



**Al- Mustaqbal University Chem. Eng. Petr. Ind. Dept.  
4<sup>th</sup> stage**

## **Industrial Management and Ethics**

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## Maintenance managements

Every industrial organization relies on well-maintained assets to keep their business going. Maintenance management is an important, yet seldom discussed, aspect of managing a company. People unfamiliar with working in industrial environments may not understand what is meant by *maintenance management*. **It is an orderly process to control the maintenance resources and activities required to preserve (maintain) assets at, or repair them to, an acceptable working order.** While you may interpret (explain) this definition of maintenance management as simply meaning “fixing things,” that would be an oversimplification. There is a lot more to maintenance management than most people realize. Since much of an organization’s money is tied up in equipment and facilities, important decisions are made regarding time, people, and money.

Maintenance directly impacts the long-term success of an organization. Assets that are poorly maintained *experience frequent, unexpected downtime, and cause a ripple effect. Instability, inconsistent product quality, stopped production, and high operational costs jeopardize (put in danger) an organization’s profitability and longevity.*

## Objectives of Maintenance Management

All forms of maintenance management share similar objectives no matter the industry, plant, or product or service offered. The following are some objectives of maintenance management:

- Minimizing asset failure and downtime
- Extending asset life
- Planning maintenance work
- Cost control and budgeting
- Improving product quality
- Developing improved policies, procedures, and standards
- Complying with regulations
- Ensuring safety of personnel

## Maintenance Management Strategies

There is no one correct way to manage maintenance. Different types of maintenance management are used depending on factors such as the nature of the imminent or present failure, availability of parts and personnel, and budget.

Maintenance management generally employs one of two strategies: reactive maintenance and proactive maintenance. Both are acceptable maintenance processes and are often used in combination with one another. Yet, each involves a different amount of time and money. Organizations must be able to decide which methods to use and when.

### Reactive Maintenance Management

Some organizations choose a reactive maintenance management strategy, sometimes referred to in the industry as the **firefighting method**. With this strategy, maintenance teams wait until assets break before they take action to fix them.

As the term “firefighting” suggests, the circumstances surrounding this type of maintenance management are chaotic (lawless *فوضوي*). Maintenance teams do not know when the next breakdown will happen, but spring into action once one occurs. Though this can place a burden (load) on maintenance teams, especially when there are multiple “fires” to put out at once, it is a common way repairs are carried out.

The type of maintenance most associated with a reactive strategy is corrective maintenance (CM). Corrective maintenance tasks restore non- or under-performing assets to operational condition. They are typically performed in response to a critical failure or breakdown, though maintenance can be planned for less severe problems.

## Proactive Maintenance Management

While some organizations take a “fix it when it breaks,” approach, others take a more proactive approach. They look to prevent failure by looking for signs of wear and tear before a problem occurs.

Proactive maintenance is performed in a number of ways. Assets are regularly inspected for signs of damage. Preventive measures, such as calibration, cleaning, and lubrication ensure assets function as expected. Pre-emptive وقائي part replacement reduces the chance of downtime caused by worn components.

Compared to reactive maintenance management, proactive maintenance requires more forethought and planning, but makes maintenance activities more predictable. The types of maintenance commonly associated with proactive maintenance are as follows:

- **Preventive Maintenance (PM)**: Fixing small problems before failure can occur.
- **Condition-based Maintenance (CbM)**: Using sensors to monitor an asset’s condition.
- **Predictive Maintenance (PdM)**: Using sensors, historical data, and real-time data to predict when an asset will fail.

## Maintenance and Repairs

Annual costs for equipment maintenance and repairs may range from 2 to 20 percent of the equipment cost. Charges for plant buildings average 3 to 4 percent of the building cost. In the process industries, the total plant cost per year for maintenance and repairs ranges from 2 to 10 percent of the fixed-capital investment, with 7 percent being a reasonable value. Table 6-16 provides a guide for estimation of maintenance and repair costs as a function of process conditions.

For operating rates less than plant capacity, the maintenance and repair cost is generally estimated as 85 percent of that at 100 percent capacity for a 75 percent operating rate, and 75 percent of that at 100 percent capacity for a 50 percent operating rate.

**Table 6-16** Estimation of costs for maintenance and repairs

Type of operation	Maintenance cost as percentage of fixed-capital investment (on annual basis)		
	Wages	Materials	Total
Simple chemical processes	1–3	1–3	2–6
Average processes with normal operating conditions	2–4	3–5	5–9
Complicated processes, severe corrosion operating conditions, or extensive instrumentation	3–5	4–6	7–11

## **REPLACEMENTS**

The term replacement, refers to a special type of alternative in which facilities are currently in existence and it may be desirable to replace these facilities with different ones. Although intangible factors may have a strong influence on decisions relative to replacements, the design engineer must understand the tangible economic implications when a recommendation is made as to whether existing equipment or facilities should be replaced. The reasons for making replacements can be divided into two general classes, as follows:

1. An existing property must be replaced or changed in order to continue operation and meet the required demands for service or production. Some examples of reasons for this type of necessary replacement are that
  - a. The property is worn out and can give no further useful service.
  - b. The property does not have sufficient capacity to meet the demand placed upon it.
  - c. Operation of the property is no longer economically feasible because changes in design or product requirements have caused the property to become obsolete.
2. The existing property is capable of yielding the necessary product or service, but more efficient equipment or property is available which can operate with lower expenses.