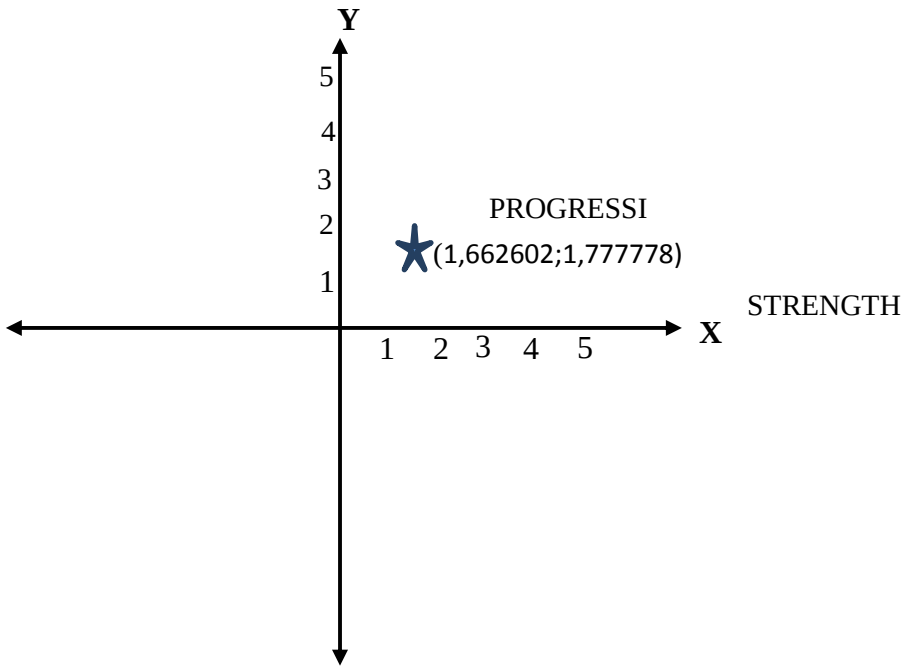

Figure 5. SWOT Analysis Graph

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C. Improvement Business Model Canvas

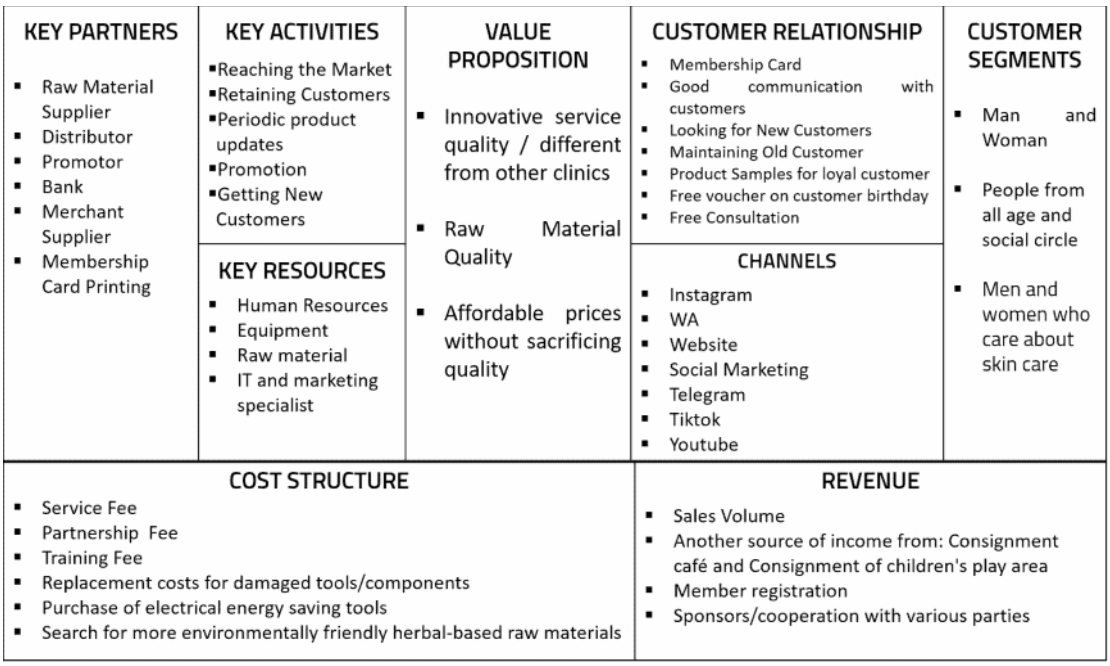

Figure 6. Improvement BMC at dr. Reni. G Beauty Clinic

V. CONCLUSION

Based on the results of the SWOT analysis, it is in quadrant I (1.662602; 1.777778) namely the progressive strategy. Based on the discussion of the business model at the dr. Reni. G by using the Business Model Canvas, the elements that will be developed are as follows:

- Customer Segments:man and woman, people of all ages and social circles, and also men and women who care about skin care.
- Customer Relationships:membership card, good communication with customers, looking for new customers, maintaining old customers, product samples for a loyal customer, free voucher on customer birthday, free consultation
- Value Propositions: Quality of service that is innovative or different from other clinics, quality of raw materials, affordable prices without sacrificing quality.
- Channels:Web Sites. social marketing, Instagram, telegram, WhatsApp, TikTok, you tube.
- Key Resources:human resources, equipment, raw materials, marketing, and IT specialist.
- Key Partners: Raw material suppliers, distributors, promoters, merchant provider banks, membership card printing.
- Key Activities: Reaching markets, retaining customers, promotions, regularly updating products.
- Cost Structure: The existence of service costs, cooperation costs, training costs, replacement costs for tools/components that have been damaged, purchases of tools that are more efficient/saving electrical energy and others, search for alternative raw materials that are more environmentally friendly based on herbs
- Revenue Streams: Increase sales volume, increasing revenue sources from cafe consignment, children's playground consignment, member registration, sponsorship/collaboration with various parties

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Improving The Heat Value of Biobriquettes Made From Rice Husk and Cabbage with The Addition of Palm Oil

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***Abstract*—Biobriquette can be used as an alternative fuel because it is made from inexpensive materials and uses simple technology, and it is expected to help overcome the energy (fossil) crisis. The problem is determining how to boost the calorific value of briquettes made from waste biomass materials. Cabbage contains approximately 18.80% fiber, so there is cellulose content that can be processed into high-value products such as briquettes, and using rice husks as fuel can increase the calorific value. The goal of this study is to determine the best calorific value of bio briquettes by varying the method of adding coconut oil and the composition of rice husks and cabbage. The stages of making cabbage and rice husk bio briquettes are raw material preparation, carbonization, adhesive manufacture, briquetting, and quality testing. The variables used are variations in the composition of rice husks: cabbage in ratios of 40:60, 50:50, 60:40, 70:30, and 80:20, as well as the variable method of giving palm oil by mixing with ingredients and dyeing after it becomes briquettes. According to the findings of this study, the best bio briquette mixing ratio resulted in the highest calorific value found in a mixture of 40% rice husk and 60% cabbage with the method of adding palm oil by dipping, with a calorific value of 6.283 kcal/g, a combustion rate of 0.0616 g/minute, and the duration of the flame is 60.26 minutes.**

Keywords: Biobriquette, Carbonization, Cabbage, Calorific value, Rice Husk

I. INTRODUCTION

The people of Indonesia are currently facing difficulties in meeting their kerosene and gas needs. The earth's availability will eventually run out. As a result, alternative energy sources are deemed necessary and urgent. One solution to this problem is to maximize the country's renewable energy potential (Mandey, 2015).

