COCOMO Model

OR

COCOMO-1 Model

OR

COCOMO' 81 Model

COCOMO(constructive COst MOdel) what purpose by **"Boehm[1981]"**. According to him, software cost estimation should be done through three stages.

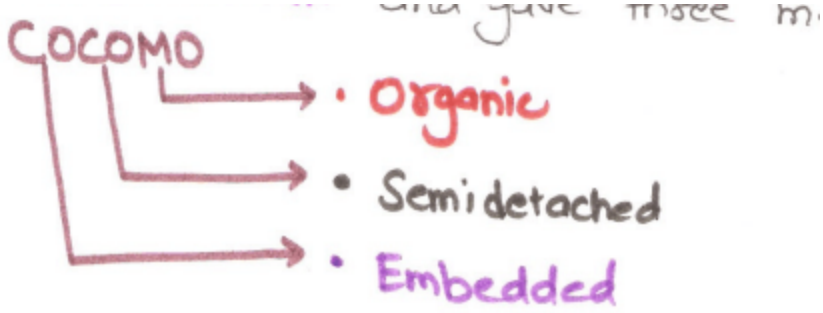
Basic COCOMO,

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 deadline and development environment and gave three modes which were

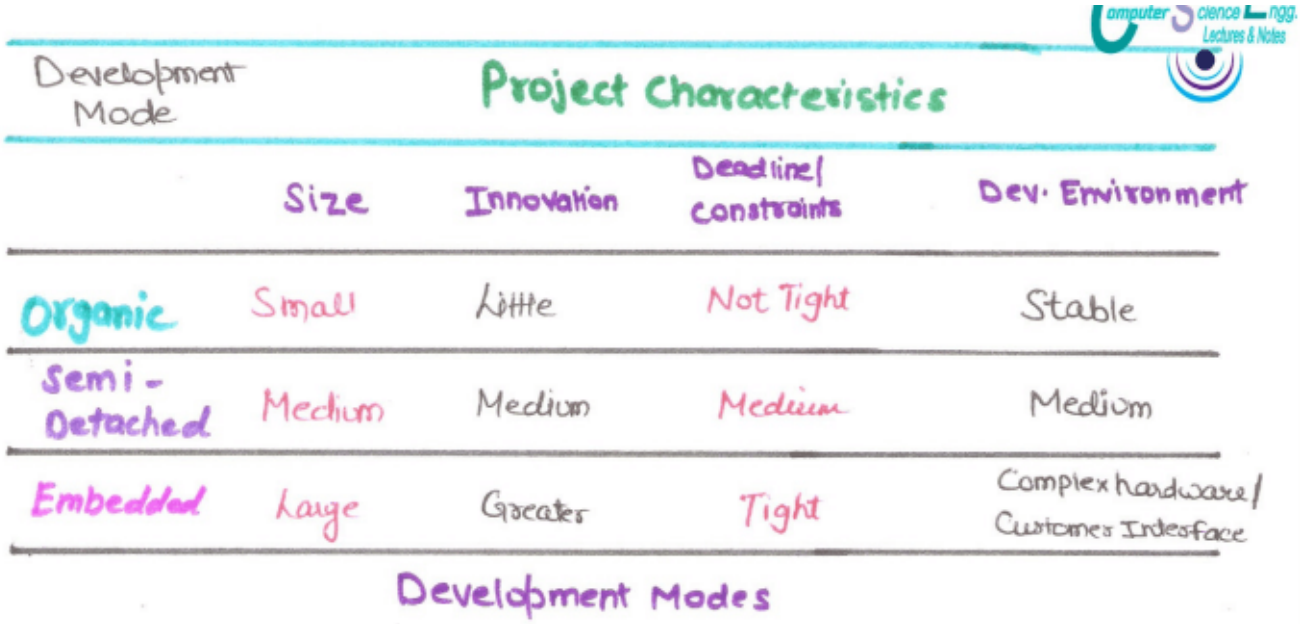


1.Organic: A development project can be treated of the organic type, if the project deals with developing a well-understood application program, the size of the development team is reasonably small, and the team members are experienced in

developing similar methods of projects. **Examples of this type of projects are simple business systems, simple inventory management systems, and data processing systems.**

2. Semidetached: A development project can be treated with semidetached type if the development consists of a mixture of experienced and inexperienced staff. Team members may have finite experience in related systems but may be unfamiliar with some aspects of the order being developed. **Example of Semidetached system includes developing a new operating system (OS), a Database Management System (DBMS), and complex inventory management system.**

3. Embedded: A development project is treated to be of an embedded type, if the software being developed is strongly coupled to complex hardware, or if the stringent regulations on the operational method exist. **For Example:** ATM, Air Traffic control.



