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Productivity Improvement Planning From Recorded Downtime Using 5M (Fish Bone Diagram) Method

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***Abstract*— The rapid development of cultivated fish causes the demand for fish feed to increase every year. This is an opportunity as well as a challenge for companies engaged in animal feed. One of the problems in dealing with the increasing demand for fish feed is the limited ability of the machine to meet the desired production. The increase in sales made the management add a new production line engaged in floating fish feed. After done mass production at the location of this research carried out within the scope of production, the production target with a value of 200Ton/day has not been achieved. There are several problems that occur in daily production so that at the time of the initial research, the average production achievement was only 150Ton/Day with total downtime reach 8,019 minutes in March 2021 or if converted to a tonnage of 50Ton/Day. In order to make improvements to the production results, the following method is used downtime analysis and Forum Group Discussion with analysis method Fishbone (5M: Man, Machine, Method, Material and Mother Nature) and Analyze 5Why by searching *Action Plan* to be carried out and make a Productivity Improvement Plan. Result of analysis downtime with the 5M method, a productivity improvement plan is obtained with the result by the analysis which can be improved, which Man 11.32Ton/Day, Machine 23.93 Tons/Day, Material total of 11.41Ton/Day and Method amount 4.12Ton/day. By doing action plan to the increase in productivity, there is an increase in productivity above the target starting in July 2021 with production achievements with anaverage of 209.4Ton/Day.**

***Index Terms*- Productivity Increase, Recorded Downtime, Production Capacity, 5M Analysis**

I. INTRODUCTION

The rapid development of the aquaculture sector is one of the keys to national, regional and world food availability. In line with meeting future nutritional security, the economic developmentof aquaculture has received priority rights from the Indonesian government as evidenced by the strengthening of production for the domestic and import markets.

Along The rapid development of cultivated fish causes the demand for fish feed to increase every year. This is an opportunity as well as a challenge for companies engaged in animal feed. One of the problems in dealing with the increasing demand for fish feed is the limited ability of the machine to meet the desired production.

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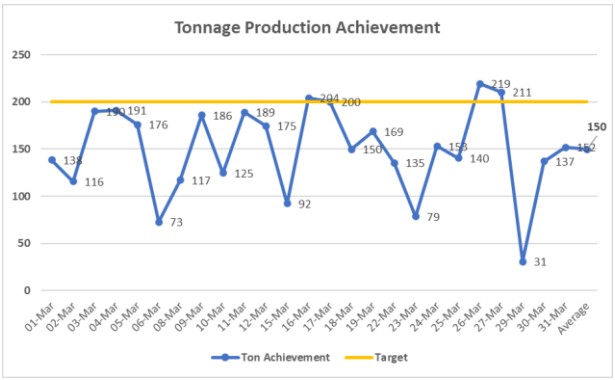
Increasing productivity is one solution in meeting the production needs to be achieved, but it turns out that the use of this machine has not gotten maximum results in one of the companies in the animal feed sector, as can be seen from the difference in the expected tonnage which should be able to produce an average of 200 tons / day but only get 150 Tons/day. Based on these problems, this research was conducted so that the productivity and efficiency of a company can be achieved. Downtime on the machine done action plan by going through several previous stages such as creating a pivot table, determining downtime, brainstorming session to carry out managerial implications.



Graph 1. Production Tonnage Achievement March 2021

Not only downtime related to engine breakdown, but also downtime related to waiting time like changeover and management tools which is not well organized there. Therefore, researchers apply visual management in relation to speeding up downtime associated with changeover which in turn will increase the desired production capacity through recorded downtime and its analysis using the 5M method (Man, Machine, Method, Material and Mother Nature).

II. LITERATURE REVIEW

According to Ambarwati and Supardi (2021) Production Capacity or production capacity is one of the important processes in a production system. Capacity can be defined as the ability to achieve, store or produce. While the production capacity itself is the maximum number of units that can be produced in a certain period of time with available sources. According to Mukhril (2021) Downtime is an unplanned event that stops production for some time. Unplanned downtime is most often caused by operator error, poor maintenance, hardware or hardware or software faults and perceived downtime which includes poor performance or slow turnover. One of the models used to improve students'

mathematical problem-solving skills is Osborn's learning according to Alfianitasari (2019). Osborn's learning model is the model learning that uses the Brainstorming method according to Nurafifah (2019). Brainstorming is a technique for generating ideas, trying to overcome all obstacles and criticisms. According to Jacob & Chase (2019), Cause and effect diagrams, also known as fishbone diagrams, provide a hypothetical relationship from potential causes. When a cause-and-effect diagram is created, the analysis will process to find out the causes of the problem that have the potential to contribute to the effect of the problem.

