Current Integrative Engineering
Volume 1, Issue 1, 78-91
DOI: 10.59762/cie570390541120231031131046

A Comparative Study Of Reliability-Centered Maintenance And New-Based Maintenance Approaches On A Working-Hours Engine: A Case Study

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ABSTRACT

Maintenance is an important system in operation. In an era where the electricity generation industry focuses on 24-hour operations to maximize the production of electrical energy, which is needed for development and as a driving force for offic equipment and the economy of the people in Timor-Leste, it is pushed to its absolute limit to meet this demand. With the increase in the operation of the electric energy generation unit, the wear and tear of the engine components will increase. So, the need for increased engine parts, to prevent failure. To remedy this situation and guarantee the machine's continued peak performance, preventative maintenance is executed. Preventive maintenance (PM) is one subfield of maintenance that aims to forestall failures before they manifest. The maintenance, production, and management teams will need to work closely together to make PM a success. This article is a case study of Electrical Diesel Timor-Leste (EDTL), a firm with two power production facilities located in Hera and Betano, and it examines the causes of inefficient PM activity and the ramifications this has for the organization.

Keywords: Electrical energy, Engine components, preventative maintenance, Working hours engines.

Introduction

Background

Expression of thought the context in conceptual comparative research on Reliability-Centered Maintenance (RCM) with research conducted by researchers at the two EDTL centers, with the direct on-site observation of Based Maintenance on Working Hour Engine (BMWHE), there is a very significant difference between the two preventives maintenance.

The theory of Reliability-Centered Maintenanceacc0rding to [1] is famous for the seven questions that are very popular among preventive maintenance practitioners. As for the Based Maintenance on Working Hours Engine, the researchers found it at the two EDTL centers in Timor-Leste. This is what motivates researchers, to make a comparison of the two preventive maintenance, between Reliability-Centered Maintenance (RCM) with Based maintenance on Working Hours Engines (BMWHE) in Timor-Leste according to [2] to find out the strengths and weaknesses of each preventive maintenance, as mentioned above. Due to the performance of the maintenance operations for the two EDTL centers in Timor-Leste, electric energy generating units called Based maintenance on Working Hours Engines (BMWHE) is a crucial issue in this company owned by the Timor-Leste government.

LITERATURE REVIEW

After reviewing several types of asset maintenance, as below, with their respective definitions and tasks, arriving at a comparison between these types of maintenance with each other, there are significant similarities, in the application even with different names and types of asset maintenance. Because according to [3], and [4] all types of asset maintenance have the same goal, namely to maintain the life cycle of an asset, which is very necessary to produce something useful, in large, medium, and small industries.

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Types of asset preventive maintenance, including Reliability-Centered Maintenance (RCM) the following:

1. The first is corrective service per [5] and [6], When an anomaly is discovered, maintenance is performed to fix the problem and get things back to normal. This strategy stems from the conviction that a preventative maintenance program is a better finan ial investment than the alternative of dealing with unexpected downtime and repair expenses. Until catastrophic failures occur, this technique may be cost-effecti e.
2. Second, routine upkeep as recommended by [7] Preventative maintenance is work done on equipment at regular intervals or based on other factors to delay the onset of failure or improve its performance. The frequency of scheduled downtime for repairs is included into the lifecycle of each equipment. The number of malfunctions during operation decreases.
3. Risk-Based According to [8], maintenance is performed by incorporating analysis, measurement, and routine testing into preventative maintenance procedures. The collected data is evaluated in light of the system's environmental, operational, and process circumstances. The objective is to evaluate the state of the assets and the associated risks in order to design a proper maintenance schedule. All malfunctioning machinery is either repaired or replaced. By doing so, the plant's useful life may be lengthened and its dependability, safety, and efficienc maintained throughout time.
4. According to [9], CBM is Maintenance centered around tracking the status of equipment and keeping tabs on how well its repairs are holding up. The live detection of crucial operating device characteristics and their automated comparison with average values and performance provides a continual evaluation of the actual state of the equipment. When warning signs appear, indicating that machinery is degrading and failing soon, maintenance is performed. The long-term benefits of this approach include reduced maintenance costs, reduced likelihood of catastrophic failure, and more efficien use of financial resources.
5. According to [10], maintenance is performed after the discovery of an anomaly and is intended to return operations to normal. This strategy stems from the conviction that a preventative maintenance program is a better fin ncial investment than the alternative of dealing with unexpected downtime and repair expenses. This plan might save money until major breakdowns occur.
6. According to [11], time-based upkeep is a viable option. Time-based maintenance (TBM) refers to routine checks and adjustments made to machinery at predetermined intervals. Due to the nature of TBM maintenance, it must be scheduled in advance and may be utilized in conjunction with either predictive or preventative servicing. The TBM process begins with the scheduling of routine inspections and maintenance for a given component or system. Maintenance tasks that can be consistently performed on a weekly, monthly, or seasonal basis are best handled using time-based maintenance schedules. TBM for an air conditioner, for instance, would be appropriate every year in late April before summer. One of the most apparent advantages of preventive maintenance is that it increases the likelihood that you will avoid issues before they ever arise. I mean, it is the entire idea.
7. According to [12], preventative maintenance is beneficial because of 1.But if you need more convincing, here are a few particular benefits to think about.
8. Second, businesses will be able to operate with fewer shutdowns and less downtime thanks to preventative maintenance.
9. Third, the money you spend on preventative maintenance will save you money in the long term since it extends the life of your equipment.
10. To avoid paying workers overtime due to unplanned machine failures, preventative maintenance should be performed regularly to guarantee that all equipment and personnel only operate during scheduled hours.
11. Safety hazards to workers and consumers may be greatly reduced by preventative maintenance, which in turn can save money by avoiding litigation and accidents.
12. High operating efficienc from assets and equipment is a direct result of preventative maintenance, which in turn lowers energy costs.
13. I'm particularly interested in examining Time-based Maintenance and Reliability-Centered Maintenance among these preventative maintenance strategies.

