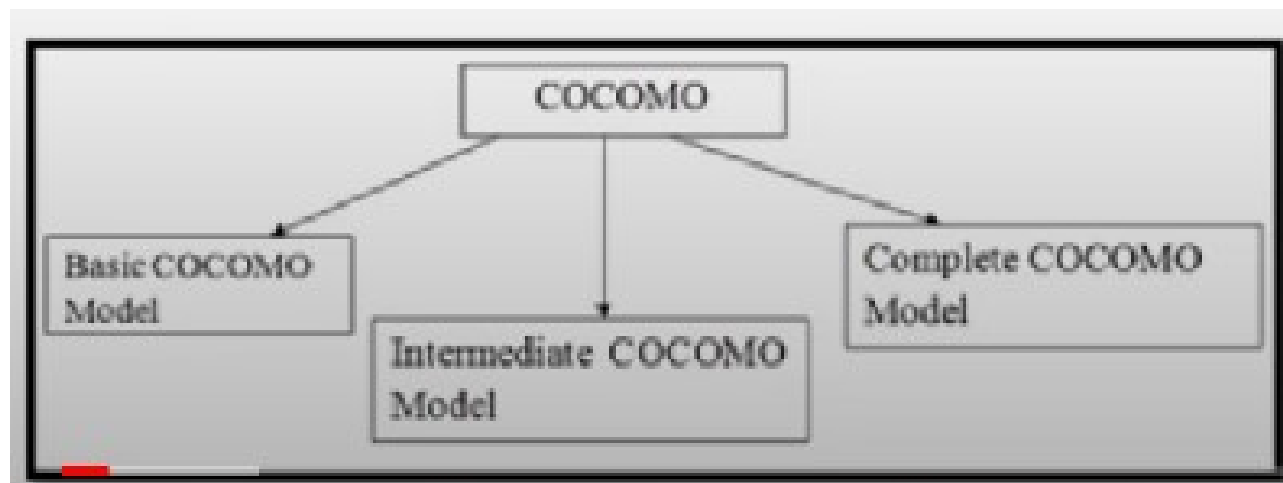


Software Engineering

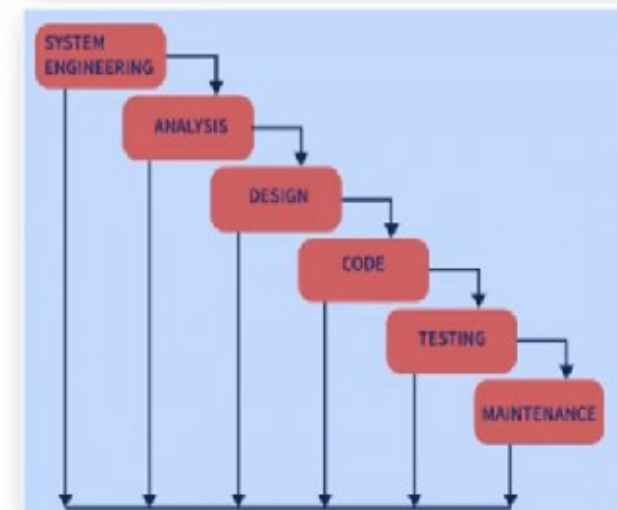
COCOMO Model

(Complete Explanation with Solved Examples)



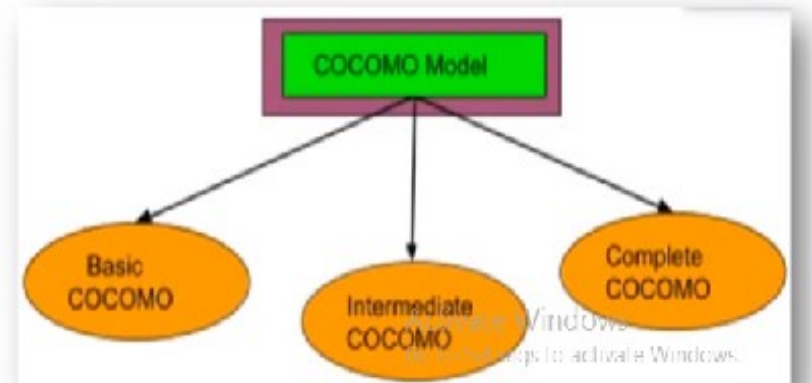
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3. Types of COCOMO Model with Examples
4. Advantages of COCOMO Model
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About COCOMO Model

- It was developed by a scientist Barry Boehm in 1981.
- The COCOMO (**Constructive Cost Model**) is one of the most popularly used software cost estimation models.
- This model depends on the size means number of lines of code for software product development.
- It estimates Effort required for project, Total project cost & Scheduled time of project.