A. Formulation of Problem

1. What are the main downtimes that prevent the production target of 200Ton/Day from being achieved?
2. How to make productivity improvements from downtime findings and corrective measures for capacity improvement?
3. What are the action plans or corrective steps that can be taken to increase productivity on the Production Line - Grower from after conducting a Forum Group Discussion and getting 5M (Man, Machine, Method, Material & Mother Nature)?

B. Research Purpose

1. Mapping of recorded downtime.
2. Increase productivity using the 5M method (Man, Machine, Method, Material and Mother Nature) from recorded downtime.
3. Provide recommendations to companies to increase their production results and carry out the execution of the recommendations for increasing productivity.

III. RESEARCH METHODS

This research is a research mixed methods which involves qualitative data and quantitative data as research data. The research model of the selected mixed method is explanatory sequential in this method, the researcher first conducts quantitative research, then analyzes the results and then develops the results to explain them in more detail with qualitative research. Quantitative data is obtained by implementing the calculation of downtime which is converted into a calculation of increasing productivity and how to overcome this problem with a brainstorming session using the method Fishbone Diagram (5M) and 5Why.

Table 1. Research Variable

Variable	Productivity
Dimension	Production Tonnage Achievement
Sub Dimension	Productivity Improvement from recordable downtime
Indicator	**Sub - Indicator**
Man	Effectivity from manpower which operate production machine
Machine	Equipment reliability and availability
Method	Standard method to operate production machine
Material	Raw material and spare part supply availability
Mother Nature	Environment effect to productivity

IV. RESULT AND DISCUSSION

The author has obtained recorded downtime data from the results of research on the company, which in March 2021 there was a total downtime of 8,019 minutes of downtime as stated.

Table 2. Downtime Recorded in March 2021

Date	Downtime Detail	Time (Minutes)
1-Mar-21	Running Low Capacity	56
1-Mar-21	Dies changing	90
1-Mar-21	Change product	40
1-Mar-21	Cleaning dies	80
1-Mar-21	Wait for dosing, lack material supply	57
1-Mar-21	Steam Drop	67
2-Mar-21	Dies Changing	110
2-Mar-21	Steam Drop	150
2-Mar-21	Speed Hammer Mill low	163
3-Mar-21	Change product	63
4-Mar-21	Change product	17
4-Mar-21	Speed Hammer Mill low	38
5-Mar-21	Dies Changing	85
5-Mar-21	Speed Hammer Mill low	67
6-Mar-21	Running Low Capacity	40
6-Mar-21	Dies Changing	115
6-Mar-21	Change Product	60
6-Mar-21	Dies Changing	120
6-Mar-21	Wait for dosing, lack material supply	143
6-Mar-21	Steam Drop	325
8-Mar-21	Running Low Capacity	60
8-Mar-21	Dies Changing	50
8-Mar-21	Change Product	60
8-Mar-21	Dies Cleaning	90
8-Mar-21	Wait for dosing, lack material supply	90
8-Mar-21	Speed Hammer Mill low	174
9-Mar-21	Speed Hammer Mill	90

