


Analysis of effectiveness and efficiency of rota use integrated filling machine on filling results 2 ml vial

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Article Info	ABSTRACT
<p>Keywords: Effectiveness, Efficiency, Rota Integrated Filling Machine, 2 mL Vial</p>	<p>This study aims to analyze the effectiveness and efficiency the use of Rota Integrated Filling Machine (RIFM) on 2 ml vials at PT. X Jakarta. It is an aimed at providing in-depth insights into the optimization of RIFM usage in the context of filling 2 ml vials. Data analysis in this research includes calculating the OEE, Pareto diagram, cause-andeffect, descriptive analysis, machine depreciation calculation, and one-sample t-test. The study results are the OEE values are 32.35% (low effectiveness) in 2020, 32.68% (low effectiveness) in 2021, and 81.36% (high effectiveness) in 2022. The effectiveness of training for RIFM operators at PT. X Jakarta falls into the good category (> 76 – 100%), indicating that the provided training is effective, although some aspects may need modification. The most frequent (dominant) obstacles during theconsecutive injection production process, from highest to lowest, are filling (62hours), capping (35hours), washing (31hours), and other obstacles (21hours). The depreciation burden in 2022, using the straight-line method without residue is Rp 3,237,907,071; the sum-of-the-years-digits method is Rp 883,065,565; the double declining balance method is Rp 2,512,441,817; the unit of working hours method is Rp 1,607,960,385; and the unit of production output method is Rp 1,619,526,867. Estimating depreciation using the machine's economic life aims to guide further actions that the management should take in managing the company's assets that may affect the company's profit and loss statement.</p>
<p>This is an open access article under the CC BY-NC license</p> 	<p>Corresponding Author: Fenny Kristanti Panggabean Master of Pharmaceutical Sciences Program , Faculty of Pharmacy, Universitas Pancasila, South Jakarta, Jakarta, 12640, Indonesia fennykristanti@gmail.com</p>

INTRODUCTION

Production operations are one of the basic functional areas in a business organization. Every organization is faced with production operations activities, where the organization must be able to show the results of its work in the form of an output. The output must be in accordance with the planned time, quality and low cost so that it must be carried out effectively and efficiently, without any rework due to errors (1). One form of production operations management is production operations control. This function is carried out in

order to optimize the results of many valuable assets, such as expensive equipment in a company. Optimizing these tools can be carried out with a concept called Total Productive Maintenance (TPM). This concept functions to reduce variability and increase reliability, through autonomous maintenance and complete maintenance (1). One program or tool to measure machine effectiveness is to calculate the Overall Equipment Effectiveness (OEE) value. OEE is one of the TPM program applications to see the effectiveness of a tool (2).

PT. X Jakarta is a drug manufacturing industry that was founded in 1988 with a focus on injection dosage products. The production process at this company (especially injection) uses a Rota Integrated Filling Machine (RIFM) and has been operating from 2015 until now. During the production process, machine interruptions sometimes occur. According to Nord et al. (3), disturbances that occur in machines can be sporadic or chronic depending on how often the disturbance occurs. Both of these disturbances produce waste or losses. Identify losses due to disruption to the machine, namely by calculating OEE by eliminating Six Big Losses (4).

This OEE method also helps companies to identify problems that can reduce machine productivity. The OEE percentage value obtained should be a reference for evaluating improvements to increase machine productivity. OEE functions to provide an accurate picture of how effectively the manufacturing process is running and makes it easier to track improvements made in the process over time (5). This effectiveness calculation is also accompanied by a calculation of the efficiency of production and maintenance costs carried out on the number of products produced to provide more detailed results regarding equipment productivity. Apart from decreasing speed in terms of machines, one factor in production is human resources. Unlike machines, humans have variations that tend to change (6). This man-machine system interaction allows for variations in the output obtained so it is necessary to measure variations in the input to see whether the output produced is still efficient or not. Effective and efficient use of the Rota Integrated Filling Machine (RIFM) means that effective is the time required and the amount of product produced in accordance with the capacity of the machine or according to theory. Based on the definition and previous research, researchers want to know and study further regarding "Analysis of the Effectiveness and Efficiency of Using the Rota Integrated Filling Machine on the Results of Filling 2 mL Vials".

The aim of this research based on the problems that have been described is as follows:

1. Knowing the effectiveness and efficiency, as well as exploring aspects related to the use of RIFM (Rota Integrated Filling Machine) 2 mL vials at PT. X Jakarta.
2. Knowing the OEE value as a method for measuring the effectiveness and efficiency of using the Rota Integrated Filling Machine on 2 mL vials at PT. X Jakarta.
3. Knowing the OEE value as a method of measuring the effectiveness and efficiency of using the Rota Integrated Filling Machine on 2 mL vials at PT. X Jakarta.
4. Find out which functions of the Rota Integrated Filling Machine are problematic and most dominantly appear during the injection production process at PT. X Jakarta.
5. Find out the depreciation value of the Rota Integrated Filling Machine during the period of use at PT. X Jakarta.