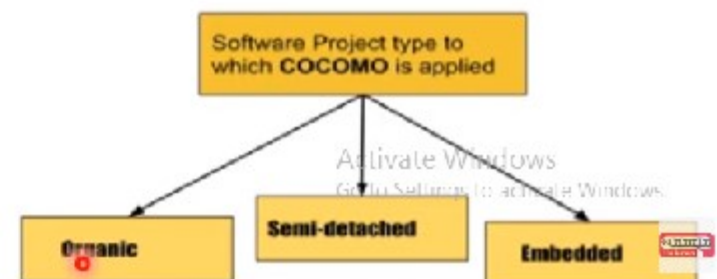


Software Project Types

In COCOMO, projects are categorized into three types:

1. Organic Type:

- Project is small and simple. (2-50 KLOC)
- Few Requirements of projects.
- Project team is small with prior experience.
- The problem is well understood and has been solved in the past.
- **Examples:** Simple Inventory Management Systems & Data Processing Systems.



Software Project Types

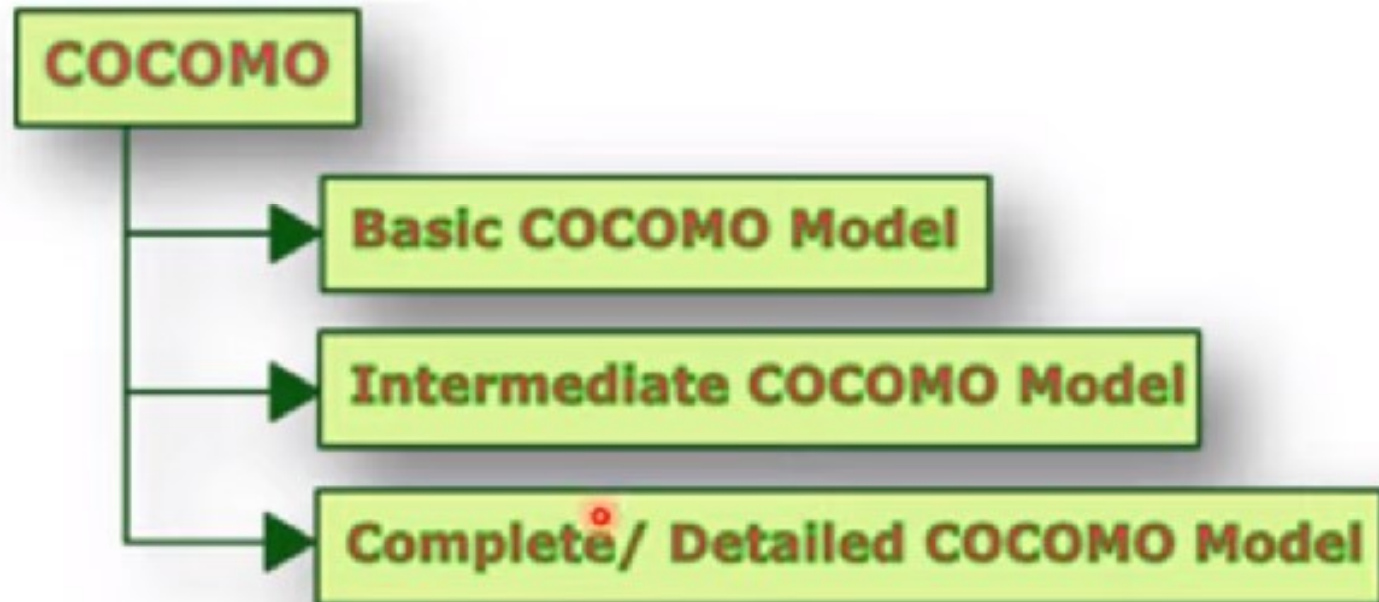
2. Semidetached Type:

- Medium size and has mixed rigid requirements. (50-300 KLOC)
- Project has Complexity not too high & low.
- Both experienced and inexperienced members in Project Team.
- Project are few known and few unknown modules.
- **Examples:** Database Management System, Difficult inventory management system.

3. Embedded Type:

- Large project with fixed requirements of resources. (More than 300 KLOC)
- Larger team size with little previous experience.
- Highest level of complexity, creativity and experience requirement.
- **Examples:** ATM, Air Traffic control, Banking software.

Types of COCOMO Model



Type 1: Basic COCOMO Model

- It is type of static model to estimates software development effort quickly and roughly.
- It mainly deals with the number of lines of code in project.

Formula:

Effort (E) = $a * (KLOC)^b$ MM

Scheduled Time (D) = $c * (E)^d$ Months(M)

Where,

- **E** = Total effort required for the project in Man-Months (MM).
- **D** = Total time required for project development in Months (M).
- **KLOC** = The size of the code for the project in Kilo lines of code.
- **a, b, c, d** = The constant parameters for a software project.

