

# **ANIMAL SHELTER WEBSITE**

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### **EXPERIMENT 9 :**

**Aim-** APPLICATION OF COCOMO MODEL FOR COST ESTIMATION.

#### **Theory-**

Types of Software Projects

- >Organic
- >Semidetached
- >Embedded

**Organic Mode**-Developed in a familiar, Stable environment ,similar to the previously developed projects relatively small and requires little innovation

**Semidetached Mode**-Intermediate between Organic and embedded

**Embedded Mode**-Tight, inflexible constraints and interface requirements . The product requires great innovation.

3 stages of Cocomo

- Basic Cocomo
- Intermediate Cocomo
- Complete Cocomo

#### **BASIC COCOMO**

$$\text{Effort} = a_1 \times (\text{KLOC})^{a_2} \text{ PM}$$

$$\text{Tdev} = b_1 \times (\text{Effort})^{b_2} \text{ Months}$$

Where

- KLOC is the estimated size of the software product expressed in Kilo Lines of Code,
- $a_1, a_2, b_1, b_2$  are constants for each category of software products,
- Tdev is the estimated time to develop the software, expressed in months,
- Effort is the total effort required to develop the software product, expressed in person months (PMs).

Software Project	a <sub>1</sub>	a <sub>2</sub>	b <sub>1</sub>	b <sub>2</sub>
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

#### ESTIMATION OF EFFORT

$$\begin{aligned} \text{Organic : Effort} &= 2.4(KLOC)^{1.05} \text{ PM} \\ \text{Semi-detached : Effort} &= 3.0(KLOC)^{1.12} \text{ PM} \\ \text{Embedded : Effort} &= 3.6(KLOC)^{1.20} \text{ PM} \end{aligned}$$

#### ESTIMATION OF DEVELOPMENT TIME

$$\text{Organic : Tdev} = 2.5(\text{Effort})^{0.38} \text{ Months}$$

$$\text{Semi-detached : Tdev} = 2.5(\text{Effort})^{0.35} \text{ Months}$$

$$\text{Embedded : Tdev} = 2.5(\text{Effort})^{0.32} \text{ Months}$$

**QUESTION:**

We have determined our project fits the characteristics of Basic, Semi-Detached mode. We estimate our project will have 1,50,000 Delivered Source Instructions. Find the Effort, Schedule, Productivity, and average staffing required for the project.

1. **Organic** :

- Effort =  $2.4 * ((\text{KLOC})^{1.05}) \text{ PMs}$   
 $= 2.4 * (1,50,000^{1.05}) \text{ PMs}$   
 $= 2.4 * (272204.8268) \text{ PMs}$   
 $= 653291.5844 \text{ PMs}$   
 $= 653291.5844 \text{ PMs}$
- Schedule (Tdev) =  $2.5 * (\text{Effort}^{0.38}) \text{ Months}$   
 $= 2.5 * (653292^{0.38}) \text{ Months}$   
 $= 2.5 * (162.0842401) \text{ Months}$   
 $= 405.2106002 \text{ Months}$   
 $= \mathbf{405} \text{ Months}$
- Productivity =  $\text{KLOC} / \text{Effort}$   
 $= 1,50,000 / 653292$   
 $= \mathbf{0.23}$

- Average Staffing = Effort / Schedule FSP  

$$= 653292 / 405 \text{ FSP}$$

$$= 1613.0667 \text{ FSP}$$

$$= \mathbf{1613 \text{ FSP}}$$

## 2. Semi Detached:

- Effort =  $3.0 * ( ( \text{KLOC} ) ^{1.12} ) \text{ PMs}$   

$$= 3.0 * ( 1,50,000 ^{1.12} ) \text{ PMs}$$

$$= 3.0 * ( 626934.5586 ) \text{ PMs}$$

$$= 1880803.676 \text{ PMs}$$

$$= 1880803 \text{ PMs}$$
- Schedule (Tdev) =  $2.5 * ( \text{Effort} ^{0.35} ) \text{ Months}$   

