EMEg 4222: Installation and Maintenance of Machinery.

December, 2018

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Content:

- Introduction
  - ✓Definition
  - ✓History (Generation) of Maintenance
  - ✓Challenge of Maintenance

Definition:

- ***Maintain*** is defined as
  - ✓ *cause to continue (Oxford Dictionary), or*
  - ✓ *keep in an existing state (Webster Dictionary).*

Definition Cont…

❖ ***Maintenance*** ***is :***

The combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function.

Definition Cont...

❖ *Maintenance* **is :**

A set of organized activities that are carried out in order to keep an item in its best operational condition with minimum cost acquired.

❖ *Maintenance activity is the systematic and scientific upkeep of equipment for:*

- ✓ ***prolonging life of the equipment,***
- ✓ ***assuring instant operational readiness,***
- ✓ ***optimal availability for production at all times, and***
- ✓ ***making sure that safety of man and machine is at no time jeopardized***

Maintenance Activities

- ***Activities of maintenance function could be either repair or replacement activities, which are necessary for an item to reach its acceptable productivity condition and these activities, should be carried out with a minimum possible cost.***

Maintenance History

✓ ***According to John Moubray (Reliability-Centered Maintenance), the evolution of maintenance since the 1930's can be traced through three generations based on three technical factors:***

I. growing expectations of maintenance,

II. changing views on equipment failures, and

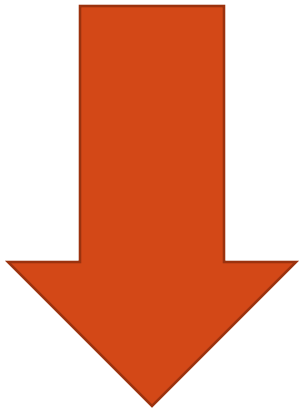
III. changing maintenance techniques.

First Generation

This covers the period up to the World War II.

During this period:

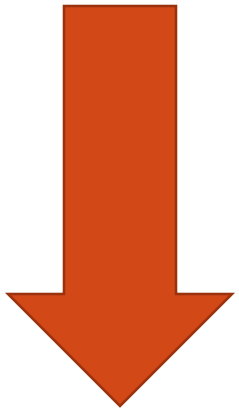
- ✓ *industry was not highly mechanized,*
- ✓ *equipment was simple and over designed,*
- ✓ *downtime did not matter much,*
- ✓ *prevention of equipment failure did not have high priority,*
- ✓ *failures were corrected as they occur.*



➢ ***As a result, there was <u>no need for systematic maintenance</u> beyond cleaning, servicing and lubrication.***

Second Generation

- ***During the war, demand for good increased and supply of industrial outputs was low. This led to increase in mechanization.***



During this period:

- ***machines became numerous and more complex,***
- ***industry started to depend heavily on these machines,***
- ***downtime started to matter,***
- ***the idea that equipment failures could and should be maintained came up.***

➢ ***As a result, the concept of preventive maintenance and maintenance planning and control systems grew up.***

Third Generation:

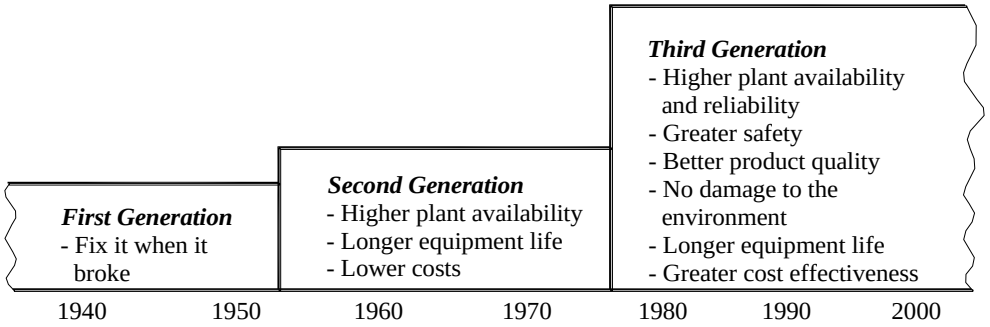
- ✓ ***Since the mid-seventies, new expectations, new research and new techniques have revolutionized maintenance.***