METHODS

This research method is descriptive and quantitative. The data analysis technique used is descriptive analysis of the percentage of effectiveness values and one sample t test. Apart from that, the Pareto diagram will describe the obstacles to each activity each year and the fish bone diagram will analyze the dominant obstacles that occur in machines. In addition, the RIFM depreciation value was calculated using 5 methods, namely the straight line method without residue, the sum of year digits method, the double declining balance method, the working hour unit method, and the production output unit method.

Conceptual framework

This research is about analyzing the effectiveness and efficiency of using the Rota Integrated Filling Machine on the results of filling 2 mL vials which affects the percentage of batch deviation and quality defects. with the Rota Integrated Filling Machine it has 4 (four) functions, namely washing vial, depyrogenation, filling and rubber stoppering, and capping. In each of these functions, obstacles are found with different time variations. In general, obstacles can come from certain parts of the machine that are disturbed and need repair or machine parts that are worn out and need replacement. By calculating OEE by multiplying the percentage of availability, performance level and quality, the OEE percentage can be obtained which can represent the actual effectiveness of the machine.

Apart from the machine aspect, the variety of operators who carry out each machine function also plays a role in the smooth operation of the machine. The machine operator in this research is the operator whose job is to run and supervise the performance of the Rota Integrated Filling Machine. Therefore, this research also wants to see the operator's level of knowledge in running the machine.

Types of research

Based on the aim of this research, it is exploratory research, namely research to explore broadly the causes and effects or things that influence the occurrence of a condition. Based on the type of data, namely quantitative research where the data is in the form of numbers (scores or values, rankings or frequencies). Based on the level of explanation, this is descriptive research. The descriptive research referred to in this research is related to data analysis of the Overall Equipment Effectiveness value of the Rota Integrated Filling Machine.

Population and Sample

The population in this study is all Rota Integrated Filling Machine production data records, while the samples taken are Rota Integrated Filling Machine production records per work shift for the period January – December 2020, 2021 and 2022.

Research Instruments/Data Collection Techniques

Data collection techniques are an action to obtain the data needed to analyze a problem. The data collection techniques used in this research are as follows.

- a) Primary data was obtained through field observations and interviews between the author and sources who are experts in their field of work, including managers, supervisors, operators and related parties regarding the Rota Integrated Filling Machine at PT. X Jakarta.

- b) Secondary data is data that is not directly observed by researchers, such as documents (batch records, work instructions, work instruction training lists, machine manuals, notes during the production process, etc.) of the PT company. X Jakarta and previous research.

Data analysis plan

The analysis in this research is divided into several parts to obtain solutions to existing problems and the influence of the variables studied, namely as follows.

1. Calculation of OEE Value

OEE is a method used to measure machine effectiveness which is based on measuring three main ratios, namely availability, performance efficiency and rate of quality. This method was first introduced by Nakajima as part of total productivity maintenance (TPM) as an equipment efficiency metric. This method is able to reflect the condition of equipment in the production process and is widely used in the manufacturing industry as an analysis of equipment efficiency⁽¹³⁾ The formula used to get the OEE percentage is as follows ⁽⁸⁾.

$$\text{OEE (\%)} = \text{Availibilitas (\%)} \times \text{Performance Level (\%)} \times \text{Quality Level (\%)}$$

Theoretically, the ideal value for each OEE factor is availability of more than 90%, performance efficiency of more than 95%, and quality level of more than 99%. This percentage will make the OEE value more than 85%. This OEE value will describe the productivity of a machine, where increasing the OEE value will increase the productivity of a machine. Not achieving OEE gives an idea that the machine actually has the potential to provide performance that could be much better than the current condition⁽⁸⁾.

2. Pareto Diagram Analysis

In this research, the Pareto diagram provides an overview in the form of a bar diagram that shows the dominant issues or problems, states the comparison and shows the level of improvement after corrections have been made⁽¹¹⁾. The results of this analysis are what issues or problems have the most dominant influence on the effectiveness and efficiency of the Rota Integrated Filling Machine at PT. X Jakarta. The diagram is arranged from highest to lowest from left to right. The further the bar diagram goes to the right, the lower it will be and the dominant nature of the problem on machine effectiveness will be lower.