COCOMO model depends on two main equations:

1. Development Efforts:

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

MM=a1*(KLOC)a2*PM

Based onMM- man month (MM)/ person month(PM)/ staff month is one month of efforts by one person. COCOMO consider 152 hours per person month. It may vary according to organization by 10% to 20%.

KLOC is the estimated size of the software product indicate in Kilo Lines of Code

2. Effort and Development Time(TDEV)

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

TDEV=Bb1*(effort)b2*Months

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

a1,a2,b1,b2 are constant for each category of software products,

Effort is the total effort required to develop the software product, expressed in **person months (PMs)**.

Basic COCOMO

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

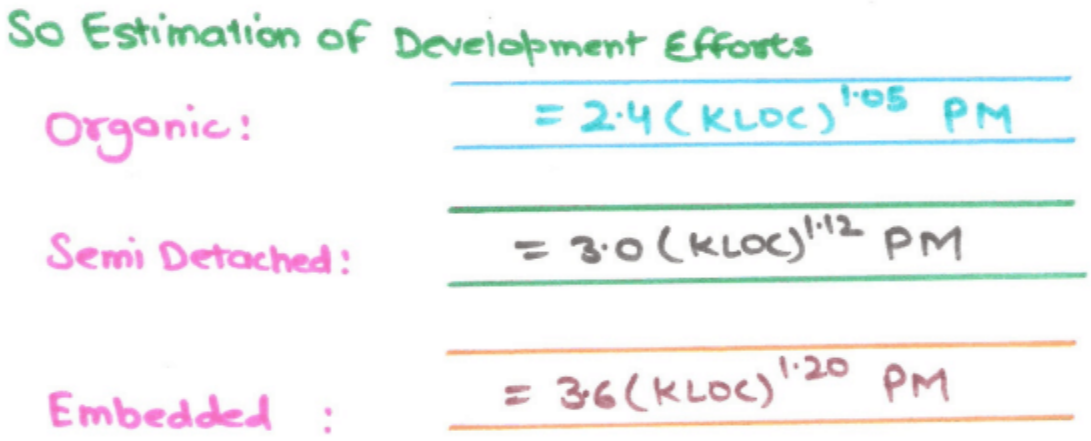
$$Effort(MM) = a_1 \times (KLOC)^{a_2} PM$$

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

$b_1 = 2.5$

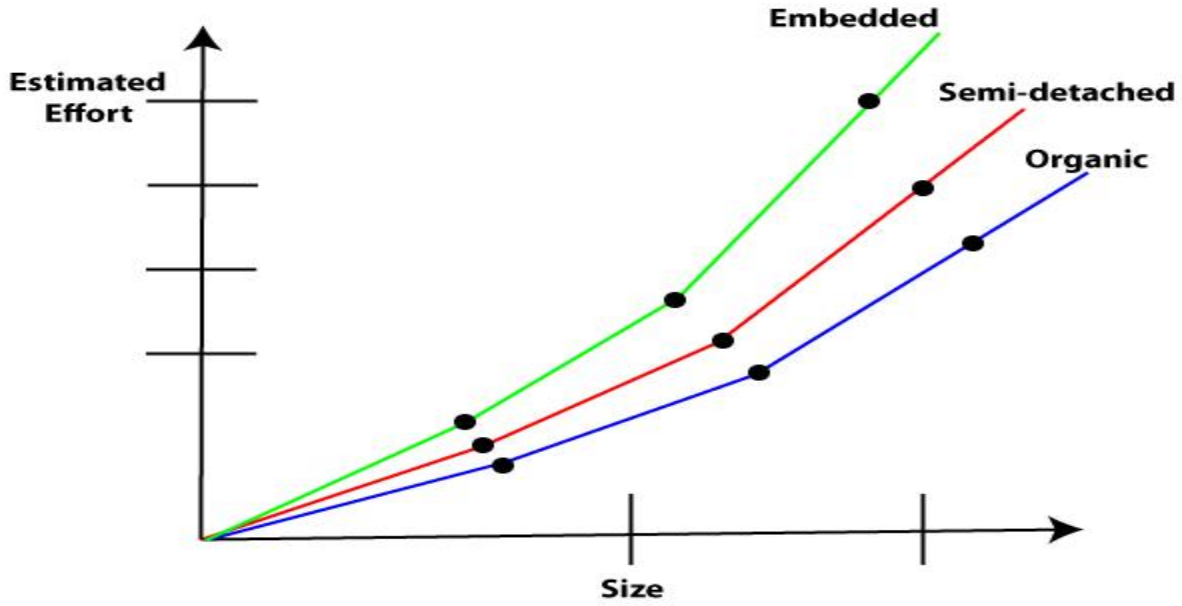
Basic COCOMO	a_1	a_2	$a_3(b_2)$
Organic	2.4	1.05	0.38
Semi-Detached	3.0	1.12	0.35
Embedded	3.6	1.20	0.32