Cabbage vegetable waste is abundant due to its short shelf life, so it decomposes quickly, and it contains approximately 18.80 percent fiber, so this natural cellulose content has great potential to be processed into high-value products such as briquettes, which can be used as an alternative energy source (Arjuna, 2018). Following that, rice husk waste, which has relatively low moisture and ash content, can be used as additional material to increase the calorific value in the manufacture of biochar briquettes (Gunawan, 2018). Rice husk has a high calorific value, approximately 4,000 kcal/kg. If Indonesia generates about 6.5 million tons of rice waste per year, the amount of heat energy that can be extracted from this waste is about 26 trillion kcal/year (Siswanto, 2018).

Figure 1. Types of Biobriquette Raw Materials (a) Cabbage and (b) Rice Husk

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Briquettes are one of the alternative fuels expected to help the world overcome the energy (fossil) crisis. Briquettes can be made from waste biomass that has been underutilized by the community (Sembiring, 2015). Even when not fanned, organic biomass briquettes ignite steadily. The benefit of this jam is that the amount of smoke produced by biomass briquettes is less than that produced by wood or kerosene (Fitriyah, 2010)

This research developed charcoal briquettes with a high calorific value from cabbage market waste by adding rice husks to a previous study titled "The application of rice husk and cabbage market waste for fuel briquette production." Cabbage crop (Brassica olerancea L. var. caitata L), also known as white cabbage, is used. The ratio of rice husks to cabbage (60:40; 55:45; 50:50; 45:55; and 40:60) was used as the independent variable in a briquette machine at a temperature of 250–270 C. Briquettes made from 60% rice husks and 40% cabbage market waste was found to be the most efficient due to their higher calorific value (5,026.7 cal/g) (Supakata, 2015).

In a previous study titled "Hydrothermal Carbonization and Torrefaction of Cabbage Waste," variables in the hydrothermal carbonization process at temperatures of 180 °C and 225 °C and the torrefaction carbonization process at temperatures of 225 °C, 250 °C, and 275 °C were tested for 30 minutes each. The study's findings demonstrate the procedure.The best is carbonization at 275°C, which increased the net calorific value by an average of 3 MJ kg-1 to 20.89 MJ kg-1 (Tamelova, 2019).

The previous study, "Determination of Optimal Conditions for Carbonization Temperature and Time in Making Charcoal from Rice Husk," seeks to identify the best conditions for rice husks. The carbonization temperatures used were 400 oC, 500 oC, and 600 oC, with time variations of 30 minutes, 60 minutes, 90 minutes, and 120 minutes. The best optimum conditions for rice husks were found to be at a temperature of 400 C for 120 minutes, with a bound carbon content of 41.3 percent, water content of 6.1 percent, ash content of 32.6 percent, and volatile matter content of 20.5 percent (Siahaan 2013).

The study "The Effect of Variations in Pressing Pressure and Material Composition on the Physical Properties of Charcoal Briquettes" makes use of waste biomass by investigating the effects of variations in pressing pressure and material composition on the physical properties of charcoal briquettes. Carbonization for 15 minutes on the coconut shell at 450 C. For 4-5 hours, sawdust was carbonized in a drum clinker. The following is a comparison of the composition of coconut shell material and sawdust. 75 percent: 25%; 25 percent: 25%; 50 percent: 50%; and 100 percent: 0% with pressing pressures of 50 N/cm2, 100 N/cm2, and 150 N/cm2. Briquettes were dried in an oven set to 60 °C for 24 hours. 5 cm in diameter, cylindrical briquettes The study's findings show that the most optimum briquette with a composition ratio of 100 percent coconut shell using a pressure between 100-150 N/cm2 with the following test parameter values: density of 0.634 gr/cm3, the mechanical strength of 43,167 N/cm2 and burning time of 64.39 minutes (Setiowati, 2014).

Based on the previous research, this study was conducted to improve the efficiency of biomass waste as a renewable alternative energy source and to increase the calorific value of bio briquettes.

II. RESEARCH METHODOLOGY

This study employs an experimental method and was conducted at the ITN Malang Bioenergy Laboratory and the MIPA Chemistry Laboratory at the State University of Malang. The following variables are used: cabbage crop, charcoal flour size 40 mesh, drying temperature 110 C, and drying time (6 hours cabbage, 30 minutes rice husk, 3 hours bio briquette). The cabbage carbonization temperature is 275 degrees Celsius, and the cabbage carbonization time is 30 minutes, 450°C, 120-minute carbonization of rice husk, 100 bar press pressure, cylindrical briquette shape (2 cm high, 1-inch diameter), 10-gram tapioca flour, 75 mL water, 100°C water temperature While the variable changes are variations in the composition of rice husks and cabbage, namely 40%:60%, 50%:50%,

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60%:40%, 70%:30%, and 80%:20%, and the method of giving palm oil to briquettes, namely method (1) the oil is mixed with the ingredients first and method (2) the briquettes that have been molded are immersed in oil.

A. Materials and tools used:

Water, cabbage, rice husk, and tapioca are the ingredients. Meanwhile, the following tools are used: press tool, 40 mesh sieve, briquette mold, furnace, and oven.

Research procedure :