$$= 2.5 * ( 1880803^{0.35} ) \text{ Months}$$

$$= 2.5 * ( 157.04358 ) \text{ Months}$$

$$= 392.6089 \text{ Months}$$

$$= \mathbf{393 \text{ Months}}$$
- Productivity =  $\text{KLOC} / \text{Effort}$   

$$= 1,50,000 / 1880803 \qquad \qquad \qquad = \mathbf{0.079753}$$
- Average Staffing = Effort / Schedule FSP

$$= 1880803 / 405 \text{ FSP}$$

$$= 4643.9580 \text{ FSP}$$

$$= \mathbf{4644 \text{ FSP}}$$

### 3. Embedded:

- $\text{Effort} = 3.6 * ( (\text{KLOC}) ^ {1.20} ) \text{ PMs}$

$$= 3.6 * ( 1,50,000 ^ {1.20} ) \text{ PMs}$$

$$= 3.6 * (1626707) \text{ PMs}$$

$$= 5856147.564 \text{ PMs}$$

$$= 5856147 \text{ PMs}$$

- $\text{Schedule (Tdev)} = 2.5 * ( \text{Effort} ^ {0.32} ) \text{ Months}$

$$= 2.5 * ( 5856147 ^ {0.32} ) \text{ Months}$$

$$= 2.5 * ( 146.4319 ) \text{ Months}$$

$$= 366.07987 \text{ Months}$$

$$= \mathbf{366 \text{ Months}}$$

- $\text{Productivity} = \text{KLOC} / \text{Effort}$

$$= 150,000 / 5856147$$

$$= \mathbf{0.02561}$$

- $\text{Average Staffing} = \text{Effort} / \text{Schedule FSP}$

= 5856147/ 405 FSP

= 14459.622 FSP

= **14459** FSP

## INTERMEDIATE COCOMO

Four areas of drivers

-Product itself:

- inherent complexity of the product, reliability requirements etc.

-Computer:

- execution speed required, storage space required, etc.

-Personnel:

- experience level, programming capability, analysis capability, etc.

-Project itself or Development environment:

- development facilities available to developers

Software Project	a1	a2	b1	b2
Organic	3.2	1.05	2.5	0.38
Semi-detached	3.0	1.12	2.5	0.35
Embedded	2.8	1.20	2.5	0.32

### •Product Attributes

-RELY --- Required Software Reliability

•The extent to which the software product must perform its intended functions satisfactorily over a period of time.

-DATA --- Data Base Size

•The degree of the total amount of data to be assembled for the data base.

-CPLX --- Software Product Complexity

- The level of complexity of the product to be developed.

## •Computer Attributes

### -TIME --- Execution Time Constraint

· The degree of the execution constraint imposed upon a software product.

### -STOR --- Main Storage Constraint

· The degree of main storage constraint imposed upon a software product.

### -VIRT --- Virtual Machine Volatility

· The level of the virtual machine underlying the product to be developed.

### -TURN --- Computer Turnaround Time

· The level of computer response time experienced by the project team developing the product.

## •Personnel Attributes

### -ACAP --- Analyst Capability

· The level of capability of the analysts working on a software product.

### -AEXP --- Applications Experience

· The level of applications experience of the project team developing the software product.

### -PCAP --- Programmer Capability

· The level of capability of the programmers working on the software product.

### -VEXP --- Virtual Machine Experience

### -LEXP --- Programming Language Experience

## •Project Attributes

### -MODP --- Modern Programming Practices

· The degree to which modern programming practices (MPPs) are used in developing software product.

### -TOOL --- Use of Software Tools

· The degree to which software tools are used in developing the software product.

### -SCED --- Required Development Schedule

· The level of schedule constraint imposed upon the project team developing the software product.



<u>COCOMO - COST DRIVERS</u>							
		<u>RATING</u>					
	<u>COST DRIVER</u>	V.LOW	LOW	NOMINAL	HIGH	V.HIGH	EX. HIGH
(PRODUCT)	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)	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	.
(PERSONNEL)	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)	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	.

.For our project now we'll calculate the effort ,schedule,productivity and Average staffing for a semidetached project of 1,50,000 KLOC of ours.

