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The Effectiveness of Preventive Maintenance in Overcoming Production Process Constraints on the Komori Lithrone G37 Offset Machine at PT X

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A B S T R A K

Kendala hingga kerusakan yang terjadi pada mesin, bukan hanya mengakibatkan kendala pada mesin tetapi juga berpengaruh pada ketercapaian target hasil produksi, seperti yang terjadi pada mesin ofset Komori Lithrone G37 yang mengalami kendala proses produksi buku A pada proses cetak 6000 terjadi 9 kali permasalahan mesin, , buku B pada proses cetak 4000 terjadi 10 kali permasalahan mesin. Kendala yang terjadi di sebabkan tekanan angin yang lemah karena filter udara yang kotor, kendala sensor yang tidak berfungsi dan kerusakan bearing. Pengoptimalan preventive maintenance menjadi solusi. Metode penelitian yang dilakukan adalah observasi dan pada mesin dan analisis. Hasil penelitian ini, setelah di lakukan preventive maintenance, kendala pada proses proses produksi tidak terjadi lagi.

A R T I C L E I N F O

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A B S T R A C T

Problems and damage occurring in machines not only cause problems for the machines themselves but also affect the achievement of production targets, as was the case with the Komori Lithrone G37 offset machine, which experienced problems during the production of book A during the 6,000-print run, with 9 machine problems occurring, and book B during the 4,000-print run, with 10 machine problems occurring. The issues were caused by weak air pressure due to a dirty air filter, malfunctioning sensors, and bearing damage. Optimising preventive maintenance was the solution. The research method employed was observation and analysis of the machine. The results of this study showed that after preventive maintenance was carried out, the issues in the production process no longer occurred.

1. INTRODUCTION

Growing industries require high-performance machines to meet production targets. The production machines used require maintenance which can further affect the compliance of production output to standards. Machines play an important role in the production process, ensuring that products meet the set standards (Azhari & Patradhiani, 2023). One of the success factors of the manufacturing industry is determined by the smooth production process (Andrianto, 2022). In this context, companies should pay special attention to machine maintenance, as this step is important to minimise major losses due to negligence in the maintenance process. Risk management, preventive maintenance, repair, and component replacement are important concepts in maintenance. (Afiva et al., 2019)

The problems on the Komori Lithroe G37 offset machine owned by PT X are experiencing problems in the production process of paper that is not smooth, the print results are sometimes uneven between trial prints and proof prints, the Komori Lithroe G37 machine makes a loud noise on

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the magenta unit so that it disturbs hearing, the Komori Lithroe G37 machine has an error caused by dusty sensors and machine conditions, pneumatic hoses that have passed the service life and have not been replaced and others.

Figure 1. Komori Lithroe G37 Machine

The Komori Lithroe G37 machine has five main units:

a) Feeder unit
The feeding system is divided into two: single-sheet feeder and continuous flow feeder. The paper feeding system distributes paper sheet by sheet. Thanks to the feeding equipment, each sheet is sucked and fed directly to the printing unit.
The paper enters the feed table in the form of stacked flats. The sheets in the stack follow each other: the topmost sheet enters the feed table, the second sheet has just entered the feed table, the third sheet follows halfway up the surface, and so on until the last sheet. The advantage of the betel stacking system is its higher speed than the sheet feeder.

b) dampening unit
Since the printable part and the non-printable part are located at the same height inside the mould, the presence of a dampening unit is essential to distinguish the part that absorbs ink from the part that rejects it.

c) Inking unit
The inking unit of an offset printing machine consists of an ink reservoir and several ink rollers that distribute, level, transport and flow ink from the reservoir to the plate. The number of ink rollers depends on the design of the inking equipment, the size of the printing plates, and the type of work performed by the machine.

d) Printing unit
Printing is the process of transferring a layer of printing ink from a mould or printing plate (offset printing) to the surface of the object, in this case the printed material, through an intermediate support medium, namely rubber cloth, at a certain printing speed and pressure.

e) delivery unit
This output unit is the last unit that contains the printout. In the output unit, the paper is transported by the gripper, then adjusted by the right and left paper adjusters, as well as the rear paper adjusters.

Preventive maintenance

Maintenance is an important strategy to keep the company's machinery and equipment operating optimally to avoid production disruptions and damage (Prabowo, 2020). Maintenance activities are divided into planned maintenance, including preventive and predictive maintenance, and unplanned maintenance. (Siregar, et al., 2022). preventive maintenance is planned maintenance, usually periodic, which includes various tasks such as inspection, repair, replacement, cleaning, lubrication and adjustment.

