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E-maintenance : A Modern Maintenance Tool

Sachin B. Bole *, Vivekanand Swami

Asst. Professor, Mechanical, Fabtech College Of Engg.& Research, Sangola , India

Lecturer , Mechanical, Fabtech College Of Engg.& Research, Sangola , India

Abstract

In Earlier days maintenance function was not considered as one integral part of production process. It was considered as cost addition and extra function. But nowadays the importance of maintenance function has increased as it helps to keep machine (system) available throughout the production which in turn helps to improve quality of the product.

This paper outlines the basic concept of e-maintenance and how e-maintenance is going to benefit the industry in terms of increased availability, reduced life cycle cost and improvement in quality. The main aim of this paper is to help readers to understand the basic of e-maintenance. **Keywords:** e-maintenance , product , quality , custome

Introduction

Because of the globalization, companies are forced to change their old style of production process into new style which will help them to stay in this competitive market. This must include right quantity of product with right quality and at right time. To achieve this, all the machines with full working condition should be available throughout the production process. Before going to understand e-maintenance, let us first understand what is mean by maintenance?

Maintenance can be defined as “The activities required to keep facility in as-built condition, continuing to have its original productive capacity.” [5].

There are different types of maintenance policies, which are as follows:

- Breakdown (Reactive) maintenance
- Preventive Maintenance
- Predictive Maintenance
- Proactive Maintenance

Breakdown (Reactive) maintenance

It is the old traditional method. It is based on the principle of “Run the equipment till it breaks” Few years back more than 50% industries were still using breakdown maintenance policy. In this method there is no maintenance approach. Equipment is allowed to run until it fails to do the function. After that either equipment is repaired or replaced by another part. This is the most costly method in the maintenance policies. Now industries are realizing the importance of different maintenance policies and they are working towards the predictive and proactive maintenance [6].

Preventive Maintenance

Preventive maintenance is a planned activity. It is based on specific time intervals. After certain time interval, inspection is carried out to check the condition of machines. Its main purpose is to prevent the future failures to occur. This is the main difference between preventive maintenance and corrective maintenance. The later (corrective maintenance) is used to correct an already existed problem. Preventive maintenance can be defined as “Any action which can avoid premature failure and extend the life of the equipment.” The main disadvantage of preventive maintenance is that it will not take into account the condition of machine so even if machine condition is good still maintenance will be done as per schedule [6]

Predictive Maintenance

Predictive maintenance is often called **as condition-based maintenance**. It can be defined as “Maintenance carried out in response to a significant deterioration in a unit as indicated by a change in a monitored parameter of the unit condition or performance, is called condition based maintenance” [6]. In Predictive Maintenance, inspection depends upon the condition of machine. This is the main difference between preventive maintenance and predictive maintenance. Preventive maintenance works on time-scheduled basis regardless of machine conditions while predictive maintenance works on condition-based in which inspection is carried out after checking the machine condition. It uses the diagnostic equipment for checking the machine

condition. When indicator reaches a specified level, work is undertaken to repair or replace the part. It means that part is repaired only when diagnostic equipment gives the proof that part is not working to its standard. Although predictive maintenance is having higher cost as compared to preventive maintenance. But once it is implemented then benefits of predictive maintenance are much greater than preventive maintenance.

Proactive Maintenance

This is the most effective method among all other maintenance policies. It is also called as **root-cause failure analysis**. Preventive and predictive maintenance also prevents the failures to occur but the one major thing is that both these maintenance policies don't go to the root causes of failure. This is the big difference between the preventive, predictive maintenance and proactive Maintenance. It goes to the root causes of the failure and corrects it so that it will not occur again. Up till now industries are using preventive and predictive maintenance policies. But now industries are realizing the importance of the proactive maintenance because if same failures occur again and again then it will decrease the life as well as performance efficiency of machine. So there is need to remove these root causes of failures and prevent them to occur again [6].

