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Analysis of Overall Equipment Effectiveness (OEE) as an Effort to Increase The Productivity Filling Line of Lithos Packaging Lubricant

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Abstract. This research was conducted at a company engaged in the lubricants business. This study examines the filling station lithos packaging. The lithos packaging filling station consists of 6 filling lines (FL), namely FL-1, FL-2, FL-3, FL-4, FL-5, and FL-6. From each filling, the line will be observed and analyzed in the format of the automation machine program. Based on the observations and analysis, it was found that FL-4 has an availability rate, performance rate, and quality rate below standard, so it is necessary to identify the cause of the low Overall Equipment Effectiveness (OEE) value of FL-4. This study analyzes the factors causing the low Overall Equipment Effectiveness (OEE) score on FL-4 using Six Big Losses and Fishbone diagrams. From the research results, it was found that several factors caused the less productive FL-4, namely breakdown losses with a value of 48%, setup and adjustment losses with a value of 3%, idling and minor stoppages with a value of 7%, reduced speed losses with a value of 41%, and defect losses with a value of 1%. An analysis was carried out using a fishbone diagram to determine the root cause of the high value of breakdown losses, reduced speed losses followed by idle and minor stoppage losses, and setup and adjustment losses. Based on the fishbone diagram, it was found that the factors causing the FL-4's unproductivity in terms of machine factors, method factors, human factors, material factors, and environmental factors. The causes of unproductive FL-4 are damage to the machine, downtime, the operator's less responsiveness to machine problems, operator expertise, decreased work ethic, defective materials, late material stocks, and hot room temperatures. Based on this, the proposed improvements given are to schedule machine maintenance at a specified time (preventive maintenance), not by the factor of damage (breakdown maintenance), make data guide for product change for each machine and attach it to each machine in full so that This downtime can be reduced, placing technical operators who focus on each filling line at least one technical operator, to speed up downtime and not disrupt the production process, add fans to speed up air circulation to reduce heat in the area and change material suppliers to get better quality.

Keyword: Lubricants, Overall Equipment Effectiveness, Fishbone Diagram, Productivity, Six Big Losses

Abstrak. *Penelitian ini dilaksanakan pada perusahaan yang bergerak di bidang usaha pelumas. Penelitian ini meneliti pada filling station kemasan lithos. Pada Filling station kemasan lithos terdiri dari 6 filling line (FL), yaitu FL-1, FL-2, FL-3, FL-4, FL-5, dan FL-6. Dari setiap filling line akan diamati dan dianalisis format program mesin otomasi. Berdasarkan pengamatan dan analisis yang dilakukan didapatkan bahwa FL-4 memiliki nilai availability rate, performance rate, dan quality rate dibawah standar sehingga perlu diidentifikasi penyebab rendahnya nilai Overall Equipment Effectiveness (OEE) pada FL-4. Tujuan dari penelitian ini yaitu melakukan analisis untuk menemukan faktor penyebab rendahnya nilai Overall Equipment Effectiveness (OEE) pada FL-4 dengan menggunakan Six Big Losses dan fishbone diagram. Dari hasil penelitian diperoleh hasil bahwa beberapa faktor yang menyebabkan kurang produktifnya FL-4 yaitu breakdown losses dengan nilai 48%, setup and adjustment losses dengan nilai 3%, idling and minor stoppages dengan nilai 7%, reduce speed losses dengan nilai 41%, dan defect losses dengan nilai 1%. Untuk mengetahui akar penyebab tingginya nilai breakdown losses dan reduce speed losses yang diikuti*