During this period:

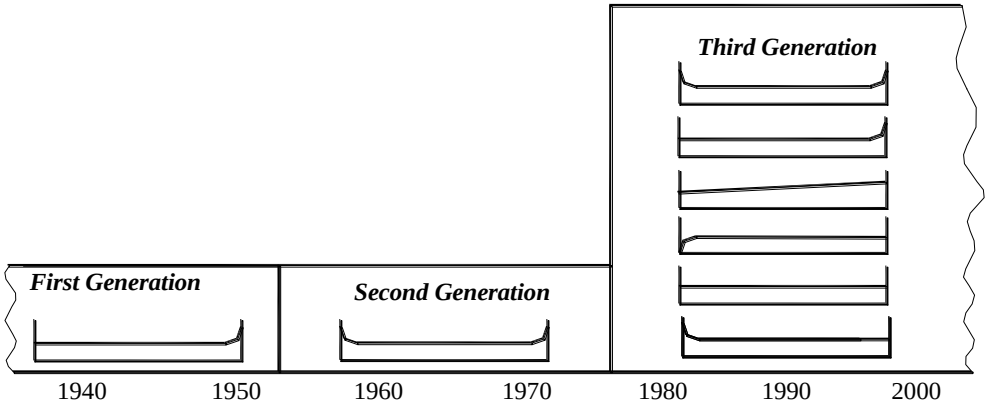
- ✓ *maximizing life of equipment has become important,*
- ✓ *higher plant availability and reliability have become very important,*
- ✓ *greater automation has been effected,*
- ✓ *quality standards, safety and environmental consequences matter quite a lot,*
- ✓ *cost of maintenance is becoming central,*

➢ ***As a result: greater expectations and leading to new research which in turn lead to new techniques.***

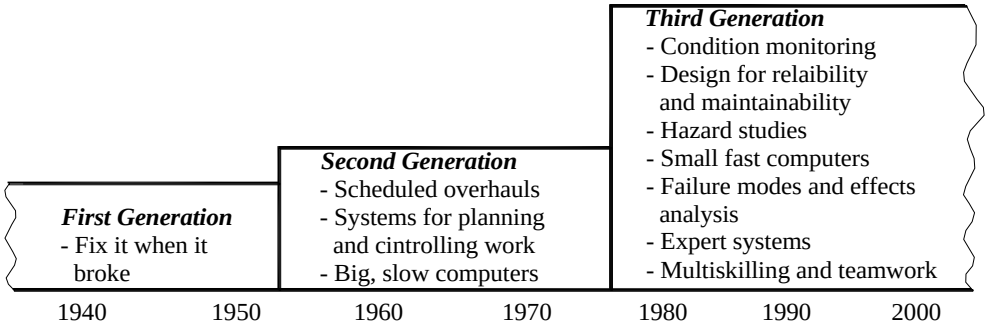
The three generation of Maintenance



Growing expectations of maintenance



Changing views on equipment failure



Changing Maintenance techniques

The Challenges of Maintenance

- ***The challenges that modern maintenance managers face are summarized as follows:***

- ✓ ***to select the most appropriate maintenance techniques,***
- ✓ ***to deal with each type of failure process appropriately,***
- ✓ ***in order to fulfill the expectations of users,***
- ✓ ***in the most cost-effective and sustainable mode,***
- ✓ ***with active support of people involved.***

Involvement of Maintenance activities

- ***Maintenance is related to profitability through:***
  - ***equipment output and equipment running cost.***
  - ***time taken for maintenance purposes.***
- ***The importance of maintenance increases with industrialization.***
- ***The level of maintenance required at the equipment operation stage is affected by factors at other stages through which the equipment passes.***

➢ *Design stage:*

- ✓ **Reliability and maintainability are the important factors which should be considered properly in relation to performance of equipment, capital and running costs.**

➢ *Installation stage:*

- ✓ **Maintainability is an important factor to be considered during the installation, for it is here that maintenance problems become clear.**

Machine:

It is a device that takes some energy as input and transforms it to another useful form of energy as output.

