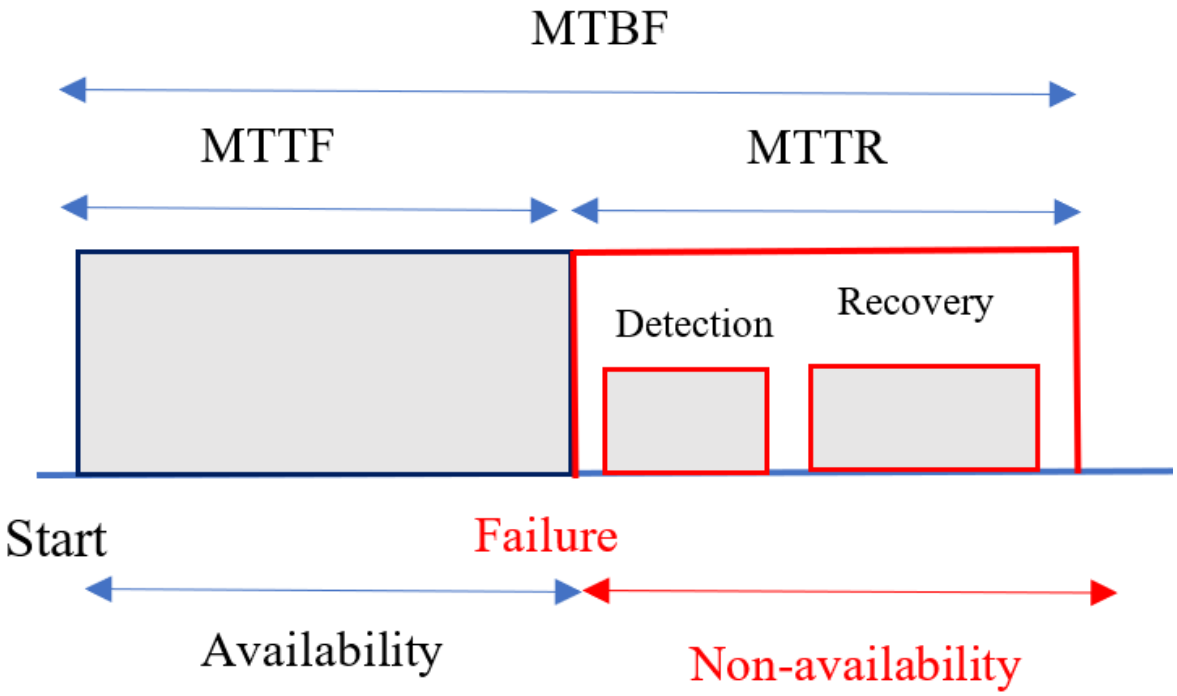
Software Maintenance

- Software maintenance is a continuous process.
- Require less amount of manpower (less number of peoples) than development.
- Software maintenance activities (100% Effort)
  1. Bug removal (or) corrective maintenance $\rightarrow$ 21% Effort
  2. Adaptation (or) adaptive maintenance $\rightarrow$ 25% Effort
  3. Enhancement (or) perfective maintenance $\rightarrow$ 50% Effort
  4. Re-engineering (or) preventive maintenance $\rightarrow$ 4% Effort

Software Maintenance (cont.)



- Mean-time-between-failure (MTBF) = MTTF + MTTR
- MTTF Availability = $\frac{MTTF}{MTTF+MTTR}$ (Implicit)
- MTBF Availability = $\frac{MTBF}{MTBF+MTTR}$ (Explicit)
- Non-availability = 1- Availability

Software Maintenance (cont.)

- Adaptive Maintenance - External specification-based
- Enhancement or perfective maintenance - Internal specification-based
- Software Maturity Index (SMI)

$$SMI = \frac{[M_T - (f_a + f_d + f_c)]}{M_T} \tag{1}$$

where

- M_T: number of modules developed totally
- f_a: number of modules added
- f_d: number of modules deleted
- f_c: number of modules changed

If SMI $< 0.4 \rightarrow$ go for software re-engineering.

Software Maintenance (cont.)

Question 1: A software of 25 modules was released to the customer. During the course of its execution 2 modules were added, 3 were deleted and 1 module was changed/modified. Find out whether the software is under maintenance or not?

Solution

$$SMI = \frac{[M_T - (f_a + f_d + f_c)]}{M_T} = \frac{[25 - (2 + 3 + 1)]}{25} = \frac{19}{25} = 0.76$$

SMI $> 0.4 \Rightarrow$ Software is under maintenance.

Software Maintenance (cont.)

Annual Cost Tariff (ACT)

$$ACT = \frac{Add + Modify}{Total\ Size} \tag{2}$$

Question 2: A software company has released a product of size 22 KLOC. During the course of execution 2 KLOC was added and 3 KLOC was been modified. Calculate the annual cost tariff for the product.