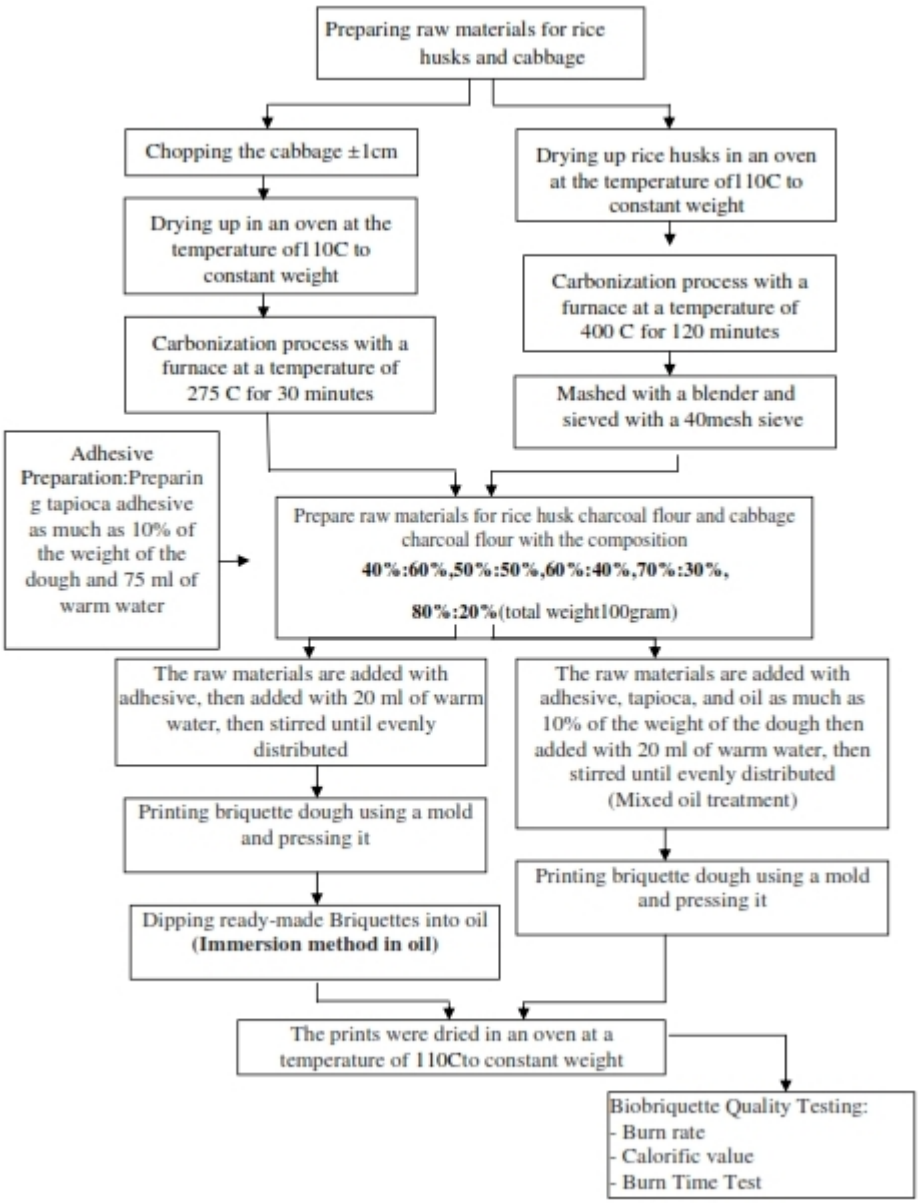

Figure 1 Research procedure

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III. RESULTS AND DISCUSSION

- **Combustion Rate**

The rate of combustion is a test in which briquettes are burned to determine the length of a fuel's flame, and then the mass of the briquettes is weighed first, minus the mass of the burned briquettes. A stopwatch was used to calculate the ignition time, and a digital scale was used to weigh the briquettes. The graph below shows the value of each sample's bio briquette burning rate:

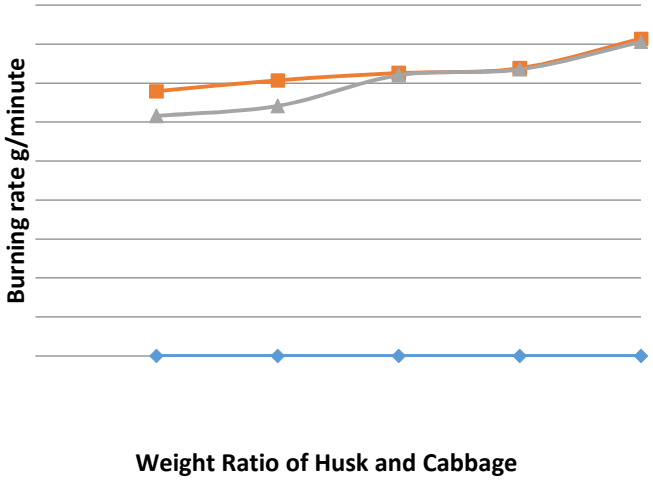

Figure 2. Graph of Relationship Between Biobriquette Composition and Palm Oil Administration Method on Combustion Rate

In Graph 2, the highest combustion rate is obtained from the composition of 80% rice husk and 20% cabbage with the mixed method of giving oil, which is 0.0814 g/min. While the composition of 40% rice husk and 60% cabbage with the method of dipping oil has the lowest burning rate at 0.0616 g/minute.

Figure 3. Combustion Rate Test on Biobriquettes

Because it is known from the data that the bio briquettes for all samples are flammable, there is no provision in SNI for standardization of the burning rate of bio briquettes. Furthermore, the type of raw material used influences the combustion rate; the graph shows that the more cabbage composition is added, the lower the combustion rate. The addition of more rice husks, on the other hand, increases the rate of burning. This is because cabbage contains more carbon than rice husks. The lower the combustion rate, the higher the carbon content of the raw material. The lower the combustion rate, the higher the briquette quality, implying that the briquettes will take a long time to burn out (Gunawan, 2018).

- **Burning Time**

The rate of combustion is a test that uses briquettes to determine the duration of a fuel's

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flame. A stopwatch is used to calculate the length of the ignition time, which begins with the flame and ends when the fire is extinguished. The graph below depicts the time required to burn bio briquettes from each sample:

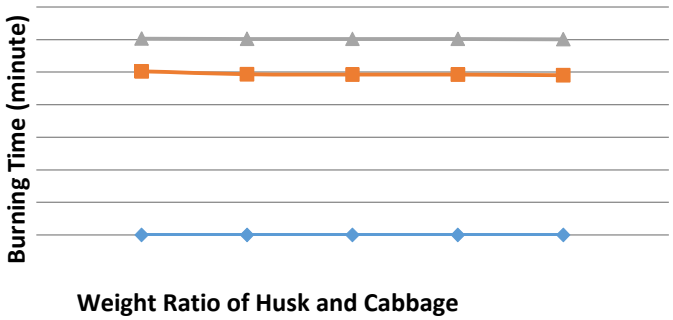

Figure 4. Graph of Relationship Between Biobriquette Composition and Palm Oil Administration Method on Burning Time

In Figure 4, the burning time graph shows that the composition of 40% rice husk and 60% cabbage by the method of dipping oil produces the longest burning duration with a time of 60.26 minutes. With a time of 49.03 minutes, the composition of 80 percent rice husk and 20 percent cabbage with the method of giving oil in a mixed manner has the fastest burning duration.

There is no standard combustion duration in SNI for testing bio briquettes over time. According to the available data, the type of raw material used influences the length of the burning time. The graph shows that the longer the burning duration increases, the more cabbage composition is added. However, the more rice husks added, the longer the duration of burning decreases. The longer the duration of burning, the higher the quality of the briquettes, implying that the briquettes will last longer and will not burn out quickly. This is because cabbage contains more carbon than rice husks. The lower the combustion rate, the higher the carbon content of the raw material. This is based on preliminary raw material observation data, which shows that cabbage has a 17.4 percent carbon content and rice husks have a 12.2 percent carbon content.