Machine Installation:

It is the process of fixing and erecting the machinery in an industry so that they can be put to use for productive purposes.

Why Machine installation is necessary?

It is the first step in the productive process of any newly established plant.

Where to install machinery?

The installation of light machinery used for domestic use may not require any expertise, where as the installation of the machinery used in the industry need attention as the performance of the machinery largely depend upon proper installation.

How to install machinery?

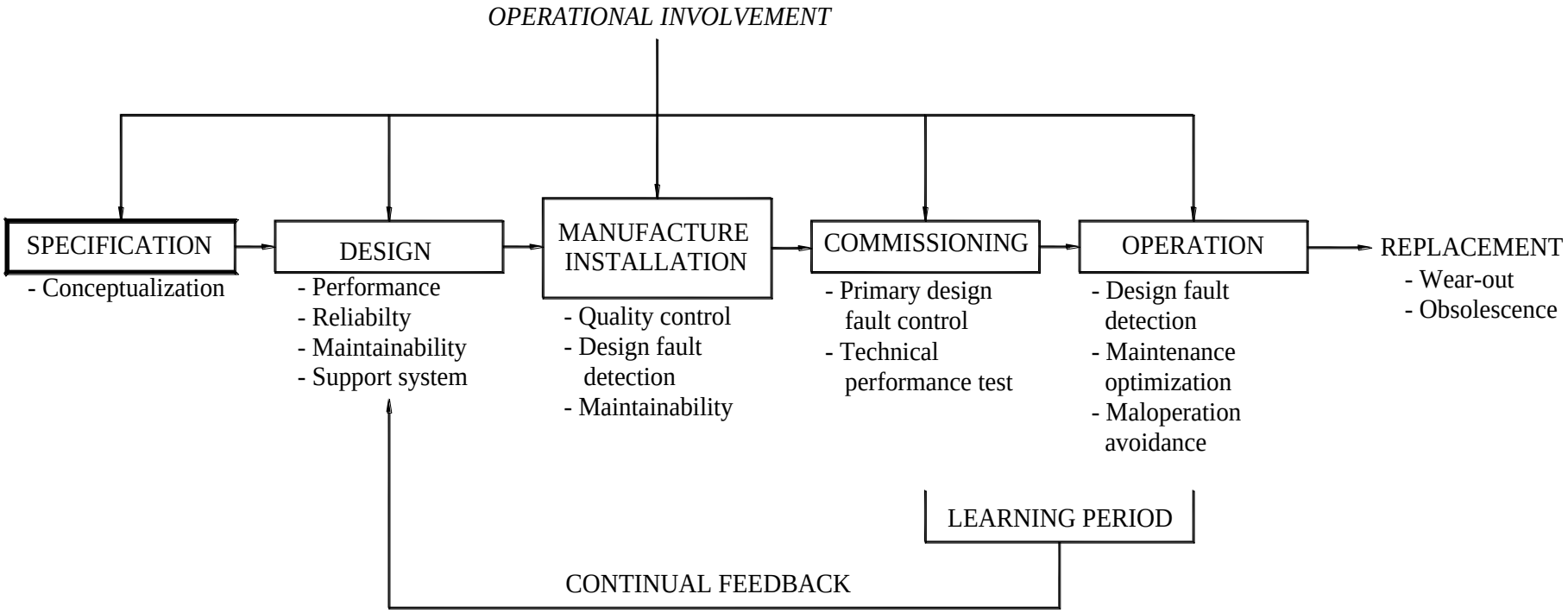
The installation process may differ from machine to machine and it is largely depend upon the main specifications of the machines to be installed.

