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Maintenance Management in Operational Management

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ABSTRACT:

In operational management, maintaining equipment, machinery, and facilities is essential to guaranteeing their best performance and dependability. The importance of maintenance management to operational effectiveness, cost containment, and overall organisational success is examined in this chapter.Unary and binary operations are the two most prevalent kinds of operations. Unary operations, such as negation and trigonometric functions, have just one value. Addition, subtraction, multiplication, division, and exponentiation are examples of binary operations that accept two values.

KEYWORDS:

Corrective Maintenance, Equipment Maintenance,Management, Operational Management, Preventive, Predictive.

I. INTRODUCTION

Previous and present maintenance practises in both the commercial and public sectors would suggest that maintenance is the actions connected with repairing damaged equipment. Maintenance is defined as the work of keeping something in appropriate condition, upkeep by the dictionary. This would indicate that maintenance should be defined as measures performed to prevent a device or component from failing or to correct typical equipment deterioration encountered during device operation in order to keep the device in appropriate operating condition. According to data acquired in several studies over the last decade, most private and government institutions do not invest the required money to keep equipment in proper operating order. They wait for equipment failure before taking whatever steps are required to fix or replace the equipment. Nothing lasts forever, and all equipment has a predetermined life expectancy or operating life[1]–[3].

Objectives of Maintenance

Equipment is a vital resource that is regularly employed to add value to products. As a result, it must be kept in top working order. Otherwise, there will be considerable downtime and production disruption if it is employed in a big manufacturing line. Equipment failure will result in quality issues. As a result, it is critical to keep the equipment in excellent working order at a low cost. As a result, we require an integrated approach to reduce maintenance costs. Several pieces of equipment will become outdated over time. If a company wishes to compete in the same industry, it must decide whether to replace or keep existing equipment while considering t6he cost of maintenance and operation.

Types of Maintenance

Most equipment has a design life that need frequent maintenance. Belts must be adjusted, alignment must be maintained, spinning equipment must be properly lubricated, and so on. In certain circumstances, specific components, such as a wheel bearing on a motor vehicle, must be replaced to guarantee that the primary piece of equipment in this case, a car lasts its design life. Several methodologies have been developed to determine how maintenance may be undertaken to guarantee that equipment lives up to or beyond its design life. Other ways, in addition to waiting for a machinery component to fail reactive maintenance, include preventive maintenance, predictive maintenance, and reliabilitycentered maintenance.

Breakdown Reactive Maintenance

Breakdown maintenance is essentially the 'run it till it breaks' approach of maintenance. There are no measures or efforts performed to maintain the equipment as the designer intended to guarantee the design life is attained. According to current studies, this is still the most common technique of maintenance.The benefits of breakdown repair are a doubleedged sword. We may expect few incidences of failure while dealing with fresh equipment. We will not waste people or incur capital costs if our maintenance programme is solely reactive. We may consider this period to be a money saver because there are no related maintenance costs. In truth, while we assume we are saving money on maintenance and capital costs, we are really spending more than we would have under an alternative maintenance strategy.

We are spending more money on capital costs since, while waiting for the equipment to break, we are decreasing its life, requiring more frequent replacement. We may incur costs if the primary device fails, resulting in the failure of a secondary device. This is an expense we would not have incurred if our maintenance programme had been more proactive.Our labour costs will almost certainly be greater than usual since the failure will almost certainly necessitate more extensive repairs than would have been required if the piece of equipment had not been run to failure. The equipment will most likely break during offhours or at the conclusion of the typical workday. We will have to pay maintenance overtime costs if it is a crucial piece of equipment that has to come back online promptly. We will need a substantial product in order of repair parts since we anticipate to operate equipment to failure. This is a cost that might be reduced if we used a different maintenance plan.

Advantages

- **i.** Requires little maintenance investment.
- **ii.** Less people are needed.

Disadvantages

- **i.** Higher costs as a result of unscheduled equipment downtime.
- **ii.** Higher labour costs, particularly if overtime is required.
- **iii.** The cost of repairing or replacing equipment.
- **iv.** Secondary equipment or process damages due to equipment failure.
- **v.** Ineffective utilisation of personnel resources

Preventive Maintenance

Preventative maintenance is described as actions conducted on a time or machinerun basis that detect, prevent, or reduce deterioration of a component or system only with goal of prolonging or extending its useful life by managing degradation to an acceptable level.Preventative maintenance allows them to improve the dependability of their equipment. Equipment life is prolonged and dependability is enhanced simply by investing the appropriate resources to undertake the maintenance tasks indicated by the equipment designer. In addition to increased dependability, a significant amount of money will be saved over a programme that just uses reactive maintenance. 6According to studies, these savings might range from 12% to 18% on average[4], [5].