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dengan adanya nilai idling and minor stoppage losses, dan setup and adjustment losses, maka dilakukan analisis dengan menggunakan fishbone diagram. Berdasarkan fishbone diagram didapatkan faktor penyebab tidak produktifnya FL-4 ditinjau dari faktor mesin, faktor metode, faktor manusia, faktor material, dan faktor lingkungan. Penyebab tidak produktifnya FL-4 yaitu adanya kerusakan pada mesin, downtime, operator kurang responsive terhadap masalah pada mesin, keahlian operator, etos kerja menurun, material cacat, stok material terlambat, dan suhu ruangan yang panas. Berdasarkan hal tersebut, maka usulan perbaikan yang diberikan adalah menjadwalkan perawatan mesin dengan waktu yang ditentukan (preventive maintenance) bukan dengan faktor adanya kerusakan (breakdown maintenance), dibuatkan panduan data format pergantian produk pada setiap mesin dan ditempelkan pada masing-masing mesin secara lengkap sehingga downtime waktu tersebut bisa dikurangi, penempatan operator teknik yang berfokus pada setiap filling line minimal 1 operator teknik, agar dapat mempercepat waktu downtime dan tidak mengganggu proses produksi, menambahkan kipas angin untuk mempercepat sirkulasi udara agar mengurangi panas pada area tersebut, dan melakukan pergantian supplier material untuk mendapatkan kualitas yang lebih baik.

Kata Kunci: *Pelumas, Overall Equipment Effectiveness, Fishbone Diagram, Produktivitas, Six Big Losses*

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1 Introduction

Competition between companies is increasing at this time. It has resulted in each company improving in all aspects and fulfilling consumer desires in quantity and quality to survive and compete against other companies [1]. Due to the recent and rapid industrial development, businesses must be able to boost productivity in order to generate the highest possible production [2]. Companies must increase their productivity, so they must have quality production facilities. One of these facilities is the machine used for production [3]. Machine performance is the most important key to success in the manufacturing industry [4]. Therefore the machine needs to be cared for and maintained [5].

This research was conducted at a company engaged in the lubricants business. This company has three filling stations: lithos packaging, drum, and bulk filling. This study only researched lithos packaging filling stations consisting of FL-1, FL-2, FL-3, FL-4, FL-5, and FL-6. From each filling, the line will be observed and analyzed in the format of the automation machine program.

Overall Equipment Effectiveness (OEE) is an approach used to measure a machine's or equipment's effectiveness by considering availability, performance, and quality [6]. OEE is also used as a tool for continuous improvement, providing benefits as a reference for improving machine/equipment performance and improving quality by minimizing rework and product defects [7]. OEE is an indicator to describe the effectiveness of machine or equipment performance by comparing output results so that the company can set new targets for improvement [8]. Another way to think of OEE is as a metric that measures how well a production process is running [9].

Based on the observations and analyses carried out during the study, it was found that among the lithos packaging filling stations consisting of FL-1, FL-2, FL-3, FL-4, FL-5, and FL-6, it was found that FL-4 had an availability value. Availability, performance, and quality rates are below standard, so it is necessary to identify the cause of the low Overall Equipment Effectiveness (OEE) value on FL-4. Therefore, it is necessary to find the causal factors so that the company can evaluate and follow up, and in the end, its performance and productivity can increase [10].

Based on the above problems, analyzing the factors causing the low Overall Equipment Effectiveness (OEE) score on FL-4 is necessary using Six Big Losses and Fishbone diagrams. Measurement of the OEE value is used as a basis for analysis to determine the level of six big losses on production machines. Six Big Losses is an indicator to discover six factors that result in losses due to ineffective and efficient use of machines [11].

After obtaining several factors that cause FL-4 to be less productive, it is continued by providing suggestions for improvements related to the root causes of the problems affecting the Six Big Losses using a fishbone diagram [6]. A fishbone diagram will identify the root causes of problems from the machine, method, human, material, and environmental factors [12]. After that, an analysis is carried out regarding the causes of a problem [13].

Based on the results of observation and analysis, it is known that several factors cause the less productive FL-4, so it is necessary to identify the most influential root causes of the problems and provide suggestions for improvements related to the root causes of these problems.

2 Research Methods

This study began with observing lithos packaging filling stations consisting of FL-1, FL-2, FL-3, FL-4, FL-5, and FL-6 to collect information on changes to the automation machine program format in all filling lines. After that, proceed with collecting data both primary data and secondary data. Primary data collection is based on observations and interviews with the company, while secondary data collection is based on the company's historical data.

