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Improvement of Lead Time Outertube Production Process Through Application of Lean Manufacturing At PT. Ki

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Abstract: The study of improving the lead time process in the KI company is carried out to improve the company's performance in obtaining economic value in each of its production processes. The data collected are data on the production performance of outertube parts in KI companies in the time period from 2017 to 2021 which includes samples of timely delivery data, outertube part rejection data, breakdown machines and outertube process flow. Analyzed by method 7 Waste, 4M-1E, fishbone diagram, & method 5W-1H. The conclusion of this research process is to identify the root cause of the problem of high process lead time, rejection part outertube ratio, machine breakdown and outertube material flow conditions, for further improvement, in relation to the level of on-time delivery (On time Delivery).

Keywords: Lean Manufacturing, Lead Time, On Time Delivery, Outertube, Rejection

I. INTRODUCTION

In this study conducted at PT. KI is a company engaged in the production of automotive parts, which strives to continue to improve competitiveness and realize an effective, efficient & profitable organization. The activities carried out are minimizing work that does not have added value or is called waste (waste) both in the form of overproduction (over production), waiting time (waiting time), unnecessary transportation (transportation), processing excessive (Processing), excess inventory (inventory), unnecessary movement (motion) or defective products (defects).

In the world of industry, competition between companies is very fierce, in the field of shockbreakers in Indonesia there is one competitor from PT. KI, namely PT.SI, in the data on the use of shockbreakers in Indonesia is almost balanced, namely PT. KI : 60% & PT.SI : 40%), so there is only a difference of 10%. With this small percentage difference data, it is possible that PT. KI will be easily rivaled if it does not innovate in carrying out production strategies and processes. Meanwhile, from the net profit data in 2020 PT. KI occupies the last position among one group of automotive component companies (PT. AB 7%, PT. CB 3.8%, & PT. KI 1.4%). Likewise, when we look at shockbreaker sales data compared to one group of automotive component companies PT. KI is also the lowest pareto (PT. CB 2M, PT. AB 1.6M, & PT. KI 1.2M) means that the company's sales still need an increase.

Therefore, in order to increase sales &increase company profits, the company must make continuous improvements so that the company's performance is more effective and efficient, in line with this (Pratama & Sulistyowati, 2019) [1] concluded that there is a relationship between quality management and operational performance. From the company's performance data that has been collected, important factors to increase customer satisfaction, one of which is the factor of accuracy in delivery (on time delivery), so that customer demand for goods and services can be met as quickly as possible. After conducting research at PT. The problem that affects the late delivery is the high rejection factor, engine breakdown, high leadtime.

II. LITERATURE REVIEW

2.1 Lean Manufacturing

Lean manufacturing refers to continuous efforts to eliminate waste and increase the added value of a product or service, thereby providing customer value. According to (Gasperz, 2011) [2]. Lean manufacturing is a continuous effort to eliminate waste that occurs in industrial companies and increase the added value of products (goods and / or services) in order to provide value to customers (customer value). The main principle of the lean method is to reduce or eliminate waste. The seven types of waste include:

1. Defects, that is, waste in the wrong form in the process of handling product quality problems, or poor performance of goods or services.
2. Over production, refers to excessive production activities or excessive movement of goods and supplies.
3. Waiting is a waste caused by the inactivity of people, information or goods for a long time, which will result in a halt in the process and a long delivery time.
4. Unnecessary Inventory, is a waste caused by excessive storage and delays.
5. Improper handling (waste of products) refers to waste caused by the use of a set of equipment, procedures or systems that do not meet the working capacity

6. Excessive transportation is a waste of personnel and excessive transmission of goods resulting in a waste of time and effort.
7. Unnecessary Motion is a waste of adverse motion in the workplace, resulting in poor ergonomics.

