COURSE TITLE

CONSTRUCTION ENGINEERING AND MANAGEMENT

Chapter 10

PROJECT MAINTENANCE

Lecture 10 (week 10)

Maintenance basics, Types of Maintenance. Planning and Scheduling Maintenance, Estimating Maintenance and Management of maintenance and financing.

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Learning Objectives

The main objective of this lecture is to understand about:

- Maintenance Basics
- Types of Maintenance
- Planning and Scheduling Maintenance
- Estimating Maintenance
- Management of Maintenance and Financing

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7.1 MAINTENANCE BASICS

After the project is handed over to the customer in the termination phase of the project, the role of maintenance comes into play. Maintenance plays an important role for the smooth operation of the project or making the facility to run without any disturbances. Maintenance includes the repair or preservation of an existing facility to prevent that facility's deterioration to an unsafe or irreparable state, or which involves the treatment of an existing facility to meet acceptable standards of operation or aesthetic quality.

Maintenance Management is an orderly and systematic approach of administrative, financial, and technical framework for assessing, planning, organizing, monitoring and evaluating maintenance and operation activities and their costs on a continual basis. Maintenance management indicates all those activities and efforts which ensure a continuous good working production flow by utilizing maximum capacity of plant and process. [1] The construction equipment or machinery constitute a substantial portion (10%-30%) of total project cost and has to be maintained to turn the project into profit making centre for any organization. [2]

Project maintenance means all activities to maintain, repair, and replace the project, and any parts thereof after the project is completed. [3] Project maintenance is the process of tracking and enabling project activities in accordance with the project plan. Project maintenance means to perform the activities required for regular and smooth running or operation of project after it has been put into work. Maintenance management is the overall process of getting works done related with maintenance of plants, machineries or systems. A project may keep on functioning well for its design period unless any defects or problems come before it. Some activity may be to bring back the system to its original functional status from that of undesirable nonfunctional one. So the maintenance of a project is the activity required to check the probable damages or to correct any deficiencies cropped upon in the system. Within the context of maintenance, 'Failure' is defined as an inability to produce works in an appropriate manner.

General Do's and Don'ts for Equipment Maintenance

Do's

- Do keep the equipment clean
- Do process operation and maintenance manuals and be through with equipment manufacturer's instruction.
- Do pay particular attention to lubrication.
- Do use only genuine spares.
- Do keep all nuts and bolts tight.
- Do examine engine oils and radiator water daily, before starting equipment.
- Do attend periodic preventive maintenance.

- Do take steps to keep safety device working.

Don’ts

- Don’t overload engine and equipment.
- Don’t run engine if black smoke is coming out of exhaust.
- Don’t use cotton waster, while cleaning engine parts.
- Don’t mix different brands of oils.
- Don’t observe economy only in cost of maintenance.
- Don’t store fuel, oil in galvanized containers.

Precaution for maintenance of equipment.

Before carrying out maintenance

1. Notification of failure should be given to proper person who has in depth knowledge of the equipment.
2. Warning tag showing “Do not operate” should be attached on work equipment.
3. Clean before inspection and maintenance.
4. Keep work place clean and tidy.
5. Take care that enough fire fighting arrangement is established and restriction of smoking is initiated.
6. Take care that engine is stopped before carrying out inspection and maintenance.

During maintenance

1. Only authorized persons should be allowed to attend to the maintenance of equipment.
2. While working under machine take care that the equipment is placed on the firm ground level.
3. Take care that no tools are left as it is inside the machine by mistake.
4. Repair should be carried out as soon as abnormality is reported.
5. Do not carry out maintenance with engine running.
6. Take care that machines are provided with personnel protective equipment.

OBJECTIVE OF MAINTENANCE

1. To ensure product and service quality and satisfaction to customers.
2. To increase the economic life of the infrastructure/system and to provide easy operation with optimum service/ production /supply. Also to reduce risk and mitigates the disaster.
3. To maximize the availability and reliability of all assets, especially a system plant, equipment and machinery and to obtain a maximum possible return on investment.
4. To extend the life of assets by minimizing wear and tear and deterioration.
5. To ensure the safety of personnel using equipment/facilities.
6. To minimize the frequency and severity of interruptions to the operating process.
7. To plan and schedule maintenance work
8. To increase the reliability of the system.
9. To ensure operational readiness of all equipment required for emergency use at all-time such as standby units, firefighting units, and rescue units.