	low	
10-Mar-21	Running Low Capacity	35
10-Mar-21	Dies Changing	150
10-Mar-21	Change Product	50
10-Mar-21	Dies Cleaning	110
10-Mar-21	Wait for dosing, lack material supply	110
10-Mar-21	Speed Hammer Mill low	21
11-Mar-21	Change Product	70
12-Mar-21	Dies Changing	20
12-Mar-21	Change Product	75
12-Mar-21	Speed Hammer Mill low	66
15-Mar-21	Running Low Capacity	65
15-Mar-21	Dies Changing	180
15-Mar-21	Change Product	45
15-Mar-21	Dies Changing	95
15-Mar-21	Wait for dosing, lack material supply	70
15-Mar-21	Steam Drop	226
18-Mar-21	Running Low Capacity	50
18-Mar-21	Dies Changing	55
18-Mar-21	Change Product	60
18-Mar-21	Steam Drop	151
19-Mar-21	Dies Changing	145
19-Mar-21	Steam Drop	52
22-Mar-21	Running Low Capacity	55
22-Mar-21	Change Product	60
22-Mar-21	Dies Cleaning	105
22-Mar-21	Wait for dosing, lack material supply	130
22-Mar-21	Speed Hammer Mill low	57
23-Mar-21	Dies Changing	85
23-Mar-21	Dies Cleaning	113
23-Mar-21	Steam Drop	200
23-Mar-21	Speed Hammer Mill low	369
24-Mar-21	Dies Changing	115
24-Mar-21	Wait for dosing, lack material supply	100
24-Mar-21	Speed Hammer Mill low	81
25-Mar-21	Dies Changing	100
25-Mar-21	Change Product	50
25-Mar-21	Wait for dosing, lack material supply	85
25-Mar-21	Steam Drop	118
25-Mar-21	Speed Hammer Mill low	23
29-Mar-21	Running Low Capacity	45
29-Mar-21	Dies Cleaning	113
29-Mar-21	Wait for dosing, lack material supply	115
29-Mar-21	Speed Hammer Mill low	797
30-Mar-21	Dies Changing	82
30-Mar-21	Speed Hammer Mill low	317
31-Mar-21	Wait for dosing, lack material supply	76
31-Mar-21	Speed Hammer Mill low	227

With these data, total downtime is obtained with classification:

A. Man (A)

a. (A1) Running Low Capacity : 406 Minutes/Month
b. (A2) Dies Changing : 1,382 Minutes/Month

B. Machine (B)

a. (B1) Low Grinding Speed : 2,490 Minutes/Month
b. (B2) Low Steam Pressure : 1,289 Minutes/Month

C. Materials (C)

a. (C1) Slow Raw Material Supply: 976 Minutes/Month
b. (C2) Unavailable Dies : 826 Minutes/Month

D. Method (D)

a. (D1) High Change Over Product: 650 Minutes/Month

E. Mother Narute (E – N/A)

Based on the downtime data, calculations are carried out with the required data are total downtime, total days, minutes in hour, tons per hour (TPH) to calculate:

$$Downtime\ Per\ Day = \frac{\text{Total Downtime}}{\text{Total Days}}$$

$$Downtime\ In\ Hour = \frac{\text{Downtime Per Days}}{\text{Minutes In Hour}}$$

$$\text{Capacity Gain} = \text{Downtime In Hour x TPH}$$

So that it is generated capacity increase from data capacity gain which was obtained based on downtime data during March 2021 which can be seen in the table below.

Tabel 3. Productivity Improvement Planning

Details	Capacity (Tons)
Before Improvement (Ton/Day)	149.88
A1 (MAN)	2.57
A2 (MAN)	8.75
B1 (MACHINE)	15.77
B2 (MACHINE)	8.16

C1 (MATERIAL)	6.18
C2 (MATERIAL)	5.23
D1 (METHOD)	4.12
After Improvement (Ton/Day)	200,662

Based on the capacity increment table above, the result is the total number of executions of 8,016 Minutes of total downtime, can produce an average total production of 200 Tons/day from the previous average of 149.88 Tons/day (Rounding 150 Tons/Day). With an average downtime tonnage of 50 tons/day (Target – current achievement = 200 tons/day – 149.88 tons/day = 50 tons/ day). These results were then discussed at Forum Group Discussion with the brainstorming method using the help of Fishbone diagram (5M) and 5why. The following is a fishbone (5M) resulting from brainstorm.