Factors to be considered before installing the machinery

- **It is important that as much information as possible be supplied regarding the machine to be installed, this will include:**
  - ✓ **Machine size and weights**
  - ✓ **Any dynamic features of its operation**
  - ✓ **Location including ground type, condition where optimal performance is required**
  - ✓ **Vibration analysis of the machine**
  - ✓ **Site conditions**

- *Commissioning stage:*
  - ✓ This is a stage of technical performance testing and also a stage of where primary design faults are located and designed out.
- *Operational stage:*
  - ✓ The operational stage is a stage of learning where maintenance plays an important role.

Equipment Life – Cycle



Maintenance Management

- ✓ is the direction and organization of resources in order to control the availability and performance of an industrial plant to a specified level.

- ✓ In maintenance management the problem is two-dimensional:
  - Determination of size and nature of the maintenance work load,
  - Organization and control of labour, spares and equipment to meet the workload.

Function of maintenance work

- ***Earlier the objective of maintenance function was considered to optimize plant availability at minimum cost.***
- ***Today it is being considered as "Maintenance affects all aspects of business effectiveness and risk-safety, environmental integrity, energy efficiency, product quality and customer service, not just plant availability and cost."***

- ***The maintenance department influences plant availability directly through preventive and corrective maintenance.***

The most basic definition of availability is

$$Availability = \frac{T_{op}}{T_{op} + T_{down}}$$

where T_{op} = cumulative time of operation

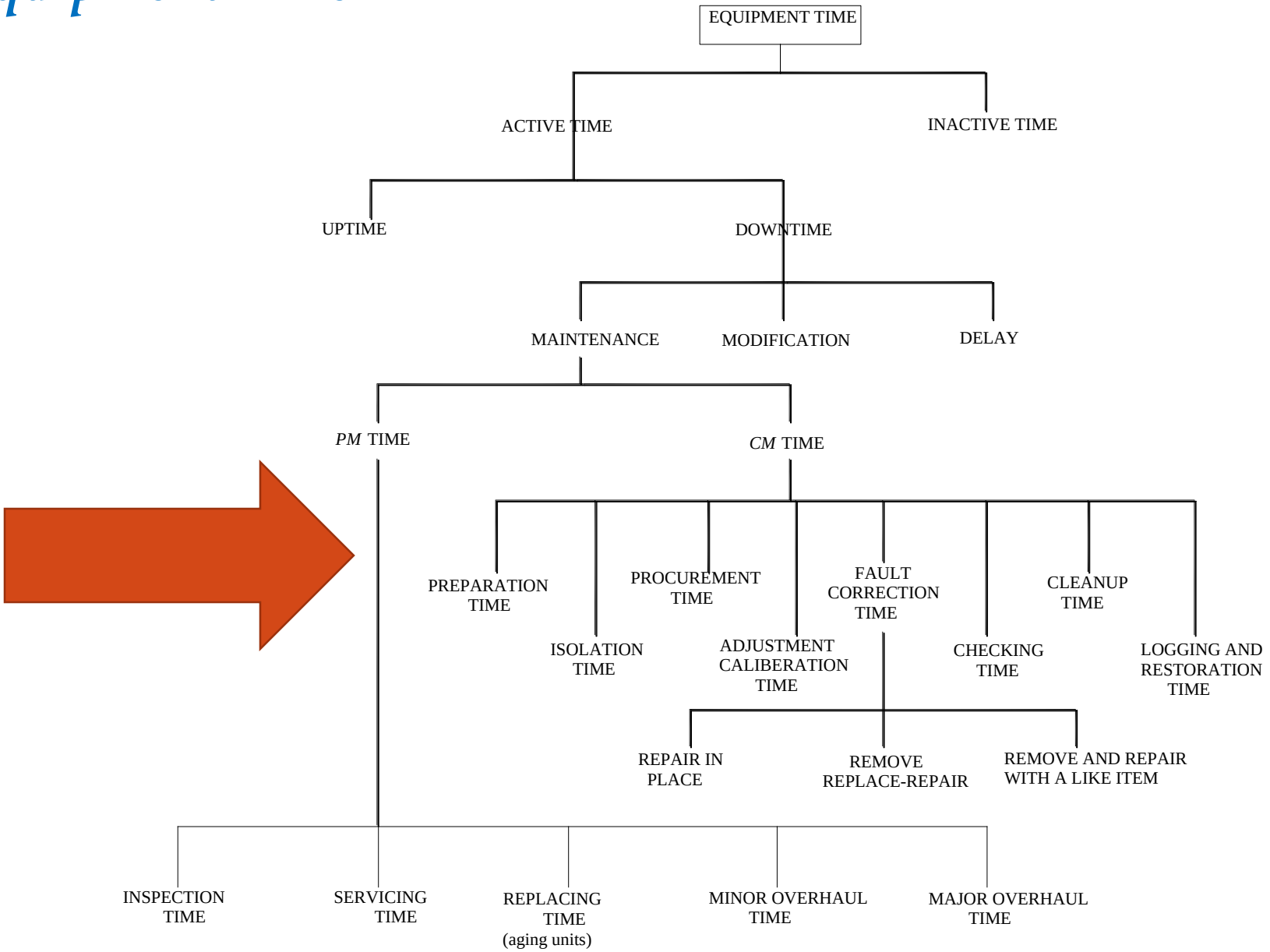
T_{down} = cumulative outage time

T_{down} = Down time = repair time + delays

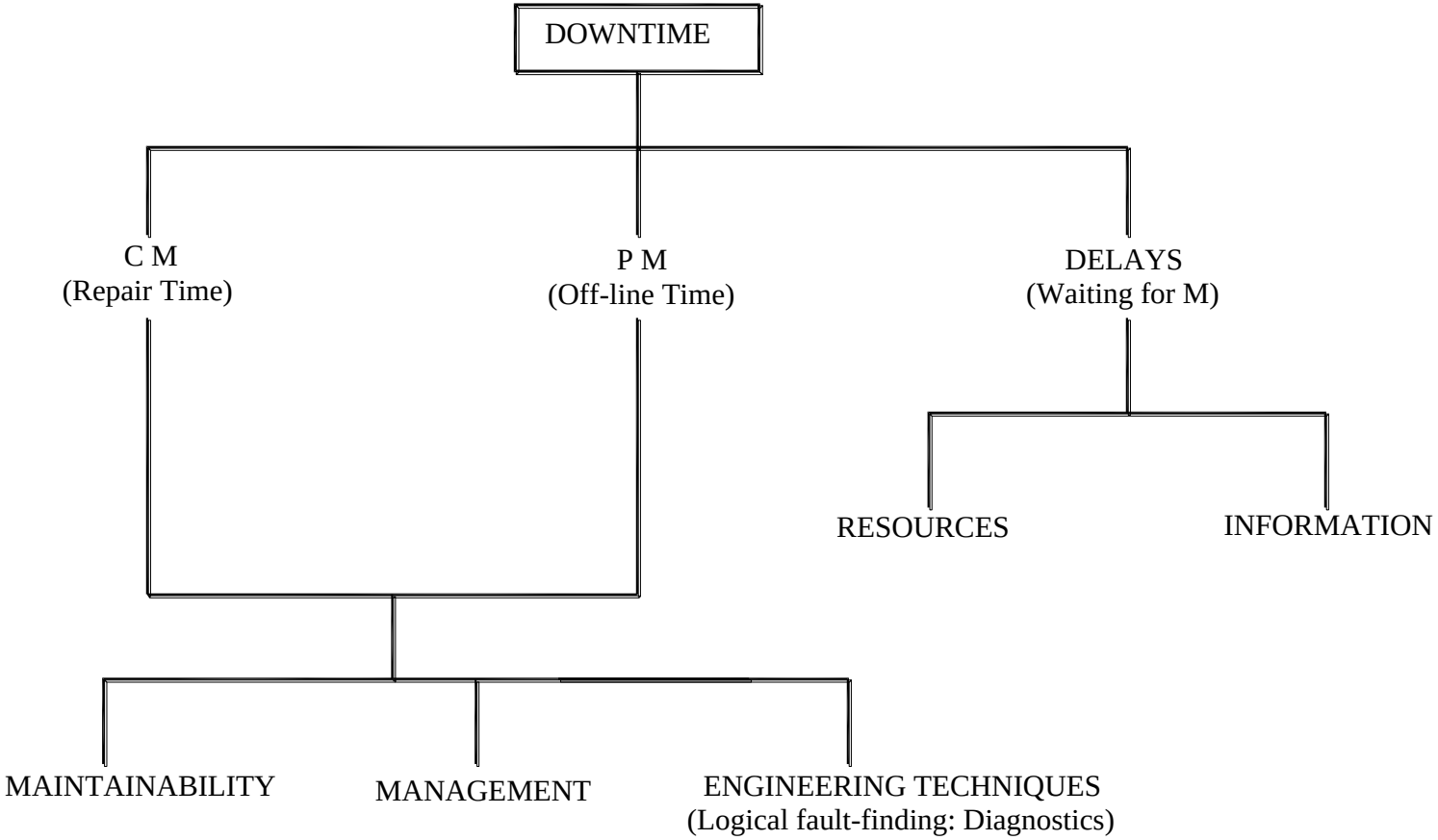
Repair time = f(maintainability, management method, engineering techniques)

