Department of Computer Engineering

Academic Term: First Term 2023-24

Class: T.E /Computer Sem – V / Software Engineering

Practical No:	5
Title:	**Estimating project cost using COCOMO Model**
Date of Performance:	
Roll No:	9567, 9552
Team Members:	Shruti Patil, Mrunal Kotambkar

Rubrics for Evaluation:

Sr. No	Performance Indicator	Excellent	Good	Below Average	Total Score
1	On time Completion & Submission (01)	01 (On Time)	NA	00 (Not on Time)	
2	Theory Understanding(02)	02(Correct)	NA	01 (Tried)	
3	Content Quality (03)	03(All used)	02 (Partial)	01(rarely followed)	
4	Post Lab Questions (04)	04(done well)	3 (Partially Correct)	2(submitted)	

Signature of the Teacher:

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COST ESTIMATION USING COCOMO MODEL

Description The table for constants for Basic COCOMO model is as follows

Software Product	A_b	B_b	C_b	D_b
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

Cost Drivers	RATINGS					
	Very low	Low	Nominal	High	Very high	Extra high
Personnel Attributes						
ACAP	1.46	1.19	1.00	0.86	0.71	..
AEXP	1.29	1.13	1.00	0.91	0.82	-
PCAP	1.42	1.17	1.00	0.86	0.70	-
VEXP	1.21	1.10	1.00	0.90	..	..
LEXP	1.14	1.07	1.00	0.95	-	-
Project Attributes						
MODP	1.24	1.10	1.00	0.91	0.82	-
TOOL	1.24	1.10	1.00	0.91	0.83	-
SCED	1.23	1.08	1.00	1.04	1.10	-

Figure 6. Ratings for cost drivers under personnel attributes and project attributes

Cost Drivers	RATINGS					
	Very low	Low	Nominal	High	Very High	Extra High
Product Attributes						
RELY	0.75	0.88	1.00	1.15	1.40	..
DATA	..	0.94	1.00	1.08	1.16	..
CPLX	0.70	0.85	1.00	1.15	1.30	1.65
Computer Attributes						
TIME	..	..	1.00	1.11	1.30	1.66
STOR	..	..	1.00	1.06	1.21	1.56
VIRT	..	0.87	1.00	1.15	1.30	..
TURN	..	0.87	1.00	1.07	1.15	..

Figure 6. Ratings for cost drivers under product attributes and computer attributes

The Function Point for Online Resource Sharing System is 95
LOC per Function Point =63 (Java and Average)
LOC =95 x 63 =5,985
KLOC=5,985/1000 =5.985 6
Considering the case study as organic the values are as follows a=2.4,b=1.05,c=2.5, d=0.38

BASIC COCOMO

Calculations:
1) Effort
E=a*(KLOC)^b
E=2.4*(6)^1.05
E=15.75 PM

2) Time
Time=c*(Effort)^d
Time=2.5*(15.75)^0.38
Time=7.13 M

3) Person Required
Person Required=Effort/Time
=15.75/7.13
Person Required=2.21 2 persons

4) Productivity=KLOC/Effort =6/15.75= 0.38 KLOC/PM
INTERMEDIATE COCOMO

Product Attributes:

RELY-1.40
DATA-1.16
CPLX-1.00

Computer Attributes:
TIME-1.66
STOR-1.21
VIRT-1.00
TURN-1.07

Personnel Attributes:
ACAP-0.86
AEXP-0.91
PCAP-0.86
VEXP-1.21
LEXP-0.95

Product Attributes:
MODP- 0.91
TOOL-0.91
SCED-1.10

EAF is the multiplication of all the above attributes
EAF=2.46

Calculations:
1)Effort
E=a*(KLOC)^b x (EAF)
E=2.4*(6)^1.05 x 2.46
E=38.74 PM

2)Time
Time=c*(Effort)^d
Time=2.5*(38.74)^0.38
Time=10.03 M

3)Person Required
Person Required=Effort/Time
=38.74/10.03
Person Required=3.86 4 persons
4) Productivity=KLOC/Effort =6/38.74= 0.15 KLOC/PM

DETAILED COCOMO

1)Lifecycle Phase Values of pg **(Phase wise effort distribution)**

Plan and Requirements:0.06 x 38.74=2.32 PM

System Design:0.16 x 38.74=6.198 PM

Detailed Design:0.26 x 38.74=10.07 PM

Module Code and Test:0.38 x 38.74=14.72 PM

Integration and Test:0.22 x 38.74=8.52 PM

Overall Effort=41.828 PM

2)Lifecycle **Phase** Values of zg **(Phase** wise development time **duration)**

Plan and Requirements:0.1 x 10.03=1.0 M

System Design:0.19 x 10.03=1.91 M

Detailed Design:0.24 x 10.03=2.41 M

Module Code and Test:0.39x 10.03=3.91 M

Integration and Test:0.18 x 10.03=1.81M

Overall Development Time=11.04 M

3)Person Required

Person Required=Effort/Time

=41.828/11.04

Person Required=3.79 = 4 persons

4)Productivity=KLOC/Effort =6/41.818= 0.14 KLOC/PM

POSTLAB:

Analyse the COCOMO model and its different modes (Organic, Semi-detached, Embedded) to determine the most suitable mode for a specific project type.

The COCOMO (COnstructive COst MOdel) is a widely used software cost estimation model that

helps project managers and software developers predict the effort, time, and cost required to develop a software project. COCOMO was first introduced by Barry W. Boehm in the late 1970s and has since evolved into several versions. The three primary modes of COCOMO are Organic, Semi-detached, and Embedded. Let's analyze these modes and discuss how to determine the most suitable mode for a specific project type.