3. Cause and effect Analysis (Fish Bone Diagram)

Cause and Effect Analysis aims to identify what production factors influence the increase in bottleneck times in the areas where obstacles occur most frequently or dominantly. This is to assist decision making in RIFM maintenance and repair steps.

4. Descriptive Analysis

Descriptive analysis aims to obtain respondents' perceptions of statements using an interval scale to facilitate interpretation. To analyze the effectiveness value of using RIFM in general from the data that has been obtained, you can use the following formula:

Information :

$$P = \frac{f}{N} \times 100\%$$

P : Percentage of Effectiveness Value

N : Maximum OEE value

f : OEE value obtained

After that, a descriptive analysis was carried out on the values obtained from each year. The scoring criteria are based on the results of interviews with the production and quality assurance manager at PT. X Jakarta, namely as follows.

Table 4. Criteria for Interpreting OEE Values

No	OEE value	Interpretation
1	≤ 40%	Low
2	> 40%	Currently
3	> 70%	Tall

The next step is to analyze the data until conclusions can be drawn using category calculations. So each year has its own effectiveness value and based on this value it is categorized into levels, so this can be done by categorizing using the ideal mean (Mi) and Ideal Standard Deviation (SDi). To determine the score criteria using a norm reference assessment on a modified scale, it can be seen in Table 5. The Score of Category formula is as follows:

Information :

Mi : $\frac{1}{2}$ (maximum score + minimum score)

SDi : $\frac{1}{6}$ (maximum score – minimum score)

Table 5. Score of Category Formula

No	Interval	Category
1	$Mi + 1,5 SDi < X \leq Mi + 3 SDi$	Tall
2	$Mi - 0,5 SDi < X \leq Mi + 1,5 SDi$	Currently
3	$Mi - 3 SDi < X \leq Mi - 0,5 SDi$	Low

Information :

Mi : Mean ideal

X : Score

SDi : Standard Deviation Ideal

5. Calculation of RIFM Depreciation Value

The calculation of RIFM Depreciation Value is carried out using 5 (five) methods consisting of calculating depreciation value based on time and use. Calculation of depreciation value based on time consists of the straight line method without residue, the sum of the year digits method, and the double declining balance method. The calculation of depreciation value based on usage consists of the working hour unit method and the production output unit method. The calculation of RIFM depreciation

value is to see the depreciation value of RIFM during its use period and will have an impact on management decisions in following up on the use of RIFM at PT. X Jakarta.

6. Statistical Analysis

The statistical analysis that will be used in this research is a one-sample t-test to see whether the obstacle time that occurred during 2020, 2021, and 2022 is lower, higher, or not at all different from the standard obstacle time, namely 1 hour.

RESULT AND DISCUSSION

Analysis of Overall Equipment Effectiveness (Oee) Value. The Overall Equipment Effectiveness (OEE) value for RIFM is obtained by multiplying the availability value by the performance level and quality level. Table 6. Interpretation of OEE Values as follows.

Table 6. Interpretation of OEE Values for 2020 - 2022

	2020	2021	2022
N (Number of Bets)	54	67	74
OEE value	32.35%	32.68%	81.36%
Category	Low	Low	Tall

The next analysis is by categorizing the RIFM OEE values using the ideal mean (MI) and ideal standard deviation (SDi) as follows.

Table 7. Categorization of RIFM OEE Values for 2020 - 2022

Year	Category	Frequency	Percentage
2020	Tall	0	0%
	currently	0	0%
	Low	54	100%
	Total	54	
2021	Tall	0	0%
	Currently	0	0%
	Low	67	100%
	Total	67	
2022	Tall	49	91%
	Currently	23	31%
	low	2	3%
	Total	74	

Based on the table above, 2020 and 2021 show that the level of effectiveness is in the low category with a percentage value of 100% in the low category. In 2022, the effectiveness level will be included in the high category with a percentage value of 91% in the high category. Based on this data, it shows that there is an increase in the OEE value every year. This shows that the repair and maintenance actions that have been carried out during 2020, 2021 and 2022 are effective in improving the performance of the machine.

One form of performance level that is part of calculating OEE effectiveness is the accuracy and precision of RIFM. CPOB explains that accuracy is the closeness of the results

obtained to the true value of a measurement or analysis, while precision refers to the level of consistency or replicability of measurement or action results. Based on these terms, it is hoped that RIFM can provide the desired filling results in 2 ml vials with a filling volume range, namely 1.15 – 1.20 mL/vial consistently. The following is RIFM filling volume data for 2 mL vials for 2020 – 2022.