Preventive maintenance is an activity that is often implemented by most manufacturing and service companies. Its purpose is to prevent sudden equipment breakdowns. Interventions are generally carried out at regular intervals, determined by the level of equipment or machinery and load conditions. Preventive maintenance activities can help extend the life of heavy equipment (up to 3-4 times) and reduce unexpected damage. According to the advantages of this programme are:
1. Reduced repair costs
2. More targeted activities
3. Reduced production downtime
4. Supply of spare parts more regularly and in smaller quantities
5. Less disruption due to sudden breakdowns
6. Reduced need for replacement of equipment or machinery
7. Reduced overtime
8. Safety in the workplace is more assured

Maintenance tasks and activities. All maintenance tasks and activities can be classified into five main tasks: inspection, engineering activities, production activities, administrative work, and housekeeping.

a) Inspection
   Inspection activities include regular inspections or checks of plant buildings and equipment in accordance with the plan, as well as inspection and reporting activities of faulty equipment. Inspection reports should indicate the condition of the equipment inspected, the cause of the damage (if any) and the repairs made. The purpose of this inspection activity is to find out whether the factory still has equipment or production facilities that are in good condition so as to ensure the smooth production process.
b) Engineering activities
   Engineering activities include testing of newly acquired equipment, development of equipment or components to be replaced, and research on the possibility of this development.

Total Productive Maintenance

Total Productive Maintenance (TPM) is the idea of maintenance that involves the entire organisation to sustainably maintain and improve equipment productivity. (Permana, 2019). TPM was chosen to improve the performance of LDSM machines by emphasising breakdown prevention and improving operational efficiency. Preventive maintenance in TPM emphasises damage prevention through regular maintenance and inspections. (Yusri & Anwar, 2022). According to Edi Santoso and Edwin Julianto C., total productive maintenance can theoretically be described as the cost of corrective maintenance which is inversely proportional to the cost of maintenance it self. The goal of Total Productive Maintenance is to improve the productivity and efficiency of manufacturing businesses

Preventive maintenance of productivity can be done as follows:
1. Design machines or equipment that are highly reliable, easy to use and maintain.
2. Analyse the investment cost of the machine or equipment, including supplier service and maintenance costs.
3. Develop preventive maintenance that can be used in practice by operators, maintenance personnel and technicians.
4. Train workers in the use of machinery or equipment, including maintenance. The concept of temporal relationships in maintenance

According Edi Santoso and Edwin Julianto, there are several terms that are often used in maintenance. Descriptions of these terms include:

a) Availability
   The duration (period) during which a machine/equipment is in good condition and can perform its function as intended (under certain conditions and with proper maintenance).

b) Machine downtime
   Machine downtime is a condition in which the machine/equipment cannot perform its function. Machine downtime can be calculated from the time the machine is stopped until it is restored after repair.

c) Operating time
The duration (period) during which a machine performs its intended function.
Uptime < Active Time

d) Waiting time
The duration (period) during which the machine is in working order
as expected, but the machine is not in use.
Active Time = Active Time + Waiting Time

e) Maintenance time
The time spent on maintenance activities includes delays that occur during their execution.

f) Active maintenance duration
The portion of maintenance time during which maintenance activities/work is actually performed.

g) Logistics time
Downtime, when maintenance activities cannot be started due to logistical reasons.

h) Administrative time
Downtime, when maintenance activities cannot be started due to administrative reasons.

i) Corrective maintenance time
The period of active maintenance during which corrective maintenance activities are performed.

j) Preventive maintenance time
The active maintenance period during which preventive maintenance activities are performed.
as expected, but the machine is not in use.
Active Time = Active Time + Waiting Time

k) Maintenance time
The time spent on maintenance activities includes delays that occur during their execution.

l) Active maintenance duration
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n) Administrative time
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o) Corrective maintenance time
The period of active maintenance during which corrective maintenance activities are performed.

p) Preventive maintenance time
The active maintenance period during which preventive maintenance activities are performed.

2. METHOD

Contains how data is collected, data sources and ways of data analysis.
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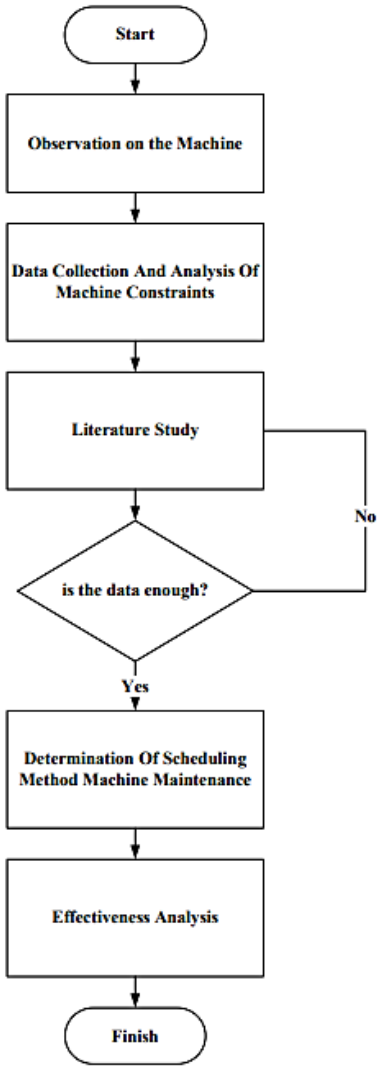

Figure 2. Resarch Flow

This research begins with direct observation to PT X to collect data on engine specifications, engine damage and analyse related performance constraints on Komori Lithroe G37 engines.