2.2 Lead Time Process

Lead Time refers to the time required between the beginning and completion of an operation or project in a company, according to (Assauri, 2008: 264) [3] lead time is also the length of time between the start of ordering materials to the arrival of the ordered materials and received in the inventory warehouse. Lead Time is influenced by the transport operator, the frequency and size of the buyer's order, and the supplier's production plan, and can be deterministic or random. The lead time of a manufacturing company basically consists of several elements or variables, including: Lead Time = pre-process time + processing time + waiting time + delivery time + inspection time + storage time

a) Pre-processing Time : The time it takes to receive the request, understand the request, and make a purchase order.
b) Processing Time : The time required to manufacture or purchase the goods.
c) Waiting time : The time it takes to wait in the production queue.
d) Delivery time : The time when the goods arrive at the customer in transit.
e) Inspection time: the time required to check whether the product is unqualified.
f) Storage time: The waiting time for goods in the warehouse or factory.

2.3 Motorcycle Front Suspension

The front suspension of the motorcycle is part of the wheel steering system that affects the stability of the motorcycle control system consisting of outertube, innertube & underbraket components
In general, motorcycle front suspension is also divided into two types, namely:

1. Bottom Link, this type has a swingarm structure mounted on the front axle, divided into two
2. Telescopic, the suspension is based on the up and down movement of the fork tube, with the help of spring pressure, to play the role of damping.

2.4 Outertube

Outertube is one of the components of a two-wheeled vehicle made of aluminum material connected to the front axle of a motorcycle, which is used as a barrier for vibration and wheel collision with the road surface

III. RESEARCH METHODOLOGY

The analysis step in this study begins with the process of finding process problems that occur in the company from the results of brainstorming (Focus discusion group) together with related parties such as the production, warehouse, engineering, and superiors of each area, to be further systematically compiled as objects, indicators & methodologies used in the research

3.1 5W-1H Analysis Method

In observations related to problems found in the company such as lead time problems, after the 4M-1E factor analysis is carried out, then a 5W-1H analysis is used to develop an improvement plan to be carried out.

Table 1. How to Use the 5W-1H Method Analysis

TYPE	5W1H	DESCRIPTION	ACTION
The main purpose of What ?	What ?	What became the main tearget and improvement / improvement of the implementation of quality management ?	Formulate targets according to needs
Reasons for Usefulness	Why ?	why is the repair plan necessary ?	
Location	Where ?	Where is the improvement plan implemented?	Change the order of activities / combinations
Squence (Order)	When ?	When will the repair plan be implemented?	
People	Who ?	Who's working on the fix?	
Method	How ?	How to implement the improvement plan?	Simplify existing repair plans

3.2 4M-1E Analysis Method & Fishbone Diagram

The 4M-1E analysis method is a method used for the analysis of factors related to problems that occur in the company, such as factor man (man), material (material), machine (machine), methode (method) & environment (environment) which can then be described in causal analysis.

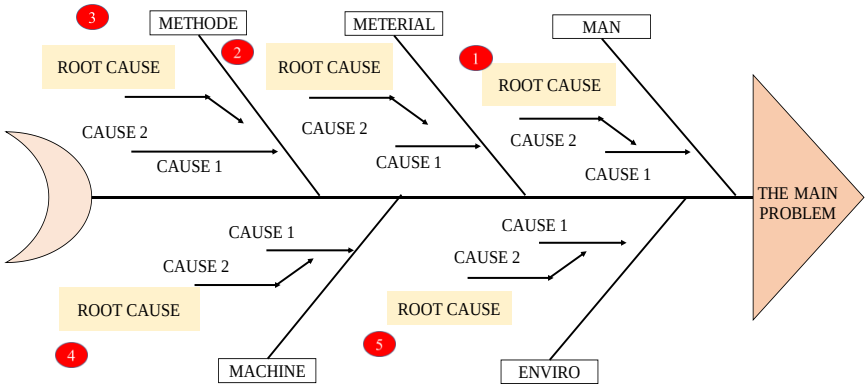

Figure 1. Steps to Use Fishbone Diagram

A cause and effect diagram is a quality control tool used to identify and display cause and effect relationships to find the root cause of the problem, because it looks like a fish bone, so the causal diagram is also called a fishbone diagram (Fishbone Diagram)

IV. RESULTS & DISCUSSION

The data collected in this study began with taking on-time delivery data that had occurred in the period 2018 to 2020.

