Improvement Suggestion Performance of Blowing Machine Line 4 with Total Productive Maintenance (TPM) Method at PT. Coca-Cola Amatil Indonesia Medan Unit

Defi Irwansyah¹, M R F Harahap¹, Cut Ita Erliana¹, Dahlan Abdullah²*, AyuEsteka Sari¹, Nurintan Asyiah Siregar⁴, AchmadDaengs GS⁵, Asmara Indahingwati⁶, Eko Sumarto⁷, Sri Wilujeng⁸, Nurma'awi⁹, Purwo Subekti¹⁰, Nuning Kurniasih¹¹, Febrianti Rosalina¹² and H Hartono¹³
¹Department of Industrial Engineering, Universitas Malikussaleh, Aceh, Indonesia
²Department of Informatics, Universitas Malikussaleh, Aceh, Indonesia
³Department of Management, STIE Sakti Alam Kerinci, Jambi, Indonesia
⁴Department of Management, STIE Labuhanbatu, Sumatera Utara, Indonesia
⁵Department of Management, Universitas 45 Surabaya, Indonesia
⁶Department of Management, School of Economics Indonesia "STIESIA" Surabaya, Indonesia
⁷Faculty of Agriculture, Universitas Bengkulu, Bengkulu, Indonesia
⁸Department of Management, Faculty of Economy, Universitas Kanjuruhan, Malang, Indonesia
⁹Program study of Industrial Engineering, University of 45 Surabaya, Indonesia
¹⁰Program Study of Mechanical Engineering, Pasir Pengaraian University, Riau, Indonesia
¹¹Faculty of Communication Sciences, Library and Information Science Program, Universitas Padjadjaran, Bandung, Indonesia
¹²Department of Agrotechnology, Universitas Muhammadiyah Sorong, Sorong, Indonesia
¹³Department of Computer Science, STMIK IBBI, Medan, Indonesia

*dahtah@unimal.ac.id

Abstract. Maintenance is an activity to maintain facilities or equipment of the factory and make repairs or adjustments to the necessary replacement to satisfactory condition of production operations in accordance with what is planned. Companies often experience damage to the Blowing machine so that interconnected machines cannot be operated. The purpose of this study was to improve the performance of Blowing line 4 engines with the Total Productive Maintenance (TPM) method at PT. Coca-Cola Amatil Indonesia Medan Unit, also to determine the level of Blowing machine performance based on the analysis of overall equipment effectiveness (OEE) at PT. Coca-Cola Amatil Indonesia Medan Unit. The method used in this study is the overall equipment effectiveness (OEE) method to measure Ishikawa's treatments and diagrams to compare and propose low engine performance. The results of data processing shows machine maintenance has not comply the OEE standards in July 81.48%, August 81.48%, September 78.07%, October 81.22%, November 78.08%, and those that fill the standards in June amount to 86.48%, with losses that most affect the effectiveness of equipment in line 4 blowroom machine is Equipment Failure Losses of 11.42% based on the results of the study, the proposed improvement in engine performance is to provide training to employees, and increase operator awareness against engine damage, thus the production process will run smoothly.
1. Introduction
At this time, engine/equipment factors very influential production results, where engine/equipment factors are affected by engine damage that takes a long time to make repairs, cleaning the installation, and setting tools. Information obtained from the department of machine production that is often damaged is the blowroom. In the Production process, we must pay attention to ergonomics in the workplace[1]. The production process can also be assisted by using ICT devices[2]. However, things that need to be considered in ensuring the use of ICT can work well in the production process are problems related to system security[3]. There are several methods that can be used to ensure system security[4][5][6]. The production process can also use ICT for the calculation process that demands high accuracy[7] and also search problems[8]. ICT-based systems also provide services for decision making[9][10][11][12]. It should be noted that the most important thing is the application of ICT-based benchmarking processes in the production process[13]. This is important to ensure that production results can be at an efficient level, this is important to ensure that production results can be at an efficient level[14][15]. When there is an inefficient process, this needs to be assessed about the inputs needed and the output produced[16][17]. The application of a web-based system is the most common example in the implementation of the ICT process[18][19]. The process also can The damage in the blowroom machine is due to human error, spare parts, not in accordance with the specifications specified. In the present time, the blowroom machine often experiences damage every month in 2017 with the duration of the machine stopping one to three hours each month, as a result the entire production process stops for a long time, accordingly wasting productive time as a result of a monthly production decline, there are losses resulting in loss[20].