IMPORTANCE OF MAINTENANCE

In any engineering project, the errors and problems are accumulated unless regular and timely maintenance is carried out. The maintenance prevents the following consequences:

1. **System deterioration**

(a) *Structural failure*: The whole or part of a structure may fail or collapse due to various reasons which are termed as structural failure.

(b) *Mechanical failure*: Some mechanical devices in a project when used under the continuous operation may reduce its effective size and failure occurs which is mechanical failure.

2. **Reduces services and problems in management**

- To achieve the adequacy, reliability, efficiency, an effective and regular maintenance is essential.

3. **Poor project operation**

The project which has poor management does increase in cost for rehabilitation than repair.

4. **Frequent and costly rehabilitation**

A small repair in time would save costly rehabilitation in the future. It is cheaper to carry out preventive works than the extended rehabilitation.

5. **Long production time**

7.2 TYPES OF MAINTENANCE

1. Planned maintenance

Maintenance works organized and carried out with forethought, control and use of records to a predetermined plan. Planned maintenance is the studied evaluation of all plant with the intention of carrying out any maintenance before it is actually needed through breakdown or obvious deterioration in performance, with the aim of reducing emergency maintenance and associated costs in machine stoppage. [4]

(a) **Preventive maintenance**

Based on principle 'prevention is better than cure'. This type of maintenance is used in those cases where deterioration and failure patterns of an item are known. The routine inspections and servicing are designed to detect potential failure conditions and suggest action, which may range from minor or major repairs to replacing parts. Preventive maintenance can be carried out on machines either when running or during the shutdown. Preventive Maintenance can be classified as

(i) **Running Maintenance**

Maintenance which can be done when the item is in service. This maintenance is carried out in a project so as to keep and efficient daily operation. Examples: lubrication, tightening of loose nut and bolts, adjustment of nut and screw.

(ii) **Shutdown Maintenance**

Maintenance, which is carried out when the project is out of service. These are generally performed after 3 or 6 months.

(b) **Corrective Maintenance**

Corrective maintenance is done after the plant, machinery or the system is out of the order to bring them in a satisfactory operating condition. In this type, action such as repair, replacement or restore will be carried out after the occurrence of the failure in order to eliminate the source of the failure and reduce the frequency of its occurrence. This is carried out to restore an item to the acceptable standard where replacement is not advisable. Corrective Maintenance can be further classified as

Breakdown Maintenance

Breakdown maintenance is maintenance performed on a piece of equipment that has broken down, faulted, or otherwise cannot be operated. [5]The goal of breakdown-maintenance is to fix something that has malfunctioned. Maintenance work implemented only when facilities or equipment fail to operate.

7.3 MAINTENANCE PLANNING AND SCHEDULING

Maintenance planning and scheduling are key elements that influence the true success of any organization.

Objectives:

- Minimizing the idle time of maintenance workers.
- Maximizing the efficient use of work time, material, and equipment.
- Maintaining the operating equipment at a responsive level to the need for production in terms of delivery schedule and quality.
- An essential part of planning and scheduling is to forecast future work and to balance the workload between these categories. [6]
- Reduce maintenance cost.
- Improved utilization of the maintenance workforce by reducing delays and interruptions.
- Improved quality of maintenance work by adopting the best methods and procedures and assigning the most qualified workers for the job.

Maintenance planning can be defined as an end-to-end process that identifies and addresses any possible issues ahead of time. [7] Maintenance planning should define the "what," "why" and "how". Planning is the process by which the elements required to perform a task are determined in advance of the job start. It highlights possible issues ahead of time and outlines strategies to address them. For example, maintenance planning identifies the tools and resources required for the job. It should specify what work needs to be done with what materials, tools and equipment; why a particular action was chosen and how the work should be completed. Maintenance planning comprises all the functions related to the preparation of:

- The work order
- Bill of material
- Purchase requisition
- Necessary drawings
- Labor planning sheet including standard times
- All data needed prior to scheduling and releasing the work order.

Basic Levels of Planning Process

- Long-range planning: it covers a period of 3 to 5 years and sets plans for future activities and long-range improvement.
- Medium-range planning: it covers a period of 1 month to 1 year.

- Short-range planning: it covers a period of 1 day to 1 week. It focuses on the determination of all the elements required to perform maintenance tasks in advance.