Data processing begins with calculating the Overall Equipment Effectiveness (OEE), which consists of the availability, performance, and quality rates. The OEE calculation considers the availability of production time, the working performance of machinery and production equipment, and the quality of the products produced [14]. After that, the calculation of the Six Big Losses is carried out to find out the factors causing the low productivity and followed by conducting an analysis using a fishbone diagram to find the root cause of the problem and to provide suggestions for improvements to the factors causing the problem. One benefit of the Fishbone technique is that it offers a theoretical framework for studying the underlying causes of issues [15].

3 Results and Analysis

Based on the Japan Institute of Plant Maintenance (JIPM) set standard values of Availability Rate ≥ 90%, Performance rate ≥ 95%, Quality Rate ≥ 99%, and OEE ≥ 85% [4]. Availability rates at lithos packaging filling stations consisting of FL-1, FL-2, FL-3, FL-4, FL-5, and FL-6 can be seen in Table 1.

Table 1 Availability Rate

	Availability Rate (%)					
Month	**FL-1**	**FL-2**	**FL-3**	**FL-4**	**FL-5**	**FL-6**
Jan	69.35	66.95	58.36	72.59	67.16	66.52
Feb	69.62	67.69	72.04	70.37	72.74	63.40
Mar	65.41	66.49	74.73	73.16	71.18	65.96
Apr	77.45	81.36	79.85	75.76	78.72	78.78
May	72.66	72.72	78.00	61.23	69.12	64.83
Jun	79.53	71.36	84.23	69.56	73.96	67.45
Average	**72.34**	**71.10**	**74.54**	**70.45**	**72.15**	**67.82**

Based on the table above, the availability rate values for FL-1, FL-2, FL-3, FL-4, FL-5, and FL-6 are below standard. The Performance Rate at the lithos packaging filling stations consisting of FL-1, FL-2, FL-3, FL-4, FL-5, and FL-6 can be seen in Table 2.

Table 2 Performance Rate

	Performance Rate (%)					
Month	**FL-1**	**FL-2**	**FL-3**	**FL-4**	**FL-5**	**FL-6**
Jan	69.34215	66.75576	73.04515	72.90205	68.12218	67.46032
Feb	69.61222	68.24031	52.79375	70.37862	72.38774	72.36785
Mar	65.42745	66.49832	74.54918	74.06783	71.16813	73.91638
Apr	73.76869	75.86495	74.70999	72.63722	75.65383	75.80145
May	71.25078	72.74171	78.01161	61.17514	66.50752	68.92821
Jun	76.10062	68.5116	80.95572	64.183	70.84153	69.90209
Average	**70.92**	**69.77**	**72.34**	**69.22**	**70.78**	**71.40**

Based on the table above, the performance values for FL-1, FL-2, FL-3, FL-4, FL-5, and FL-6 are below standard. Quality Rate at lithos packaging filling stations consisting of FL-1, FL-2, FL-3, FL-4, FL-5, and FL-6 can be seen in Table 3.

Table 3 Quality Rate

	Quality Rate (%)					
Month	**FL-1**	**FL-2**	**FL-3**	**FL-4**	**FL-5**	**FL-6**
Jan	99.19	98.76	99.26	98.87	98.75	98.51
Feb	99.05	98.86	99.20	98.98	99.01	98.86
Mar	99.06	99.23	99.25	99.33	99.22	98.79
Apr	98.81	98.12	99.46	99.06	98.98	98.98
May	99.17	98.83	99.62	99.19	99.19	99.06
Jun	98.55	97.96	99.63	97.32	97.27	94.52
Average	**98.97**	**98.63**	**99.40**	**98.79**	**98.74**	**98.12**

Based on the table above, the quality values for FL-1, FL-2, FL-4, FL-5, and FL-6 are close to standard, while FL-3 meets the standard. Based on the results of calculating the availability, performance, and quality rates, the OEE value at the lithos packaging filling station can be seen in Table 4.