METHODOLOGY (RCM)

Methodology for Reliability Centered

Maintenance based on seven (7) Questions according to [13]following:

1. What are the roles and performance requirements of the machinery in use today? Functional performance criteria are mentioned.
2. Explain how it's not performing as intended. Functional failure is a term that has been used.
3. Thirdly, why does each loss in functionality occur? The term "Functional failure mode" is used here.
4. When every possible failure has place, what then?
There is refer to Failure effect
5. In what ways is every failure important? There is refer to Failure consequent.
6. What can be done to prevent failure? There is refer to Failure prevent task intervals.
7. What should be done if the appropriate preventive tasks cannot succeed? There is refer to Identify the activities action.
On these seven questions (RCM), divided in three section. From number 1,2 and 3, it is referring to the function, and number 4, 5 and 6 it is referring to the failure, and number 7 refer to the activities action. So that, if compare

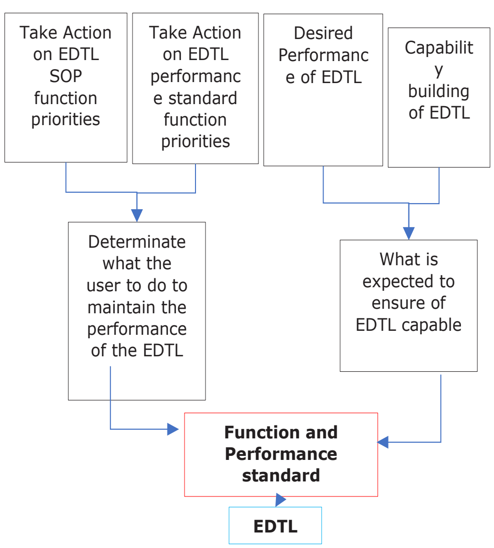


Figure (1) Diagram of the RCM question no.1.

with Based Maintenance on Working Hours Engine (BMWHE), has eighteen categories of K even numbers, with different membership functions. Where the eighteen K even numbers are divided into fi e groups, which have the smallest number of K numbers, up to the largest K numbers. The assignments and functions of K numbers, even and odd, will be explained last.

Electrical Diesel Timor-Leste (EDTL)

According to the views and analysis of the researchers on the seven RCM questions, it is very suitable to be implemented in EDTL Timor-Leste. Researchers estimate that the seven questions from the RCM are applied to the two diesel engine power plants in Timor-Leste, they would be able to take advantage of reduced maintenance costs, while maintaining optimal performance of the EDTL standard. It can be seen from the seven block diagrams, which the researcher describes below.

1. Explain concerning functions and related performance standards of equipment in the current operating context? Answer: The first question from this RCM, leads to Functional performance standards. This can be seen in the block diagram, which the researcher describes, to identify functional performance standards, from RCM, according to question number one.

The first RCM question to identify according to [14] functional standard performance, according to the standard operation procedure (SOP),

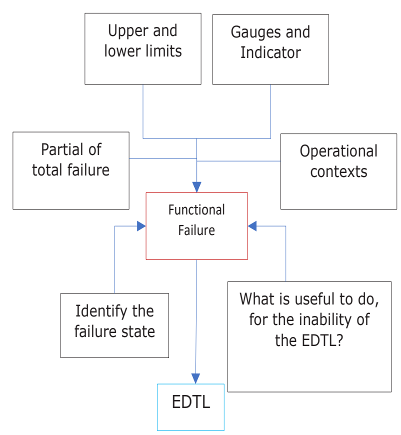


Figure (2) Diagram of the RCM question no.2. In general the second RCM question according to [16] a functional failure is defined as the unfitness of any assets to perform a function to the expected and acceptable performance standards. In the RCM process, it is very important to identify under which circumstances an EDTL can be declared to have a failed state. There are four different aspects of functional failures (as shown below).

and according to [15] the functions priorities are usabilities, such as speed, quality, and output functions; Besides that, the user is the satisfaction, safety, comfort, control, structural integrity, aesthetics, and efficien , with the EDTL performance standard. The performance standards EDTL in Timor-Leste with each engine capacity of 17 MW, can be defined as the degree to which a user wants EDTL to do anything. This can be identified in two ways: desired performance and innate capability. This performance standard is necessary to identify because a maintenance can only return an EDTL to its initial level of capability (designed capability or built-in capability).