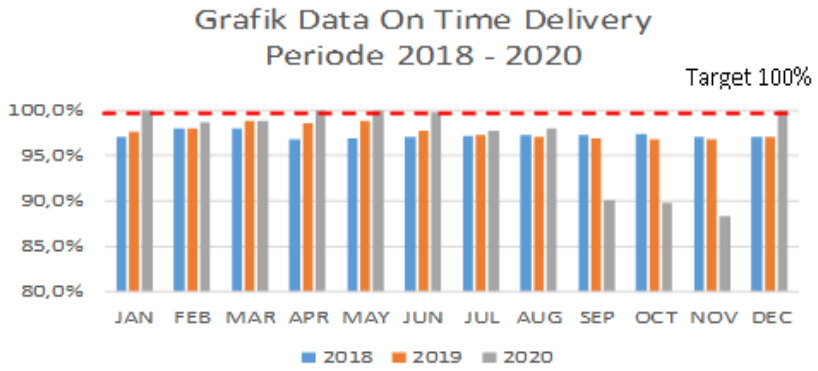

Figure 2. Data Graph Ontime Delivery PT. Ki

From the target data of 100% delivery during the period 2018 to 2020 there was a problem, so there was a difference from the target. It can be seen that the achievement of on-time delivery only occurred in 2020, the worst condition occurred in 2018 where the best achievement was only 98%, from these data, further research was carried out regarding what problems made the delivery not reach the 100% target (delay in delivery).

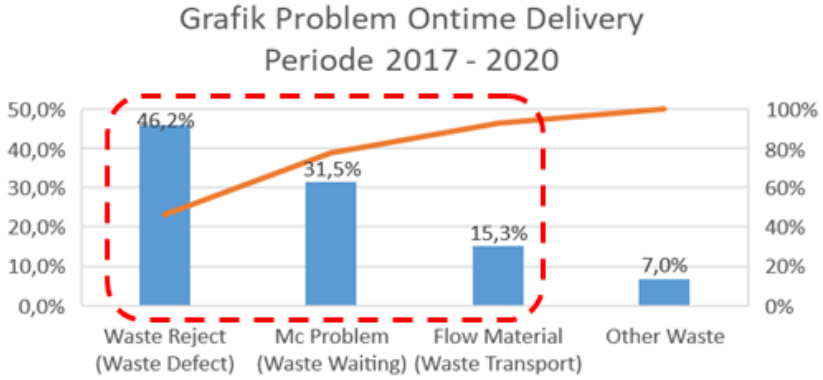

Figure 3. Data Graph Causes Problems On Time Delivery

The results of collecting data on problems that occur in the delivery process (on time delivery) there are 3 problems with the highest percentage including problem rejection (waste defect), machine problem (waste waiting) and material flow (waste transport). Where the problem of on time delivery caused by the problem reject is 46.2%, the problem that occurs by the problem of a damaged machine is 31.5%, & the problem is due to material flow of 15.3%. this is what will then be focused on to be examined in more depth. After being carried out, there was a type of rejection in the period from 2017 to 2020. The problem of kropos rejection is the highest pareto almost every year, with the highest condition in 2018 rejection kropos of 13%.

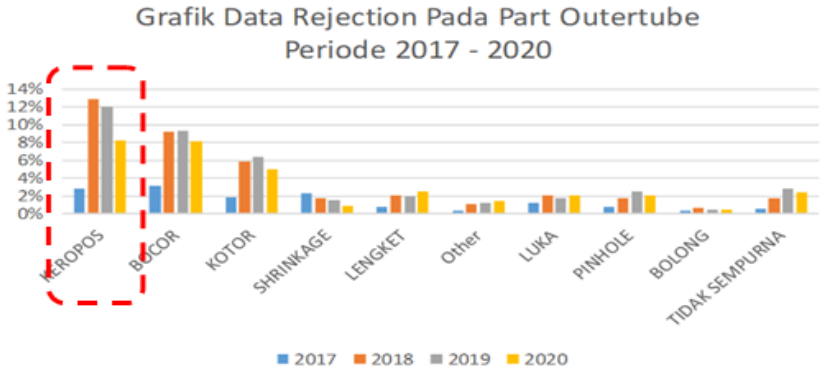

Figure 4. Data Graph of Rejection Finding Type On Part OutertubePareto engine problems that often have problems occur in manual gravity, which is 50.7%