Table 8. Filling Volume Data for 2 mL RIFM Vials

Results	Year		
	2020	2021	2022
Min (mL)	1.15	1.15	1.15
Max (mL)	1.21	1.20	1.20
Avg (mL)	1.18	1.18	1.18
Total Reject (Vial)	14,819	83,824	48,616
Reject Volume (Vial)	2,290	4,839	6,833
%	15%	6%	14%

Based on the data above, it can be seen that in 2020 - 2022 the minimum value of filling volume is 1.15 mL and the maximum value of filling volume is 1.20 -1.21 mL. There is one production batch with a maximum yield above the specified standard (1.15 – 1.20 mL/vial), namely 1.21 mL in 2020. If we look at the type of reject due to the volume mismatch in 2020, namely 15%, in 2021 it will be 6%, and in 2022 it will be 14% of the total rejected vials. The total vial rejects consist of rejects due to impurities, inappropriate volume and imperfect capping.

Production Cost Analysis. The average effective working hours of RIFM in 2020 – 2022 are in the range of 9 (nine) to 10 (ten) hours. If the RIFM speed is 300 vials/minute, then a maximum of 180,000 vials per batch should be able to be produced with a value of IDR 2,128,500,000. However, the production department's target is in the range of 80,000 based on trial results and process validation. Vials of 80,000 will provide a production value of IDR 900,000,000. The following is data on the batch that has the highest effective RIFM working hours in 2020 - 2022 as follows.

Table 9. Bets with the Highest Working Hours

Year	No Bets	Working hours Machine (Minutes)	Gross Results	Reject	Net Results	Rupiah Conversion Net Results	Rupiah Reject Conversion
2020	0600428	1084.8	80,210	813	79,397	938,869,525	9,613,725
2021	1100628	900	81,366	809	80,557	952,586,525	9,566,425
2022	2100128	784.8	80,567	770	79,797	943,599,525	9,105,250

The results in the table were obtained using the RIFM filling speed stated in the 2020 - 2022 work instructions, namely a minimum of 205 vials/minute and a maximum of 245 vials/minute. If calculated theoretically without changing working hours and reject results, the following data will be obtained.

Table 10. Theoretical Rupiah Value of Bets with High Working Hours

Year	No Bets	Machine Working Hours (Minutes)	Gross Results	Reject	Net Results	Rupiah Conversion Net Results	Rupiah Reject Conversion
2020	0600428	1084.8	265,776	813	264,963	3,133,187,475	9,613,725
2021	1100628	900	220,500	809	219,691	2,597,846,075	9,566,425
2022	2100128	784.8	192,276	770	191,506	2,264,558,450	9,105,250

Based on OEE data in terms of quality rate, the percentage obtained by almost all data is above 90.00% or in other words the product output target is achieved. However, the next consideration is how much economic value should be obtained by increasing the machine's working time. Based on table V.3, the rupiah conversion net result is in the range of IDR 900,000,000 and V.4, the rupiah conversion net result is the theoretical result that RIFM should be able to achieve, namely in the range of IDR 2,000,000,000 – IDR 3,000,000,000. Apart from that, the linear machine's working time increases with the operator's working time so that production costs will also increase both in terms of operations and human resources.

Analysis of RIFM (Rota Integrated Filling Machine) Barriers for each Operator

The resistance that occurs on the Rota Integrated Filling Machine is generally 1 hour, and in 2020 - 2022 the averages were 1.12; 0.38 and 0.66, respectively. Based on this data, the point we want to take is whether the average that occurs each year is higher than the standard average (1 hour) or lower than the standard average (1 hour) or statistically there is no difference. with a standard average (1 hour). To see this, a one-sample t test analysis was carried out. So the output and conclusions that can be drawn are as follows.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
2020 Hambatan	54	1.1187	1.72216	.23436
2021 Hambatan	67	.3849	1.37067	.16745
2022 Hambatan	74	.6597	1.82070	.21165

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
2020 Hambatan	4.774	53	.000	1.11870	.6486	1.5888
2021 Hambatan	2.299	66	.025	.38493	.0506	.7193
2022 Hambatan	3.117	73	.003	.65973	.2379	1.0816

Figure 1. One Sample T Test SPSS Output for Barriers to RIFM 2020 – 2022

Table 11. Interpretation of SPSS Output Results One Sample T Test for Barriers to RIFM 2020 - 2022

	2020	2021	2022
Ket Mean	μ (1.12 hours) $> \bar{x}$ (1 hour)	μ (0,38 hour) $< \bar{x}$ (1 hour)	μ (0,66 hour) $< \bar{x}$ (1 hour)
Hypothesis	H0 : $\mu = 1$ hour H1 : $\mu > 1$ hour	H0 : $\mu = 1$ hour H1 : $\mu < 1$ hour	H0 : $\mu = 1$ hour H1 : $\mu < 1$ hour
Significance Level	$\alpha = 5\%$		
Critical Area	Reject H0 if p.value $< \alpha$		
Test Stat	p.value= 0.000	p.value=0.025	p.value=0.003
Decision	Failed to Reject H0	Reject H0	Failed to Reject H0
Conclusion	No different / $\mu = 1$ hour	Different / $\mu < 1$ hour	No difference / $\mu = 1$ h

Based on the table above it can be explained as follows.