2. In what ways does it fail to fulfil its function? This question is referred, to Functional failure. The answer is like the researcher, illustrate in the block diagram below

1. Complete loss of function is known as complete failure; whereas if the EDTL malfunction occurs beyond the acceptable limits, it is known as partial failure.
2. Any aspect of the failure is associated with the upper and lower limits of the performance standards. Such limits imply that an asset will be considered to be a failed EDTL if it produces output energy electrical that are over the upper limit and under the lower limit.
3. Then there are functional failures associated with the performance standards of the gauges and indicators.

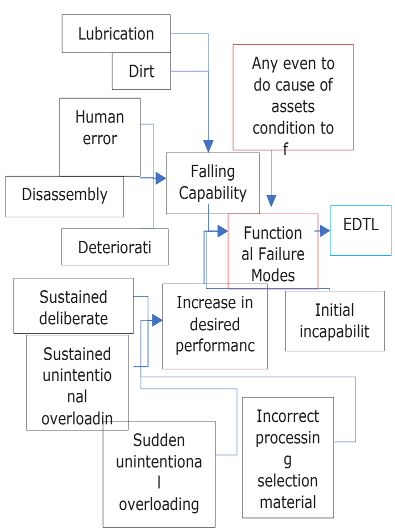


Figure (3) Diagram of the RCM question no.3.

4. The final aspect associated with a functional failure is the operating context of the EDTL. The failed state or the failure may be different for the identical EDTL

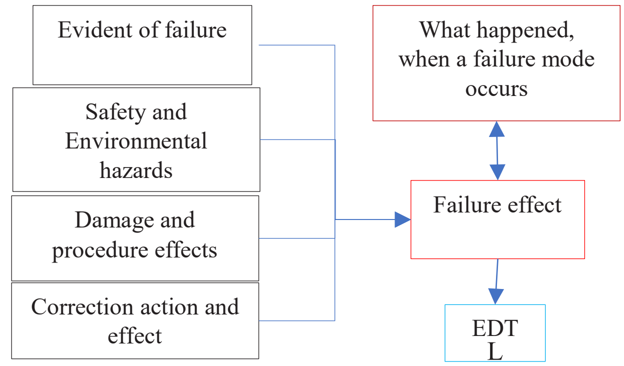


Figure (4) Diagram of the RCM question no.4.

depending upon the operating context.

Functional failures can be divided into two groups based on whether the occurrence of a failure is evident to the operating crew while performing its normal duties:
1. Hidden failure, whereas hidden or offlin functions are ones that are discovered either when operation of infrequently used equipment is attempted or when protective or back-up systems fail to operate when needed.

2. evident failure. Evident or online functions are the ones that reveal themselves to the operating crew during their normal routine;
3. What is the cause of each functional failure?

The question number three is refer to Functional failure mode. The answer is as the researcher describes in the block diagram below.

To analyze the failure modes of EDTL, we are going to a category on three views. There are falling capabilities and increase in desired performance, and then the initial of the incapability. Nonetheless, the breakdown will be linked to a decline in capability and a rise in expected performance. The most important concept in RCM analysis, functional failure modes, is introduced in the third RCM question [17]. The term "failure mode" is used to describe all the possible scenarios that might lead to a failed condition. The following are the three groups into which the functional Failure modes fall: It's important to remember that not every possible functional failure mode needs to be documented while doing so. Only failure modes that may be realistically anticipated in the given context should be documented. The following are examples of possible failure modes:

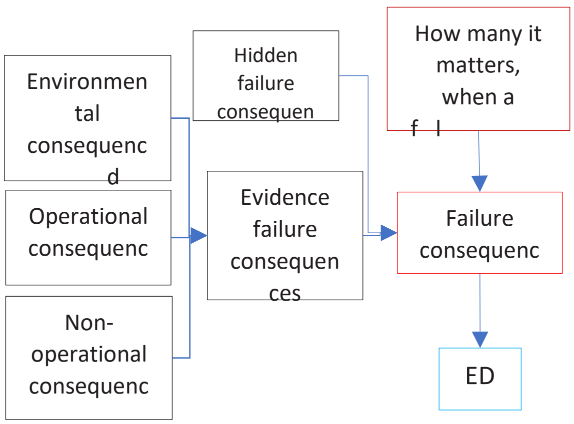


Figure (5) Diagram of the RCM question no.5.

• Functional Failure modes are already the subject of proactive maintenance routines. as well as a description of the consequences of each functional failure condition. These are what we call the "effe ts of failure." The following diagram depicts the most fundamental pieces of data that must be documented when discussing the repercussions of a failure.

• Functional Failures Modes that have occurred before on the same or similar assets.

• Any other Functional Failure Modes which have not yet occurred but which are considered to be real possibilities.

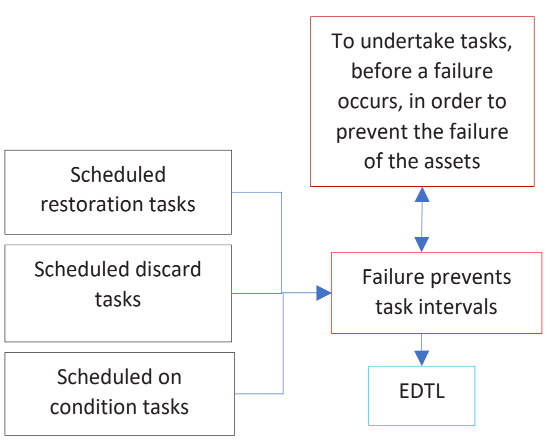


Figure (6) Diagram of the RCM question no.6.

