

# Proposed Preventive Maintenance in a Small Machinery Rental Company

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## Abstract

*The purpose of this implementation proposal is to propose the company to reduce costs and prevent equipment breakdown, with the equipment stopped causing delays in services and unnecessary expenses. It has been observed that their maintenance is not scheduled and performed when the equipment is already defective / breakage. Inadequate services are performed that in the future an easily resolved problem will become difficult to solve as a result of greater damage and equipment stopped for a longer time. With the proposed implementation of the system we can make the company have reliability in the market (employees / partners) generating more profit and less waste, and we can gradually implement a tool that is used in large companies in small companies adding to it. more value in your development.*

**Keywords:** Implementation; Costs; Reliability; Profit.

## 1. introduction

Currently there are several types of maintenance ranging from a simpler to a more complex, bringing major benefits to companies, such as improvements in production and especially with the reduction of costs.

In this paper we will address preventive maintenance by implementing it in a small company with segment in machinery leasing, where it was observed the lack of adequate structure to perform maintenance on their equipment that are performed randomly when the equipment already has defect / breakdown, the preventive maintenance has the purpose of preventing and avoiding the consequences of the failures where we perform

the change of the part before the problem occurs, preventing the machines stop, problems that end up hindering the development of the work. preventive maintenance implementation showing that we can apply this tool gradually without generating large costs but with the visibility of unnecessary cost and expense reduction and ensuring a uniform and safe work in a small business, with the main objective to prevent and prevent machine breakage eliminating unscheduled downtime due to lack of improper maintenance, impairing production and work development and the confidence given to the company, aimed at increasing equipment life, reducing costs and especially employee safety, adding value and reliability to the company. to the market.

## **2. Theoretical Review**

### **2.1 Maintenance History**

As it says Different authors identify different stages in the evolution of Maintenance's role over time. But overall, the perspectives converge. Moubray [1] brings together some consensus and distinguishes three generations in the evolution of Maintenance (Figure 1):

#### **2.1.1- 1st Generation**

Time period from the industrial age until World War II. At this time maintenance was in an embryonic state, as companies repaired or replaced equipment only in the event of a malfunction. Prevention was not an action taken by maintenance managers

#### **2.1.3 - 2nd Generation**

In the early 1950s, the increase in process automation made equipment more valuable. Any such breakdown would entail high costs for long stops, and there was a general feeling that such breakages could be prevented. This results in a progressive awareness of the preventive maintenance of equipment, which became increasingly complex.

#### **2.1.3 - 3rd Generation**

The emergence of bold and revolutionary philosophies, such as just time, required a substantial improvement in resource management. Low stock levels meant that an equipment malfunction resulted in high losses. Severe Maia became, because the increasing automation generated more and more malfunctions. Hence maintenance has progressively developed towards prevention and is in full development to this day. Thus, emerging new techniques, policies and ways to manage maintenance, which today is horizontal to the organization of a company.

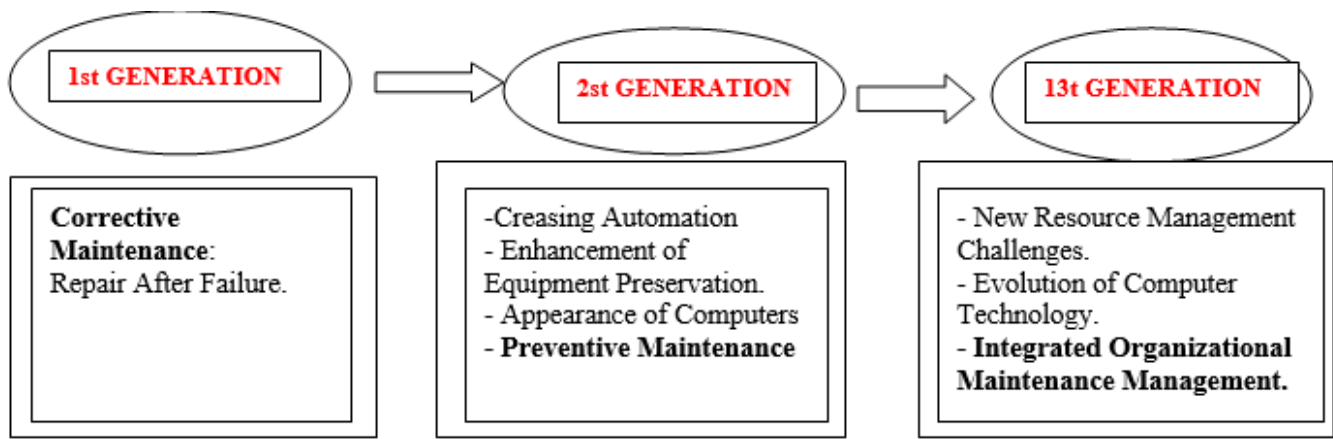


Figure 1- Maintenance Evolution

### 2.2 Maintenance Engineering

As Pinto & Xavier [2] assures an efficient Maintenance project is to continually abandon repair practices to look for root causes, modify permanent underperformance, stop living with chronic problems, improve standards and systematics, develop maintainability , give feedback to the Project, technically interfere with purchases. Engineering's attributions in the maintenance process are characterized by the use of elements for analysis, study and improvements in the intervention and maintenance models of the machines through modern methods, thus overcoming an impediment in the already solidified tradition of society. (PINTO & XAVIER, 2001). A Maintenance Engineering program has reflections on the maintenance system enrichment, and it is a more complex perception to be instituted because it establishes structural changes.

