Experiment No 2 Date 15.10.2021

Aim :- Using COCOMO Model Estimate the effort for Library Management System.

COCOMO MODEL

COCOMO is the Algorithmic Cost and Effort Estimation technique which works in bottom-up manner. A Single variable model is based only upon the size of the project.

$$\text{Effort} = a \times \text{Size}^b$$

Size is measured in terms of KLOC (thousand lines of code per person month (PM).

Where a and b are constants.

We can have different categories like organic, Semidetached and Embedded.

Where organic projects are very simple and can be developed within small team size, Embedded projects are very complex and have stringent constraints, semidetached projects are intermediate in size and complexity.

There are three types of COCOMO Model

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

Effort Estimation using Basic COCOMO Model

The values of a and b constants.

project category	a	b
Organic	3.5	1.02
Semidetached	2.8	1.23
Embedded	2.5	1.31

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

Development time (T) = $c \times (E)^d$

The values of c and d Constants.

project category	c	d
Organic	2.2	0.36
Semidetached	2.2	0.28
Embedded	2.2	0.26

We have a system for Library Management System, planned to be developed and it's Estimated Size is approximately 5.7kilo lines of code.

Size

1. login/ sign up – 0.8 KLOC
2. Search / reserve a book – 0.9 KLOC
3. Book transactions – 1 KLOC

4. Maintain Inventory – 1.2 KLOC
5. Report Generation – 0.8 KLOC
6. Account Maintainance – 1 KLOC

Development or Estimated Size = 5.7 KLOC

Development Effort (E) = $2.8 \times (5.7)^{1.23} = 23.816$ PM

Development time (T) = $2.2 \times (23.816)^{0.28}$

$= 5.344$ months

$\approx 5\frac{1}{2}$ months.

Estimating Effort using Intermediate COCOMO Model.

This model determines the Effort and time on the basis of project size. And there are also certain factors termed as Effort Adjustment factors (EAF). The EAF is calculated as the product of 15 cost drivers. finally the total Effort is determined by multiplying the initial Effort with the total value of EAF

Development Effort (E):

Initial Effort (E_i) = $a \times (KLOC)^b$

$EAF = EAF_1 \times EAF_2 \times \cdots \times EAF_n$

Total development effort (E) = $E_i \times EAF$

Development time (T) = $C \times (E)^d$.

Intermediate COCOMO MODEL.

Cost drivers	Ratings					
	Very low	low	Nominal	High	Very high	Extra high
product attributes						
Software reliability (RELY)	0.73	0.85	0.8	1.0	1.2	–
Size of database (DATA)	–	0.92	0.8	0.8	1.0	–
product Complexity (CPLX)	0.5	0.6	0.8	1.0	1.1	1.5
Hardware attributes						
Runtime performance Constraints (TIME)	–	–	0.8	1.3	1.6	1.8
Memory storage Constraints (STORE)	–	–	1.2	1.3	1.5	1.7
Virtual machine volatality (VIRT)	–	1.0	1.2	1.3	1.6	–
Required turnabout (TIME)	–	1.0	1.2	1.2	1.3	–
personnel attributes						
Analyst Capability (ACAP)	1.4	1.2	0.9	0.8	0.6	–
Applications Experience (AEXP)	1.2	1.0	0.8	0.7	0.8	–
Programmer Capability (PCAP)	1.4	1.2	1.1	0.8	0.7	–
Virtual Machine Experience (VEXP)	1.1	1.0	0.8	0.7	–	–

programming language Experience (LEXP)	1.2	1.0	0.93	0.85	-	-
project attributes						
Modern programming practices (MODP)	1.3	1.2	1.0	0.8	0.7	-
Use of Software tools (TOOL)	1.3	1.24	1.0	0.8	0.72	-
Development Schedule (SCHED)	1.27	1.06	1.0	1.1	1.2	-

Initial Effort $(E_i) = 3.5 \times (5.7)^{1.23}$

$E_i = 23.816$ PM

$EAF = EAF_1 \times EAF_2 \times EAF_3 \times \cdots \times EAF_n$

The library management system has nominal reliability, high product complexity, high runtime performance, High memory storage, low virtual machine volatality, nominal required turnabout time, all the remaining cost drivers are assumed to be nominal.

$EAF = 0.8 \times 1.0 \times 1.3 \times 1.3 \times 1.0 \times 1.2 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1$

$= 1.6224$

Total development Effort $(E) = E_i \times EAF = 23.816 \times 1.6224 = 38.639$ PM

Development Time $(T) = c \times (E)^d = 2.2 \times (38.639)^{0.28} = 6$ months

Effort Calculation (or) Estimation using detailed COCOMO Model.

Project type and size	Plan & Requirement	System design	Detailed Design	Code & unit test	Integration & test.
percentage-wise distribution of the development effort					
Organic (3 KLOC)	5	14	28	44	18
Organic (34 KLOC)	5	14	26	36	20
Semidetached (34 KLOC)	6	15	27	32	24
Semidetached (130 KLOC)	6	15	26	30	26
Embedded (130 KLOC)	7	17	27	28	30
Embedded (322 KLOC)	7	17	26	26	32
percentage-wise distribution for development time					
Organic (3 KLOC)	12	18	24	36	18
Organic (34 KLOC)	14	18	20	32	24
Semidetached (34 KLOC)	20	24	20	26	24
Semidetached (130 KLOC)	24	26	18	24	30
Embedded (130 KLOC)	38	34	16	16	26
Embedded (322 KLOC)	42	36	14	14	30

Total Size = 5.7 KLOC which is between 3 and 34 KLOC.
The actual percentage of Effort can be calculated as follows.

- plan and requirement (%) = 5 + (5-5)/(34-3) x 5.7
  = 5%.

Estimated Effort = 38.63 PM Effort = 1.9315 PM

- System design = 14 + (14-14)/(34-3) x 5.7
  = 14%.

  Effort = 0.14 x 38.63 PM = 5.4082 PM
- Detailed design = 26 + (28-26)/(34-3) x 5.7
  = 26%.

  Effort = 0.26 x 38.63 PM = 10.2931 PM
- Code and unit test = 36 + (44-36)/(34-3) x 5.7
  = 37%.

  Effort = 0.37 x 38.63 PM = 14.2931 PM.
- Integration and test = 20 + (18-20)/(34-3) x 5.7
  = 20%.

  Effort = 0.2 x 38.63 PM = 7.726 PM

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