4. What happens when every failure occurs? There is refer to Failure effect

The answer is as the researcher describes in the block diagram below.

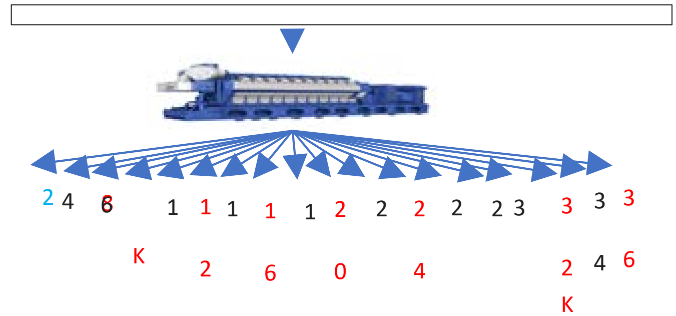


Figure (7) Diagram of the RCM question no.7.

The fourth RCM question according to [18] helps an analyst describe

5. In what ways is every failure important? There is refer to Failure consequent. The answer is as the researcher describes in the block diagram below

The fifth RCM question according to [19] permit analysts concerning occurrence of the failure and extent of impacts. 6. What can be done to prevent failure? There is refer to Failure prevent task

intervals. The answer is as the researcher describes in the block diagram below.

The sixth RCM question according to [20] provides the proactive insight by letting the analyst determine what could be done to predict or prevent failure. These are known as proactive tasks. Proactive tasks are defined as the tasks that are undertaken before a failure occurs in order to prevent the asset from failing. There are three categories of these tasks as shown above.

7. What should be done if the appropriate preventive tasks cannot succeed? There is refer to Identify the activities action. The answer is as the researcher describes in the block diagram below.

The seventh RCM question according to [20], and [21] is about identifying the tasks or activities that need to be undertaken when a suitable proactive task cannot be found. These are known as default actions. There are three default actions identified in RCM, as shown above.

Machine Maintenance Pattern (MMP)

This is a machine maintenance pattern (MMP) that is applied to the two EDTLs in Timor-Leste. This maintenance pattern is based maintenance on working hours engines (BMWHE). If you look at the diagram below, it looks very simples. But behind the simplicity lies a huge waste of money, both in financing and in component replacement, which is based on maintenance on working hours engines (BMMWH). Based maintenance working hours engines (BMWHE), almost the same as time base maintenance (TBM). But this Based maintenance working hours engines, has its own machine maintenance pattern (MMP). The pattern can be seen in the diagram depicted below.

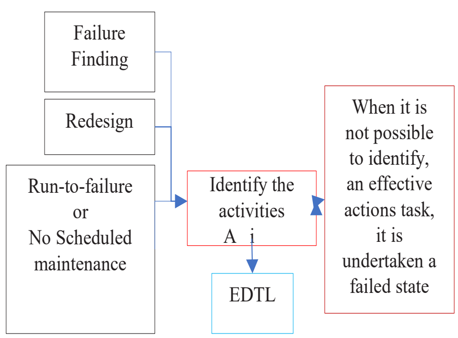


Figure (8) Diagram of the Machine Maintenance Pattern, based on working hours

2.1.3. Information about the even number of members K.
a. 2K members are 1K.
b. 4K members are 2K and 1K
c. 6K members are 1K. Because the number 6 is the product of the even number 2 and the odd number 3. So, 2K and 3K are ignored. Since the number 6k/6K=1, then what is needed is 6K and 1K.
d. 8K members are 4K, 2K, and 1K.
e. Likewise for an even number of 10K it only has an 1K members. Since 2 x 5 = 10 is an even number. The odd number 1K is the number obtained by self-dividing, namely, 10/10=1.
f. The even number of members of 12K are 6K, 2K and 1K.
g. Only 1K is an even number of 14K.
h. The even number of members of 16K are 8K, 4K, 2K, and 1K. Truth check. If $\frac{16}{2}=8$, $\frac{8}{2}=4$, $\frac{4}{2}=2$, $\frac{16}{16}=1$
i. The even number of members of 18K are only 1K
j. The even number of members of 22K is also only 1K.
k. The even number of members of 24K is 12K, 6K, and 1K. Truth check if $\frac{24}{2}=12$, $\frac{12}{2}=6$, 2K $\frac{24}{24}=1$
l. The even number of members of 26K is only 1K
m. The even number of members of 28K is only 1K. Truth Check if $\frac{28}{2}=14$, $\frac{14}{2}=7$ The number 7 is odd
n. The even number of members of 30K is only 1K
o. The even number of members of 32K is 16K, 8K, 4K, 2K, and 1K. Truth the equal $\frac{32}{2}=16$, $\frac{16}{2}=8$, $\frac{8}{2}=4$,, $\frac{4}{2}=2$ and $\frac{32}{32}=1$
p. The even number of members of 34K is only 1K.
q. The even number of members of 36K is 16K, 8K, 4K 2K, and 1K.