1. The average resistance value in 2020 is 1.12 hours. This value is higher than the average standard resistance value, namely 1 hour. Therefore, researchers want to see whether the 1.12 hour barrier is statistically significantly different from 1 hour or it can also be said whether the 1.12 hour barrier far exceeds the standard 1 hour barrier. The results of the one sample t test provide a decision of Fail Reject H0/Accept H0 with the conclusion that the average resistance of 1.03 hours is not significantly different from the standard resistance of 1 hour. Therefore, the obstacles that occurred in 2020 can still be tolerated.
2. The average resistance value in 2021 is 0.38 hours. This value is lower than the average standard resistance value, namely 1 hour. Therefore, researchers want to see whether the 0.38 hour barrier is statistically significantly different from 1 hour or whether the 0.38 hour barrier is far below the standard 1 hour barrier. Based on the results of the one sample t test, the decision to Reject H0 was given with the conclusion that the average resistance of 0.38 hours was significantly different from the standard resistance of 1 hour. Therefore, the obstacles that occur in 2021 are still very good because they are far below the standard obstacles.
3. The average resistance value in 2021 is 0.66 hours. This value is lower than the average standard resistance value, which is 1 hour. Therefore, researchers want to see whether the 0.66 hour barrier is statistically significantly different from 1 hour or whether the 0.66 hour barrier is far below the standard 1 hour barrier. Based on the results of the one sample t test, the decision was Failed to Reject H0/Accept H0 with the conclusion that the average resistance of 0.66 hours was not significantly different from the standard resistance of 1 hour. Therefore, the obstacles that occur in 2022 are less than the standard obstacles, but based on this test it is considered not significantly different.

Based on the data above, the obstacles that occur in 2020 – 2022 can still be tolerated from the maximum number of hours that obstacles occur, namely 1 hour. Therefore, it can be said that the obstacles that occur can still be overcome by operators. This is due to the knowledge of the operators who regularly receive machine operation training every year. Operator knowledge level categories are as follows⁽¹²⁾.

- a. good $\geq 76 - 100\%$
- b. Enough $60 - 75\%$
- c. not enough $\leq 60\%$

The interview results to determine the level of knowledge of RIFM operators are calculated using the following formula ⁽¹²⁾.

$$N = (Sp / Sm) \times 100\%$$

Information :

N : The Value of Knowledge

Sp : Score obtained

Sm : Maximum highest score ⁽⁵⁾

The interview results can be seen in Appendix 3. Interview Result Data on Knowledge Level of RIFM Operators. The following are the results of calculating the knowledge level of RIFM operators.

Table 12. Calculation Results of RIFM Operator Knowledge Level Values

Group I			Group II		
Name	Position	Value	Name	Position	Value
SR	Leader	100.00%	AD	Leader	100.00%
DN	Preparation /IPC	80.00%	MR	Preparation /IPC	80.00%
WD	Preparation /IPC	90.00%	WI	Preparation /IPC	80.00%
MA	Filling & Rubber	80.00%	RL	Filling & Rubber	100.00%
JK	Filling & Rubber	80.00%	AW	Filling & Rubber	80.00%
IR	Filling/Capping	80.00%	WY	Filling/Capping	80.00%
AR	Filling/Capping	80.00%	SD	Filling/Capping	90.00%
RJ	IPC/Washing Tunnel	80.00%	SW	IPC/Washing Tunnel	90.00%
AH	IPC/Washing Tunnel	80.00%	WK	IPC/Washing Tunnel	80.00%
MD	Washing & Tunnel	100.00%	KM	Washing & Tunnel	80.00%
SB	Washing & Tunnel	80.00%	NP	Washing & Tunnel	90.00%
Average Value		84.55%	Average Value		86.36%

Based on the table above, the category of operator knowledge level in operating RIFM according to their respective functions is included in the good category with an average figure of Group I, namely 84.55% and Group II, namely 86.36% where the value is $> 76 - 100\%$.