According to Siqueira [3] maintenance aims to “preserve the functional capabilities of operating equipment and systems”. Siqueira [3] says that the goal of maintenance is to “ensure that physical items continue to do what their users want them to do”, we can say that over time maintenance has undergone major changes making it more effective where we have different types of maintenance where each has application and right time to apply.

Almeida [4] tells us that maintenance generally encompasses all the procedures necessary to maintain the required facilities, machines, equipment and all infrastructure resources. According to the French Association for Standardization (AFNOR), in its NF 60-010, "maintenance is the set of actions that allows the restoration of a good to its specific state or measures to guarantee a specific service." NBR / 5462/1994, paragraph 2.81, states that maintenance is the combination of all administrative technical actions, including supervisory actions designed to maintain or relocate an item to a state in which it can perform a required function.

### 2.3 Corrective Maintenance

Almeida [4] Corrective maintenance happens in the event of unforeseen stops. The machine that is in production is responsible for ensuring the delivery deadline, so it is the accuracy that guarantees the quality and reliability of the product. Maintenance personnel immediately act to restore the operation of a damaged machine or equipment as soon as possible. According to NBR / 1994 “corrective maintenance is maintenance performed after a breakdown has occurred to replace an item in a position to perform a required function”.

### **2.4 Preventive Maintenance**

Almeida [4] Preventive maintenance is planned and controlled maintenance, performed at predetermined dates, with the objective of keeping the machine or equipment in proper working and conservation condition, in order to avoid unplanned shutdowns. Planning is possible when documenting corrective maintenance operations performed with part life information provided by the manufacturer. Another relevant factor is the conditions of the workplace where the machine or equipment is being used.

### **2.5 Predictive Maintenance**

Almeida [4] Predictive maintenance is possible to indicate the actual operating conditions of a machine according to data obtained based on the phenomena presented by it when any part begins to wear or some adjustment is necessary; This is what mechanics popularly call “listening to the machine”. Based on periodic inspections during which phenomena such as temperature, vibration, excessive noise is observed through specific instruments, enabling short-term planning for a maintenance intervention with part replacement and defect elimination.

### **2.5 Total Productive Maintenance (TPM)**

Total productive maintenance encompasses preventive and predictive maintenance programs, as well as a training program for operators that assists in machine monitoring with a predictive maintenance practice and performs maintenance-free operations such as changing oil, which is a preventive maintenance practice, highlighting the elimination of large losses, autonomous maintenance, planned maintenance and education and training. ALMEIDA [4]

### **2.6 Reliability Centered Maintenance**

MCC can be defined as a program that brings together various engineering techniques to ensure that plant equipment will continue to perform the specified functions. They enable companies to achieve excellence in maintenance activities by increasing equipment availability and reducing costs associated with accidents, defects, repairs and replacements.

## **3. Methodology**

The methodology that was used to achieve the objectives for which this article proposes is described below: Bibliographic review on the subject, in order to know the original thinking of several authors and the latest events in the area that was studied.

Observation of the methods and techniques used by companies that use the preventive maintenance model in their programming framework and in companies that are in the implementation phase.

Field research was carried out at ATHAYDE LOCASÇÕES E SERVICES - LTDA that the study is being destined, where we made the survey of the problems found and possible solutions in order to be proposing the implementation of preventive maintenance in the company.

From the acquired knowledge and lived experiences, based on the initial objective outlined, it was possible to reach conclusions and results for the possible implementation of the system in a small company.

#### **4. Application of Study**

The study aims to study the best way to apply preventive maintenance in equipment (tractors, excavator and backhoe), where currently the entire process of maintenance of the company is corrective type, which generates a lot of occurrence and failure and downtime, become a big bottleneck in the company's production process. Thus, a preventive maintenance policy was elaborated, raising the main points to be inspected during a preventive maintenance stop, in order to find the right time to make the preventive maintenance stops, in order to maximize equipment availability at the lowest possible cost.

Application of preventive maintenance was performed in 5 steps:

1-Mapping of equipment, where a technical evaluation was performed, analyzing the current condition of the equipment, its lifetime and the time the equipment spends in operation. After this survey with the data everything is documented to go to the second part.

2- Classification as to the criticality, the classification was based on criteria of safety, cost, necessity and frequency of failure. It was analyzed what cost will be needed to maintain each equipment, if the machines are able to meet the demands.

3- Staff assessment is one of the most important steps for the preventive maintenance plan to become effective, assessing staff whether they have the ability and qualifications to perform routine and preventive maintenance on each equipment and have sufficient staff to meet the needs. ensuring all equipment receives the necessary attention.