- **Calorific Value Test**

The calorific value has a significant impact on the quality of charcoal briquettes. The higher the calorific value of the charcoal briquettes, the higher the quality of the produced charcoal briquettes. The graph below depicts the test of the calorific value of bio briquettes from each sample:

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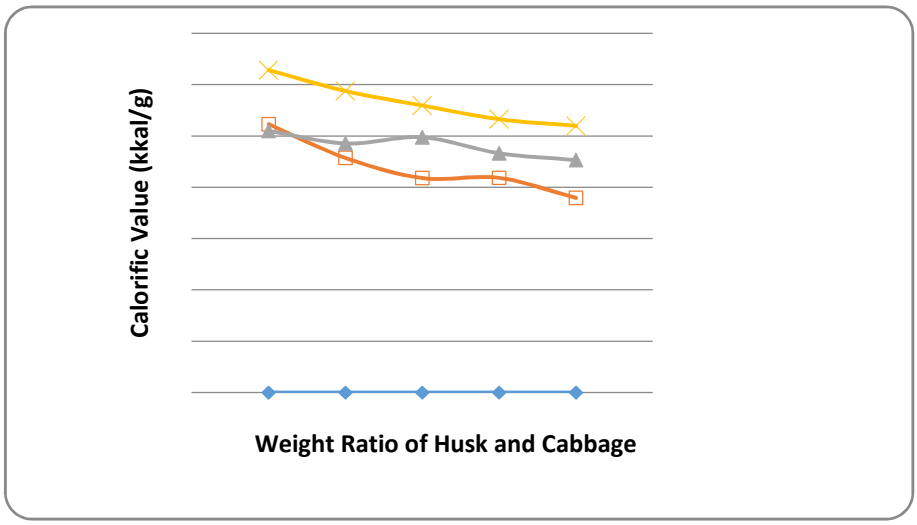

Figure 5. Graph of Relationship Between Composition of Biobriquettes and Method of Giving Palm Oil compared to without giving oil to the Calorific Value of Biobriquettes

Figure 5 shows that the composition of 40% rice husk and 60% cabbage with the oil dipping method yielded the highest calorific value of 6.283 kcal/gram. The composition of 80 percent rice husk and 20 percent cabbage with the method of adding mixed palm oil has the lowest calorific value, which is 4,532 kcal/gram. This is because the carbon content of cabbage is higher than that of rice husks.

According to the study's findings, only calorific values greater than 5,000 kcal/gram met the quality requirements for briquette quality (SNI 01-6235-2000). Meanwhile, some samples have a lower calorific value than the required standard.

According to the research data, the briquettes that were not given additional palm oil had a calorific value that did not meet the SNI standard; only one treatment had a calorific value that met the SNI standard, namely with variations in the composition of rice husks and cabbage, 60 percent:40 percent, namely of 5.230 kcal/g. When comparing the treatment of briquettes that have not been added to briquettes that have been added with palm oil, it is clear that the calorific value increases. As a result, the addition of palm oil and the composition of the ingredients had a significant impact on the calorific value produced. The calorific value of the resulting briquettes is also affected by variations in the method of adding oil. Because each raw material has a different bonded carbon value, each type of charcoal briquette raw material has a different calorific value (Sidiq, 2017).

According to the findings of this study, bio briquettes made of 40% rice husk charcoal and 60% cabbage charcoal with the method of adding palm oil by dipping have a significant effect on the increase in calorific value and meet the SNI standard for bio briquettes (SNI 01-6235-2000).

IV. CONCLUSION

This study concludes that the addition of palm oil using various methods and variations in the composition of the material from rice husk charcoal to cabbage charcoal affects the quality of bio briquettes. The best bio briquette mixing ratio results in the highest calorific value, which is found in a mixture of 40% rice husk charcoal and 60% cabbage charcoal by using palm oil by the dipping method, with a calorific value of 6.283 kcal/g, a burning rate of 0.0616 g/minute, and a burning time of 60.26 minutes.

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Applied Ergonomic Design Of E-Bike WithAntropometric Approach

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***Abstract*—Transportation is a tool that can be easiness for mobilities a thing or people from the place one to the othe place. Along with the times, transportation also develops. The one of transportation that developing is electric bike (e-bike). The development of electric bike is to improve the previous product, so that the electric bicycle that will produced is better than before as models, colors etc. when we make the electric bike design, the first thing that we do is ergonomic analytical so the product that will produced didn't give long term effect as muscle injury and joint pain for the user. We use analitycal RULA for analytical ergonomi to our design electric bike. We take 31 samples use the database from Student of Industrial Engineering AdiBuana Surabaya College. The result of the RULA value which shows the most ergonomics is at a headtube angle of 15 ° with a RULA value of 3. This shows that the design of this electric bicycle is quite ergonomic and the design is acceptable, although to be ideal in its body posture, further analysis is needed in order to obtain a better RULA value.**

Keywords: **Electric Bike; Ergonomic; Anthropometry; Design.**

I. INTRODUCTION

The development of transportation in this modern times is currently growing rapidly. A good transportation system is by considering at conditions that facilitate mobility and environmentally friendly [1]. One of the efforts to creating this environment is the development of transportation that uses electrical energy. One of the forms of transportation that uses electrical energy is an electric bicycle (E-bike). Electric bicycles are a type of transportation like other bicycles but, have an electric machine as the driving tools. Electric bicycles have been popular in the Indonesian market with various attractive designs. Electric bicycle products that commonly use in Indonesia are imported products from China such as the Yahonta and Tiger brands, but there are also some domestic products such as Xelimo and Betrix[2].

In terms of the use of electric bicycles as the transportation is significantly increased than before. In addition, the use of electric bicycles must be in accordance with their needs both in terms of shape and accessible features. [3]Electric bicycles can also be used for teenagers to the elderly so that, there are various types of electric bicycle (E-Bike) designs nowadays. However, the development of electric bicycle design must be adjusted to the body as well, and anthropometric measurements of the dimensions of the human body becomes one form to obtain an ergonomic condition. In addition, the design of an electric bicycle must have a tool size compatibility with the dimensions of the human who wears it, which is very important to reduce the occurrence of danger due to work errors and design errors [4].

In the elements of bicycle design, it cannot be separated from ergonomics [[4]. This is because ergonomics or Ergonomics (in English) comes from the Greek, namely Ergo which means work and Nomos means rules or laws. In Indonesia, the meaning of ergonomics is a science and application that needs to harmonize work with the environment on people or vice versa with the aim of achieving maximum productivity and efficiency through optimal human utilization [5]. Ergonomics is closely related to

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designing electric bicycles so that the resulting output can provide an effective, safe, comfortable, healthy and efficient for its users.

To analyze ergonomics, anthropometric measurements are needed. Because humans have several body sizes that are different from each other, so that anthropometric data measurements are needed for various purposes, one of the design of an electric bicycle design is to fit the dimensions of the user's body. Anthropometry is a part of ergonomics which studies body size including linear dimensions, as well as content and also includes areas of size, strength, speed and other aspects of body movement [6].