II. DISCUSSION

Measures that detect the start of a degradation mechanism, allowing cause stresses to be avoided or regulated prior to any major deterioration in the component physical condition. The results show existing and future functioning capabilities.Predictive maintenance varies from preventive maintenance in that it bases maintenance requirements on the actual state of the equipment rather than on a predetermined timetable. Preventative maintenance has a time limit. Tasks like changing lubrication are timebased, similar to calendar time or equipment run time. Most people, for example, replace the oil in their cars every 3,000 to 5,000 miles. This basically bases oil change requirements on equipment run time.There is no regard for the oil's real condition or performance capacity. It has altered due to the passage of time. This practise is comparable to a preventative maintenance activity. If, on the other hand, the driver discounted the vehicle run time but had the oil examined on a regular basis to establish its true condition and lubricating qualities, he could be able to postpone the oil change until the vehicle had driven 10,000 miles.

This is the primary distinction between predictive and preventive maintenance, with predictive maintenance being utilised to determine required maintenance tasks based on quantifiable material/equipment condition.Predictive maintenance has several advantages. A wellplanned predictive maintenance programme will reduce the likelihood of catastrophic equipment breakdowns. A maintenance activity schedule can be created to reduce or eliminate overtime costs. It is feasible to reduce inventory and order components as needed ahead of time to meet downstream maintenance needs and improve equipment operation, minimising energy costs and enhancing plant dependability[6], [7].Previous research has suggested that a fully operating predictive maintenance programme may save 8% to 12% more than a preventive maintenanceonly programme. Depending on a facility's reliance on reactive maintenance and material condition, it might potentially see savings of 30% to 40%. According to independent assessments, the following industry average savings arise from the implementation of a functioning predictive maintenance programme:

- **i.** Tenfold return on investment.
- **ii.** Maintenance cost reduction of 25% to 30%.
- **iii.** Removal of breakdowns—70% to 75%.
- **iv.** 35% to 45% reduction in downtime.
- **v.** Boost output by 20% to 2.

Advantages

- **i.** Extends component operating life and availability.
- **ii.** Enables proactive remedial measures.
- **iii.** Reduced downtime of equipment or processes.
- **iv.** Cost savings on components and labour.
- **v.** Improved product quality.
- **vi.** Increased worker and environmental protection.
- **vii.** Increased worker morale.
- **viii.** Saving energy is number eight on the list.
- **ix.** Cost savings of 8% to 12% above preventative maintenance programme.

Disadvantages

- i. Increasing expenditure on diagnostic equipment.
- ii. Greater spending on employee training.
- iii. Management is unaware of the possible savings.
- iv. Maintenance Reliability Concept.

The chance of surviving in a particular operational environment is defined as reliability. The period between successive failures of a refrigerator, for example, if continuous operation is necessary, is a measure of its dependability. If this time is longer, the product is deemed to be more reliable.In a textile mill, the light is normally kept at a minimum defined level. To do this, suppose there are 100 lamps in use, each with a guaranteed life of 5000 hours. If we collect information on the number of bulbs that have survived for 5000 hours, we may calculate the bulb's dependability.Some notable instances of showing the dependability notion are railway signalling systems, aeroplanes, and power plants. Failure in certain circumstances will result in severe penalties.

The notion of dependability can be linked to the concept of systems. In general, products/equipment will contain several components that may perform in a serial or parallel connection. As a result, the dependability of each component influences the product's dependability. As a result, sufficient attention must be paid during the design stage to optimise the product's reliability. For improving dependability, the cost of maintenance must also be addressed. The general failure pattern of any product. This is known as the bathtub curve.There will be a high number of failures in the early phase, . This is mostly due to nonalignment while shipment, or misfit during manufacture assembly, or extremely high initial friction between moving parts, and so on.

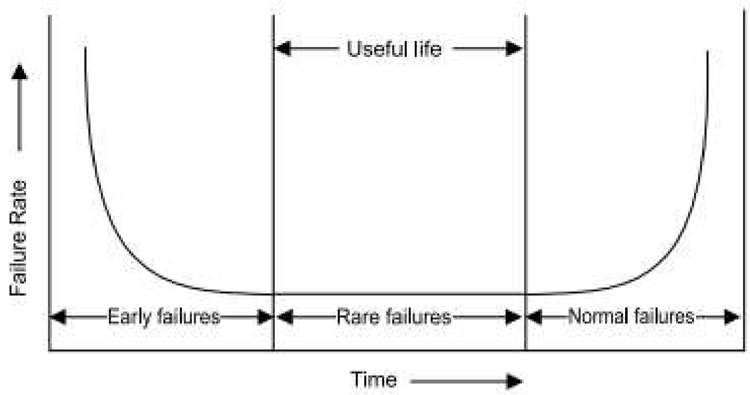

Figure 1: Represent the 1 Product failure rate [Research Gate.Net].