Effectiveness of RIFM Work Instruction Training for Operators

Review of applicable work instructions at PT. X Jakarta. RIFM work instructions (IK) that apply at PT. X Jakarta in 2020 – 2022 received revisions 4 (four) times. In 2020, the RIFM IK in effect is revision 2 which took effect on 16 December 2019. The third revision

took effect on 06 July 2020 for the reason of improvement, namely "change in target". On May 7 2021, the fourth revision of the IK RIFM took effect due to improvements in "changes in engine range settings". This IK was then revised on November 28 2022 with the reason of improvement "changes in machine setting range parameters on 3 mL vials". The changes that occurred in the RIFM IK from revisions 2 to 4 can be seen in the table as follows.

Table 13. Revised Work Instructions on RIFM

Reason for Change	revision 2	revision 3	revision 4	revision 5
Changes in Tunnel Belt Speed settings				
- Vial 2 mL	98,5 mm/min	98,5 mm/min	90 - 100 mm/min	90 - 100 mm/min
- Vial 3 mL	98,5 mm/min	98,5 mm/min	90 - 100 mm/min	90 - 100 mm/min
Washing Machine Speed Change				
- Vial 2 mL	205 - 235	215 - 225	215 - 225	215 - 225
- Vial 3 mL	205 - 235	195 - 205	195 - 205	180 - 190
Filling Machine Speed Change				
- Vial 2 mL	215 - 245	215 - 245	225 - 235	215 - 225
- Vial 3 mL	215 - 245	215 - 245	225 - 235	205 - 215
Capping Machine Speed Change				
- Vial 2 mL	215 - 245	215 - 245	225 - 235	215 - 225
- Vial 3 mL	215 - 245	215 - 245	225 - 235	205 - 215
Net Volume Monitor				
Revision 2				
	2 ml		3 ml	
	Product A	Product B		
Target Volume	0,65 - 0,70 ml	1,15 - 1,20 mL	3,15 - 3,20 mL	
Alarm Limit Low	0,65 mL	1,15	3,15	
Alarm Limit High	0,70	1,20	3,20	
Density	1,010 - 1,030 g.ml	1,035 - 1,045	1,015 - 1,025	
Revision 3, 4, dan 5				
	2 ml		3 ml	
	Product A	Product B		
Target Volume	0,62 - 0,66	1,15 - 1,20 mL	3,15 - 3,20 mL	
Alarm Limit Low	0,63	1,16	3,16	
Alarm Limit High	0,65	1,19	3,19	
Density	1,010 - 1,030 g.ml	1,035 - 1,045	1,015 - 1,025	

Every change that occurs to the IK will provide training to the operator. The training in question is providing information to operators regarding changes that occur so that they can be applied in the field. This is assisted by the availability of batch records and/or IK RIFM in the field. Each operator is required to read the batch record and/or IK while the

process is running. Written evaluation for operational IK is carried out once every 1 (one) year. Apart from that, an evaluation of the results of the training carried out by the Production Manager is also carried out to assess the operator's performance throughout the year for the specified training materials. Some of the evaluation competencies assessed are activeness in participating in training, interest in the material provided, understanding of the material provided, written or oral evaluation results, case studies, ability to implement the material, increased skills/knowledge in participating in training, and discipline towards training regulations. .

Barrier Pareto Diagram in RIFM

This Pareto diagram functions as the first step in a logical approach to the process of improving a condition which is depicted in the form of a histogram, known as the concept of the vital few and the trivial many to find the main cause. The Pareto principle is known as 80 – 20, namely in this research that 80% of production problems are caused by 20% of the causes of obstacles to RIFM (13). Therefore, researchers want to see which causes of failure/defects have the highest cumulative and/or reach 80% with the assumption that 80% can represent all types of obstacles that occur.

The following is a Pareto diagram of obstacles to the 2020 - 2022 RIFM with the x-axis, namely the type of obstacle in the RIFM and the y-axis, namely the length of time the obstacle lasts.