The use of anthropometry in the design of electric bicycles is worked well so that, users do not feel tired when using them over long distances[7]. In addition, if the size of the bicycle does not suit the user, it can have long-term effects such as muscle injury or joint pain. Therefore, bicycle design must be based on data so that, the resulting product is also on target. In the manufacture of electric bicycles based on anthropometric data. The application of anthropometric data has been widely applied to all aspects of life [2]. one of which is applied to the design of bicycle designs. Also when we use a bicycle that does not fit our body dimensions, we will feel tired and uncomfortable.

Anthropometry is the science of the relationship between the structure and function of the body (including body shape and size) with the design of the tools used by humans[5]. Anthropometric data can be used for various purposes such as the design of work stations, work facilities, and also product design in order to obtain appropriate and appropriate sizes with the dimensions of the human body members who will use them[6]. Then the application of anthropometric data in the design process of electric bicycle designs for students is to determine the sizes of some bicycle parts so that the resulting product can be balanced and also ergonomic. In addition, also so that users or users of bicycles do not experience health problems in the long term such as joint pain, and other health problems.

Therefore, it is necessary to analyze an ergonomic design by applying anthropometric data. For this reason, it is necessary to have CATIA VR5 software in analyzing ergonomic body posture using the RULA method. Based on the description above, this article carries the title "Ergonomic Analysis on E-Bike Product Design with Anthropometric Approach"[8]. This article is considered important, considering that the use of anthropometric data for the manufacture of electric bicycle designs is very necessary so that the products produced are on target and do not cause long-term effects if there is an error in size.

II. RESEARCHMETHOD

In making this electric bicycle design, we measured anthropometric data using several tools such as a meter tape, weight scales, segmometer, elbow ruler and also a chair as a backrest. The sample used is by using data from students of Industrial Engineering, Universitas PGRI Adi Buana Surabaya with a total of 31 students.

The use of anthropometric data in designing electric bicycles for students uses body dimensions, namely arm length, buttock height to floor, popliteal height, ankles to floor, leg width, palm width, hip width, shoulder width and arm length [7].

Then this research uses a quantitative approach, the RULA method with the help of CATIA VR5 software, and anthropometric data measurement is one of the important tools for data collection, the authors use several techniques in data collection, namely observation (observation through pre-existing designs), and measurement anthropometric data[9]. The data that has been obtained will be processed and used to design electric bicycles to be more ergonomic. Anthropometric data collection was carried out in the Ergonomics Laboratory of Industrial Engineering, Universitas PGRI Adi Buana Surabaya in November 2021. This research was carried out systematically and gradually according to Figure 1 as follows:

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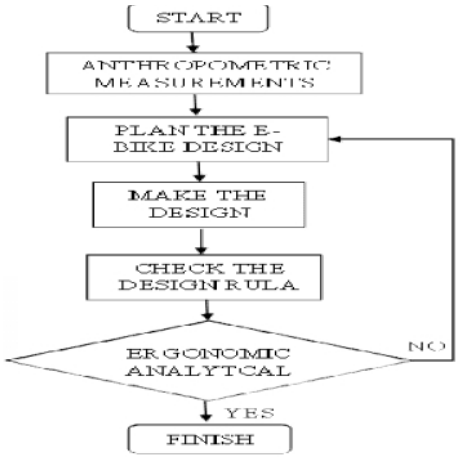

Figure 1. Flowchart Diagram of Planning The Design

III. Results and Discussion

In designing this E-Bike there are several things that need to be considered:

1. The length of the arm used to measure the distance from the saddle to the handlebar.
2. Height of the butt to the floor to measure the distance from the saddle to the floor.
3. Popliteal height is used to measure the distance from the saddle to the footrest.
4. The ankle to the floor is used to measure the height of the footrest
5. Foot width is used to measure the width of the footrest.
6. The width of the palm is used to measure the width of the hand grip on the handlebar.
7. Hip width is used to measure the width of the saddle to be used.
8. Shoulder width is used to measure the width of the handlebar.
9. The length of the hand is used to measure the width of the handlebar grip

Then, in order to develop an electric bicycle (E-Bike), some genuine data is required to identify the most ergonomic size. As a result, we used a sample of 31 Industrial Engineering students from PGRI Adi Buana University Surabaya. We process the data after knowing the sample data to determine the ergonomic size using the existing sample. Several sizes are known based on the measurements taken, as shown in table 1 below.

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Table 1. Anthropometric Data Measurement Results

No.	Nama	Ukuran Tubuh (dalam satuan mm)								
		Lebar Pinggul	Tinggi Pantat ke Lantai	Lebar Tangan	Panjang Tangan	Mata Kaki ke Lantai	Lebar Kaki	Lebar Bahu	Tinggi Popliteal	Panjang Lengan
1	Arief Multi P. D.	390	885	110	190	75	112	430	425	780
2	Ayu Dwi C. K.	340	810	90	160	75	95	380	425	680
3	Putri Nia Luki P.	360	735	90	160	70	90	390	400	650
4	Rama Maulana K.	360	860	110	190	90	100	420	43	770
5	Yunnanta Adi Putra	400	860	90	170	90	100	430	470	760
6	Dida Kristian Adi W.	335	770	95	175	65	110	420	395	690
7	Fani Ardiansyah	380	860	140	180	100	100	400	490	760
8	Sindi Berliyani	350	730	90	175	60	90	380	420	640
9	Wahyu Illahi	370	790	90	170	100	100	430	470	750
10	Dhanny Ar-Royan	425	850	90	170	90	105	480	460	770
11	Alfi Rohmatil M.	400	830	90	180	90	110	460	490	730
12	Muhammad Nizar N.	380	860	115	180	90	120	500	420	770
13	Muhammad Irvan W.	390	860	105	180	70	120	450	420	780
14	Diva Nalurita S.	350	835	85	175	90	85	410	420	700
15	M. Ramadhan N.	360	740	110	160	80	100	380	470	700
16	Andre Puja Kusuma	400	810	100	190	80	110	480	390	700
17	M. Ahsanudin	350	860	110	185	75	100	400	430	750
18	Dimas Tio Pratama	440	860	115	200	100	120	510	480	810
19	Kelvin Fariez Al-Hikam	410	770	85	185	90	100	420	480	750
20	Neysa Ivah Umma	340	755	85	160	60	90	400	415	700
21	Erlita Rusdiana	410	800	90	165	65	100	400	420	675
22	Oki Lilian Purnama	380	810	120	180	90	110	440	420	710
23	Rifka Ayu Laiyyinah	400	760	95	170	100	90	400	420	670
24	Nabila Afni Ulul A.	320	760	90	155	70	95	360	430	660
25	Rivaldo Josua Getrin R.	340	930	100	190	90	100	400	470	800
26	Alif Dwi Prasetyo	400	870	115	195	70	95	460	480	750
27	Putri Amelia Divaio	320	790	90	160	70	90	370	490	680
28	Erika Zahra F.	320	760	95	160	100	95	390	495	660
29	Ahmad Hikam Nuril R.	300	740	90	170	80	85	430	470	700
30	Gerald Binta Syaifudin A.	450	870	125	200	70	120	450	470	720
31	Novia Alvi Andari	340	820	95	180	80	80	400	420	680

