Constructive Cost Model
COCOMO

COCOMO

- Boehm [1981] proposed the Constructive Cost Model (known as COCOMO model). The model proposed by him was the result of data analysis of 63 projects .

The data base used included:

- Programms written in various high level languages (like FORTRAN COBOL etc) and assembly level languages.

- program sizes varying from 2 KDSI to 900 KDSI.

- application areas encompassing scientific and business sectors.

COCOMO :COnstructive COst MOdel:

The COCOMO model estimates the overall effort in terms of person month as well as the development time and schedule.

It also breaks down the overall effort into phases and activities and the associated cost for each phase separately.

Software Project Planning

COCOMO applied to

- Organic mode
- Semidetached mode
- Embedded mode
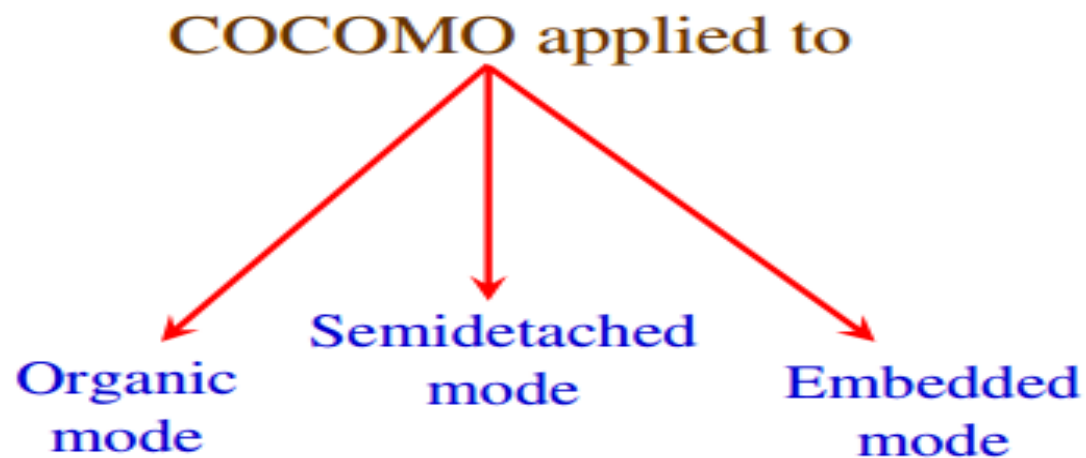
COCOMO Modes

- Development project modes are Organic, Embedded or Semi-detached.

The Organic development mode has the following features

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  - Small and comparatively simple project
  - relaxed delivery requirement
  - stable in-house development environment
  - dependence on other systems are minimal and may run by itself.

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COCOMO Modes

- Development project modes are Organic, Embedded or Semi-detached.

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- The Embedded mode has the following features

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  - Relatively large project and hard timing constraints are to be met

  - Substantial interaction between custom hardware and software

  - Complex user interface design

COCOMO Modes

- Development project modes are Organic, Embedded or Semi-detached.

- The Semi- detached mode is in between the two.

Software Project Planning

Mode	Project size	Nature of Project	Innovation	Deadline of the project	Development Environment
Organic	Typically 2-50 KLOC	Small size project, experienced developers in the familiar environment. For example, pay roll, inventory projects etc.	Little	Not tight	Familiar & In house
Semi detached	Typically 50-300 KLOC	Medium size project, Medium size team, Average previous experience on similar project. For example: Utility systems like compilers, database systems, editors etc.	Medium	Medium	Medium
Embedded	Typically over 300 KLOC	Large project, Real time systems, Complex interfaces, Very little previous experience. For example: ATMs, Air Traffic Control etc.	Significant	Tight	Complex Hardware/ customer Interfaces required

Table 4: The comparison of three COCOMO modes

Levels of COCOMO

- Depending on the details to be incorporated in the cost estimation, the COCOMO model has three levels known as Basic, Intermediate and Detailed.

- In Each of the levels, the nominal development effort (Enom) had been estimated using the relation in the form

$$\text{Enom} = a \cdot S^b$$

Software Project Planning

Basic Model

Basic COCOMO model takes the form

$$E = a_b(KLOC)^{b_b}$$

$$D = c_b(E)^{d_b}$$

where E is effort applied in Person-Months, and D is the development time in months. The coefficients a_b, b_b, c_b and d_b are given in table 4 (a).

Software Project Planning

Table 4a to be learnt by Heart

Software Project	a_b	b_b	c_b	d_b
Organic	2.4	1.05	2.5	0.38
Semidetached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

Table 4(a): Basic COCOMO coefficients

Suppose that a project was estimated to be 400 KLOC. Calculate the effort and development time for each of the three modes i.e., organic, semidetached and embedded.

Solution

The basic COCOMO equation take the form:

$$E = a_b(KLOC)^{b_b}$$

$$D = c_b(KLOC)^{d_b}$$

Estimated size of the project = 400 KLOC

(i) Organic mode

$$E = 2.4(400)^{1.05} = 1295.31 \text{ PM}$$

$$D = 2.5(1295.31)^{0.38} = 38.07 \text{ PM}$$

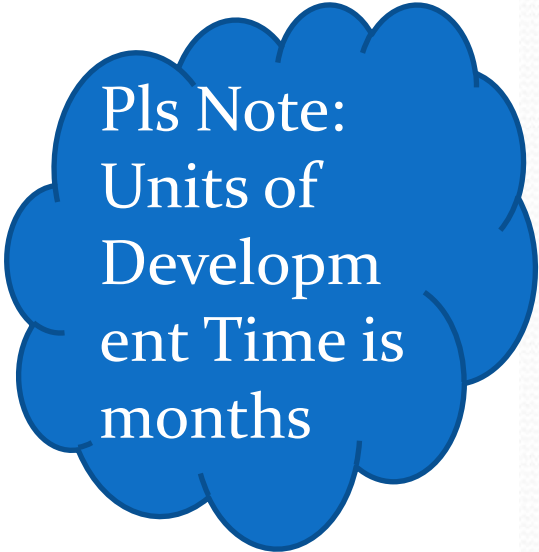Pls Note: Units of Development Time is months

(ii) Semidetached mode

$$E = 3.0(400)^{1.12} = 2462.79 \text{ PM}$$

$$D = 2.5(2462.79)^{0.35} = 38.45 \text{ PM}$$

(iii) Embedded mode

$$E = 3.6(400)^{1.20} = 4772.81 \text{ PM}$$

$$D = 2.5(4772.8)^{0.32} = 38 \text{ PM}$$

Pls Note: Units of Development Time is months

Software Project Planning

When effort and development time are known, the average staff size to complete the project may be calculated as:

$$\text{Average staff size } (SS) = \frac{E}{D} \; Persons$$

When project size is known, the productivity level may be calculated as:

$$\text{Productivity } (P) = \frac{KLOC}{E} \; KLOC \, / \, PM$$

A project size of 200 KLOC is to be developed. Software development team has average experience on similar type of projects. The project schedule is not very tight. Calculate the effort, development time, average staff size and productivity of the project.

Solution

The semi-detached mode is the most appropriate mode; keeping in view the size, schedule and experience of the development team.

Hence $\quad E = 3.0(200)^{1.12} = 1133.12 \text{ PM}$

$$D = 2.5(1133.12)^{0.35} = 29.3 \text{ PM}$$

Average staff size $(SS) = \dfrac{E}{D} \text{ Persons}$

$$= \dfrac{1133.12}{29.3} = 38.67 \text{ Persons}$$