

## # Cocomo model

Boehm proposed Cocomo (Constructive cost estimation model) in 1981. Cocomo is one of the most generally used S/W estimation model in the world. Cocomo predicts the efforts and schedule for a project based on the size of the S/W.

The necessary steps in this model are:-

1. Get an initial estimation/estimate of the development efforts from evaluation of thousands of delivered lines of source code (KLOC)
2. Determine a set of 15 multiplying factors from various attributes of the project.
3. Calculate the efforts by multiplying the initial estimate with all the multiplying factors i.e; multiply the values in step 1 & step 2.

The initial estimate (also called nominal estimation) is determined by an Equation of the form used in the Static Single variable model, using KLOC as the measure of size. To determine the initial efforts  $E_i$  in person-months the equation is used.

$$E_i = a * (KLOC)^b$$

In Cocomo projects are determined categorized in three types.

1. Organic
2. Semidetached
3. Embedded.



Organic: A S/W project is said to be an organic type ~~type~~ if the team size measured is adequately small, the problem is well understood and has ~~been~~ been solved in the past and also the team members have a nominal experience regarding the problem.

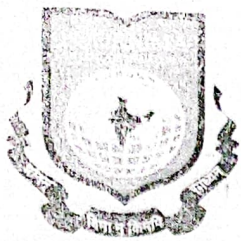
Semi-detached: A S/W project is said to be semi-detached type if the vital characteristics such as team size, experience and knowledge of the ~~specific~~ various programming environment are in b/w that of organic and Embedded. The project classified as semi-detached are comparatively less familiar and difficult to develop compared to the organic ones and require more experience and better guidance and ~~creativity~~ creativity. eg Compilers or different Embedded systems can be considered semi-detached types.

Embedded: A S/W project requiring the highest level of ~~complexity~~ complexity, creativity and experience requirement fall under this category. Such software requires a larger <sup>team</sup> size than the other 2 models and also the developers need to be sufficient experience and creative to develop such complex model.

→ ~~There are~~ According to Boehm Cost estimation is done in 3 stages

- 1) Basic model
- 2) Intermediate model
- 3) Detailed model.





⇒ Basic Model: The basic cocomo model provides an accurate size of the project parameters. The following expression gives basic cocomo estimation model:

(Development Time)  $D$  ←  $E = a(KLOC)^b$  → ~~for finding staff~~  
→  $E = \text{Efforts}$   
→ Average staff size =  $\frac{E}{D}$   
→ Productivity =  $\frac{KLOC}{E}$   
→  $\text{time} = c(Effort)^d$   
→ Person required =  $\text{Efforts} / \text{time}$

The above formulas are used for cost estimation in cocomo model and also used in the subsequent models. ~~the ca~~

→ the constant values for  $a, b, c, d$  for basic model for different categories of system

S/w Project	a	b	c	d
organic	2.4	1.05	2.5	0.38
Semi-detached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

eg:- Suppose a project was estimated to 300 KLOC. Calculate Efforts and development time/cd each of the 3 model i.e organic, Semi-detached & Embedded.



⇒ organic

$$E = a(KLOC)^b \\ = 2.4(300)^{1.05} = 957.609 \text{ pm}$$

$$D = C(E_{\text{faults}})^d \\ = 2.5(957.609)^{0.38} = 33.94 \text{ pm}$$

⇒ Semidetached model:

$$E = 3.0(300)^{1.12} = 1784.41$$

$$D = 2.5(1784.41)^{0.35} = 34.35$$

⇒ Embedded Model:

$$E = 3.6(300)^{1.20} = 3379.46$$

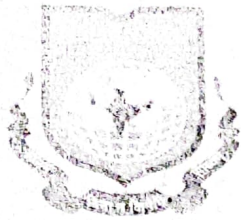
$$D = 2.5(3379.46)^{0.32} = 33.66$$

### Intermediate Model:

Intermediate COCOMO model is an extension of Basic COCOMO model which include a set of cost drivers into account in order to enhance model accuracy. The cost estimation model as a result. The estimation model makes a use of set of cost scheduled time are given by relationship.

$$\begin{aligned} E_{\text{faults}}(E) &= a * (KLOC)^b * EAF \\ D &= C * (E_{\text{faults}})^d \end{aligned}$$





$E$  = total Efforts required for project in month.  
KLOC - The size of the code for the project in  
Kilolines of code  
 $ab$  = The ~~size~~ constant parameters for S/W  
Project.

EAF: It is an Effort Adjustment factor  
which is calculated by multiplying the  
parameters values of different cost  
driver parameters for ideal the values.

### Classification of Cost Drivers and their attributes

#### → Product attributes

- Required S/W Reliability extent (RELY)
- Size of the application database (DATA)
- The complexity of the product (CPLEX)

#### → Hardware attributes

- Run time Performance constraints (TIME)
- Memory constraints (STOR)
- The Volatility of the virtual machine environment (VIRT)
- Required ~~turn~~ turnaround time (TURN)

#### → Personal attributes

- Analyst capability (ACAP)
- Software Engineering capability (AEXP)
- Application experience (PCAP)
- Virtual Machine experience (VEXP)
- Programming language experience (LEXP)



## → Project Attributes

• Use of S/W tools (MODP)

- Application of S/W Engineering methods (Tool)
- Required development schedule. (SCED)

\* ~~date given in question~~

All attribute values are given in form of very low to Extra High.

→ very low, low, nominal High very high & Extra high

Eg: For a given project was estimated with a size of 300 Kloc. Calculate the Efforts, Scheduled time for development by considering developer high application experience & very low experience in programming.

## Solution

Given = Kloc = 300

Developer high <sup>application</sup> experience = ~~0.82~~ 0.82

Developer Low <sup>programming</sup> ~~application~~ experience = 1.14

EAF = Multiplication of given attributes experience

$$= 0.82 \times 1.14$$

$$= 0.9348$$

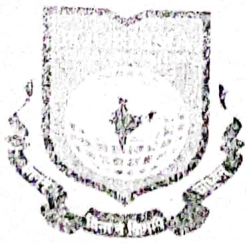
$$\text{Efforts} = a(\text{Kloc})^{1.2} \times \text{EAF}$$

$$= 3.0(300)^{1.2} \times 0.9348$$

$$= 1668.07$$

Rough

0.9348



# POORNIMA

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### DETAILED LECTURE NOTES

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$$\text{Schedule time (D)} - C(E)^d =$$

$$= 2.5(1668.07)^{0.35} = 33.55 \text{ Months (M)}$$

⇒ Detailed / Advanced COCOMO model