Before we analyze the anthropometric data as above, the data adequacy test is carried out first. By using the following formula:

$$N' = \left[\frac{\frac{k}{s}\sqrt{N\sum X^2 - \sum X^2}}{\sum X} \right]^2 \qquad (1)$$

By using the data adequacy formula above, a data adequacy test is calculated using the number of observational data (N) of 31 for each data presented in table 1. If N' N then the data is considered sufficient [10]. So that the

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results obtained as table 2 as follows:

Table 2. Results of the Data Sufficiency Test

No.	Body Size	Test for data adequacy (N')	N'≤ N
1	Hip Width	3,91	Enough
2	Buttocks Height to the Floor	1,62	Enough
3	Hand Width	7,22	Enough
4	Hand Length	2,01	Enough
5	Ankle to the Floor	9,25	Enough
6	Feet Width	4,60	Enough
7	Shoulder Width	3,12	Enough
8	Popliteal Height	12,94	Enough
9	Arm Length	1,66	Enough

The results are acquired from the average in table 3 after acquiring the anthropometric data above and looking for the average in each body size:

Table 3. Average of Body Size

No.	Body Size	Average (mm)
1	Hip Width	371,3
2	Buttocks Height to the Floor	814,2
3	Hand Width	100,0
4	Hand Length	176,1
5	Ankle to the floor	81,5
6	Feet Width	100,5
7	Shoulder Width	421,6
8	Popliteal Height	432,2
9	Arm Length	720,8

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The standard deviation, as well as the 5th and 95th percentiles, are then calculated to determine which size is the most ergonomic. The 5th and 95th percentiles are calculated to determine the adequacy of the data results, which will subsequently be used to select bicycle size. Calculate the sample standard deviation, which is the square root of the sample variance[8], before estimating the size of the 5th and 95th percentiles. The following is the formula:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} \quad (2)$$

Calculate the 5th percentile using the formula 3 after knowing the standard deviation of each body dimension:

$$p \quad 5 = a \quad -(1{,}645 \times s \quad d \quad)$$

The formula for calculate 95th percentile is change the minus to plus so the formula as the fourth bellow:

$$p \quad 95 = a \quad +(1{,}645 \times s \quad d \quad)$$

While the formula for the 95th percentile is to change the – sign to + so that it uses the 4th formula as follows:

Table 4.
Measurement of 5th Percentile and 95 Percentile Deviation

No.	Body Size	Standard Deviation (mm)	Percentile 5 (m)	Percentile 95(mm)
1	Hip Width	37,3	309,9	432,7
2	Buttocks Height to the Floor	52,7	727,5	900,9
3	Hand Width	13,7	77,5	122,5
4	Hand Length	12,7	155,2	197,0
5	Ankle to the Floor	12,6	60,7	102,2
6	Feet Width	11,0	82,5	118,6
7	Shoulder Width	37,9	359,3	483,9
8	Popliteal Height	79,0	302,2	562,2
9	Arm Length	47,2	643,1	798,5

The following findings are achieved after understanding the results of the 5th percentile and 95th percentile calculations, then deciding the size for the e-bike design using the 5th percentile or 95th percentile calculations:

1. The width of the saddle is taken from the size of the 95th percentile hip width, which is 21.5cm
2. The height of the bicycle is taken from the height of the buttocks to the 5th percentile floor, which is 72.7cm
3. The width of the handlebar grip is taken from the size of the 95th percentile hand width, which is 12.2cm
4. The width of the footrest is taken from the size of 2x the width of the 95th percentile foot, which is 23.6cm
5. The length of the handlebar is taken from the 5th percentile shoulder width, which is 35.9cm
6. The distance from the saddle to the footrest is taken from the 95th percentile popliteal height, which is 56.2cm

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7. The distance from the saddle to the handlebar is taken from the 5th percentile arm length, which is 64.3cm

After obtaining the anthropometric size values above, a reference is made to the electric bicycle design that has been made in the CATIA VR5 software, making the E-Bike design as shown in Figure 2, as follows:

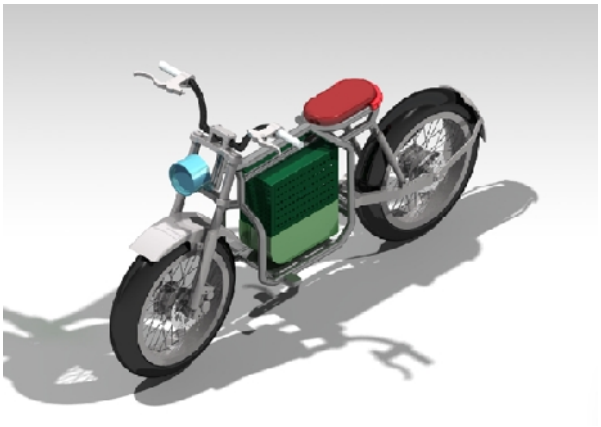

Figure 2. *E-Bike* Design

Then, using the RULA approach and the CATIA VR5 software, an analysis of the ergonomic elements of the electric bicycle design is performed. The goal of this ergonomics analysis is to estimate the value of the rider's risk of injury; the lower the RULA value on the bicycle, the more ergonomic the bicycle. The RULA analysis was performed using a headtube angle of 15° and 17° for comparison, with the goal of determining which angle is the most ergonomic. We chose a 15° headtube angle based on the headtube angle comparison. Figure 3 shows the results of an RULA analysis with a 15° headtube angle:

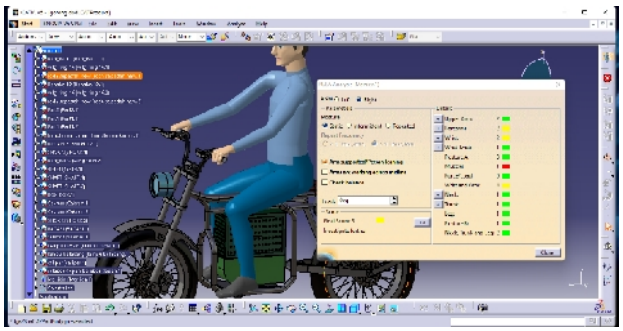

Figure 3. Posture at Headtube Position 15°

The result of the RULA value which shows the most ergonomics is at a headtube angle of 15 ° with a RULA value of 3. This shows that the design of this electric bicycle is quite ergonomic and the design is acceptable, although to be ideal in its body posture, further analysis is needed in order to obtain a better RULA value. Smaller

IV. Conclusion

The conclusion of the research is, before we make the design product we have to measurement the antropometri for determine ergonomic of the product so the product that produced suitable with body posture so it's didn't give long term effect. The antropometri database we get from 31 student of Industrial Engineering Adi Buana Surabaya University with range 19-27 age.

