

COCOMO

OR

COCOMO I

OR

COCOMO'81

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COCOMO (CONSTRUCTIVE COST MODEL) was proposed by **Boehm [1981]**. According to him, Software cost estimation should be done through three stages

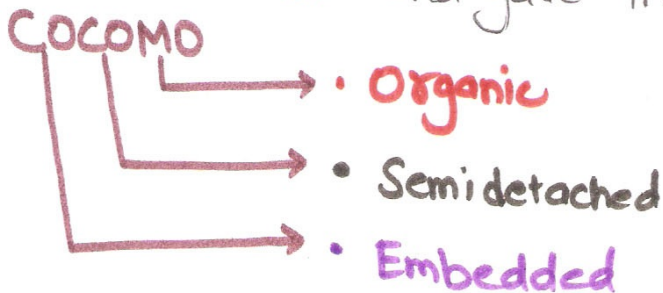
Basic COCOMO

Intermediate COCOMO

Complete COCOMO

Modes of Development:

Boehm proposed that there can be three modes of software development project based on development complexity. He considered software **size, Innovation, Deadline/Constraint and Dev Environment** and gave three modes which were



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Development Mode	Project Characteristics			
	Size	Innovation	Deadline/Constraints	Dev. Environment
Organic	Small	Little	Not Tight	Stable
Semi-Detached	Medium	Medium	Medium	Medium
Embedded	Large	Greater	Tight	Complex hardware/ Customer Interface

Development Modes

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COCOMO models depends on Two Main Equations

1. Development Efforts :

$$MM = a_1 \times (KLOC)^{a_2} PM$$

based on MM - man Month / Person Month (PM) / Staff Month is one month of effort by one person. COCOMO considers 152 hours per person month. It may vary according to organization by 10% to 20%.



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2. Effort and Development Time (TDEV)

$$TDEV = b_1 \times (Effort)^{b_2} \text{ Months}$$

Tdev is the estimated time to develop the software, expressed in months.

a_1, a_2, b_1, b_2 are constants for each category of software products,
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BASIC COCOMO

Basic COCOMO applies the parameterised equation without much detailed consideration of project characteristics.

$$\text{Effort (MM)} = a_1 \times (\text{KLOC})^{a_2} \text{ PM}$$

$$\text{TDev} = b_1 \times (\text{Effort})^{b_2} \text{ Months}$$

$$b_1 = 2.5$$

Basic COCOMO	a_1	a_2	$a_3 (b_2)$
Organic	2.4	1.05	0.38
Semi-Detached	3.0	1.12	0.35
Embedded	3.6	1.20	0.32

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So Estimation of Development Efforts

Organic:

$$= 2.4 (\text{KLOC})^{1.05} \text{ PM}$$

Semi Detached:

$$= 3.0 (\text{KLOC})^{1.12} \text{ PM}$$

Embedded :

$$= 3.6 (\text{KLOC})^{1.20} \text{ PM}$$



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So Estimation of Development Time

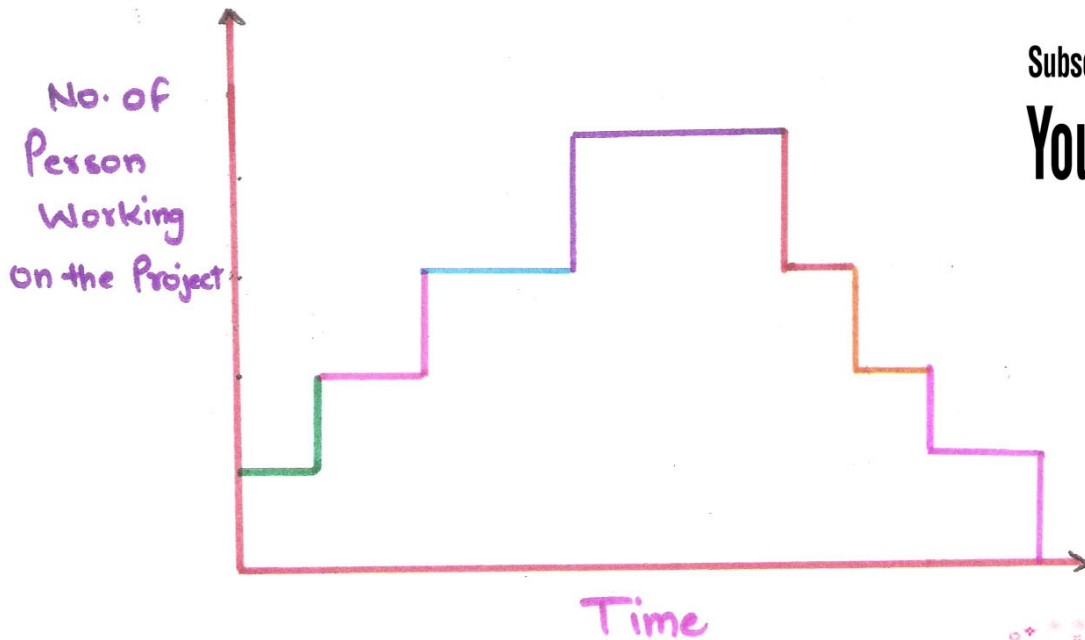
Organic : $2.5 (\text{Effort})^{0.38} \text{ Months}$

Semi detached : $2.5 (\text{Effort})^{0.35} \text{ Months}$

Embedded : $2.5 (\text{Effort})^{0.32} \text{ Months}$

Basic COCOMO : Person-Month Curve

The effort estimation is expressed in units of person-months (PM).
It is the area under the person month plot



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Point to be noted



It should be carefully noted that an effort of 100 PM does not mean that 100 persons should work for 1 month nor does it mean that 1 person should be employed for 100 months, but it denotes the area under person-month curve.

In this curves we see that as project progresses the no. of person working on it get increases and as project reached near to its end the no. of person become decreases. *Role of every person is specific.*

Intermediate COCOMO

The same basic equation for the model is used, but fifteen cost drivers are rated on a scale of 'very low' to 'very high' to calculate the specific effort multipliers and each of them returns an adjustment factor which multiplied yields in the total **EAF** (Effort Adjustment Factor).

Only a_1 is slightly different.

$$MM(\text{Effort}) = a_1 * (KLOC)^{a_2}$$

$$TDev = b_1 * (\text{Effort})^{b_2} \text{ Month}$$

Intermediate COCOMO	a_1	a_2	b_2
Organic	3.2	1.05	0.38
Semi-Detached	3.0	1.12	0.35
Embedded	2.8	1.20	0.32

Man Month Correction is now

$$MM_{KORR} = EAF * MM_{NORMAL}$$



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Advanced or Detailed COCOMO or Complete

Both Basic and Intermediate COCOMO models consider a Software product as a single HOMOGENEOUS ENTITY.

However Most large Systems consist several Sub System in which some may be Organic, some may be Semi-detached and some may be Embedded.

Eg:- A distributed Management Information System (MIS)
Which consists

- Database part
- Graphical User Interface part
- Communication Part



The Communication part can be considered as embedded Software.

The Database part could be - semi-detached Software and GUI part could be Organic.

All of these Cost can be estimated separately, and Summed up to give the overall Cost of the System.

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