Solution

$$ACT = \frac{Add + Modify}{Total\ Size} = \frac{2\ KLOC + 3\ KLOC}{22\ KLOC} = \frac{5}{22} = 0.227$$

Software Maintenance (cont.)

COCOMO Maintenance

- Maintenance Effort

$$M_E = 1.0(ACT)D_E \ Person\ month \tag{3}$$

where $D_E \rightarrow$ Development effort
$D_E = a_b(KLOC)^{b_b}$

- Maintenance Duration

$$M_D = 1.0(ACT)D_D \ month \tag{4}$$

where $D_D \rightarrow$ Development duration
$D_D = c_b(KLOC)^{d_b}$

- Persons involved in a maintenance team

$$M_N = 1.0(ACT)(\frac{M_E}{M_D}) \ persons \tag{5}$$

Software Maintenance (cont.)

Question 3: A company has developed a software of size 22 KLOC. During the course of is execution 3 KLOC was added and 2 KLOC was modified. Calculate the ratio of people required for development as well as maintenance for all categories of project. Prepare the report.

Solution

$$ACT = \frac{Add + Modify}{Total\ Size} = \frac{3\ KLOC + 2\ KLOC}{22\ KLOC} = \frac{5}{22} = 0.227$$

- Project Size (KLOC) =22 K
- **Basic COCOMO**

Software Maintenance (cont.)

- **Organic mode software**
  - Maintenance Effort $M_E = 1.0(ACT)D_E$ *Person month*
  - Development Effort: $D_E = a_b(KLOC)^{b_b} = 2.4(22)^{1.05}$ $= 61.62$ person-month
  - Maintenance Effort $M_E = 1.0(0.227) \times 61.62 = 13.98$ person months
  - Maintenance duration $M_D = 1.0(ACT)D_D$ months
  - Development Duration: $D_D = c_b(D_E)^{d_b} = 2.5(61.62)^{0.38}$ $= 11.96$ month
  - Maintenance duration $M_D = 1.0(0.227) \times 11.96 = 2.72$ months
  - Persons involved in a development team $D_N = \frac{D_E}{D_D} = \frac{61.62}{11.96} = 5.15 \equiv 5$ persons
  - Persons involved in a maintenance team $M_N = 1.0(ACT)(\frac{M_E}{M_D})$ *persons*
    $M_N = 1.0(0.227)(\frac{13.98}{2.72}) = 1.17 \equiv 1$ *person*

Software Maintenance (cont.)

- **Semidetached mode software**
  - Maintenance Effort $M_E = 1.0(ACT)D_E$ *Person month*
  - Development Effort: $D_E = a_b(KLOC)^{b_b} = 3.0(22)^{1.12}$ $= 95.64$ person-month
  - Maintenance Effort $M_E = 1.0(0.227) \times 95.64 = 21.71$ person months
  - Maintenance duration $M_D = 1.0(ACT)D_D$ months
  - Development Duration: $D_D = c_b(D_E)^{d_b} = 2.5(95.64)^{0.35}$ $= 12.33$ month
  - Maintenance duration $M_D = 1.0(0.227) \times 12.33 = 2.80$ months
  - Persons involved in a development team $D_N = \frac{D_E}{D_D} = \frac{95.64}{12.33} = 7.75 \equiv 8$ persons
  - Persons involved in a maintenance team $M_N = 1.0(ACT)(\frac{M_E}{M_D})$ *persons*
    $M_N = 1.0(0.227)(\frac{21.71}{2.80}) = 1.76 \equiv 2$ *person*

Software Maintenance (cont.)

- **Embedded mode software**
  - Maintenance Effort $M_E = 1.0(ACT)D_E$ *Person month*
  - Development Effort: $D_E = a_b(KLOC)^{b_b} = 3.6(22)^{1.20}$ $= 146.96$ person-month
  - Maintenance Effort $M_E = 1.0(0.227) \times 146.96 = 33.36$ person months
  - Maintenance duration $M_D = 1.0(ACT)D_D$ months
  - Development Duration: $D_D = c_b(D_E)^{d_b} = 2.5(146.96)^{0.32}$ $= 12.34$ month
  - Maintenance duration $M_D = 1.0(0.227) \times 12.34 = 2.80$ months
  - Persons involved in a development team $D_N = \frac{D_E}{D_D} = \frac{146.96}{12.34} = 11.90 \equiv 12$ persons
  - Persons involved in a maintenance team $M_N = 1.0(ACT)(\frac{M_E}{M_D})$ *persons*
    $M_N = 1.0(0.227)(\frac{33.36}{2.80}) = 2.70 \equiv 3$ *person*

Software Maintenance (cont.)

	Organic Mode Software	Semidetached Mode Software	Embedded Mode Software
Software Development	5	8	12
Software Maintenance	1	2	3

Table: Manpower requirement for the software development and maintenance