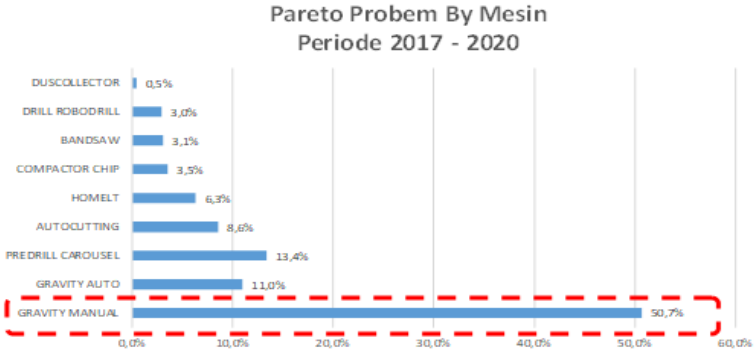

Figure 5. Pareto Probem Machine Graph

While in the material flow, the longest process occurs in 2 parts of the process, namely the Outertube Casting process (75,802 seconds) and outertube Painting (72,200 seconds) to produce 1 set of material. this is caused by waste in the process, so it is felt that it has the potential to be improved in order to reduce the lead time of the outertube process at a more optimal stage. As concluded (Erry Rimawan, 2020) [4] improvements in the composition of the work station can result in a smoother production flow.

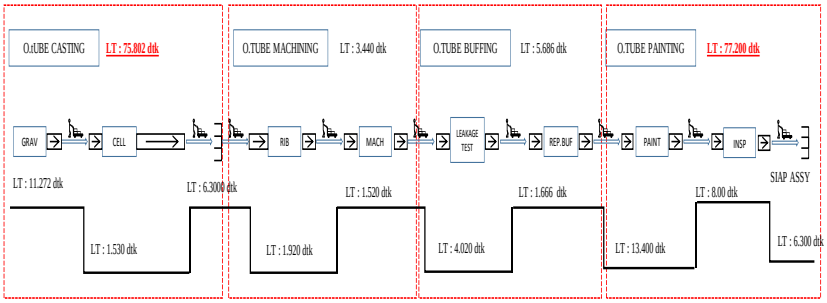

Figure 6. Flow Material Outertube

4.1 Fishbone Analysis Diagrams & 5W-1H

In problem solving begins with identifying problems with 4M-1E, further spelled out using a fishbone diagram.

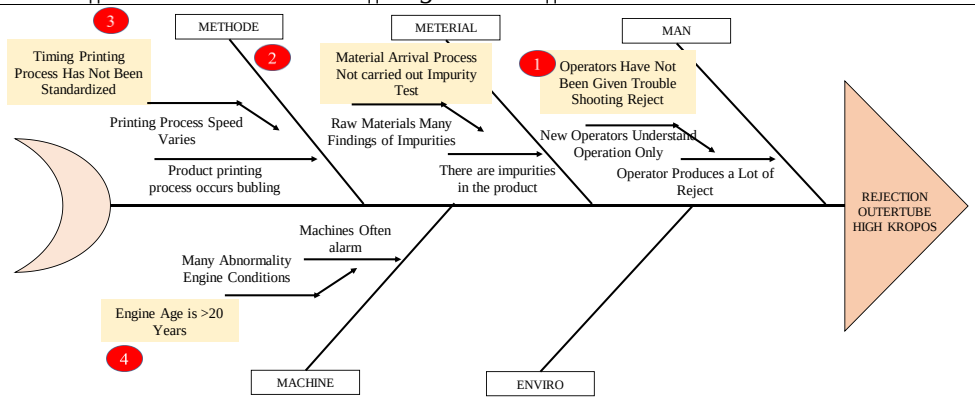

Figure 7. Fishbone Diagram Problem Rejection Outertube Kropos

The next step is to conduct an analysis using the 5W-1H method from the findings of 4 root causes of the problem, so that it can be analyzed for the problem, the cause, and what actions will be taken next on the problem