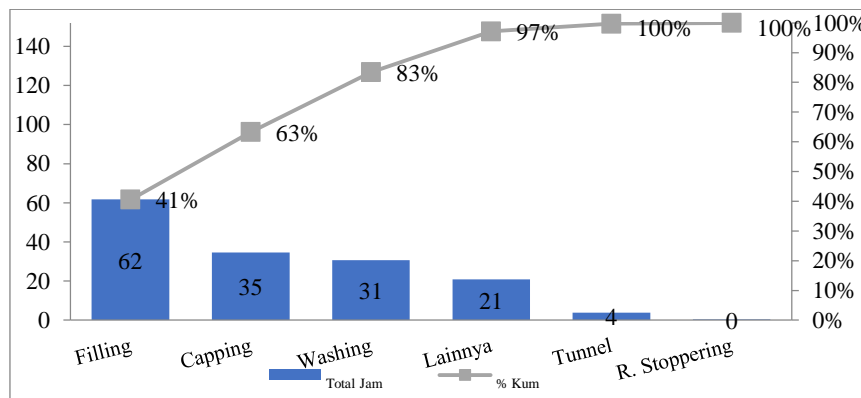


Figure 2. Pareto Diagram of Barriers to RIFM 2020 - 2022

Based on the Pareto diagram above

it can be seen that the Filling section has the highest duration of resistance, namely 62 hours. Respectively, the duration of capping, washing and other obstacles is 35 hours, 31 hours and 21 hours. Other obstacles in question are obstacles that occur outside the RIFM, such as foamy bulk, filling room temperature above the threshold, obstacles in the boiler, purified water pH outside the standard, and others. If these four parts are improved, it will provide improvements to the injection dosage production process at PT. X Jakarta at 97%.

Cause and Effect Diagram Analysis (Fish Bone Diagram). After it was found that the obstacle that occurred the longest was in the filling machine, to find out the root cause, a fish bone diagram was used. The factors analyzed are production factors which, if managed

in such a way, produce output in accordance with demand (7). The following is a fish bone diagram of the increase in resistance time on the filling machine.

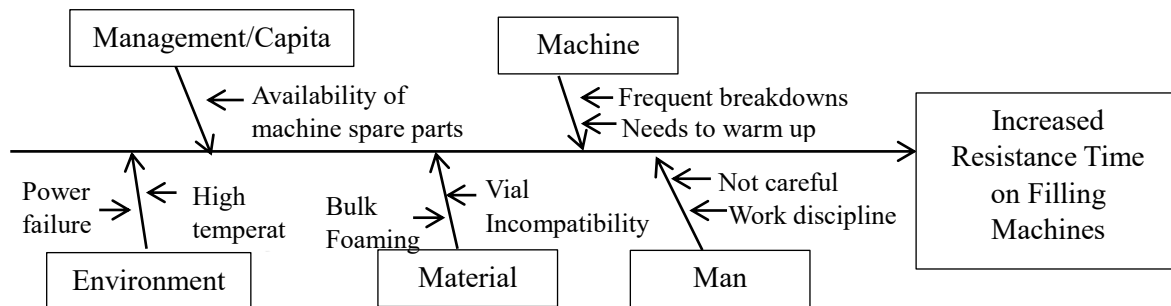


Figure 3. Cause and Effect Diagram (Fish Bone Diagram)

Based on the cause and effect diagram, it is known that there are 5 (five) production factors that cause increased time constraints on RIFM filling machines, namely Machines, Management/Capital, People, Materials and Environment.

Calculation of RIFM Depreciation Value

Depreciation is an accounting process that can be used to reduce the value of fixed assets acquired by a company during their useful life. Depreciation of fixed assets can help companies manage their financial reports (14). In this research, the fixed asset is the Rota Integrated Filling Machine (RIFM). The decrease in the value of RIFM due to use by companies cannot be seen directly in the form of a decrease in physical form. Therefore, a depreciation method is needed to measure how much RIFM value is lost each year. The following is a calculation of the depreciation value of RIFM using 5 methods, namely the straight line method without residue, the sum of year digits method, the double declining balance method, the working hour unit method, and the production output unit method. The example used is the economic life of RIFM, which is 10 years.

1. RIFM Depreciation Calculation Straight Line Method Without Residue

This method assumes that the asset in question provides the same benefits for each period throughout the life of the asset. These asset expenses are not influenced by changes in productivity or asset efficiency. Economic life estimates are made in annual periods. Depreciation expense is obtained from the difference between the acquisition price of the asset and its residual value divided by the useful life of the asset (15). The advantages of using this method are that it is easier to detect and time efficient compared to other methods. This method focuses on the function of time and not the function of its use (16). Based on the calculation results, it is found that the depreciation expense over a 10 year usage period using the straight line method is the same, namely IDR 1,618,953,536 with a depreciation rate of 10%. Depreciation charges carried out throughout the economic life of the RIFM show a book value of Rp. 0. Equal allocation of fixed depreciation costs without experiencing variations will have an impact on the net book value or zero when the life of the fixed asset has expired.