So estimation development Efforts



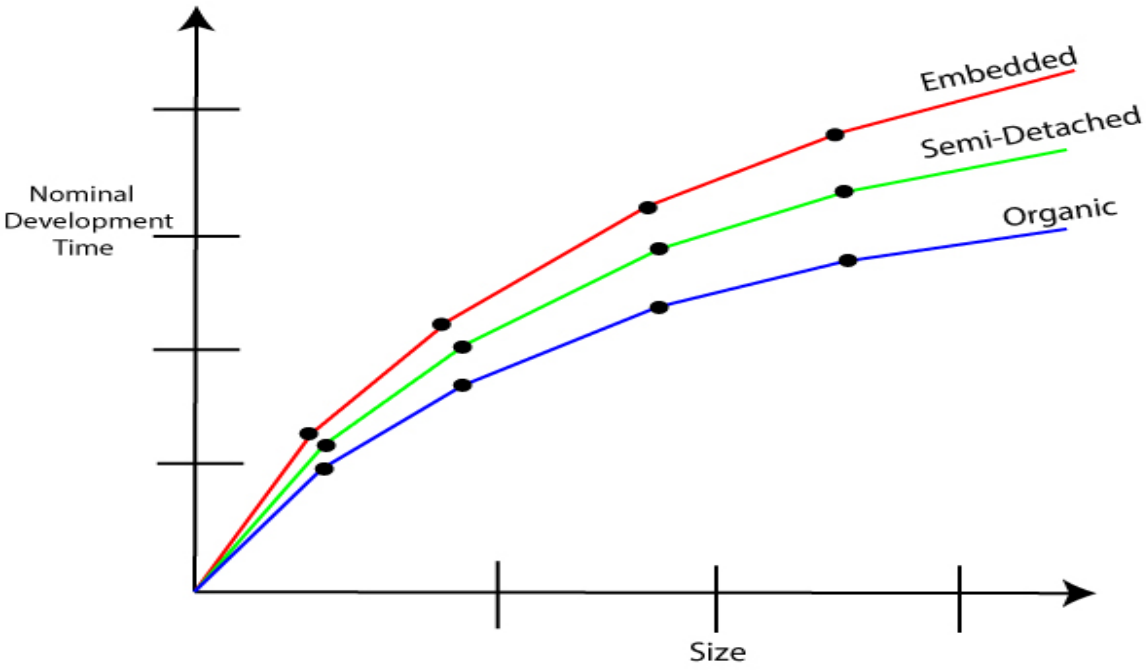
so estimation of Development Time

Some insight into the basic COCOMO model can be obtained by plotting the estimated characteristics for different software sizes. Fig shows a plot of estimated effort versus product size. From fig, we can observe that the effort is somewhat superliner in the size of the software product. Thus, the effort required to develop a product increases very rapidly with project size.



Effort versus product size

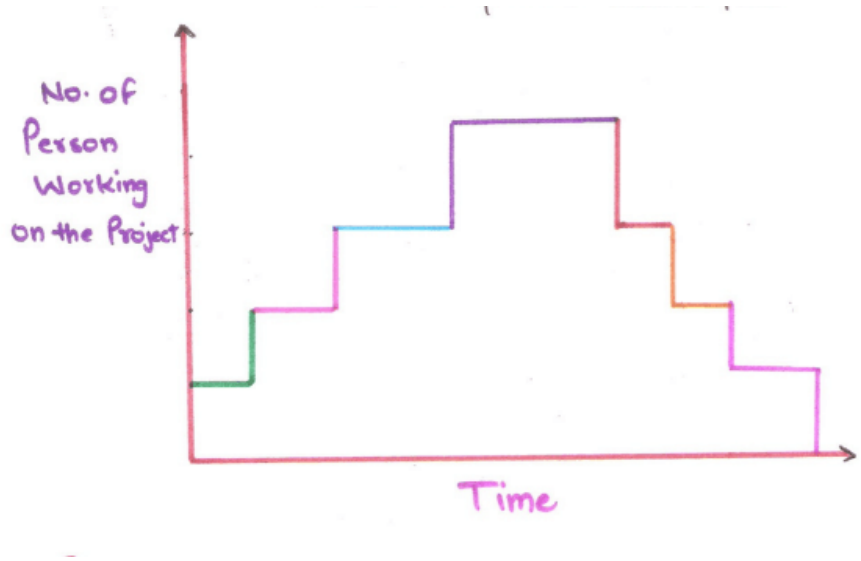
The development time versus the product size in KLOC is plotted in fig. From fig it can be observed that the development time is a sub linear function of the size of the product, i.e. when the size of the product increases by two times, the time to develop the product does not double but rises moderately. This can be explained by the fact that for larger products, a larger number of activities which can be carried out concurrently can be identified. The parallel activities can be carried out simultaneously by the engineers. This reduces the time to complete the project. Further, from fig, it can be observed that the development time is roughly the same for all three categories of products. For example, a 60 KLOC program can be developed in approximately 18 months, regardless of whether it is of organic, semidetached, or embedded type.