Table 2. 5W-1H Analysis Data Problem Rejection Outertube Kropos

DETERMINATION OF ACTIONS WITH 5W-1H					Participants :	
Problem Title :		REJECTION OUTERTUBE HIGH KROPOS			ADT, EKW, EDY, EKO, SY, GFA, ALK, PND, TB, SR	
Area Improvement		Outertube Casting				
NO	WHAT	WHY	HOW	WHERE	WHEN	WHO
	PROBLEM	MAIN CAUSES	CORRECTIVE ACTION	WHERE	WHEN	PIC
1	Operator Produces a Lot of Reject	Operators Have Not Been Given Trouble Shooting Reject	Training Conducted Training Related to Traouble Shooting Reject	Training Centre	Jan 2021	Produksi
2	There are impurities in the product	Material Arrival Process Not carried out Impurity Test	Carried out Testing of material impurities upon arrival (minimum sampling)	Incoming	Mar 2021	Quality
3	Product printing process occurs bubling	Timing Printing Process Has Not Been Standardized	The study of standardization timings proper printing according to the model	Area O.utertube Casting	Feb 2021	Engineering
4	Machines Often alarm	Engine Age is >20 Years	Submission of engine rejuvenation (overhoul)	Gravity Engine	Feb 2021	Engineering

Analysis of the problem of the high breakdown time of the manual gravity machine in the outertube production process, found 7 root problems that resulted in the breakdown of a high manual gravity machine

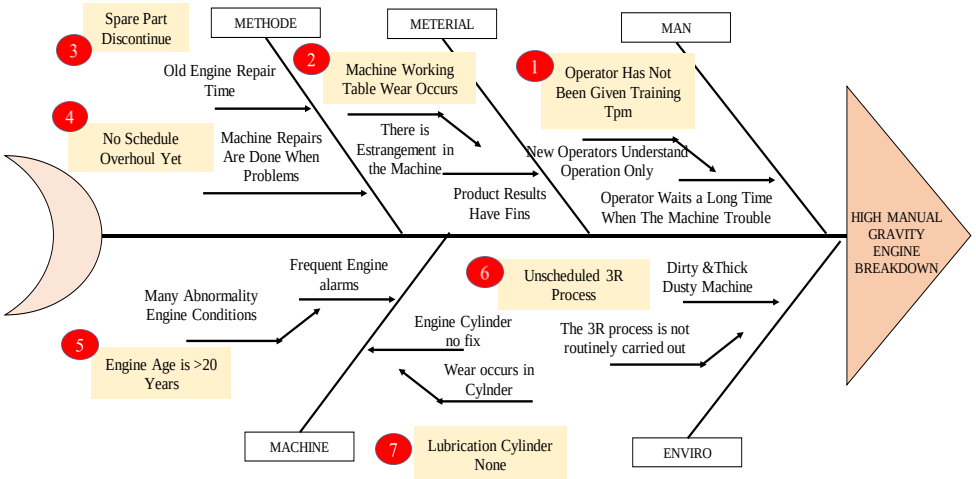

Figure 8. Fishbone Diagram of High Engine Breakdown Problem

After the engine breakdown problem is described in the fishbone diagram, then the root of the problem that arises is analyzed using 5W-1H to find corrective actions and who is the person in charge (PIC) who must be coordinated to follow up the problem.

