Cost Estimation Techniques.

COCOMO Model.

*) Different parameters of a project that need to be estimated include
- Project size
- Effort required to complete the project
- Project Duration and
- Cost

*) Accurate estimation of these parameters is important for resource planning & scheduling. Estimation techniques can be classified as
- Empirical Estimation Technique
- Heuristic " "
- Analytical " "

Empirical Estimation (EE)

*) EE techniques are based on making an educated guess of the project parameters and common sense.

*) This technique is based on prior experience of development of similar products & projects

*) An educated guess based on past experience.

*) Two popular empirical estimation techniques are
→ Expert judgment Technique
→ Delphi cost Estimation

Expert judgment Technique.

*) In this an expert makes an educated guess of the problem size after analyzing the problem thoroughly.

*) The expert estimates the cost of different components of the system e.g. GUI, database module, communication module, billing module. etc.

*) Combines them to arrive at the overall estimate.

Delphi Cost Estimation

*) Is carried out by a team comprising of a group of experts and a co-ordinator.

*) The co-ordinator provides each estimator with a copy of the SRS documents & a form for recording his cost estimate

*) Estimators complete the ~~technique~~ individual ~~expert judgment~~ estimates anonymously & submit to the co-ordinator

Heuristic Techniques.

*) In this the relationship that exists among different project parameters can ~~be~~ modeled using suitable mathematical expression.

*) Once the independent parameters are known, the dependent parameters can be easily determined by substituting the values of the independent parameters in the current corresponding mathematical Expressions.

*) assume that the characteristics to be estimated can be expressed in terms in terms of some mathematical Expressions can be classified as single variable & multivariable models.

*) Example of single variable cost estimation is Basic CoComo model.

Basic Cocomo (Constructive cost Model)

*) It was first proposed by Dr. Barry Boehm in 1981.

*) Is a Heuristic Estimation technique - this techniques assumes that relationship among different parameters can be modeled using some mathematical expression.

*) This approach implies that size is primary factors have for cost, other factor have lesser effect.

*) Constructive implies that the complexity

*) This approach implies that site is primary factor for cost, Other factor have lesser effect.

*) CoComo prescribes a three stage process for project estimation.

*) An initial estimation is obtained; and over next two stages the initial estimate is redefined to arrive at a more accurate estimate.

*) Projects used in this model have following attributes

→ Range in Size from 2000, to 100,000 lines of code

→ Programming language ranging from Assembly to PI/I.

→ These projects were based on waterfall model of S/w development.

*) According to Both Boehm, any S/w development project can be classified into three categories.

    1. Organic

-) The Size of development is reasonably small & experienced.

-) The team members are experienced with developing similar kind of projects.

Mode	Project Size	Nature of project	Innovation	Deadline	Development Environment
Organic	2-50 KLOC	Small Size, experienced developer e.g:- payroll, inventory	little	Not tight	Familiar in house.
Semi detached	Typically 50-300 KLOC	Medium Size, Avg Previous Experience on similar project e.g. Utility Systems like Compilers, DBMS, editors etc	Medium	Medium	Medium
Embedded	Over 300 KLOC	Large Project, Real time, Systems, Complex interface, very little previous Experience e.g. ATMs, Air traffic control etc..	Significant	Tight	Complex h/w custom on interface rea.

*) The effort estimation is expressed in units of person-months (PM)

Person month is a measurement in s/w engineering. 1 person month means effort put by a person in one month. But 100 person month does not mean effort put by 100 person in one month. As requirement of

Staff varies time to time in the development. So there is no constant no of people is there to work. It is the graph of no. of people working & time.

First Version : CoComo 81.

According to Boehm, s/w cost estimation should be done through three stage.

1) → Basic CoComo
2) → Intermediate CoComo
3) → Complete CoComo.

Basic CoComo

It computes s/w development effort, time & cost as a function of program size. program size is expressed in estimated thousands lines of code. (Slock, Kloc)

$$\text{Effort } E = a_1 * (KLoc)^{a_2} \quad PM$$
$$T_{dev} = b_1 * (Effort)^{b_2} \quad months.$$

where Coefficients a_1, a_2, b_1, b_2 are constants for each category of s/w projects.

*) T_{dev} - is the estimated development Time of s/w in month

*) Effort is the total effort required to develop the s/w in Person month

Effort Estimation

Organic : C

Organic : Effort = $2.4 (Kloc)^{1.05}$ PM

Semi-detached : Effort = $3.0 (Kloc)^{1.12}$ PM

Embedded : Effort = $3.6 (Kloc)^{1.20}$ PM

Development Time Estimation

Organic : $Tdev = 2.5 (Effort)^{0.38}$ months

Semi-detached : $Tdev = 2.5 (Effort)^{0.35}$ months

Embedded : $Tdev = 2.5 (Effort)^{0.32}$ months

S/w Projects	a_1	a_2	b_1	b_2
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

e.g :- Consider a S/w Project using Semi-detached mode with 30,000 lines of code. Find the total effort, Time Duration & no. of person Required to Complete the project.

Sol^n)   30,000 → 30 (K)

Effort E = a_1 * (Kloc)^{a_2}

= 3.0 * (30)$^{1.12}$ = 135 PM.

Tdev = b_1 * (E)^{b_2}

= 2.5 * (135)$^{.35}$ = 14 Month.

No. of Person   N = E/D ≐ 135/14 = 10 Approximately.

→ Average Staff Size (SS)

Productivity   P = $\dfrac{Kloc}{E}$ Kloc/PM.

= $\dfrac{30}{135}$

eg.   ~~Suppose a project was estimated to be 200 Kloc. Calculate the effort & development time for each~~

e.g. 2   A project Size of 200 Kloc is to be developed. S/w development team has average experience on similar type of projects; The project schedule is not very tight. Calculate the effort, development-time, average staff size & productivity of the project.

Sol^n)   Project is Semi detached mode as it is 200 Kloc

$\cdot E = 3.0 \, (200)^{1.12} = 1133.12 \text{ PM}$

$D = 2.5 \, (1133.12)^{.35} = 29.30 \text{ M}$

Average Staff Size (SS) $= E/D = \dfrac{1133.12}{29.30} = 38.67$ Persons.

Productivity (P) $= \dfrac{Kloc}{E} = \dfrac{200}{1133.12} = .1765 \, Kloc/PM$

$P = 176 \quad loc/PM$