Table 4 Overall Equipment Effectiveness (OEE)

Overall Equipment Effectiveness (%)						
Month	**FL-1**	**FL-2**	**FL-3**	**FL-4**	**FL-5**	**FL-6**
Jan	47.70	44.14	42.31	52.32	45.18	65.53
Feb	48.00	45.67	37.73	49.02	52.13	62.68
Mar	42.39	43.87	55.29	53.82	50.26	65.16
Apr	56.45	60.56	59.33	54.51	58.95	77.98
May	51.34	52.28	60.62	37.15	45.60	64.22
Jun	59.65	47.89	67.94	43.45	50.96	63.75
Average	**50.92**	**49.07**	**53.87**	**48.38**	**50.51**	**66.55**

Based on the table above, the OEE values for FL-1, FL-2, FL-3, FL-4, FL-5, and FL-6 are below the standard OEE value. Among the six filling lines (FL), FL-4 has the lowest OEE value. An analysis of the causes of the low OEE value in this filling line will be conducted.

After that, it continued by analyzing six big losses. Six big losses are divided into 3, namely, downtime losses, speed losses, and quality losses. Downtime Losses are wasted time spent without the production process operating, typically as a result of machine damage [16]. Downtime losses consist of Breakdown Losses and Set-up and Adjustment Losses. Speed Losses consist of Idle and Minor Stoppages and Reduced Speed Losses. Quality Losses consist of Defect Losses and Reduced Yield. The low productivity of machinery or equipment that causes losses to the company is often caused by the use of machinery or equipment that is not effective and efficient [17]. The recapitulation of the six big losses calculation results in FL-4 can be seen in Table 5.

Table 5 Six Big Losses FL-4 (January 2022 – June 2022)

No	**Six Big Losses**	**Total Time Losses (Hours)**	**Percentage (%)**	**Cumulative Percentage (%)**
1	Breakdown Loss	314.91	48	48
2	Reduce Speed Loss	266.56	41	89
3	Idling and Minor Stoppages	47.06	7	96
4	Setup and Adjustment Loss	20.69	3	99
5	Deffect Losses	7.47	1	100
6	Reduced Yield	0.00	0	100
	Total	**656.69**	**100**	

Based on the calculation and analysis of the six big losses from the OEE value in FL-4, several factors cause the less productive FL-4, namely breakdown losses with a value of 48%, reduced speed losses with a value of 41%, idling and minor stoppages with a value of 7%, setup and adjustment losses with a value of 3%, and defect losses with a value of 1%.