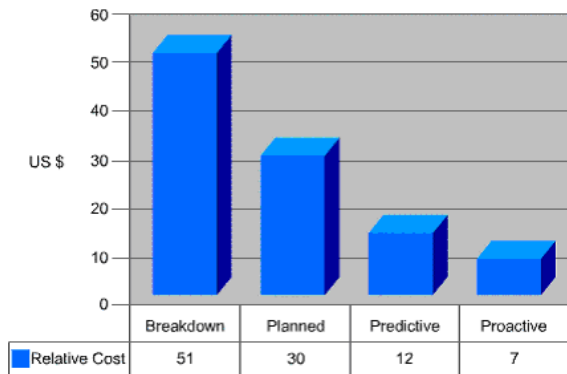


Fig. 1 Comparison of cost of maintenance policies

E-maintenance

Before defining E-maintenance, first we have to understand this word. There are two different parts “e-part” and “maintenance part”. So E-maintenance can be defined as “The combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it ss to, a state in which it can perform a required

function”. [1]. It can also be defined as “The execution of maintenance and/or the exchange of maintenance related information in an electronic way.”

Need of E-maintenance:

Another question may arise why we require E-maintenance or how e-maintenance will help to improve the maintenance strategy of a company? Every company wants to shift their maintenance policy from reactive to proactive.

Reactive → Preventive → Predictive → Proactive

1. Reactive → Preventive

If any company wants to shift their maintenance policy from reactive to preventive, we need **planning**. As Preventive maintenance is a planned activity, E-maintenance uses CMMS software which takes into account production schedule and after that it develops maintenance schedule accordingly.

2. Preventive → Predictive

To shift from preventive to predictive we require knowing current status (condition) of machine. To know the current status of machine, it has to be monitored. Maintenance person should know when machine starts the degradation. Monitoring can be done by two ways: a worker of that machine should closely monitor the important parameters of the machine based on which he can conclude when machine starts to degrade. But this process is really a hectic and worker will not be able to effectively monitor the machine throughout his 8 hour shift. Another way is to use sensors for monitoring the machine. The data received from these sensors can be given to maintenance person. With the help of this data, maintenance person can made conclusion of that machine's condition. E- Maintenance uses the sensors and communication network to help maintenance person to take the decision.

3. Predictive → Proactive

Proactive means taking the action of that cause so that it will not happen again in the future. Proactive requires a root cause analysis. Once we find root cause, we have to remove that root cause so that it will not happen again in the future. To find out root cause, it requires extensive data analysis. Sensors and communication network provides this data to maintenance person.

Components of E-maintenance

There are ten different components which are necessary to understand e-maintenance



Fig. 2 Components of E-maintenance [3]

- **Business and Organization:** It is expected that e-maintenance will maintain the balance between customer, product and supplier. E-maintenance will make sure that daily activities of organization has been run without any interruption and customer will receive the product at right time[3].
- **Product, Services , Information and Methodologies :** e-maintenance retracts the information which are necessary for finding out which products are supported by which services[3].
- **Technology:** If any company wants to implement e-maintenance, it has to adopt new technology. But implementing new technology is not a easy thing, as workers are get to used old technology. So when implementing e-maintenance, care must be taken that technology should be implemented such that it should motivate the workers as well as it should not disturb the production or any other process.
- **Customer:** One of the major benefit of implementing e-maintenance is that it will reduce machine downtime which in turn helps to produce the product at right time with right quality. Customer is always centre point for e-maintenance.
- **Education and training:** If company wants to get good result from e-maintenance then it should give continuous training of e-maintenance to its workers.