2. RIFM Depreciation Calculation Sum of Year Digits Method
The number of years method is a method of calculating the number of years that the ideal asset function can be used by the company. This method is to be able to see the maximum effectiveness function of an asset that can be used properly. Expenses resulting from the sum of the year digits method will decrease according to the fractional amount of depreciated costs (original cost minus residual value) (16). Based on the calculation results, it was found that the depreciation expense per year has decreased. Each decrease in RIFM depreciation expense is known to be IDR 294,355,188 per year. The resulting book value at the end of the economic life is IDR 0. The existence of a depreciation basis in the calculation causes the charge to be based on a fraction, namely the depreciation basis taken from the sum of the economic lives of fixed assets.
3. RIFM Depreciation Calculation Double Declining Balance Method
The double declining balance method is a method of calculating depreciation expense by multiplying a percentage rate by the decreasing book value of the asset. Asset calculations have a positive effect with the double declining balance method in charging higher costs at the end of the period (16). Based on the calculation results table, it is found that there is a decrease in the value of depreciation expense each year. The depreciation rate charged under this method is 2 (two) times greater than the straight line method and is based on book value. This will cause the depreciation value to vary each year. The book value each year will decrease by the value of the expenses in that year and in this method, the final book value is not IDR 0, but IDR 1,607,962,763.
4. RIFM Depreciation Calculation Working Hour Unit Method
This method has the basis that the purchase of an asset represents the purchase of a number of direct services. This method is based on the assumption that the decrease in the useful life of fixed assets is directly related to the amount of time the assets are used. The acquisition price obtained is divided by the estimated total hours of service, resulting in the depreciation rate for each hour of asset use (15). Based on the calculation results, it is found that the annual depreciation expense fluctuates due to the influence of the number of RIFM working hours. Depreciation expense is charged at the beginning of the production period, namely 2017. Depreciation expense at the end of 2022 is IDR 2,320,137,315 with a book value of IDR 1,607,960,385. The highest depreciation expense was obtained in 2019 amounting to IDR 2,803,186,400. This is because the number of batches produced that year was also the highest, namely 1,120 hours.
5. RIFM Depreciation calculation Unit Production Results Method
The unit of production method is based on the assumption that the assets acquired are expected to produce services in the form of results from certain production units. The theory of this method is that an asset is owned to produce products, so depreciation is also based on the number of products produced. The acquisition price is divided by the estimated total output, resulting in the asset depreciation rate for

each unit of production. The number of production units produced during a period multiplied by the depreciation rate per unit produces the amount of periodic depreciation expense (15). Based on the calculation results, it was found that the annual depreciation expense fluctuates due to the influence of the number of RIFM vials per year. Depreciation expenses are charged at the beginning of the production period, namely 2017. Depreciation expenses at the end of 2022 are IDR 2,275,862,526 with a book value of IDR 1,619,526,867. The highest depreciation expense was obtained in 2019 amounting to IDR 2,829,849,960. This is because the number of batches produced that year was also the highest, namely 9,625,340 vials.

CONCLUSION

After conducting research on the Effectiveness and Efficiency Analysis of Using the Rota Integrated Filling Machine on the results of filling 2 ML vials at PT. X Jakarta, it can be concluded several things as follows. The OEE value obtained from using the Rota Integrated Filling Machine at PT. X Jakarta respectively, namely in 2020 it was 32.35%, in 2021 it was 32.68%, and in 2022 it was 81.36%. The OEE value in 2020 and 2021 is in the low category or the machine has low effectiveness and efficiency, but in 2022 it is in the high category or the machine has high effectiveness and efficiency. The production output value obtained with the highest RIFM working hours (700 – 1000 minutes), which is around IDR 900,000,000 with a RIFM filling speed of 205 – 245 vials/minute. However, if used at its maximum capacity, namely 300 vials/minute, then each batch will provide an output of around IDR 2,000,000,000 – 3,000,000,000 with the same effective working hours. Effectiveness of training for RIFM operators at PT. X Jakarta, based on its objectives and supported by data from the calculation results of the Knowledge Level of RIFM Operators, is included in the good category (> 76 – 100%), it can be said that the training provided has been effective even though several aspects of the training need to be changed. The functions that have the most frequent (dominant) obstacles during the injection production process, in order from highest to lowest, are filling (62 hours), capping (35 hours), washing (31 hours), and other obstacles (21 hours).). If these four parts are improved, it will provide an improvement in the injection dosage production process by 97%. The filling function has the most frequent obstacles, namely scroll output/infeed of 26.33%. If these obstacles can be overcome, it will provide an improvement in the injection dosage production process by 50%. Apart from that, we also found production factors that play a role in increasing the bottleneck time of the filling machine using cause and effect analysis. Depreciation value of RIFM during the period of use at PT. X Jakarta experiences a decline every year which is influenced by the value of depreciation expenses. Depreciation expense in 2022 using the straight line method without residue is IDR 3,237,907,071, the sum of year digits method is IDR 883,065,565, the double declining balance method is IDR 2,512,441,817, the working hour method is IDR 1,607,960,385, and the unit method production results amounted to IDR 1,619,526,867. Calculating estimated depreciation using the economic life of the machine aims to determine further actions that must be taken by management in managing company assets which can affect the company's profit and loss balance sheet.

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