Timetable

a. Timetable 1K
- Checking instrument mechanism
- Check the circulation of the lubricating oil engine
- or cooling water if needed
- Remove condensate water and impurities from the tank
- Check the temperature of the engine lubricatio
- Check the water cooling for the lubrification engin
- Check the temperature of the engine cooling water

b. Timetable 2K
- Change the lubricating oil of certain equipment concerning the manufacturer's manual.
- Oiling bearings
- Check the oil filte
- Check the water filte
- Adding chemicals to cooling water
- Add more job 1K like the above

c. Timetable 4K
- Oiling bearings
- Change the oil filte
- Changer the water filte

- Adding chemicals to cooling water
- Add jobs 2K+1K

d. Timetable 6K
- Check the function and operation of security devices and alarm systems
- Check valve and valve rotator
- Changing governor lubrication
- Check and clean the grease filte
- Check the quality of cooling water and water treatment units
- Check oil and battery viscosity
- Add jobs 1K

e. Timetable 8K
- Check and clean injectors
- Check the camshaft, crankshaft, and flexible couplin
- Check the looseness of bolts, nuts, gears, and bearings
- Check and replace cooling water
- Checking the oil filte
- Add jobs 4K+2K+1K

f. Timetable 10K
- Check and clean injectors
- Check the camshaft, crankshaft, and flexible couplin
- Check for looseness of bolts, nuts, gears, and bearings
- Check and replace cooling water
- Checking the oil filte
- Add job 1K
- g. Timetable 12K
- Maintenance of 12000 hours is the maintenance of the Connecting Rod parts, including measuring, replacing, or reconstructing worn components to get optimal operation. Work carried out on Semi Overhaul as Top Overhaul Check, Inspection of all cylinder heads and their components, Inspection and measurement of Piston, Piston Ring, Cylinder Liner, and Cylinder Head, Connecting Rod inspection, material replacement if needed, Turbocharger inspection and cleaning, Check for cracks, corrosion or wear, Check bearing lubrication, Machine capability testing, Add jobs 6K+2K+1K.

- h. Timetable 14K
- Check and clean injectors
- Check the camshaft, crankshaft, and flexible couplin
- Check for looseness of bolts, nuts, gears, and bearings
- Check and replace cooling water
- Checking the oil filte
- Add jobs 1K
- i. Timetable 16K
- Maintenance of 16000 hours on the EDTL Machine includes measuring, replacing, or reconditioning worn components to get optimal operating conditions. The work carried out is as follows:
- 16K Semi Overhaul work, will be replaced if there is a material defect.
- Crankshaft inspection and bearing inspection, and inspection of the tooth surface, Check the engine vibration damper, auxiliary equipment, and machine testing, Adds more job 8K+ 4K+2k+1k

- j. Timetable 18K
- Check the function and operation of security devices and alarm systems
- Check valve and valve rotator
- Changing governor lubrication
- Check and clean the grease filte
- Check the quality of cooling water and water treatment units
- Check oil and battery viscosity
- Add jobs 1K
-
- k. Timetable 20K
- Check and clean injectors
- Check the camshaft, crankshaft, and flexible couplin
- Check the looseness of bolts, nuts, gears, and bearings
- Check and replace cooling water
- Checking the oil filte
- Add jobs 10K+2K+1K
-

- l. Timetable 22K
- Check and clean injectors
- Check the camshaft, crankshaft, and flexible couplin
- Check for looseness of bolts, nuts, gears, and bearings
- Check and replace cooling water
- Checking the oil filte
- Add jobs 1K

- m. Timetable 24K
- Maintenance of 24000 hours on the EDTL Machine includes measuring, replacing, or reconditioning worn components to get optimal operating conditions. The work carried out is as follows: 24K is Semi Overhaul work, if there is a material defect, it will be replaced, Crankshaft inspection, bearing inspection, and inspection of the tooth surface, Check the engine vibration damper, auxiliary equipment, and machine testing.
- Adds more jobs 12K+6k+2k+1K

- n. Timetable 26K
- Check the oil filte
- Remove the oil filte
- Clean the oil filte
- Change the oil filte
- Add jobs 1K

- o. Timetable 28K
- Check and clean injectors
- Check the camshaft, crankshaft, and flexible couplin
- Check for looseness of bolts, nuts, gears, and bearings
- Check and replace cooling water
- Checking the oil filte
- Add jobs 14K+2K+1K

- p. Timetable 30K
- Check the oil filte
- Remove the oil filte
- Clean the oil filte
- Change the oil filte
- Add jobs 1K

- q. Timetable 32K
- Check and clean injectors
- Check the camshaft, crankshaft, and flexible couplin
- Check the looseness of bolts, nuts, gears, and bearings
- Check and replace cooling water
- Checking the oil filte
- Add jobs 16K+8K+4K+2K+1K

- r. Timetable 34K
- Check and clean injectors
- Check the camshaft, crankshaft, and flexible couplin
- Check for looseness of bolts, nuts, gears, and bearings
- Check and replace cooling water
- Checking the oil filte
- Add jobs 2K+1K

- s. Timetable 36K
- Maintenance of 36,000 hours on the Machine: overhaul total for Diesel Overhaul Services:
- General overhaul of a diesel engine as per Maker manual instructions
- Recondition of all Turbochargers
- Overhaul and calibration of governors
- Calibration and overhaul of engine components i.e. cylinder heads, pistons, connecting rods, etc.
- Reconwwdition and calibration of fuel injection pumps and injectors at the workshop renewable
- Renewal of cylinder liners
- Renewal of crankpin bearings and main bearing shells
- Dismount and remount the alternator
- Chemical cleaning of the radiator
- Calibration and functional test

total project window of 60 days for the 7 units.