4- Structuring the plan, with already defined information from the previous steps, had to take other factors into account for the plan to become effective. Considering this as a considerable factor, a schedule was prepared with the maintenance period of each equipment, analyzing if there is need to schedule scheduled shutdowns (routine / preventive) for each machine, estimated maintenance time of each machine, resources needed for maintenance. , being defined who will take care of each equipment, how the work orders will be issued.

5- Monitoring the preventive maintenance plan, already presented the maintenance plan to the team and explained the procedures and goals, the plan is implemented gradually, defining the responsible for each task. Accompanied by checklists to ensure that scheduled procedures have been performed, visit and inspection routines are also performed to avoid corrective maintenance where faults can be detected before they become major failures. The entire procedure is documented (work order, maintenance history, machine guide), and staff undergo training to ensure the efficiency and effectiveness of the implemented plan.

#### **5. Results and Discussions**

The process of performing preventive maintenance includes planning for machines to be overhauled without having a major impact on production and not disrupting the production cycle, planning maintenance times so that no service delay occurs. If preventive maintenance is not performed, the chance of an accident at work is very likely and the machinery is operating in a problematic way, putting the team at risk and causing major damage to the company.

After the implementation of preventive maintenance, the company had several benefits, preventive

maintenance started to be performed regularly, the results of preventive inspections are recorded in the regular maintenance program, the equipment operator began to contribute reports about the conditions of the equipment where it performs inspection checklists daily and is analyzed by the maintenance team for abnormal problems, corrective maintenance occurrences are analyzed and follow up actions are taken so that it does not happen again.

The cost of preventive maintenance versus corrective maintenance has a big difference, making it the best choice and lowest cost preventative.

In order to assess the technical knowledge of the operators responsible for the tractors analyzed, a control form was prepared with the items evaluated on the machinery, as shown in Figure 2:

Operator Name: Operator	Code:
Level of education	
Procedures for Starting and Shutting Down the Tractor	
Checking Daily Maintenance Items	
Importance of fuel supply	
Engine acceleration	
How did you become an operator?	
Machine operation and maintenance course	
Most frequent operations you perform	
Correct use of tools	
Knowledge about air filter cleaning procedure	
How to proceed when starting on a tractor without battery	
Instrument reading	
Consult the manual	

Figure 2 - Control Sheet

Source: Adapter-Quality Control Sheet by Own Author (2019)

With the control sheet we have the quality control of the service and the responsible of the machine, analyzing its capacity. With this data the company can also be studying to be qualifying and training its employees, adding both beneficial to itself and the employee making it high capacity.

Table 1 - Service Order.

<b>ATHAYDE RENTAL AND SERVICES-LTDA</b>	
<b>S.O. SERVICE ORDER No. 45</b>	
<b>OPENING DATE: 08/17</b>	<b>MAINTENANCE: preventive</b>
<b>Type of maintenance activities:</b>	<b>Application: Excavator</b>
<b>Service Request:</b>	
<b>01</b>	Diesel oil filter
<b>02</b>	Fuel filter

<b>03</b>	Water separator filter		
<b>04</b>	Air conditioner filter		
<b>05</b>	Engine oil hydraulic return filter		
<b>06</b>	Swivel Command Oil		
<b>07</b>	Hydraulic system filter		
<b>Pointing of manpower</b>			
<b>Date:</b>	Description of the service performed	<b>H start</b>	<b>H ending</b>
<b>17/08</b>	Performed the exchange of all items above.	<b>13:00</b>	<b>18:00</b>
<b>Closing Maintenance Order</b>			
Closing date	Labor resp. Service	Workshop clerk	
08/17/2019	Nonato	Paulo	

Source: adapted by own author (2019)

In Table 1 we have the Service Order, through which we obtained a more precise control, where it contains all the data for the control of the plan in a practical and simple way facilitating the understanding of all. By gradually implementing preventive maintenance on machinery, the company will be ensuring that they are and are properly repaired, adjusted and maintained to prevent abnormal wear and to detect defects before they can result in accidents.

### 6. Final Considerations

The main purpose of this work is to propose a preventive maintenance policy to be applied to equipment. Thus, corrective interventions related to preventable type failures are expected to be reduced to near zero. This guarantee is not only about the integrity of the machinery, which keeps it available for production and operation, but also for safety, as failure to perform the correct maintenance endangers the physical integrity of the people involved and society.

The main difficulties presented in the implementation of the plan was the adaptation of the employees to the new rules, as they already presented their own way of working having difficulties in adapting to the new techniques.

We concluded that failure to perform preventive maintenance increases the occurrence of corrective maintenance, increasing the cost of maintenance, downtime of maintenance machinery, increasing service demand due to unscheduled downtime, and endangering employee safety. operating equipment with abnormal problems.

And finally, it was observed that it has the possibility to be inserting a high cost maintenance technique in a small company having time saving results, gaining credibility in the market of operation.

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