Table 1. Machine Specification

Machine Specification	
Model	Komori Lithrone G37
Sheet Size	Max. 640 x 940 mm
Printing Size	Max. 620 x 930 mm
Printing Speed	Max. 15.000 sph
Sheet Thickness	0,04 – 0,6 mm

3. RESULT AND DISCUSSION

Product defects and cause analysis

Komori Lithrone G37 4 colour machine experiences several problems that can affect production results in the printing process, these problems include:

a) The printout is only half of the printing of book A with a print count of 10000

Figure 3. image and text are not printed perfectly
Source: Author

Table 2. Constains on book A printing

No	Print	number of problems	Cause	Solusion
1	1000	0	-	-
2	2000-4000	3	Air pressure is unstable and tends to be lacking (due to dirty air filter on the compressor)	Clean the Air filter Priodicaly
3	5000-6000	6	Broken Hose	Return the air hose

Table 2 shows that during the printing process of 2000-4000 sheets, there were three instances of unstable and low air pressure. Upon inspection, it was found that the cause of the problem was a dirty air filter. During the printing process of 5000-6000 sheets, there was a leak in the water hose. Upon inspection, it was found that the cause of the problem was that the water hose had become hard and brittle.

Problems with the air system in offset printing machines can cause partial printing or rejects. This problem can occur due to a lack of air entering the machine or blockages. A lack of air can interfere with the operation of equipment such as rollers, cylinders, or paper distribution systems, causing uneven ink distribution, friction, or incorrect image placement on the paper surface, resulting in imperfect printing.

b) The paper entry unit is often stopped at printing book B

Figure 4. double paper enters the cylinder area

Table 3. Constraints on book B printing

No	Print	Number of problem	Cause	Solusion
1	1000-2000	6	Entry unit shut down due to double sheet detector sensor error	Reset double sheet detector sensor and clean the sensor
2	3000-4000	4	Double paper enters to silinder area	Clean the sensor and replace the sensor that has passed its service life.
3	5000-6000	2	There was a loud noise at the edge of the roll, due to worn bearings	Perform regular lubrication and replacement of bearings that show signs of wear

Table 3 shows that in print runs of 1000-2000 sheets, the feed unit shut down due to a problem with the double paper detector sensor. During the printing of 3000-4000 sheets, double paper entered the cylinder area. After inspection, it was found that the problem was caused by a malfunctioning double paper detector sensor. During the printing of 5000-6000 sheets, there was a loud noise coming from the edge of the roll. After inspection, it was found that the problem was caused by a damaged bearing.

Based on the data above, it shows that there is negligence or periodic machine maintenance processes are not carried out according to standards.

After the repair and countermeasures are carried out, the print results become more perfect again, as in the picture below.

Figure 5. Photo of perfect print result
Source: Author

Table 4. constraint data after preventive maintenance

No	Print	Number of problem	Cause	Solusion
1	1000-2000	-	-	-
2	3000-4000	-	-	-
3	5000-6000	-	-	-

Based on the data in table 4, it shows that after preventive maintenance, there are no more problems with the Komori Lithroe G37 offset machine from 1000 - 6000 sheets.

4. CONCLUSION

The Komori Lithroe G37 offset machine owned by PT X often experiences problems during the production process. These problems occur during the book production process. In the production process for book A, with a print run of 1,000-6,000 copies, there were 9 machine problems, while for book B, with a print run of 1,000-2,000 copies, there were 11 problems. The problems that occurred included weak air pressure and sensor issues, which resulted in rejects in the production output. This indicates that regular machine maintenance activities have not been carried out. The lack of preventive maintenance measures can be seen from the poor condition of the machine. Based on the data and discussion, this shows that there has been negligence or that the preventive maintenance process has not been carried out according to standards. This is certainly detrimental to the company and causes rejects. After analysing and coordinating with the Maintenance team and management, it was agreed to carry out routine maintenance. After preventive maintenance was carried out, the production process was monitored. Based on production monitoring on book printing C, there were no further machine issues. Thus, implementing preventive maintenance can maintain machine performance and ensure a smooth production process.

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