Planning Procedures

- Determine the job content.
- Develop a work plan. This entails the sequence of the activities in the job and establishing the best methods and procedures to accomplish the job.
- Establish crew size for the job.
- Plan and order parts and material.
- Check if special tools and equipment are needed and obtain them.
- Assign workers with appropriate skills.
- Review safety procedures.
- Set priorities for all maintenance work.
- Assign cost accounts.
- Complete the work order.
- Review the backlog and develop plans for controlling it.
- Predict the maintenance load using effective forecasting technique.

Maintenance Scheduling is the process by which jobs are matched with resources and sequenced to be executed at a certain point in time. Scheduling deals with the specific time and phasing of planned jobs together with the orders to perform the work, monitoring the work, controlling it, and reporting on job progress. Successful planning needs feedback from scheduling. Maintenance Schedule Can be Prepared at Three Levels: Long-range (master) schedule, Weekly schedule, and Daily schedule.

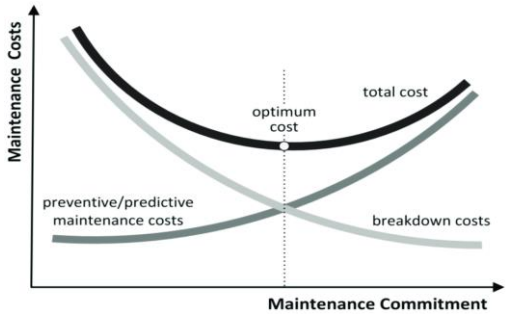
Requirements for effective scheduling:

- Written work orders that are derived from a well-conceived planning process. (Work to be done, methods to be followed, crafts needed, spare parts needed, and priority).
- Time standards.
- Information on the availability of special equipment and tools necessary for maintenance work.
- Access to the plant production schedule and knowledge about when the facilities will be available for service without interrupting production schedule.

- Information about craft availability for each shift.
- Well-define priorities for maintenance work.
- Information about jobs already scheduled that are behind the schedule (backlog).

7.4 ESTIMATING MAINTENANCE COST

Maintenance expenses are costs incurred for the routine maintenance of an asset to keep it in its optimal working condition. Maintenance expenses are recorded in the profit and loss account, thus reducing the profit for the year. The benefits of maintenance expenses are not expected to last beyond a period of 12 months. The operation and maintenance cost in subsequent years over the project life cycle includes Land rent, if applicable, operating staff, labor and material for maintenance and repairs, periodic renovations, insurance and taxes, financing costs, utilities, owner's other expenses.



Source: [8]

To carry out maintenance activities some direct cost are evolved. The investment in direct cost results from the sound operation of plant and machinery that minimizes failure cost. It is always recognized that the direct cost involved in regular maintenance is very less compared to the resulting failure cost due to a breakdown of the machine if maintenance is not carried out in time.

Costing the intended maintenance program is an easy operation because the amount of work to be done has been determined and the basic unit prices are known. It may be important to present a detailed justification for some of the intended works emphasizing the consequences (financial and social) if they are not carried out. It is also advisable to earmark some funds for unexpected repairs. About up to 5 percent of the total budget for this purpose is generally accepted. [4]

7.5 MANAGEMENT OF MAINTENANCE AND FINANCING

Management of maintenance/Maintenance management is the overall process of getting works done related with maintenance of plants, machineries or systems. Management of maintenance/Maintenance management generally consists of: Setting objectives, Identifying and providing the means of attaining the set objectives, and Decision making.

Finance is the field within economics that deals with the allocation of assets and liabilities over time under conditions of certainty and uncertainty. It is the science of money management. A key

point in finance is the time value of money, which states that one unit of currency today is worth more than one unit of currency tomorrow. Finance aims to price assets based on their risk level and their expected rate of return.

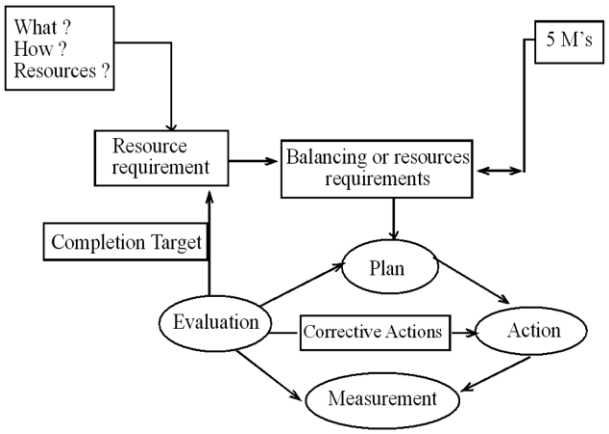


Fig: Maintenance Management Cycle [4]

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