PT. Coca-Cola Amatil Indonesia Medan Unit is one of the companies engaged in large-scale beverage production. PT. Coca-Cola Amatil Indonesia Medan Unit is located on Jl. Yos Sudarso KM. 14 Medan-Belawan. The company produces bottle beverage such as Coca-Cola, Sprite, Fanta, Fresh Tea, Pulpy Orange, Ades. PT. Coca-Cola Amatil Indonesia Medan Unit make a production stock to maintain the level of finished products inventory in the warehouse to fill demand for the next few days. This is due to the availability and reliability of the engine is very important to recorded. The machines used in the company are mixer machines, empty bottles, bottle washer, filler, crowner, date code, packer, and palletizer. The several machines, has often damaged suddenly is the blowroom. The blowroom functions as a bottle printing tool, the machine is one of the most important machines in the production of coca-cola drinks in the company.

To get a machine that can maintain its reliability, it is necessary to do a good concept. Total Productive Maintenance (TPM) is a good concept to realize this. Because the concept besides involving all personnel in the company also aims to take care of all production facilities/performance maintenance owned by the company. TPM is a management system in the maintenance of equipment, machinery with the aim of achieving zero defects, zero breakdown, and zero accident[21]. With the implementation of a good maintenance system, production facilities are expected to work as expected. Thus, production facilities will have a high level of reliability, so the quality of the products produced will be maintained and productivity can be maintained

2. Related Works
Maintenance is an activity to maintain machinery/equipment and make repairs or adjustments/replacements that are needed to satisfactory condition of production operations in accordance with what is planned. With the maintenance activities, the machine/equipment can be used according to the plan and not damaged as long as it is used for the production process or before a certain period is planned to be achieved[22]. Maintenance is a supporting activity for commercial activities, like other activities, maintenance must be effective, efficient and low-cost. With this maintenance activity, the machine/production equipment can be used according to plan and not damaged for a certain period of time that has been planned to be achieved.

3. Research Methodology
3.1. Operational Variable
Operational variables used in this study are:
    a. The loading time data is the data of the time activity.
    b. Engine breakdown data is damage that usually occurs more than 10 minutes.
    c. The setup time data is the unavailability of the production machine due to the exchange of models or products.
    d. Cycle time data is the length of time for one product unit.
    e. The amount of output is how much product is produced by the machine.
    f. The number of product defects is that many defective products are produced by the machine.

3.2. Analysis Model
In this study has been used analysis model as follows:

- **Counting Availability Rate**
  \[ AR = \frac{\text{Loading time} - \text{Downtime}}{\text{Loading time}} \times 100\% \]

- **Counting Performance Rate**
  \[ PR = \frac{\text{Processed amount} \times \text{Ideal cycle time}}{\text{Operation time}} \times 100\% \]

- **Counting Quality Rate**
  \[ RQ = \frac{\text{Output} - \text{Defect}}{\text{Output}} \times 100\% \]

3.3 Step by Step in Research Implementation
The research steps contain the steps to be taken during the research and useful as a reference for systematic progress. The following are the research steps which can be seen in Figure 1.
Overall Equipment Effectiveness (OEE) is a total measurement of availability that is related to the effectiveness of production activities and product quality. OEE measurement shows how well the company uses its resources including equipment, workers and the ability to satisfy consumers in terms of shipping according to quality specifications according to consumers.

To calculate OEE, a calculation will be made to find OEE’s components, like Availability, Production effectiveness, Rate of Quality Product, by multiplying the values of Availability, Production effectiveness, and Rate of quality (AV x PE x RQ).