The result of the RULA value which shows the most ergonomics is at a headtube angle of 15 ° with a RULA value of 3. This shows that the design of this electric bicycle is quite ergonomic and the design is acceptable, although to be ideal in its body posture, further analysis is needed in order to obtain a better

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RULA value. Smaller

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Glucose Supply Control Using Silver Meal Heuristic Method at PT. XM Sidoarjo

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Abstract - Inefficient supply of glucose is a problem for PT XM Sidoarjo, where too much raw material inventory can result in high storage costs, or too little inventory causes the production process to stop. The research uses the Silver Meal Heuristic method which is based on future demand, so that the purchase of raw materials can be determined precisely.The company calculates the cost of raw materials and storage for a year using the Company's Real Method is around Rp. 16, 465, 582, 200. If using the Heuristic Silver Meal method, the number of orders for glucose by predicting the optimal number of orders for raw materials to meet the inventory needs every month is 1,050.62 tons at a cost of Rp. 1,261,094,000. so the total cost from January to December 2020 will be Rp 15,133,128,000. Thus the savings that can be made from January to December 2020 is Rp. 1,332,454,200 with an efficiency of 8.09%.

Keywords: Inventory Control, Silver Meal Heuristic Method, Glucose Raw Material.

1. INTRODUCTION

The role of the compounding process in the production process creates dependency on the availability of glucose at PT. XM Sidoarjowhich become an important aspect that needs to be considered by the company. The supply factor for glucose raw materials areoften a problem and causes inefficiency, where sometimes the inventory is too excessive which results in high storage costs, sometimes the inventory is too small, causing the production process to stop and unable to meet production targets on time (Nasution, 2006). In order to ensure the smooth production process on time, a research was conducted using the Silver Meal Heuristic method.

According to Ariyani (2010), inventory control is a major concern for the company because it's large portion, which is around 40% of the total invested capital. According to Assauri (1999), the total cost in a certain period is the sum of the purchase cost, ordering cost and storage cost, where Total Cost = Purchase Cost + Ordering Cost + Storage Cost

The Silver Meal Heuristic method in its calculation is based more on the purchase period variable and not based on the total demand during the planning period (Assauri, 1999).

The purpose of this study was to obtain the optimal total cost of supply and glucose requirements using the Silver Meal Heuristic method and to compare the efficiency using the company's Real method with the Silver Meal Heuristic method.

2. RESEARCH METHOD

2.1. Data collection

Data from PT. XM in Sidoarjo, was taken in 2019 through the company's internal data.The dependent variable in this study is the minimum total inventory cost. The independent variables in this study are the purchase cost, the need per period, the cost of ordering, the cost of storage and the cost of raw materials.

2.2. Data processing

Data processing for inventory control planning begins with performing calculations such as the following steps:

a. Calculating average inventory cost

Determination of the average cost per period is the number of periods in increasing orders, according to Riggs (1981) in Fuad (2011).

$$A \quad u \quad c \quad = \frac{(O \quad F \quad) + (T \quad .S \quad F \quad A \; E \quad o \; P \quad T)}{T}$$

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Or :

Where :

AC = Average cost of raw materials

TU

D_T = Demand during period T

b. Calculating the level of cost efficiency

$$Eff = \frac{TC_A - TC_B}{TC_A} x100\%$$

Where :

TCA = Total Cost of the company's inventory control policies

TCB = Total Cost Calculation of the Silver Meal Heuristic.

Eff = Cost efficiency rate

O = Cost per ordering

H = Cost of holding per unit per period

T = Period

3. RESULTS AND DISCUSSION

The calculation of the remaining glucose raw materials for the period January 2019 to February 2019 is as follows:

a. Leftover January 2019 (ton) =

Order – Requirement + Starting Balance = 1.140,00 – 1.050,62 + 53,72= 143,10 ton

b. LeftoverFebruary 2019 (ton)

= 1.380,00 – 1.150,71 + 143,10= 372,39 ton

Furthermore, the calculation of the remaining glucose for the period March 2019 - December 2019 using the same formula as the above formula then the results are entered in Table 1.

Table 1.Order Data and Glucose Needs (tons)
Period : January 2019 – December 2019

No	Month	Order (Ton)	Beginning Inventory(Ton)	Needs (Ton)	Ending Inventory(Ton)
1	Jan'19	1.140,00	53,72	1.050,62	143,10
2	Feb'19	1.380,00	143,10	1.150,71	372,39
3	Mar '19	1.080,00	372,39	1.221,04	224,15
4	Apr '19	1.110,00	224,15	1.111,35	222,80
5	May ‘19	1.230,00	222,80	1.138,49	302,10
6	Jun ‘19	1.020,00	302,10	1.153,98	168,11
7	Jul ‘19	930,00	168,11	887,76	210,36
8	Agust‘19	1.290,00	210,36	1.175,29	379,64
9	Sep‘19	1.020,00	379,64	1.143,32	256,33
10	Oct ‘19	1.200,00	256,33	1.155,55	252,59
11	Nov ‘19	990,00	252,59	1.118,75	243,22
12	Dec ‘19	1.170,00	243,22	1.050,62	362,60

Cost Data at PT. XM Sidoarjo

- Glucose price per ton = Rp. 1,200,000
- Glucose order fee is Rp. 350,000 per order, which includes transportation costs of Rp. 300,000 and administration fee of Rp. 50,000
- The cost of storing glucose Rp. 60,000 obtained from the company's policy of 5% of the price of Glucose per tonne Rp. 1,200,000

Data processing of raw material inventory control Glucose using the Company's Real Method (TCA), namely the calculation of storage costs, purchase costs, and the total cost of the company's real method (TCA) for the period January 2019 - February 2019 as follows:

a. January 2019

- Storage CostJanuary 2019 = 143,10 ton x Rp. 60.000 = Rp. 8.586.000.

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- Purchasing CostJanuary 2019 = 1.140,00 ton x Rp. 1.200.000 = Rp. 1.368.000.000
- Total cost January 2019 = Rp. 350.000 + Rp. 8.586.000 + Rp. 1.368.000.000= Rp. 1.376.936.000

b. February 2019

- Storage CostFebruary 2019 = 372,39 ton x Rp. 60.000= Rp. 22.343.400
- Purchasing CostFebruary 2019 = 1.1380,00ton x Rp. 1.200.000 = Rp.1.656.000.000
- Total cost February 2019 = Rp. 350.000 + Rp. 22.343.400 + Rp. 1.656.000.000= Rp. 1.678.693.400

For the calculation of storage costs, purchase costs, and the total cost of the company's real method (TCA) for the period March 2019 to December 2019 the same calculation is carried out and the results are in Table 2.

