

Experiment no : 2

Date: 15-10-21

Aim:- Using COCOMO Model estimate effort.

Procedure:-

The Cocomo model uses a multivariable size estimation model for effort estimation

size is measured in KLOC (thousand delivered lines of code) per person-month (PM). The constants  $a$  and  $b$  are derived from historical data of past projects  
cocomo estimation is a family of hierarchical models which include

1. Basic COCOMO Model
2. Intermediate COCOMO Model
3. Detailed COCOMO Model.

Basic Cocomo Model:

$$\text{Development effort (E)} = a \times (\text{KLOC})^b$$

Let us consider the size (total) of modules is 7 KLOC

Online data entry - 1.0 KLOC

Data update - 2.0 KLOC

file Input and Output - 1.5 KLOC

$$\begin{aligned} \text{Development time (T)} &= C \times (E)^{0.38} = 2.5 \times (24.6889) \\ &= \underline{8.4546 \text{ months}} \end{aligned}$$

The values of  $a$  and  $b$  in the COCOMO model vary across three categories of projects: organic, semidetached and embedded

Project category	$a$	$b$
organic	3.2	1.05
semi detached	3.0	1.12
Embedded	2.8	1.20

Organic projects are very simple and can be developed with a small size team

Embedded projects are very complex and have stringent constraints

semidetached projects are intermediate in size and complexity

$$\text{Development time } (T) = C \times (E)^d$$

The  $c, d$  for organic, semidetached and embedded-type projects are given by

Project category	$c$	$d$
Organic	2.5	0.38
semi detached	2.5	0.35
Embedded	2.5	0.32



## COST DRIVERS AND THEIR VALUES

Cost drivers	Ratings					
	very low	low	Nominal	High	Very high	extra high
Product attributes						
software reliability (RELY)	0.75	0.88	1.00	1.15	1.40	-
size of database (DATA)	-	0.94	1.00	1.08	1.16	-
product complexity (CPLX)	0.76	0.85	1.00	1.15	1.30	1.65
Hardware attributes						
Runtime performance constraints (TIME)	-	-	1.00	1.11	1.30	1.66
Memory storage constraints (STORE)	-	-	1.00	1.06	1.21	1.56
virtual machine volatility (VIRT)	-	0.87	1.00	1.15	1.30	-
Required turnabout time (TURN)	-		1.00	1.07	1.15	-
Personnel attributes						
Analyst capability (ACAP)	1.46	1.19	1.00	0.86	0.71	-
Applications experience (AEXP)	1.29	1.13	1.00	0.91	0.82	-
Programmer capability (PCAP)	1.42	1.17	1.00	0.86	0.70	-
virtual machine experience (VEXP)	1.21	1.10	1.00	0.90	-	-
programming language experience (LEXp)	1.14	1.07	1.00	0.95	-	-
Project attributes						
Modern programming practices (MODP)	1.24	1.10	1.00	0.91	0.82	-
use of software tools (TOOL)	1.24	1.10	1.00	0.91	0.83	-
development schedule (SCHED)	1.23	1.08	1.00	1.04	1.10	-

Library reports - 2.0 KLOC

Query and search - 0.5 KLOC

Total size - 7.0 KLOC

It comes under Organic projects, Examples of this type of projects are simple business systems, simple inventory management systems

$$\begin{aligned} \text{Development effort} &= a \times (\text{KLOC})^b \\ &= 3.2 \times (7)^{1.05} \\ &= \underline{\underline{24.6889 \text{ PM}}} \end{aligned}$$

Intermediate COCOMO Model:-

$$[E_i] \quad \text{Initial effort} = a \times (\text{KLOC})^b$$

EAF - effort adjustment factors

$$\text{EAF} = \text{EAF}_1 \times \text{EAF}_2 \times \dots \times \text{EAF}_n$$

$$\text{Initial effort} = 3.2 \times (7)^{1.05} = 24.6889 \text{ PM}$$

$$\begin{aligned} \text{EAF} &= 1.15 \times 1.00 \times 0.7 \times 1.00 \times 1.21 \times 1.00 \times 1.00 \\ &\quad \times 1.00 \times 1.00 \times 1.00 \times 1.10 \times 1.07 \times 1.00 \times \\ &\quad \quad \quad 1.00 \times 1.00 \\ &= 1.0422 \end{aligned}$$

$$\begin{aligned} \text{(E) Total effort} &= E_i \times \text{EAF} \\ &= 24.6889 \times 1.0422 \\ &= \underline{\underline{25.7307 \text{ PM}}} \end{aligned}$$

$$\text{Development time} = C \times (E)^d = 8.4546 \text{ months}$$



# PHASE - WISE DISTRIBUTION OF THE DEVELOPMENT EFFORT AND TIME

Project type and size	plan and requirement	System design	detailed design	code and unit test	Integration and Test
Percentage-wise distribution effort					
Organic (2KLOC)	6	16	26	42	16
Organic (32KLOC)	6	16	24	38	22
Semidetached (32KLOC)	7	17	25	33	25
Semidetached (128KLOC)	7	17	24	31	28
Embedded (128KLOC)	8	18	25	26	31
Embedded (320 KLOC)	8	18	24	24	34
percentage-wise distribution of development time					
Organic (2KLOC)	10	19	24	39	18
Organic (32KLOC)	12	19	21	34	26
Semidetached (32KLOC)	20	26	21	27	26
Semidetached (128KLOC)	22	27	19	25	29
Embedded (128KLOC)	36	36	18	18	28
Embedded (320KLOC)	40	38	16	16	30

## Detailed COCOMO Model:-

The total estimated effort (E) = 25.7307 PM

The total size = 7 KLOC

The phase-wise development effort =

$$\text{plan and requirement (\%)} = \frac{6 + (6-6) / (32-2)}{7} \times 7 = 6\%$$

$$\text{Effort} = 0.06 \times 25.7307 \text{ PM} = 1.5438 \text{ PM}$$

$$\text{system design} = \frac{16 + (16-16) / (32-2)}{7} \times 7 = 16\%$$

$$\text{Effort} = 0.16 \times 25.7307 = 4.116912 \text{ PM}$$

$$\text{Detailed design} = \frac{24 + (26-24) / (32-2)}{7} \times 7 = 25\%$$

$$\text{Effort} = 0.25 \times 25.7307 \text{ PM} = 6.4327 \text{ PM}$$

$$\text{code and unit test} = \frac{38 + (42-38) / (32-2)}{7} \times 7 = 39\%$$

$$\text{Effort} = 0.39 \times 25.7307 \text{ PM} = 10.0350$$

$$\text{Integration and test} = \frac{22 + (16-22) / (32-2)}{7} \times 7 = 24\%$$

$$= 0.24 \times 25.7307 = 6.1754$$

$$\text{Development time (T)} = 2.5 \times (E)^{0.38} \text{ months} = 8.4546 \text{ months}$$

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## FAQ'S :-

- ① Why do we need effort estimation?
- ② What are the disadvantages of using COCOMO for effort estimation?
- ③ What is the difference between COCOMO and function point?
- ④ What is the unit for effort estimation in COCOMO?
- ⑤ How is the intermediate COCOMO Model different from the basic COCOMO Model?