SOEN 6841 Software Project Management
Winter 2025
Chapter 3 Exercise
Amanpreet Kaur (40301892)

3.2 Describe the COCOMO technique for deriving effort and cost estimates for software projects?

Answer:

COCOMO (COnstructive COst MOdel) is a widely used technique for estimating the effort and cost of software development projects. It provides a realistic way to estimate the resources required for software development based on project characteristics. COCOMO was introduced by Barry Boehm in 1981 and has three variations: Basic, Intermediate, and Detailed.

- **Basic COCOMO:**

  Basic COCOMO is the simplest version, used for rough estimates in the early stages of project planning. It provides a high-level estimation of effort and cost without considering detailed project attributes. The estimation is based on the size of the software, measured in **Kilo Lines of Code (KLOC)**, and categorized into three modes of development:

  - **Organic**: Small teams working on well-understood projects (e.g., payroll system).
  - **Semi-Detached**: Projects with a mix of experienced and inexperienced developers (e.g., a database management system).
  - **Embedded**: Complex, real-time, hardware-software integrated projects (e.g., aircraft control systems).

  Formula for Basic COCOMO:

  $$\text{Effort} = 2.94 \times \text{EAF} \times \text{KLOC}^{E}$$
  $$\text{Duration} = \text{Effort}^{SE}$$

  where:
  EAF = Effort Adjustment Factor (Default is 1 in Basic COCOMO).
  KLOC = Size of the project in Kilo Lines of Code.
  E and **SE** are exponents derived from scale drivers.

  Example

  Consider a payroll management system estimated to be **50 KLOC**. Assuming it falls under the **organic** category:

  $$\text{Effort} = 2.94 \times 1 \times 50^{1.05} = 2.94 \times 57.87 = 170.15 \text{ Person-Months}$$
  $$\text{Duration} = 170.15^{0.38} = 10.3 \text{ Months}$$

This means that about **170 person-months** of effort will be required, and the project may take around **10 months** to complete.

- **Intermediate COCOMO:**

  Intermediate COCOMO refines the Basic COCOMO model by considering **cost drivers** that impact software development. These cost drivers are divided into **four categories**:

  - **Product Attributes**: Complexity, required reliability, database size, etc.
  - **Hardware Attributes**: Execution time constraints, memory requirements, etc.
  - **Personnel Attributes**: Experience level, programming capability, etc.
  - **Project Attributes**: Development tools, schedule constraints, etc.

  Each attribute is assigned a weight (0.7 to 1.7), which affects the estimation.

Formula for Intermediate COCOMO:

$$\text{Effort} = a \times EAF \times KLOC^{E}$$

Where:

a and **E** depend on the type of software project (Organic, Semi-Detached, Embedded).

EAF is the calculated effort adjustment factor based on cost drivers.

Example

For a database management system (semi-detached), assume:

KLOC = 100

Cost drivers (EAF) = 1.2 (after adjusting for complexity and team experience)

a = 3.0, E = 1.12

$$\text{Effort} = 3.0 \times 1.2 \times 100^{1.12} = 3.0 \times 1.2 \times 132 = 475.2 \text{ Person-Months}$$

This shows that the effort required will be **475 person-months**, considering project-specific cost drivers.

- **Detailed COCOMO**

  Detailed COCOMO extends Intermediate COCOMO by applying cost driver analysis to **each phase** of software development (e.g., requirements, design, coding, testing). This results in more precise effort estimation per phase.

- Used during project development, unlike Basic and Intermediate COCOMO, which estimate the entire project.
- Breaks down effort estimation phase-wise, ensuring better resource allocation.
- More suited for large-scale or long-duration projects.

Example:

For an automobile control system (embedded project, 200 KLOC):

Effort for Design Phase = 35% of total effort
Effort for Coding Phase = 40% of total effort
Effort for Testing Phase = 25% of total effort

If the total estimated effort from Intermediate COCOMO is **800 person-months**, we can distribute effort per phase:

Design Phase Effort = 280 person-months
Coding Phase Effort = 320 person-months
Testing Phase Effort = 200 person-months

By selecting the appropriate **COCOMO model**, project managers can make realistic software effort and cost estimations, ensuring smooth project execution.