Enhancement of Reliability

Several elements influence a system's or product's dependability. As a result, we should focus on improving product reliability at the grassroots level.The following are some methods for increasing system reliability:

1. Component design has been improved.
2. Simplifying the product structure
3. Better manufacturing equipment is used.
4. higher quality standards
5. improved testing standards
6. a sufficient number of backup units
7. If required, use preventative maintenance at the proper time.

Maintenance Planning

Maintenance work planning consists mostly of addressing two questions: 'what' and 'How' of the task; 'what activities are to be done?' and 'how those jobs and actions are to be done?'Other supplemental questions, such as 'where the task is to be done?' and 'why the job is to be done?' must be addressed when answering these two questions, but all of these will aid in establishing the 'what' and 'how' of the job. It is critical that engineering expertise be used widely to maintenance projects in order to establish proper job plans employing the most appropriate procedures, tools, materials, and special facilities, etc.Because job planning is the foundation upon which the efficiency and cost of actions are based, those in charge of job planning should have adequate capabilities, such as knowledge of jobs and available techniques, facilities and resources, analytical ability, conceptual logical ability, and judgmental courage, among others.

Steps of Job Planning

The basic steps to good task planning are as follows:

i. **Knowledge Base:** This comprises information about equipment, jobs, processes, materials, and facilities.
ii. **Onsite Job Investigation:** It provides a comprehensive picture of the overall number of positions.
iii. **Identify And Document Relevant Work:** Understanding the previous two processes as well as the requirements of preventive, predictive, and other maintenance operations.
iv. **Repair Plan Development:** creation of stepbystep methods for completing the task with the least amount of time, people, and material. A list of preparation tools and facilities detailing the particular equipment, tackles, and facilities required. Work measurement technique and critical path analysis are used to estimate the time necessary to complete the project.

Maintenance Scheduling

Scheduling is the job of organising all logistical concerns pertaining to the execution phase of the activity. Maintenance work scheduling essentially deals with addressing two questions: Who would do the task? and When would the job start and finish?Good scheduling 6necessitates realistic thinking based on extensive data and records. The majority of the schedule work must be done in areas such as overhead labour hours, safety and toolbox meetings, break periods and training times, and so on. Addition of remedial and authori6ed improvement activities as directed by the priority system and operations plan, among other things[8], [9].

Requirements for Schedulers

Scheduling is the role of organising all logistical concerns related to the work's execution phase. Maintenance work scheduling essentially deals with addressing two questions: 'Who' and 'When' of the task, i.e., who would do the job and when the job would be begun and finished.Good scheduling necessitates practical thinking based on extensive facts and records. The majority of scheduling work must be done in areas such as overhead labour hours, safety and toolbox meetings, break periods and training times, and so on. Addition of correction and authorised improvement activities as directed by the priority system and operations plan, etc.

Requirements for Schedulers

A scheduler should also be knowledgeable about the task, procedures, and facilities, as well as possess analytical ability and judgemental fortitude. The scheduler must learn/learn aboutfollowing ability and judgemental bravery. Before beginning his duties, the scheduler must gather the following information:

1. Labor availability by trade, location, shift, crew arrangement, and allowable overtime limit, among other things.
2. A backlog of man hours on existing or incomplete tasks.
3. The availability of the necessary equipment or the location where the job must be done.
4. The availability of necessary tools, tackles, parts, consumables, structural and other materials.
5. External workforce availability and capabilities; they may come from different shops/departments of the plant or from contractors local, nearby, ancillary etc.
6. Access to specialised equipment, jigs/fixtures, special lifting and handling facilities, and cranes, among other things. This should also incorporate laborsaving technology like as pneumatic hammers and excavators.

III. CONCLUSION

A crucial component of operational management, maintenance management seeks to maximise the dependability, availability, and performance of machinery and infrastructure. Organisations may decrease downtime, manage maintenance costs, and improve overall operational efficiency by putting into place efficient maintenance policies and practises.Preventive, corrective, and predictive maintenance of equipment are some of the numerous categories that it might fall under. In order to avoid malfunctions and guarantee optimum equipment performance, preventive maintenance includes prearranged inspections, maintenance activities, and replacements. Following a breakdown of the equipment, corrective maintenance fixes it. In order to anticipate equipment breakdowns and carry out repair in advance, predictive maintenance employs condition monitoring methods and data analysis.

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