The success of TPM activities must be measured the implementation of activities is clear and directed. The parameter for measuring this activity is the TPM index, which includes availability, which is the
availability of the machine. This value is a parameter of the success of maintenance activities. The availability index (AV) set by the JIPM (Japan Institute of Plant Maintenance) is a minimum of 90%. Calculation of Availability of Blowing machines in June 2017 can be seen in the table below:

Table1. Research Data of Availability Blowing Machine on June 2017

| Month       | Information | June (minute) | July (minute) | August (minute) | September (menit) | October (minute) | November (minute) |
|-------------|-------------|--------------|---------------|-----------------|-------------------|------------------|-------------------|
| Loading Time|             | 24960        | 22080         | 22080           | 24960             | 23040            | 24960             |
| Downtime    |             | 2639         | 2856          | 2856            | 3866              | 3866             | 4016              |

Counting of Availability machine on June 2017, is Discovered:

\[ \text{Operation time} = \text{loading time} - \text{downtime} \]
\[ = 24960 - 2639 \]
\[ = 22321 \text{ minute} \]

Then, \( \text{availability} = \frac{\text{loading time} - \text{downtime}}{\text{loading time}} \times 100\% \)
\[ = \frac{24960 - 2639}{24960} \times 100\% \]
\[ = 89.42\% \]

With the same method to count Availability on July, August, September, October, and November can be seen in Appendix 2. Recapitulation of Availability calculations can be seen in Table 2.

Table 2. Recapitulation of Availability During Six Months in 2017

| Month      | Loading time (minute) | Downtime (minute) | Operating time \( \text{LT} - \text{DT} \) (minute) | Availability AR (%) |
|------------|-----------------------|-------------------|-----------------------------------------------|---------------------|
| June       | 24960                 | 2639              | 2639                                          | 89.42               |
| July       | 22080                 | 2856              | 19224                                         | 87.06               |
| August     | 22080                 | 2856              | 19224                                         | 87.06               |
| September  | 24960                 | 3866              | 21094                                         | 84.51               |
| October    | 23040                 | 3866              | 19174                                         | 83.22               |
| November   | 24960                 | 4016              | 20944                                         | 83.91               |
| Total      | 142080                | 16233             | 121981                                        |                     |
| Average    | 23680                 | 2705              | 20330                                         | 85.86               |

From the above calculation recapitulation can be seen the highest Availability value is in June that is 89.42% and the lowest is in November with a value of 83.42% and the average value of Availability Rate is 85.86%.

The overall effectiveness of equipment and machinery (overall equipment effectiveness) is a TPM index to see overall line conditions and overall equipment effectiveness which is the result of multiplication between availability (AV), production effectiveness (PE), and quality level (RQ). The standard for overall effectiveness of equipment and machinery (OEE) set by JIMP is 85%.

The OEE calculation for June 2017 is as follows:

\[
\text{OEE} = \text{AV} \times \text{PE} \times \text{RQ}
\]
\[
= (89.42\% \times 96.76\% \times 99.96\%) \times 100\%
\]
IOP Publishing

Based on the results of the evaluation with the TPM method using the OEE calculation (Overall Equipment Effectiveness), the effectiveness of the equipment and the machine as a whole was not good only in June which fill the standard of 86.48%, while July, August, September, October and November did not reach the value OEE is 81.48%, 81.48%, 78.07%, 81.22%, 78.08% and the average value of Overall Equipment Effectiveness is 81.13%. Thus the OEE value of Blowing Line 4 machine is still below the standard value set by JIPM which is 85% aka and losses which most influence the effectiveness value of the equipment in the blowroom machine is Equipment Failure Losses of 11.42%.

The development of machine maintenance procedures is intended to improve engine performance. Low engine performance due to the maintenance system of the engine that has not run well identified by the Cause And Effect Diagram, then re-analyzed based on the mapping of maintenance activities and the development of maintenance programs with indicators will be obtained that can indicate an increase in company productivity. Analysis of indicators of productivity improvement is also discovered out by using the Cause and Effect Diagram approach so that a clear picture of the difference between actual conditions and the conditions of the effort is obtained.