The cost drivers are set as follows-

.Product cost drivers-high

.Computer cost drivers-nominal

.Personnel cost drivers-low

.Project cost drivers-high

Solution:

•Product cost drivers (from the table) set **high** =  $1.15 \times 1.08 \times 1.15 = 1.43$

•Computer cost drivers (from the table) set **nominal** = 1.00

•Personnel cost drivers (from the table) set **low** =  $1.19 \times 1.13 \times 1.17 \times 1.10 \times 1.07 = 1.85$

•Project cost drivers (from the table) set **high** =  $0.91 \times 0.91 \times 1.04 = 0.86$

•**product(cost drivers)** =  $1.43 \times 1.00 \times 1.85 \times 0.86 = 2.28$

.For a semidetached project of 1,50,000 KLOC :  $a_1=3, a_2=1.12, b_1=2.5, b_2=0.35$

EFFORT= $(3 \times (1,50,000)^{(1.12)}) \times 2.28$   
=4288232 PM

SCHEDULE= $2.5 \times (4288232)^{0.35}$   
=524 months

PRODUCTIVITY=150000/4288232  
=0.03497 KLOC/PM

AVERAGE STAFFING=4288232/524  
=8183 PM/months

## COCOMO 2

**QUESTION:** let's adapt the question for an animal shelter website project. In this scenario, we'll consider the development of an animal shelter website with 4 main pages, each containing 4 different views, and 10 data tables for managing products, users, orders, and other related information. The website is designed to handle traffic from 1 server and 5 clients. Additionally, the project includes the generation of 3 different reports, each consisting of 7 sections, all of which are derived from the data stored in the 10 data tables. We'll also assume a 20% reuse of object points, and that the developer's experience and capability in a similar environment is Nominal.

### **Step 1: Determine the number of screens and reports.**

- Number of screens = 4 features (Report and Rescue, Chatbot, Community, Adoption) \* 1 main page each = 4 screens.
- Number of reports = 3 reports.

### **Step 2: Determine the factors for screens and reports.**

#### **For Screens:**

- Number of views per screen = Varies for each feature (Not specified)
- Number of data tables per screen = Varies for each feature (Not specified)
- Number of servers = 1
- Number of clients = 5
- Complexity level for each screen = Nominal

#### **For Reports:**

- Number of sections per report = 7
- Number of data tables per report = 10
- Number of servers = 1
- Number of clients = 5
- Complexity level for each report = Nominal

### **Step 3: Assign complexity weights.**

Since you've mentioned that the developer's experience is Nominal, we can assign weights as follows:

- Complexity weight for each screen = 5 (Nominal)
- Complexity weight for each report = 5 (Nominal)

#### **Step 4: Calculate Object Point Count**

##### **For Screens:**

Object Point Count for Screens = (Number of screens \* Complexity weight for each screen)

Object Point Count for Screens = (4 screens \* 5) = 20 Object Points

##### **For Reports:**

Object Point Count for Reports = (Number of reports \* Complexity weight for each report)

Object Point Count for Reports = (3 reports \* 5) = 15 Object Points

##### **Now, we can calculate the total Object Point Count:**

Total Object Point Count = Object Point Count for Screens + Object Point Count for Reports

Total Object Point Count = 20 + 15 = 35 Object Points

Given that there is a 20% reuse of object points, we can calculate the Non-Reused Object Points (NOP):

Non-Reused Object Points (NOP) = [Total Object Points \* (100 - % Reuse)] / 100

Non-Reused Object Points (NOP) = [35 \* (100 - 20)] / 100

Non-Reused Object Points (NOP) = [35 \* 80] / 100

Non-Reused Object Points (NOP) = 28

#### **Step 6: Developer's Experience and Capability**

The developer's experience and capability are Nominal.

Using the information given about the developer and productivity rate table:

Productivity rate (PROD) of the given project = 13

#### **Step 7: Effort Calculation**

Effort = NOP / PROD

Effort = 28 / 13

Effort ≈ 2.15 person-days (rounded to two decimal places)