COCOMO MODEL

Boehm proposed COCOMO (Constructive Cost Estimation Model) in 1981.COCOMO is one of the most generally used software estimation models in the world. COCOMO predicts the efforts and schedule of a software product based on the size of the software.

- The COCOMO model is an empirical model.
- The COCOMO model was derived by collecting data from a large no. of software-projects.
- These data were analysed to discover formulae that were the best fit to the observations.
- These formulae link the size of the system/product, project/team factors to the effort to develop the system.
- COCOMO model is popular for following reasons:
    1) It is well documented.
    2) It is available in the public domain.
    3) It is supported by public domain and commercial tools.
    4) It has been widely used & evaluated in a range of organisations.
- Here 2 models are considered: i) COCOMO-81 & ii) COCOMO-II

1) COCOMO-81

- COCOMO 81 was the first version of the COCOMO model.
- COCOMO 81 was a three-level model.
- Here, the levels corresponded to the detail of the analysis of the cost-estimate.
    1) The first level (basic) provided an initial rough estimate.
    2) The second level modified this using a number of project and process multipliers.
    3) The most detailed level produced estimates for different phases of the project.

Project complexity	Formula	Description
Simple	$PM = 2.4\ (KDSI)^{1.05} \times M$	Well-understood applications developed by small teams
Moderate	$PM = 3.0\ (KDSI)^{1.12} \times M$	More complex projects where team members may have limited experience of related systems
Embedded	$PM = 3.6\ (KDSI)^{1.20} \times M$	Complex projects where the software is part of a strongly coupled complex of hardware, software, regulations and operational procedures

Figure 26.6 The basic COCOMO 81 model

where multiplier M reflects product, project and team characteristics.

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

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

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

Estimation of development time

For the three classes of software products, the formulas for estimating the development time based on the effort are given below:

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

PROBLEMS

1. 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=$a*(KLOC)^{b}$ PM
Tdev=$c*(efforts)^{d}$ 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

$E=3.6*(400)^{1.2}=4772.81$ PM

$D = 2.5 * (4772.8)^{0.32} = 38$ PM

Example 2: A project size of 200 KLOC is to be developed. Software 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, and productivity of the project.

Solution: The semidetached mode is the most appropriate mode, keeping in view the size, schedule and experience of development time.

Hence $E=3.0(200)^{1.12}=1133.12$PM
$D=2.5(1133.12)^{0.35}=29.3$PM

$$\text{Average Staff Size (SS)} = \frac{E}{D} \text{ Persons}$$

$$= \frac{1133.12}{29.3} = 38.67 \text{ Persons}$$

$$\text{Productivity} = \frac{KLOC}{E} = \frac{200}{1133.12} = 0.1765 \text{ KLOC/PM}$$

2) COCOMO-II

- COCOMO II model recognizes different approaches to software development such as
  - → prototyping
  - → development by component composition and
  - → use of database programming.
- COCOMO II supports a spiral model of development.
- COCOMO II embeds several sub-models that produce increasingly detailed estimates.
- These sub-models can be used in successive rounds of the development spiral.

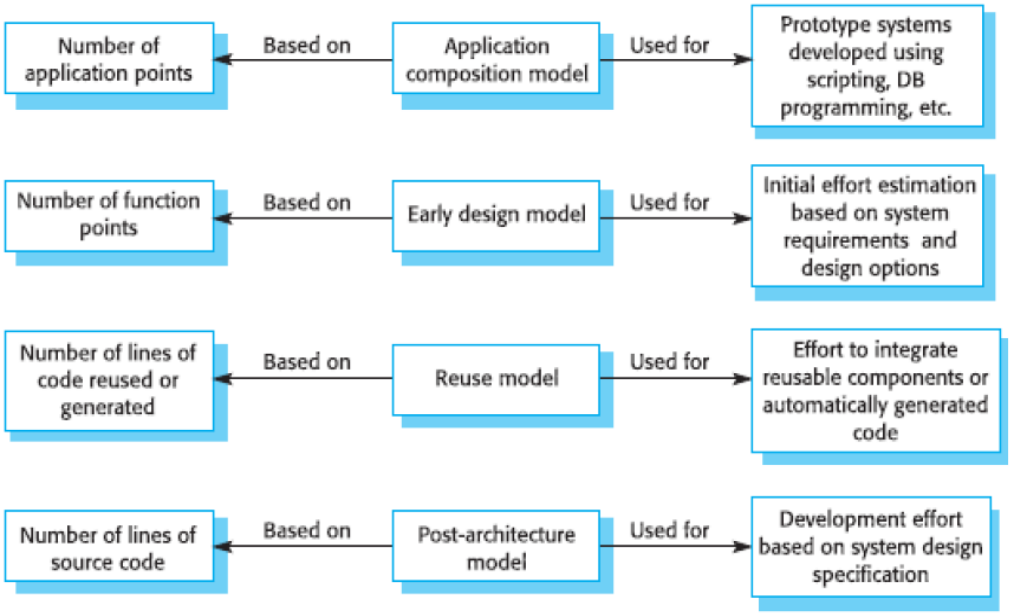

Figure 26.7 The COCOMO II models