Development time versus size

Basic COCOMO:Person-month curve

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



Points to be noted:

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

In this curves we see that as project progresses the number of person working on it get increases and as project reached near to its end the number of person become decreases. Because role of every person is specific.

Example1: Suppose a project was estimated to be 400 KLOC. Calculate the effort and development time for each of the three model i.e., organic, semi-detached & embedded.

Solution: The basic COCOMO equation takes the form:

Effort=a_1*(KLOC) a_2 PM

Tdev=b_1*(efforts)b_2 Months

Estimated Size of project= 400 KLOC

(i)Organic Mode

E = 2.4 * (400)1.05 = 1295.31 PM

D = 2.5 * (1295.31)0.38=38.07 PM

(ii)Semidetached Mode

E = 3.0 * (400)1.12=2462.79 PM

D = 2.5 * (2462.79)0.35=38.45 PM

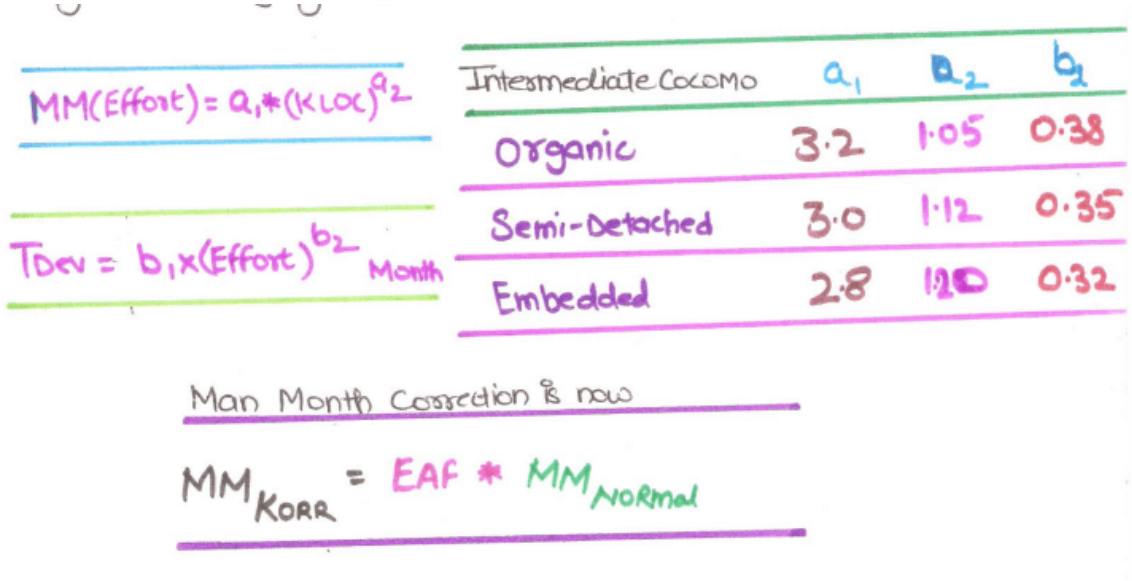
(iii) Embedded Mode

E = 3.6 * (400)1.20 = 4772.81 PM

D = 2.5 * (4772.8)0.32 = 38 PM

Intermediate COCOMO

The same basic equation for the model is used, but fifteen cost drivers are related on a scale of ' very low' to ' very high' to calculate the specific effort multiplier and each of them returns an adjustment factor which multiplied yields in in the total EAF (Efforts Adjustment factor). Only a1 is slightly different.



Advanced or Detailed or Complete COCOMO

Both Basic and Intermediate COCOMO model consider a software product as a single HOMOGENEOUS entity. However most large systems consist several sub-system in which some maybe organic, some may be semi-detached and some maybe Embedded.

Example a Distributed Management Information system(MIS) Which consists

Database path,

graphical user interface part,

communication part.

The communication can be considered as embedded software. The Database part could be semi-detached software and GUI part could be organic.

All of three cost can be estimated separately, and summed up to give the overall cost of the system.