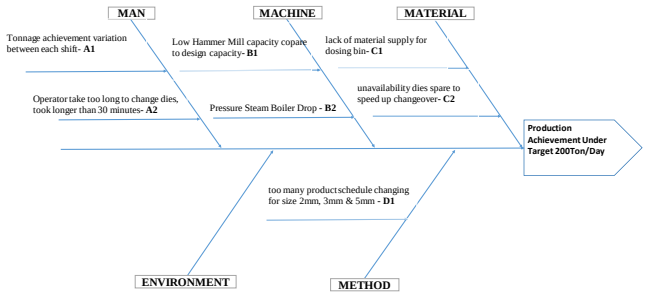


Figure 1. Root Cause Analysis of unreachable target 200Ton/day

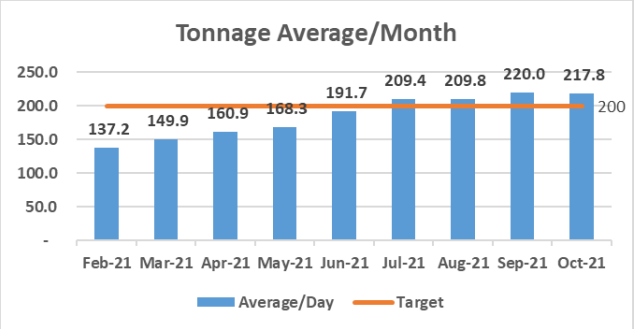
The result of Fishbone above, found there are 4 aspects Man (A), Machine (B), Material (C) and Method (D) which affect the plan to increase production capacity. Whereas environment or the environment has no effect on the research. While table 3 below is the result of 5why. After carrying out the above method, several action plans to overcome the problems encountered. Action plans can be seen in table 3 below.

Table 4. Main Root Cause and Action Plan to achieve 200 Ton/day

No	FishBone Aspect	Code	Play Problem	Action Plan	Capacity Gain/ Day
1	MAN	A1	There is no guide regarding how to run the machine according to standard settings	Create Work Instructions or Work Instructions for PCS machine operation (Extruder)	2.57
		A2	Stock dies run out and still waiting for fabrication	Make a Checklist Consumable spare parts with molds or dies as one of the spare parts or spare parts that are monitored. And determine the Person In Charge or the person in charge who does the checking.	8.75
		A2'	There are no automatic tools like Impact Wrench to speed up disassembly of bolts	Create a Work Order to hold an Impact tool Wrench to speed up the work of opening and installing bolts on dies	
		A2"	Tool unavailability automatic as High-Pressure Water Cleaner for clean the die hole from the feed.	Create a Work Order to procure High. tools Pressure water cleaner (above 150Bar) for easy cleaning of feed presses or dies.	
2	MACHINE	B1	Make rules for checking the condition of the screen at the beginning of each shift	Making WI Hammer Mill Operations in it there are rules for checking the Hammer Mill screen per shift	15.77
		B1'	There is no Pressure sensor in the cyclone hammer mill suction line for gives an indication if the hammer mill straw is starting to weaken or not	Order and install for Hammer Mill Pressure Sensor Indicator	
		B1"	After an engineering check, there is	Transferring the power	

			Noise Conductivity on the cable due to the Control Cable side by side with the Power Cable	cable and control cable to the Hammer Mill and replacing the control cable with a Shielded Cable. give Anti Conductivity Noise)	
		B2	Installing this Steam header after going through the previous 3 steam headers	Make modifications the addition of a new steam pipeline approaching the source, namely Boiler 10 & 5 TPH (Ton Per Hour	8,16
3	MATERIAL	C1	Because the chain conveyor body is reduced to install the chain holder the conveyor	Make modifications against the chain conveyor and change the position of the chain conveyor retainer and increase the speed chain conveyor from 50Hz to 60 Hz by installing an inverter	6,18
		C2	There is no reminder or reminder for when made an order or purchase of spare parts or feed printing equipment	Apply checklist spare part checking wrong consumable only one there is checking dies	5,23
4	METHOD	D1	No mapping yet production per size, type or ratio of feed	Make the division of the production schedule between the old tower and the new tower (place study)	4,12
5	MOTHER NATURE	N/A	N/A	N/A	N/A

After the action plans have been carried out, the results of the managerial implications that have been described based on the above tables result in an increase in production volume. An increase in the average production above 200 Tons/day can be seen in July 2021, with a yield of 209.4 Tons/day. Following is the graph of the increase in the average production along with the action plan by the author.



Graph 2. Result of Productivity Improvement

V. CONCLUSION

Based on research on Production data in March 2021, with the achievement of production tonnage a total of 150 tons/day, a total downtime measurement of 8,019 minutes of total downtime per month has been carried out, which when converted to a total tonnage of 50 tons/day. After analysis, downtime occurs in the Man, Machine, Material and Method aspects, so it is necessary to do an Action Plan from Fishbone (5) & 5Why by carrying out a number of actions such as making Work Instructions, Spare Parts Checklist, Installing Pressure Sensors on Hammers Mills, changing steam pipelines, as well as providing a quick dies opener and cleaner. In addition, the implementation of the action also affects the increase in the average production against the specified target. This also indicates a change in capacity as shown in Graph 4. 3 Average Production Tonnage/Day (Feb-21 to Oct-21) which tends to increase, with the achievement starting from July 2021 amount to 209.4 Tons/Day.

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