The following table is a description for engine performance efforts at PT. Coca-Cola Amatil Indonesia MedanUnit.

| Table 3. Recapitulation Counting of Overall Equipment Effectiveness in 2017 |
| --- | --- | --- | --- |
| Month | Availability Rate (%) | Performance Efficiency Rate (%) | Rate of Quality Rate (%) | OEE (%) |
| June | 89.42 | 96.76 | 99.96 | 86.48 |
| July | 87.06 | 93.63 | 99.96 | 81.48 |
| August | 87.06 | 93.63 | 99.96 | 81.48 |
| September | 84.51 | 92.44 | 99.94 | 78.07 |
| October | 83.22 | 97.65 | 99.95 | 81.22 |
| November | 83.91 | 93.10 | 99.96 | 78.08 |
| Total | 515.18 | 567.21 | 599.73 | |
| Average | 85.86 | 94.53 | 99.95 | 81.13 |

The following table is a description for engine performance efforts at PT. Coca-Cola Amatil Indonesia MedanUnit.

| Table 4. Improvement Suggestion Performance of Blowing Machine |
| --- | --- | --- |
| Common Factor | Causes of problems in the maintenance system | Level 1 | Level 2 | Level 3 |
| Human /operator | Provide training to operators | Training of tackling machine damage | Providing knowledge to the operator in the maintenance of the engine |
| | Operators must increase their level of concern | Improve discipline |
Common Factor | Causes of problems in the maintenance system
--- | ---
**Machine and Equipment** | It is offer to minimize the frequency of engine damage | Carry out regular maintenance activities | Provide parts that are difficult to obtain before damage occurs
 | | | Provide parts that are difficult to obtain before damage occurs | Check the nose water and lubricate the extruder

Material | In order to keep the Blowing machine from being damaged | Immediately replace damaged components | Improve accuracy in setting the machine

Method | OEE | Shorten *downtime* | Routine maintenance

5. Conclusion
The conclusions that can be drawn from the discussion of this final project are as follows:
1. From the results of processing data obtained, maintenance of the machine has not fill the OEE standard, like in July 81.48%, August 81.48%, September 78.07%, October 81.22%, November 78.08% and that fulfilling The OEE standard is 86.48% in June, with the average value of Overall Equipment Effectiveness being 81.13% on blowroom line 4 and based on the Japan institute of Plant Maintenance (JPIM) the value has not reached the standard of > 85% and losses that most influence the effectiveness of equipment in the blowroom machine are Equipment Failure Losses of 11.42%.
2. Based on the results of the research, the improvement suggestion in engine performance is to provide training to employees, as well as to increase operator awareness of engine damage, thus the production process will run smoothly.

References
[1] C. I. Erliana and D. Abdullah, “Application of The MODAPTS Method with Innovative Solutions in The Cement Packing Process,” *International Journal of Engineering & Technology*, vol. 7, no. 2, pp. 470–473, Apr. 2018.
[2] D. Napitupulu, M. Syafrullah, R. Rahim, D. Abdullah, and M. I. Setiawan, “Analysis of user readiness toward ICT usage at small medium enterprise in south tangerang,” *J. Phys.: Conf. Ser.*, vol. 1007, no. 1, p. 012042, 2018.
[3] D. Abdullah et al., “Super-Encryption Cryptography with IDEA and WAKE Algorithm,” *J. Phys.: Conf. Ser.*, vol. 1019, no. 1, p. 012039, 2018.
[4] M. Mesran et al., “Combination Base64 and Hashing Variable Length for Securing Data,” *J. Phys.: Conf. Ser.*, vol. 1028, no. 1, p. 012056, 2018.
[5] R. Rahim et al., “Combination Base64 Algorithm and EOF Technique for Steganography,” *J. Phys.: Conf. Ser.*, vol. 1007, no. 1, p. 012003, 2018.
[6] R. Rahim, H. Nursidyanto, A. S. A. D. Abdullah, D. Hartama, and D. Napitupulu, “Keylogger Application to Monitoring Users Activity with Exact String Matching Algorithm,” *J. Phys.: Conf. Ser.*, vol. 954, no. 1, p. 012008, 2018.
[7] D. Abdullah, R. Rahim, D. Hartama, A. Abdisyah, Z. Zulmiardi, and S. Efendi, “Application of Web Based Book Calculation using Deterministic Dynamic Programming Algorithm,” *J. Phys.: Conf. Ser.*, vol. 1019, no. 1, p. 012040, 2018.
[8] R. Rahim et al., “Breadth First Search Approach for Shortest Path Solution in Cartesian Area,” *J. Phys.: Conf. Ser.*, vol. 1019, no. 1, p. 012036, 2018.
[9] T. Simanihuruk et al., “Hesitant Fuzzy Linguistic Term Sets with Fuzzy Grid Partition in Determining the Best Lecturer,” *International Journal of Engineering & Technology*, vol. 7, no. 2.3, pp. 59–62, Mar. 2018.