Timetable Overhaul
The dismantling of the electric energy generating machines at the Hera EDTL center was carried out from October 2020 to November 2020, for 7 units of diesel engines generating electricity.
Benefits of esearch at the two EDTL Centers in Timor-Leste is to modify the management, and maintenance system

2.1.4. K Element Member

2.1.4.1. K Element Members, which has only one member there are 8 elements Those are eighteen work routines, which are carried out, through preventive maintenance, which determines the age of the machine, and machine components, based on machine hours.

3. Discussion

1. Regarding Reliability-Centered Maintenance.
The preventive maintenance based on seven question, and divided in to tree categories as
1. What are the functions and related performance standards of equipment in the current operating context? There is referred to Functional performance standards.
2. In what ways does it fail to fulfil its function? There is refer to as Functional failure.
3. What is the cause of each functional failure? There is refer to Functional failure mode.
4. What happens when every failure occurs? There is refer to the Failure effect
5. In what ways is every failure important? There is refer to Failure consequent.
6. What can be done to prevent failure? There is refer to Failure prevent task intervals.
7. What should be done if the appropriate preventive tasks cannot succeed? There is refer to Identify the activities action.
On these seven questions (RCM), divided in three section. From number 1, 2, and 3, it is referring to the function, and number 4, 5 and 6 it is referring to the failure, and number 7 refer to the activities action.

So, if compared with Based Maintenance on Working Hours Engine (BMWHE), has eighteen categories of K even numbers, with different membership functions. Where the eighteen K even numbers are divided into fi e groups, which have the smallest number of K numbers, up to the largest K numbers. The assignments and Functions of K numbers, even and odd, will be explained last.

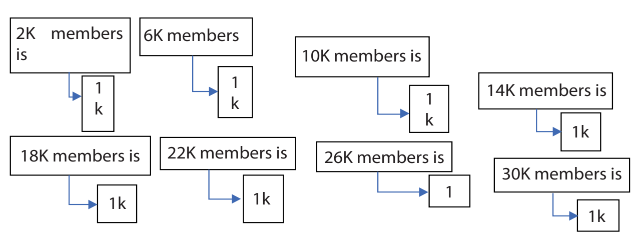
Regarding Machine Maintenance Pattern

Preventive maintenance that is applied to power generating units, electricity in Timor-Leste has 18 job descriptions with an even number of K.
By analyzing the schedule of activities with an even number of K, it is identified

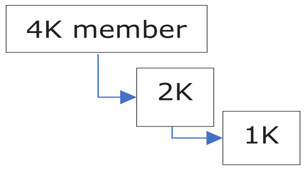
1. there are 8 K, even numbers, each of which has only 1K members, namely: 2K, 6K, 10K, 14K, 20K, 26K, and 30K. That is an even K number that has only 1K members.
2. An even number K, which has only 2 members, is 4K because it has 2K and 1K members.
3. The even numbers that have elements of 3 are 8K, 12K, 20K, 28K, 34K, and 36K. One thing that is confusing is the even number 36K, the deadline for preventive maintenance, so it is necessary to carry out preventive maintenance overhaul activities.

2.1.4. K Element Member

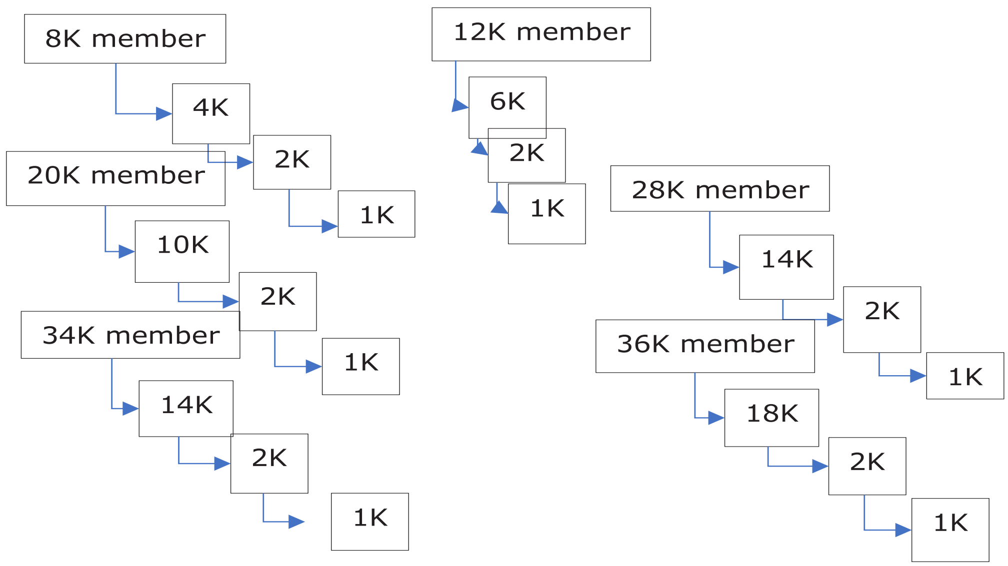
2.1.4.1. K Element Members, which has only one member there are 8 elements