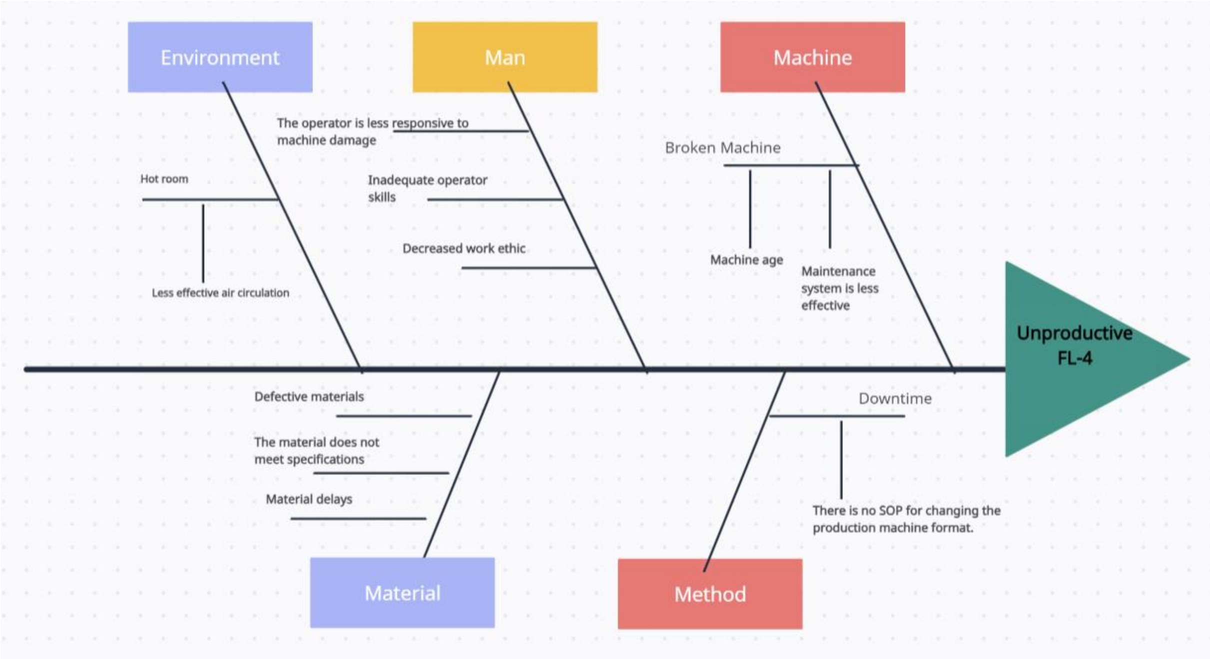

Figure 1 Fishbone Diagram of Unproductive FL-4

An analysis will be carried out using a fishbone diagram to determine the cause of the low OEE value, high losses in breakdown losses¸, and reduced speed losses resulting in less productivity of FL-4. The fishbone diagram can be seen in Figure 1.

Based on the fishbone diagram, several factors causing unproductive FL-4 and suggestions for improvement can be described from the engine factor caused by damage to the machine due to the inaccurate machine maintenance schedule coupled with the machine's age factor, which has been used for a long time. The proposed improvement is to schedule machine maintenance at a specified time (preventive maintenance), not by the factor of damage (breakdown maintenance). Preventive maintenance is a maintenance activity to prevent damage to equipment/facilities [18]. Beside that, preventive maintenance is maintenance that is carried out regularly and scheduled [19]. Breakdown Maintenance can be interpreted as a maintenance policy by means of a machine/equipment being operated until it breaks down, then it is repaired or replaced [20].

From the method factor, it is caused by a long downtime which can disrupt the next production process activity. Proposed improvements include a data guide format for product replacement on each machine and affixed to each machine in full to reduce downtime. The human factor is caused by the operator needing to be more responsive to problems on the machine, different operator skills, and decreased work ethic. Proposed improvements include placing operators that focus each filling line at least one operator to speed up downtime and not disrupt the production process. Then all machine operators need to be given training to control at least three machines so that machine operators are not fixated on one machine. Related to the declining work ethic, the company rewards the operators' performance per filling line section that is successful and consistent with production results that reach the target. The late arrival of material stocks causes material factors, rejected materials, and materials that must comply with specifications. Proposed improvements, namely, the company needs to consider changing material suppliers to get better material quality. Environmental factors are caused by a lack of air circulation, especially in the doos transfer section, which results in hot room temperatures. The proposed improvement is adding a fan to increase air circulation and reduce the area's heat.

4 Conclusion

Based on the results of the calculations and analysis performed, it was found that the lithos packaging filling stations consisting of FL-1, FL-2, FL-3, FL-4, FL-5, and FL-6 had values below the standard OEE value. Among the six filling lines (FL), FL-4 has the lowest OEE value. After identification by measuring the six big losses on Fl-4, it is known that the losses that result in low FL-4 productivity are breakdown losses with a value of 48%, reduce speed losses with a value of 41%, idling and minor stoppages with a value of 7%, setup and adjustment losses with a value of 3%, and defect losses with a value of 1%. Based on the results of the fishbone diagram analysis, it is known that machine factors, method factors, human factors, material factors, and environmental factors cause this. Proposed improvements to increase productivity on FL-4, namely scheduling machine maintenance at a specified time (preventive maintenance), not by the factor of damage (breakdown maintenance), making a data guide for product change for each machine and affixing it to each machine in full so that This downtime can be reduced, placing technical operators who focus on each filling line at least one technical operator, to speed up downtime and not disrupt the production process, add fans to speed up air circulation to reduce heat in the area, and change material suppliers to get better quality.

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