Table 3. 5W-1H Analysis Data Problem Breakdown Gravity Machine

DETERMINATION OF ACTIONS WITH 5W-1H					Participants :	
Problem Title :		HIGH MANUAL GRAVITY ENGINE BREAKDOWN			ADT, EKW, EDY, EKO, SY, GFA, ALK, PND, TB, SR	
Area Improvement		Outertube Casting				
NO	WHAT	WHY	HOW	WHERE	WHEN	WHO
	PROBLEM	MAIN CAUSES	CORRECTIVE ACTION	WHERE	WHEN	PIC
1	Operator Waits a Long Time When The Machine Trouble	Operator Has Not Been Given Training Tpm	Conducted Basic Skill Training Related to Technical Machine Maintenance (Total Preventive Maintenance)	Area Outertube Casting	Jan 2021	Production
2	Product Results Have Fins	Machine Working Table Wear Occurs	Machine Working Table Repair	Gravity Engine	Feb 2021	Maintenance
3	Old Engine Repair Time	Spare Part Discontinue	Manufacture of Spare Parts In Internal Whorksop	Gravity Engine	Feb 2021	Maintenance
4	Machine Repairs Are Done When Problems	No Schedule Overhoul Yet	Making a Machine Overhoul Schedule Submission	Gravity Engine	Jan 2021	Engineering
5	Frequent Engine alarms	Engine Age is >20 Years	Machine Rejuvenation Submission (Overhoul)	Gravity Engine	Mar 2021	Engineering
6	Dirty &Thick Dusty Machine	Unscheduled 3R Process	3R Process Scheduling On Machine	Gravity Engine	Jan 2021	Production
7	Oblak Engine Cylinder	Lubrication Cylinder None	Routine Cylinder Lubrication	Gravity Engine	Jan 2021	Maintenance

The depiction of the fishbone diagram below was carried out after analysis of 4M-1E related to the problem of too high material flow time, from the results of the study found 5 roots of the problem of high material flow, for further elaboration with the 5W-1H method which includes problems and corrective actions to be carried out

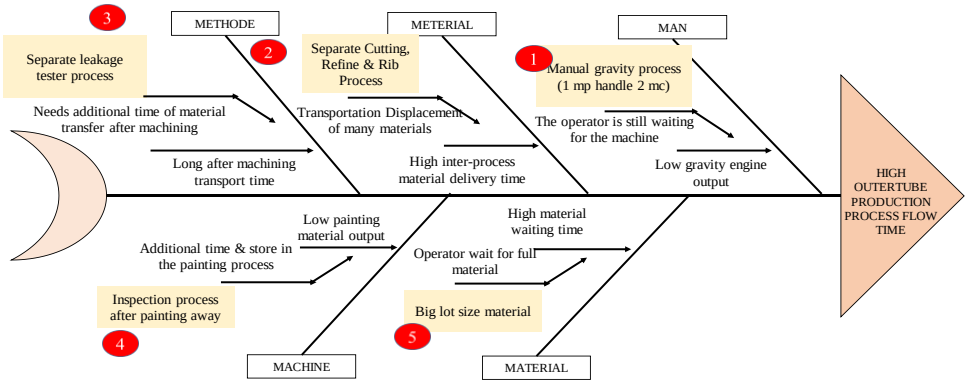

Figure 9. Fishbone Diagram of The Problem of High Material Flow Time

Table 4. 5W-1H Analysis Data Problem High Material Flow Time

DETERMINATION OF ACTIONS WITH 5W-1H					Participants :	
Problem Title :		HIGH PRODUCTION PROCESS FLOW TIME			ADT, EKW, EDY, EKO, SY, GFA, ALK, PND, TB, SR	
Area Improvement		Outertube Proses				
NO	WHAT	WHY	HOW	WHERE	WHEN	WHO
	PROBLEM	MAIN CAUSES	CORRECTIVE ACTION	WHERE	WHEN	PIC
1	Low gravity engine output	Manual gravity process (1 mp handle 2 mc)	Combine gravity machine to 3 mc in 1 robot handle, with 1 operator	Gravity Engine	Apr 2021	Engineering
2	High inter-process material delivery time	Separate Cutting, Refine & Rib Process	Combining the Process of Cutting, Refine &Ing Rib into one whole (Auto Cutt-Rib)	Mesin Auto Cutt-Rib	Apr 2021	Prod. System - Enggineering
3	Long after machining transport time	Separate leakage tester process	Relayout Process Leakage test is close to line machining	Machining - Leakage test	Jun 2021	Prod. System - Enggineering
4	Low painting material output	Inspection process after painting away	Relayout inspection painting process from outline to inline	Painting	July 2021	Prod. System - Enggineering
5	High material waiting time	big lot size material	Lowering lot size material from per 20 sets to per 10 sets	Area Outertube Proses	July 2021	Prod. System

4.2 Improvement Results

From taking data on time delivery for the period 2021 to June 2022, there are quite good changes, where the average achievement every month is 99.5% (2021) & 99.8% (2022 to June), this is inseparable from the improvement of problems that occur in decreasing process lead time, controlling damaged machines, and rejection