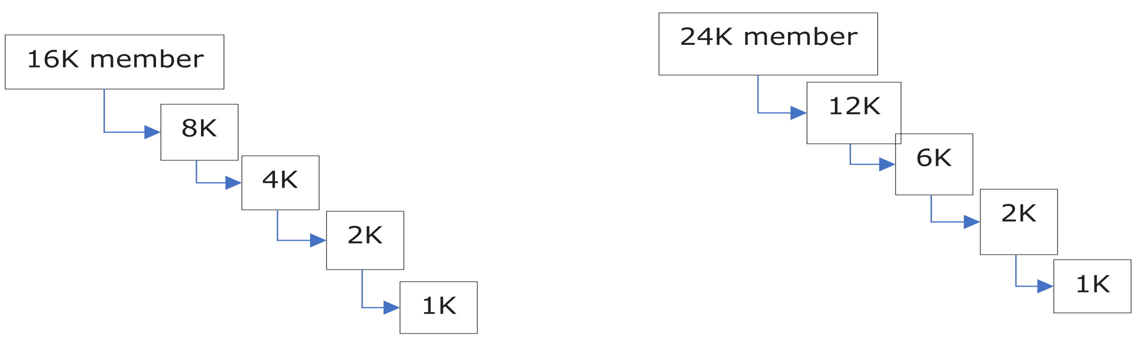
2.1.4.2. K elements that have members of two, only one.



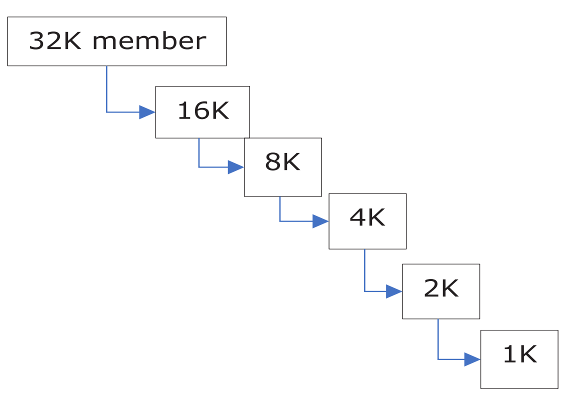
2.1.4.3. K elements that have elements of three, there are six.



2.1.4..4 K elements that have four members, there are two



2.1.4.4. K elements whose members are five, there is only one.



4. Even numbers that have elements of 4 are 16K and 24K. In activity 16K and activity 24K, replace new engine components, such as pistons, crankshaft, metal seats, and others.
5. There is only one even number K, which has 5 elements, namely 32K. The same thing is ineffecti e and effici t in this 32K even number activity, doing a lot of replacement of new components in the machine. With a span of short engine working hours, up to an even number of 36K, carrying out overhaul activities. In carrying out overhaul activities, all engine components must be replaced with new ones. Activities like this, which is not desirable in doing, preventive maintenance activities.
6. Preventive maintenance applied to power generating units, in Timor-Leste, according to the researcher, according to the results of the discussion above, preventive maintenance, based Maintenance on working hours engines (BMWHE), is implemented in the two EDTL centers, in Timor-Leste.
7. From the standpoint of the method being applied, it is very detrimental, the only state-owned EDTL company in Timor-Leste today. As seen from the activity of changing machine components, with such a short span of time, the cost of preventive maintenance is very high.
8. From the data analysis, the researchers saw that the wastage occurred because the replacement of machine components based on machine hours was very inefficient
9. This can be predicted through group member K, with an even number, which the researcher divided into 18 groups of preventive maintenance activities.
10. This can be seen in the 32K preventive maintenance activities, which replaced many new engine components.
11. In a relatively short span of time, up to the overhaul activity, at 36K.
12. In the overhaul activity, will replace the engine components, total. Therefore, the researcher saw that in 17 preventive maintenance activities out of 18 activity patterns, the preventive maintenance that was applied, as long as the preventive maintenance took place, was just in vain.

From the discussion results presented the advantages of each type of preventive maintenance, according with maintenance action. Like other types of maintenance, TbM can be beneficial when used as part of a larger maintenance management strategy from Time Base Maintenance:

And then from Reliability Centered Maintenance based on to maintenance based on the reliability of the equipment or system design and at the same time recognize that changes based on reliability can only be made through design rather than maintenance [22] and [23]. Other type of preventive maintenance is quite similar, maybe difference on software. On researcher opinion, the seven questions should be divided into four groups. So, there must be a question that will follow this idea which is: why should the seven questions be divided into four groups? Isn't the division into three groups still unclear? If such a question, my answer is question number one out of seven questions, still vague, and does not show any relevant statements. Because question number one, out of seven Reliability Centered Maintenance questions, says What are the functions and performance standards of equipment in the context of today's operations? This actually leads to the proper functioning of standard operating procedures [24]. The purpose of Standard Operation Procedure (SOP) is to assign the procedures for the preparation, approval, distribution, amendment and storage of Standard Operating Procedures.