PROJECT TYPE	a	b	c	d
Organic	2.4	1.05	2.5	0.38
Semidetached	3	1.12	2.5	0.35
Embedded	3.6	1.2	2.5	0.32

Type 1: Basic COCOMO Model Example

□ Problem Statement:

➤ Consider a software project using semi-detached mode with 300 Kloc.

Find out Effort estimation, Development time and Person estimation.

□ Solution:

Effort (E) = $a * (KLOC)^b$ = $3.0 * (300)^{1.12}$ = 1784.42 PM

Development Time (D) = $c(E)^d$ = $2.5(1784.42)^{0.35}$ = 34.35 Months(M)

Person Required (P) = E/D = $1784.42/34.35$ = 51.9481 Persons ~52 Persons

PROJECT TYPE	a	b	c	d
Organic	2.4	1.05	2.5	0.38
Semidetached	3.0	1.12	2.5	0.35
Embedded	3.6	1.2	2.5	0.32

Type 2: Intermediate COCOMO Model

- Extension of Basic COCOMO model which enhance more accuracy to cost estimation model result.
- It include cost drivers (Product, Hardware, Resource & project Parameter) of project.

Formula:

Effort (E) = $a * (KLOC)^b * \underline{EAF}$ MM

Scheduled Time (D) = $c * (E)^d$ Months(M)

PROJECT TYPE	a	b	c	d
Organic	2.4	1.05	2.5	0.38
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Type 2: Intermediate COCOMO Model

- **EAF: Effort Adjustment Factor**, which is calculated by multiplying the parameter values of different cost driver parameters. For ideal, the value is 1.

COST DRIVERS PARAMETERS	VERY LOW	LOW	NOMINAL	HIGH	VERY HIGH
Product Parameter					
Required Software	0.75	0.88	1	1.15	1.4
Size of Project Database	NA	0.94		1.08	1.16
Complexity of The Project	0.7	0.95		1.15	1.3

Hardware Parameter					
Performance Restriction	NA	NA	1	1.11	1.3
Memory Restriction	NA	NA		1.06	1.21
virtual Machine Environment	NA	0.87		1.15	1.3
Required Turnabout Time	NA	0.94		1.07	1.15

Personnel Parameter					
Analysis Capability	1.46	1.19	1	0.86	0.71
Application Experience	1.29	1.13		0.91	0.82
Software Engineer Capability	1.42	1.17		0.86	0.7
Virtual Machine Experience	1.21	1.1		0.9	NA
Programming Experience	1.14	1.07		0.95	NA

Project Parameter					
Software Engineering Methods	1.24	1.1	1	0.91	0.82
Use of Software Tools	1.24	1.1		0.91	0.83
Development Time	1.23	1.08		0.91	0.82

Activate Windows
Go to Settings to activate Windows.

Type 2: Intermediate COCOMO Model Example

Problem Statement:

- For a given Semidetached project was estimated with a size of 300 KLOC. Calculate the Effort, Scheduled time for development by considering developer having high application experience and very low experience in programming.

Solution:

$$EAF = 0.82 * 1.14 = 0.9348$$

$$\text{Effort (E)} = a * (\text{KLOC})^b * EAF = 3.0 * (300)^{1.12} * 0.9348 = 1668.07 \text{ MM}$$

$$\text{Scheduled Time (D)} = c * (E)^d = 2.5 * (1668.07)^{0.35} = 33.55 \text{ Months(M)}$$

PROJECT TYPE	a	b	c	d
Organic	2.4	1.05	2.5	0.30
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Software Engineer Capability	1.42	1.12		0.86	0.7
Virtual Machine Experience	1.21	1.1		0.9	NA
Programming Experience	1.34	1.09		0.85	NA

Type 3: Detailed / Complete COCOMO Model

- The model incorporates all qualities of both Basic COCOMO and Intermediate COCOMO strategies on each software engineering process.
- The whole software is divided into different modules and then apply COCOMO in different modules to estimate effort and then sum the effort.

The Six phases of detailed COCOMO are:

1. Planning and requirements
2. System design
3. Detailed design
4. Module code and test
5. Integration and test
6. Cost Constructive model

Advantages of COCOMO Model

1. Provides a systematic way to estimate the cost and effort of a software project.
2. Estimate cost and effort of software project at different stages of the development process.
3. Helps in identifying the factors that have the greatest impact on the cost and effort of a software project.
4. Provide ideas about historical projects.
5. Easy to implement with various factors.

Disadvantages of COCOMO Model

1. It ignores requirements, customer skills and hardware issues.
2. It limits the accuracy of the software costs.
3. It is based on assumptions and averages.
4. It mostly depends on time factors.
5. Assumes that the size of the software is the main factor that determines the cost and effort of a software project, which may not always be the case.

Important Questions

As per previous year question papers

1. Explain COCOCMO Model for project estimation with suitable example.
8M
2. Explain COCOCMO Model with levels with examples. 8M