[10] M. F. Syahputra et al., “Identification Male Fertility Through Abnormalities Sperm Based Morphology (Teratospermia) using Invariant Moment Method,” *J. Phys.: Conf. Ser.*, vol. 978, no. 1, p. 012107, 2018.

[11] M. F. Syahputra et al., “Implementation of augmented reality to train focus on children with special needs,” *J. Phys.: Conf. Ser.*, vol. 978, no. 1, p. 012109, 2018.

[12] A. Alesyanti, R. Ramlan, H. Hartono, and R. Rahim, “Ethical decision support system based on hermeneutic view focus on social justice,” *International Journal of Engineering & Technology*, vol. 7, no. 2.9, pp. 74–77, 2018.

[13] D. Abdullah, Tulus, S. Suwilo, S. Effendi, and Hartono, “DEA Optimization with Neural Network in Benchmarking Process,” *IOP Conference Series: Materials Science and Engineering*, vol. 288, p. 012041, Jan. 2018.

[14] D. Abdullah, T. Tulus, S. Suwilo, S. Efendi, M. Zarlis, and H. Mawengkang, “A Research Framework for Data Envelopment Analysis with Upper Bound on Output to Measure Efficiency Performance of Higher Learning Institution in Aceh Province,” *International Journal on Advanced Science, Engineering and Information Technology*, vol. 8, no. 2, 2018.

[15] D. Abdullah, S. Suwilo, Tulus, H. Mawengkang, and S. Efendi, “Data envelopment analysis with upper bound on output to measure efficiency performance of departments in Malaiakulsaleh University,” *Journal of Physics: Conference Series*, vol. 890, p. 012102, Sep. 2017.

[16] D. Abdullah, Tulus, S. Suwilo, S. Efendi, Hartono, and C. I. Erliana, “A Slack-Based Measures for Improving the Efficiency Performance of Departments in Universitas Malikussaleh,” *International Journal of Engineering & Technology*, vol. 7, no. 2, pp. 491–494, Apr. 2018.

[17] D. Abdullah et al., “A Slack-Based Measures within Group Common Benchmarking using DEA for Improving the Efficiency Performance of Departments in Universitas Malikussaleh,” *MATEC Web Conf.*, vol. 197, p. 16005, 2018.

[18] R. Sitompul, A. Alesyanti, H. Hartono, and A. S. Ahmar, “Revitalization Model The Role of Tigo Tungku Sajarangan in Fostering Character of Children in Minangkabau Family and Its Socialization Through Website,” *International Journal of Engineering & Technology*, vol. 7, no. 2.5, pp. 53–57, Mar. 2018.

[19] R. Sitompul, A. Alesyanti, H. Hartono, and R. Rahim, “Factors Cause Understanding Level of Low Soft Skill for Political Party Members and its Socialization Through Website,” *International Journal of Engineering & Technology*, vol. 7, no. 2.14, pp. 286–288, 2018.

[20] A. Corder and K. Hadi, *Teknik Manajemen Pemeliharaan*. Erlangga, 1988.

[21] N. Ansori and M. I. Mustajib, “Integrated Care System,” p. 156, 2013.

[22] K. E. McKone, R. G. Schroeder, and K. O. Cua, “The impact of total productive maintenance practices on manufacturing performance,” *J. Oper. Manag.*, vol. 19, no. 1, pp. 39–58, 2001.