The benefit of Standard Operation Procedure (SOP) is the improvement and use of Standard Operation Procedure (SOPs) promotes quality through consistent implementation of a process or procedure within the organization reduced work effort, along with advanced data comparability, credibility, and legal defensibility.

2. Conclusion Comparative Between Reliability-Centered Maintenance (RCM), and Machine Maintenance Pattern (MMP)

A. Reliability-Centered Maintenance (RCM)

Advantages:

In general, RCM improves system efficienc by doing the following: increasing performance activity by removing failure; increasing usage of assets by simply making them error-free; decreasing maintenance causes, etc.

Because certain failures are more expensive

and time-consuming to correct, RCM may save money on maintenance by preventing them before they happen. Therefore, RCM lowers the total cost of maintenance and supplies.
Thirdly, RCM boosts productivity by increasing customer satisfaction and lowering the frequency of unexpected system breakdowns.
When an asset fails for whatever reason or is destroyed, it is crucial to replace it with a similar one that has the potential to perform the same role but with improved characteristics.
5. Decreases the likelihood of unexpected failures by maintaining a specific asset and reducing all potential points of failure.

Disadvantages:

One of RCM's key drawbacks is that it requires constant and regular maintenance to maintain assets safe from failure and more dependable.
The initial investment in RCM may be substantial, and training is required before any work can begin.
Third, it is resource- and time-intensive to undertake RCM Analysis, which is crucial for keeping priorities straight.
RCM is a successful strategy, but it is also quite complicated and difficult to implemen
Fifthly, RCM does not pay much attention to economic issues.
RCM is a procedure that calls for constant upkeep, but it ignores the supplementary expenses associated with owning and managing assets.

MMP stands for "Machine Maintenance Pattern."

Advantages:

As MMP is only concerned with system management, it improves system efficienc in a number of ways, including: increased performance activity; increased utilization of assets; and reduced maintenance reasons, etc.
Second, MMP lessens the likelihood of assets breaking down by preventing the incidence of breakdowns that would otherwise be more costly to repair. Therefore, due to general maintenance and resource failure, MMP decreases the capacity of each unit power plant from 17 MW to 12 MW. In general, MMP lessens the likelihood of an unexpected breakdown of equipment or assets by maintaining them and reducing as many potential points of failure as feasible.
Thirdly, Productivity is boosted because MMP boosts customer satisfaction and decreases the likelihood of unexpected breakdowns.
When an asset fails for whatever reason or is destroyed, it is crucial to replace it with a similar one that has the potential to perform the same role but with improved characteristics.
5. MMP Requires Safety; MMP Gives Electrical Energy Productivity Safety Top Priority.
MMP is easy to use, which is reason #6.

Disadvantages:

One of the major drawbacks of MMP is the need for constant and regular maintenance in order to maintain assets secure from failure and more dependable.
Second, there is a learning curve and a large initial investment needed to get started with MMP.
Third, MMP doesn't put an emphasis on minimizing maintenance costs
4. Time and resources needed: MMP Analysis, although essential for prioritization, often requires more time and resources than is available.
5. Complexity: Despite its effica , MMP is not a simple procedure due to its many moving parts.
Sixth, the economy is not a priority for MMP.
Maintenance Management Planning (MMP) is a method that calls for regular upkeep, however it doesn't factor in the expense of owning and maintaining assets.
At 36K, or 36000 hours of operation, the engine unit work must be overhauled.
Because the SOP comprises a fairly uniform operating system, the same dedication will be made to all forms of asset upkeep, regardless of when or where the SOP is used.
upkeep with a focus on dependability and upkeep Organizations may boost equipment efficien , simplify maintenance procedures, and decrease downtime with the use of machine patterns. Preventive maintenance is an integral part of both Machine Working Hours and reliability-centered maintenance.
Eleven. The Machine Maintenance Pattern differs from RCM in that it takes into account the number of hours a machine is in use.
From the perspective of EDTL, RCM is supe-

rior than the conventional pattern of machine maintenance determined by the number of hours the machines are in use.
Therefore, the study author recommends that RCM be used in lieu of machine operating hours immediate

4. Suggestion

1. Change the operational Manager in both EDTL centers.
2. Replace the operating system of the electric energy generation unit at the EDTL central district in Timor-Leste.
3. Replaced the preventive maintenance system based on machine hours, for the two EDTL centers in Timor-Leste.
4. Use local experts to handle all activities at the two EDTL centers in Timor-Leste.
5. Modification of Based Maintenance on Working Hours engines, by reducing the replacement of engine components, and overhaul. Doing monitor engine lubricating oil and engine cooling water.
6. To be:
- Minimal Training
- Lower Long-term Cost.
- Easy to Implement.
- Predictable Schedule
- Effecti e for Continuously Running Assets.

5. Nomenclature

BMWHE = Based Maintenance on Working Hours Engine
EDTL = Electrical Diesel Timor-Leste.
1K = 1000 hours
36K = 36000 hours
MMP = Machine Maintenance Pattern
MW = Mega Watt
RCM = Reliability-Centered Maintenance
MWH = Machine Working Hours
SOP = Standard Operation Procedure

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Recieved: May-5-2023 Revised: Aug-14-2023 Accepted: October-24-2023