Table 2. Company Real Method Calculation Results

No	Month	Storage Cost (Rp)	Purchase Cost (Rp)	**Total(Rp)**
1	Jan '19	8.586.000	1.380.000.000	1.376.936.000
2	Feb '19	22.343.400	1.656.000.000	1.678.693.400
3	Mar '19	13.449.000	1.296.000.000	1.309.779.000
4	Apr '19	13.368.000	1.333.200.000	1.346.918.000
5	Mei '19	18.126.000	1.476.000.000	1.494.476.000
6	Jun'19	10.086.600	1.224.000.000	1.234.436.000
7	Jul '19	12.621.000	1.116.000.000	1.128.971.000
8	Ags '19	22.778.400	1.548.000.000	1.571.128.400
9	Sep '19	15.379.800	1.224.000.000	1.239.729.800
10	Okt '19	15.115.400	1.440.000.000	1.455.465.400
11	Nov '19	14.593.200	1.188.000.000	1.202.943.200
12	Des '19	21.756.000	1.404.000.000	1.426.106.000
Total Cost (Rp)				16.465.582.200

From the calculation for a year in table 2, the results of the Company's Real Method are Rp. 16,465,582,200. The calculation of the average cost of glucose raw materials using the Heuristic Silver Meal method is:

$$A \quad u \quad c \quad = \frac{(O \quad F \quad) + (T \quad .S \quad F \quad A \; E \quad o \; P \quad T)}{T}$$

Or :

$$\frac{\mathrm{AC}}{\mathrm{TU}} = \frac{0 + [1-1)\mathrm{D1} + (2-1)\mathrm{D2} + \cdots + (\mathrm{T}-1)\ \mathrm{DT}]\ (\mathrm{H})}{T}$$

a. January 2019 (T = 1)

$$\frac{AC}{TU} = \frac{350.000 + [(1-1)1.050{,}62]60.000}{1} = \text{Rp. } 350.000$$

b. Februari 2019 (T = 2)

$$\frac{AC}{TU} = \frac{350.000 + [(1-1)1.050{,}62 + (2-1)1.150{,}71]60.000}{2} =$$

Rp. 34.696.300

For the months of March 2019 to December 2019 the same calculation is carried out with the above formula. Then from the results of all calculations are entered in Table 3

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Table 3. Average cost calculation results for January – December 2019

No.	Period	T	AC TU (rupiah)	Repurchasing
1	January ‘19	1	350.000	
2	February ‘19	2	34.696.300	1.150,71
3	March ‘19	3	71.972.467	2.021,33
4	April ‘19	4	103.990.100	3.442,28
5	May ‘19	5	137.769.600	4.553,63
6	June ‘19	6	172.565.333	5.672,12
7	July ‘19	7	195.569.371	6.826,1
8	August ‘19	8	231.071.725	7.713,86
9	September ‘19	9	266.374.156	8.889,15
10	October ‘19	10	302.136.440	10.032,47
11	November ‘19	11	335.692.218	11.188,02
12	December ‘19	12	365.501.967	12.306,77

From the glucose requirement data needed by the company for the January – December 2019 period, the results of the Exponential Smoothing Heuristic Silver Meal forecasting using the WinQSB Software were obtained as follows:Table 4. Pengolahan Data dengan Software WinQSB

Table 4. Pengolahan Data dengan Software WinQSB

Month	Needs in Total (Ton)
Jan '20	1.050,62
Feb '20	1.050,62
Mar '20	1.050,62
Apr '20	1.050,62
Mei '20	1.050,62
Juni '20	1.050,62
Juli '20	1.050,62
Agust'20	1.050,62
Sep '20	1.050,62
Okt '20	1.050,62
Nov '20	1.050,62
Des '20	1.050,62

Forecasting calculation results in table 4 can be calculated the purchase cost and the total in table 5. The cost of storage and the total cost of glucose inventory is as follows:

- January 2020

Purchasing Cost :
1.050,62 ton x Rp 1.200.000 = Rp. 1.260.774.000
Storage Cost :

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0 ton x Rp. 60.000 = Rp. 0
Rp 350.000 + Rp 1.260.774.000+ Rp0
= Rp. 1.261.094.000

1.050,62 tonx Rp.1.200.000=
Rp.1.260.774.000
Storage Cost:
0 ton x Rp. 60.000 = Rp. 0
Total cost :
Rp 350.000 + Rp 1.260.774.000 + Rp. 0

Total cost :

- February 2020
  Purchasing Cost:

= Rp. 1.261.094.000
For the calculation of March 2020 - December 2020, the calculation is carried out the same as the calculation above, then the results can be seen in Table 5.

Table 5.Glucose Inventory Using the Silver Meal Heuristic Method

Month	Needs (Ton)	Order Cost (Rp)	Purchasing Cost (Rp)	Total (Rp)
Jan '20	1.050,62	350.000	1.260.744.000	1.261.094.000
Feb '20	1.050,62	350.000	1.260.744.000	1.261.094.000
Mar '20	1.050,62	350.000	1.260.744.000	1.261.094.000
Apr '20	1.050,62	350.000	1.260.744.000	1.261.094.000
Mei '20	1.050,62	350.000	1.260.744.000	1.261.094.000
Juni '20	1.050,62	350.000	1.260.744.000	1.261.094.000
Juli '20	1.050,62	350.000	1.260.744.000	1.261.094.000
Agus'20	1.050,62	350.000	1.260.744.000	1.261.094.000
Sep '20	1.050,62	350.000	1.260.744.000	1.261.094.000
Okt '20	1.050,62	350.000	1.260.744.000	1.261.094.000
Nov '20	1.050,62	350.000	1.260.744.000	1.261.094.000
Des '20	1.050,62	350.000	1.260.744.000	1.261.094.000
				15.133.128.000

In table 5, the calculation using the Silver Meal Heuristic Method obtained a total cost of Rp. 15,133,128,000. Meanwhile, with the real method or the method used by the company at this time, it was obtained Rp. 16,465,582,200 so that the difference was Rp. 1,332,454,200 which is the profit of the company

Data Processing Efficiency Level
The calculation of the efficiency level is as follows:

$$Eff = \frac{TCA - TCB}{TCA} \times 100\%$$

$$Eff = \frac{16.465.582.200 - 15.133.128.000}{16.465.582.200} \times 100\% = 8.09\%$$

4. CONCLUSION

From the research results can be drawn a conclusion, namely:

a. The total result from January 2019 to December 2019 using the Company's Real Method is Rp. 16,465,582,200.
b. The optimal number of orders for glucose in order to meet the needs of production supplies every month is 1,050.62 with a total cost of Rp. 1,261,094,000. so the total cost from January to December 2020 will be 15,133,128,000
c. By using the Silver Meal Heuristic method, the total cost of Glucose inventory (TCA) is Rp. 15,133,128,000. which turns out to be more minimum and efficient when compared to the company's total real inventory cost, namely
   Rp. 16,465,582,200.
d. Thus the savings can be done in the next year is Rp. 1,332,454,200 with an efficiency of 8.09%

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