Organic Mode:

Characteristics: Suitable for relatively small, simple software projects with well-understood requirements. These projects typically have a small team of experienced developers.

Key Factors: Low complexity, familiar technology, a stable environment, and clear and well-understood requirements.

COCOMO Equation: E = a * (KLOC)^b, where 'a' and 'b' are mode-specific constants, and KLOC is the estimated size of the software in thousands of lines of code.

Suitable Project Types: Projects like personal websites, small mobile apps, or simple desktop applications with limited complexity.

Semi-detached Mode:

Characteristics: Suitable for moderately sized projects that fall between Organic and Embedded in terms of complexity and size.

Key Factors: Moderate complexity, moderate use of new technology, and a mix of experienced and inexperienced team members.

COCOMO Equation: E = a * (KLOC)^b, with different 'a' and 'b' values compared to the Organic mode.

Suitable Project Types: Projects like mid-sized web applications or mobile apps with moderate complexity and a mix of known and new technologies.

Embedded Mode:

Characteristics: Appropriate for large, complex projects with a high degree of novelty, often seen in mission-critical systems.

Key Factors: High complexity, extensive use of new technology, a challenging or changing environment, and a large team of experienced and inexperienced developers.

COCOMO Equation: E = a * (KLOC)^b, with different 'a' and 'b' values compared to the other

two modes.

Suitable Project Types: Large-scale enterprise software, aerospace systems, complex ERP systems, and other mission-critical applications with significant complexity and technology challenges.

To determine the most suitable mode for a specific project type, you should consider the following factors:

Project Size: Estimate the size of the project in terms of lines of code or function points. Larger projects are more likely to require the Semi-detached or Embedded mode.

Complexity: Assess the complexity of the project, including the technology used, the novelty of the project, and the stability of the requirements. More complex projects are better suited to the Embedded mode.

Team Experience: Evaluate the experience and skill levels of the development team. If the team is mostly inexperienced, it might be more suitable for the Organic mode, whereas a mix of experienced and inexperienced developers may indicate the Semi-detached mode.

Environmental Factors: Consider the stability of the project environment and the level of support available. Projects in unstable or changing environments may require the Embedded mode.

Risk Tolerance: Assess the criticality of the project. Mission-critical projects with low risk tolerance may lean toward the Embedded mode.

In practice, COCOMO is often used as a starting point for cost estimation, and adjustments are made based on specific project characteristics. It's essential to remember that COCOMO provides an estimate, and the final choice of mode should be made with a full understanding of the project's unique attributes and constraints.

Evaluate the factors influencing COCOMO estimates, such as project size, personnel capabilities, and development tools, and their implications on project planning and scheduling.

COCOMO (COnstructive COst MOdel) estimates for software projects are influenced by various factors, including project size, personnel capabilities, and development tools. Understanding these factors and their implications on project planning and scheduling is crucial for effective project management. Here's an evaluation of each of these factors:

1. Project Size:
    - Influence on COCOMO Estimates: Project size, typically measured in lines of

code (LOC) or function points, is a fundamental factor in COCOMO. Larger projects require more effort and time for development and are associated with higher costs.
    - Implications on Project Planning and Scheduling:
        - Resource Allocation: Larger projects demand a more extensive allocation of resources (personnel, time, and budget). Project managers must plan for sufficient resources to meet the size-related demands.
        - Phased Development: Large projects may be broken down into smaller phases or modules, with distinct schedules and milestones, to manage complexity and dependencies effectively.
2. Personnel Capabilities:
    - Influence on COCOMO Estimates: The experience and skill levels of the development team significantly influence COCOMO estimates. Experienced and highly skilled teams can be more efficient and may require less effort for a given task.
    - Implications on Project Planning and Scheduling:
        - Resource Skill Matching: Project managers should assign tasks to team members based on their capabilities, leveraging the strengths of experienced team members for complex or critical components.
        - Training and Onboarding: If the team lacks necessary skills, time and budget may need to be allocated for training and onboarding of personnel.
3. Development Tools:
    - Influence on COCOMO Estimates: The choice of development tools and technology can impact productivity and development speed. Efficient, well-established tools may lead to faster development.
    - Implications on Project Planning and Scheduling:
        - Tool Selection: Choose tools and technologies that align with the project's requirements and the team's familiarity. Efficient tools can expedite development.
        - Tool Integration: Ensure seamless integration of tools into the development environment to minimize potential bottlenecks and disruptions.
4. Complexity and Novelty:
    - Influence on COCOMO Estimates: Highly complex projects or those involving novel technologies are associated with increased risk and uncertainty, which can lead to higher effort and costs.
    - Implications on Project Planning and Scheduling:
        - Risk Assessment: Project managers must conduct thorough risk assessments for complex and novel aspects of the project and allocate time and resources to address potential challenges.
        - Milestone Planning: Plan milestones and checkpoints to monitor progress and address issues related to complexity and novelty.
5. Environmental Factors:
    - Influence on COCOMO Estimates: Factors like project stability, requirements

volatility, and external dependencies can impact project estimates. Unstable environments can lead to increased effort and schedule overruns.
    - Implications on Project Planning and Scheduling:
        - Change Management: Develop change control procedures to manage evolving requirements and external dependencies.
        - Contingency Planning: Allocate contingency time and resources for dealing with potential disruptions in unstable environments.
6. Project Management and Oversight:
    - Influence on COCOMO Estimates: Effective project management, including proper planning, monitoring, and control, can positively influence project outcomes.
    - Implications on Project Planning and Scheduling:
        - Project Governance: Implement robust project governance, regular reporting, and effective communication to maintain control over the project's progress and costs.
        - Continuous Improvement: Periodically evaluate and adjust project plans based on actual progress and performance data.