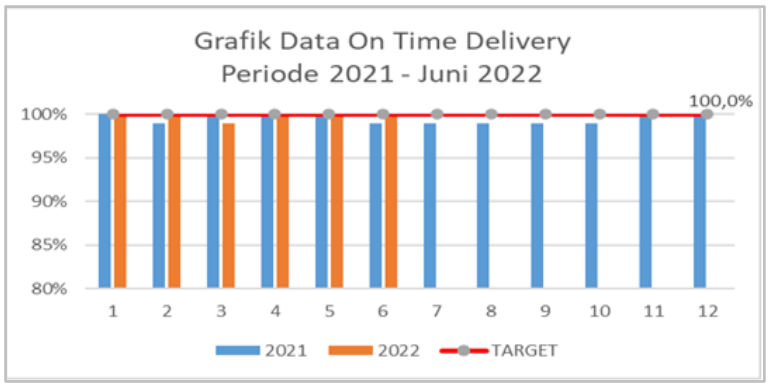

Figure 10. Ontime delivery data graph

Rejection of the process on the outertube part has decreased, after analysis &improvement, from previously in 2017 it was estimated at 16%, to 9% in 2019 or to 6% in the middle of 2022

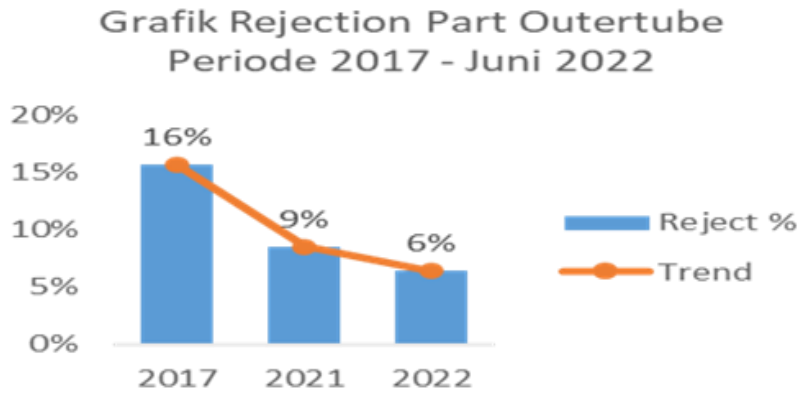

Figure 11. Outertube Rejection Part Chart

The results of the evaluation of the engine breakdown, there was a decrease in the engine breakdown index in the outertube casting process from a peak of 0.56 in 2020, to 0.22 in June 2022, or there was a decrease in the machine breakdown index by 60%.