Delays = f(organization of maintenance resources and information)

Equipment Time



Equipment Down Time



- *PM All actions carried out on a planned, periodic, and specific schedule to keep an item/equipment in stated working condition through the process of checking and reconditioning.*
- *PM may be described as the care and servicing by individuals involved with maintenance to keep equipment/facilities in satisfactory operational state by providing for systematic inspection, detection, and correction of incipient failures either prior to their occurrence or prior to their development into major failure.*

Main objectives of PM are to:

- ✓ *Enhance capital equipment productive life,*
- ✓ *Reduce critical equipment breakdowns,*
- ✓ *Allow better planning and scheduling of needed maintenance work,*
- ✓ *Minimize production losses due to equipment failures,*
- ✓ *Promote health and safety of maintenance personnel.*

- *Corrective maintenance may be defined as the remedial action carried out due to failure or deficiencies discovered during preventive maintenance, to repair an equipment/item to its operational state.*
- ***Usually,*** *corrective maintenance is an unscheduled maintenance action, basically composed of unpredictable maintenance needs that cannot be preplanned or programmed on the basis of occurrence at a particular time.*

Objectives of Maintenance:

- ✓ ***Maintenance purposes, functions and objectives are inter-related and are overlapping to some extent. From the various aspects and paragraphs mentioned earlier in this chapter, maintenance objectives for an industry can be the followings:***

- ➢ ***To maintain plants and equipment's at its maximum operating efficiency, reducing down times and ensuring operational safety; ensure maximum availability of plant, equipment and machinery for productive utilization through planned maintenance***

- *To safeguard investments by minimizing rate of deterioration and achieving this at optimum cost through budgeting and controls; maintain plant equipment, and facilities at an economic level of repairs at all times, to conserve these and increase their life-span*

- *To help management in taking decisions on replacements or new investments and actively participate in specification preparation, equipment selection, its erection and commissioning etc,*

- ***Help in implementation of suitable procedures for procurement, storage and consumption of spares, tools and consumables etc (inventory control etc)***
- ***Standardization of spares and consumables, in conformity with plant, national and international standards and help in adoption of these standards by all users in the plant***
- ***Running of centralized services like steam generation and distribution, water supply, air supply and fuel etc.***
- ***Running of captive workshops for repairs and conditioning and also for making some new spares; etc.***

Question?

- ***Why do we need maintenance?***
- ***What are the costs of doing maintenance?***
- ***What are the costs of not doing maintenance?***
- ***What are the benefits of maintenance?***
- ***How can maintenance increase profitability of company?***

Thank you

If you have any questions ???