Benefits of E-maintenance

Remote maintenance: In earlier days, if maintenance person wants to analyze the machine then he must be with the machine throughout the analysis. Beside this if that machine requires to visit (work) at

customer premises (site) then company has to deploy additional manpower for maintenance. With the help of e-maintenance, maintenance person can easily

- access the machine from anywhere by using wireless and internet technologies. He can check the status (condition) of machine and takes the appropriate corrective action. This will help to reduce the manpower at customer’s site [2].
- **Easily Accessible Expert Knowledge:** Involvement of internet and communication network system helps maintenance person to take expert advice online easily. It will help to analyze machine’s critical problem.
- **Condition Based Maintenance:** The main aim of e-maintenance is to keep machine available throughout production process. It optimizes condition based maintenance strategy by using equipment failure analysis and predicting future life of machine. Because of the rapid development of ICT and sensor technology, we can use various data for analysis purpose so we can accurately find out the root cause. Failure analysis helps to understand the root cause of failure and prevents it to occur again [2].
- **Reduction in machine downtime:** E-maintenance can easily predict the future life of machine so maintenance person can take the precaution of future problems so that he can be ready with repair tools or replacement of that machine parts.

Structure Of E-maintenance

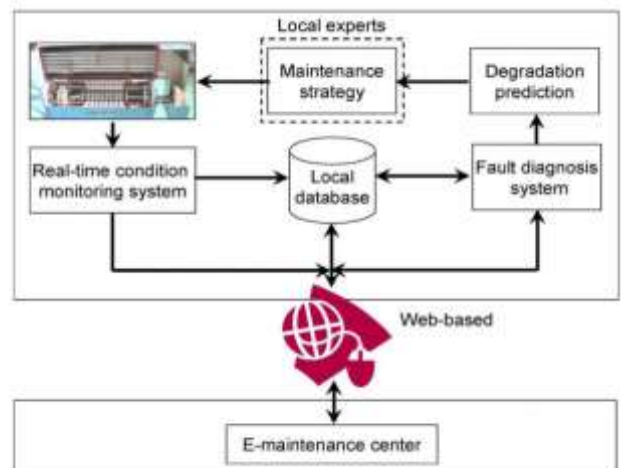


Fig. 3 Structure OF E-maintenance [1]

Before implementing e-maintenance, first finalize the maintenance strategy. Analyze the previous breakdown history of that machine. So maintenance person can easily understand the major reason for breakdown. Then he can select the parameters based on machine's previous history for monitoring. With the help of e-maintenance, maintenance person can easily predict the future life of that machine. Also with the help of sensor and internet technologies he can easily do the failure analysis. If any critical problem arises then he can search on the web for the solution and implement that solution. One of the major benefits of the e-maintenance is that now maintenance person can easily look for advice on internet or he can easily consult with the expert. Also maintenance person can easily update his local database so if in future same problem arises he can then implement the same solution.

Challenges of E-maintenance

- One of the major challenges of e-maintenance is to find out right parameters for machine monitoring. As explained earlier e-maintenance uses sensor and communication network for monitoring and conveying information to maintenance manager. So the first priority is to select correct parameters for monitoring. The selection of parameters solely depends upon the experience of maintenance manager. If the selection of parameter goes wrong then company cannot expect the correct output from e-maintenance.
- Another challenge of e-maintenance is the ICT technology. Most of the workers are not having current knowledge of ICT technology. Most of them are reluctant to learn the new technology as they think it will add burden to their workload. Here management role can be handy. They can convince the maintenance team that e-maintenance will actually reduce their workload.
- One of the myths of e-maintenance is that it is very expensive to use. Although initial cost of implementation of e-maintenance is very high. But after implementation it will give great benefits in terms of reduction in machine downtime, improvement in productivity and quality.
- As explained earlier e-maintenance can do the remote maintenance by just log in the maintenance platform. But some machines require actual presence of human being as they are not completely automated. Also safety and reliability are the major concerns when we use internet successively [4]. If the machines are at customer site then problems of maintenance agreement and training also comes in the picture. So before implementing e-maintenance, it is always beneficial to do the agreement with the customer so that future problems may not arise.
- E-maintenance success depends upon the correct selection of sensors for those machine parameters. Most of the maintenance persons do not have knowledge of the sensors. In that case he can take the help of ICT engineer.
- E-maintenance can be used as a single maintenance platform for retrieving various information. The success of e-maintenance depends on the collection, recording of various information related with the maintenance such as breakdown frequency, failure analysis etc.
- Another major challenge is the uniformity of e-maintenance. It is not a uniform standard. It has to be modified as per the industry requirements. So it is but obvious that e-maintenance technology which is implemented in one industry will not be completely applicable to another industry. It has to be modified as per industry requirement.
- The construction of e-maintenance system involves a variety of cross-platform information integration issues, that have to be resolved, such as development of data transformation mechanism, data transmission network, communication network etc. To achieve success on e-maintenance a formal agreement and co-operation between department must be done so that a common communication platform, data transmission protocol must be decided before implementing e-maintenance.
- E-maintenance always uses local database for solving the maintenance problems. The main difficulty arises for updating the maintenance database. It must be updated periodically. So that if any critical problem comes in the future then maintenance person