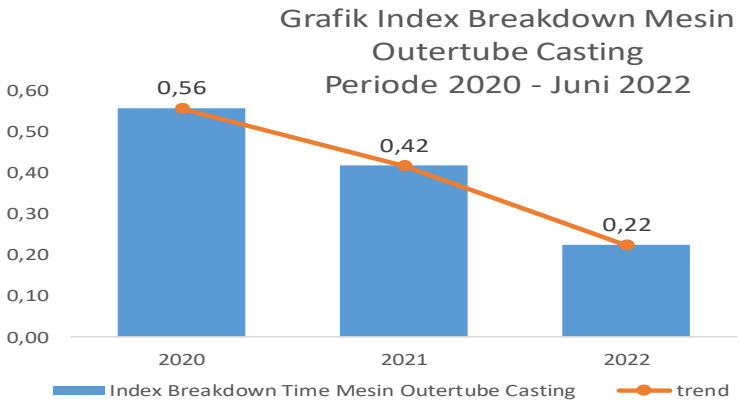

Figure 12. Index Breakdown Graph of Outertube Casting Machine

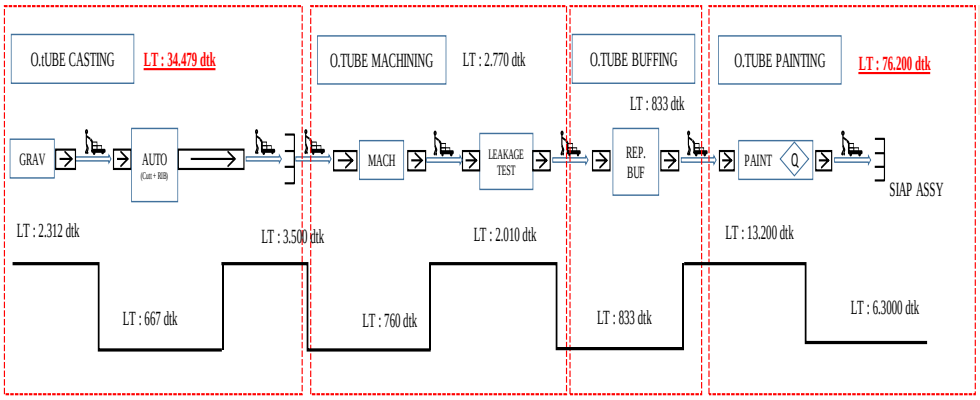

Figure 13. Flow Material Outertube Casting

There are several items of material flow process improvement carried out, namely:

1. In the casting process, by carrying out gravity machine automation from the previous 2 machines operated by 1 operator changed, to 3 machines operated by 1 robot and 1 operator as a loading & unloading material process (previously 11,272 seconds to 2,312 seconds).
2. The combination of the rib process in outertube machining with the cell process in outertube casting becomes an auto cut-rib process (previously 1,350 seconds to 667 seconds).
3. The painting process, which is by bringing the layout of the outertube painting process closer to the inspection process, thus eliminating the transportation process from painting to inspection (previously 14,200 seconds, to 13,200 seconds).
4. In addition to the process in the machine, the change of lot size is also an improvement item, in accordance with the lean principle of waste inventory, where the smaller the size per lot, the faster it will run (previously 20 sets, to 10 sets)

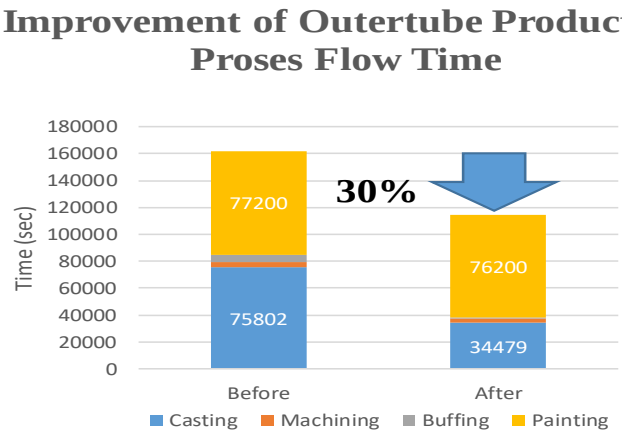

Figure 14. Results of Improvement of Outertube Casting Material Flow

From the improvements that have been made to the production process flow, it has a positive impact on the improvement of the lead time of the outertube part production process., that there is a decrease in the lead time of the outertube production process which is quite good, which is 30% from the previous process, this is in line with (Sri Ngadono, Teguh, Rokhim, M, & Fitri Ikatrinasari. Z, 2020) [5] that the implementation of lean manufacturing can reduce leadtime processes.

V. CONCLUSION

From the results of research conducted at PT. KI, there are 3 main problems that cause disruptions in on time delivery, namely:

1. Problem rejection
2. Problem breakdown machine,
3. Problem of high material flow time

The above is detrimental to the company, because the cause of the lead time process is hampered and delivery is delayed, as well as causing the company's costs to swell and waste resources in the work area. The application of lean manufacturing in the production line is quite optimal, as a tool to improve the lead time of the process, by analyzing what waste occurs in the process

5.1 Recommendations

As a suggestion and recommendation for KI companies, it is hoped that the company can conduct an in-depth analysis of the problems that occur in the production process related to waste, using lean manufacturing methodology (7 waste), 4M-1E, fishbone diagrams & 5W-1H as a detailed description of the analysis, so that the risk of problems on time delivery can be minimized or even eliminated as soon as possible.

VI. ACKNOWLEDGMENTS

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