

Subject-Operations Management Topic-Maintainability and Availability

Lecture Notes

Mrs. Anjali Upadhyay Pandya
Mechanical Engineering Department
SoET, VU, Ujjain

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Maintainability

- Maintainability is a characteristic of design and installation, which is expressed as the probability that an item will be restored to specified conditions within a given period of time when maintenance action is performed in accordance with prescribed procedures and resources.

-Goldman and Slattery (1967)

- Maintainability is defined as the probability of performing a successful repair action within a given time.
- Maintainability measures the ease and speed with which a system can be restored to operational status after a failure occurs.

Maintainability can be expressed as

$$M = 1 - \exp[-t/MTTR]$$

Where,

t= Specified time to repair

MTTR=Mean time to repair.

Methods to improve maintainability

- Parts standardisation
- Interchangeability
- Fault isolation
- Self diagnostics
- Modularisation
- Accessibility

Availability

- Probability that a system or component is performing its required functions at a given point in time or over a stated period of time when operated and maintained in a prescribed manner.
- Availability depends on both reliability and maintainability.
- Availability can be expressed as-
$$\text{Availability} = \frac{\text{Up time}}{\text{Up time} + \text{Down time}}$$

Types of availability measures

- 1. Inherent Availability**
- 2. Operational Availability**
- 3. Use Availability**

1) INHERENT AVAILABILITY

- The probability that a system, when used under conditions, without consideration of any preventive action in an ideal support situations shall operate satisfactory at a given point of time.
- Inherent availability is expressed as-

$$A_i = \text{MTBF} / (\text{MTBF} + \text{MTTR})$$

2) OPERATIONAL AVAILABILITY

- For **operational availability** counts all sources of downtime, including logistical and administrative, against a system.
- It is expressed as-

Mean time between failures (MTBF)

$$A_o = \frac{\text{Mean time between failures (MTBF)}}{\text{MTBF} + \text{Mean time waiting for spares} + \text{Mean administrative time} + \text{Mean time for repairs}}$$

3) USE AVAILABILITY

- For **use availability**, downtime associated with both corrective and preventive maintenance counts against a system.
- It is also known as **ACHIEVED AVAILABILITY**.

$$A_u = \frac{\text{Operation time+ off time}}{\text{Operation time+ off time+ total downtime}}$$

Relationship between Reliability, Availability and Maintainability (RAM)

Reliability	Maintainability	Availability
■ Constant	↓ Decreases	↓ Decreases
■ Constant	↑ Increases	↑ Increases
↑ Increases	■ Constant	↑ Increases
↓ Decreases	■ Constant	↓ Decreases

Reliability- Maintainability- Availability