can take the help of updated database for finding out the solution. Here maintenance person should be internet savvy so that he can update the maintenance database.

Economic impact of e-maintenance

For any company major concern is cost factor. Generally maintenance cost are divided into main four major categories [1].

Direct Cost: It includes costs such as :

a) Labor cost: Labors who are working in maintenance department for daily activities. E-maintenance always works on condition based maintenance. So the company which implements e-maintenance will always have minimum workers.

b) Spare parts inventory: Company always requires to have some important spare parts in inventory. It should be always beneficial if they have optimum inventory. E-maintenance always predicts the future life of equipments so company based on e-maintenance reports can purchase only required additional spare parts. It will reduce unnecessary inventory cost.

Economic Losses, Potential Savings or Potential, Income Sources : It includes losses due to having insufficient maintenance activities, i.e. unplanned stoppages and failures [1].

a) Less availability of machine: Because of the poor maintenance, machine will not be available throughout production process. It will impact negatively on productivity and it will not meet the delivery requirement.

b) Lower performance : Because of the less availability of machines , it will not give expected performance.

c) Bad quality : Less availability of machine , poor maintenance will ultimately affects negatively on product quality. Bad product quality will give negative impact on customers mind.

d) Extra operational Cost : Company has to replace rejected product with right product . So company has to spend additional operational cost to produce right product.

E-maintenance overcomes all above deficiencies and helps company to improve their productivity and quality.

Risk Capital Involved For Improving Maintenance Performance:

The investment that is required to improve the current maintenance policy . It includes such as additional instruments or software costs , worker training cost etc [1].

Maintenance Results: The profit or losses that are gained after implementing new maintenance policy [1].

Conclusion

The above paper describes fundamental concepts of e-maintenance, its components, e-maintenance benefits and challenges. Every company wants to have better productivity, good quality with less cost. E-maintenance completes all these expectations. Although initial cost (implementation) of e-maintenance requires high cost but once company implements the e-maintenance it will give tremendous amount of benefits in terms of machine availability, labor cost, product quality. But implementation of e-maintenance must not be done in a hurried manner. Maintenance person should select right machine parameters for monitoring, right selection of sensors to get high benefits. There are also some challenges such as internet security and motivation of the maintenance person for using e-maintenance. Company should work on these areas before implementing e-maintenance.

References

- [1] N.A. Daqqa and S. Alen, " On the requirements to implement e-maintenance cost effectively". Degree project , Linaeus University.
- [2] A.Crespo-Marquez , B. Iung and E. Levrat , " On the concept of E-maintenance. Information and Communication technologies applied to maintenance. Review and current research."
- [3] M. kajko-Mattson, R. Karim and A. Mirajamdotter , " Fundamentals of the emaintenance concept.", The 1st inetrnational workshop and congress on eMaintenance 2010 , 22-24 June , Lulea , Sweden.
- [4] A.Crespo-Marquez and B. Iung, " On the concept of A review of E-maintenance capabilities and challenges."
- [5] Maintenance Management by Lawrence Mann, Jr. 1983
- [6] S. B. Bole and J. De Coster, "E-maintenance technology and application"