



COnstructive COst MOdel (COCOMO): A Microprocessor Example

Microprocessor Software Example

- Microprocessor-based communications software
- 10,000 LOC communication processing software
- Embedded mode, Intermediate model
- Local use - moderate effect of failures
- 20,000 byte database
- Uses 70% of available CPU capacity
- Uses 45K of 64K storage
- Senior analysts: 75th percentile
- Applications experience: 3 years
- Programmer capability: 75th percentile
- Virtual machine experience: 6 months
- Programming language experience: 12 months
- Most programming practices in use more than 1 year
- Tools used at basic mini level
- 9 month schedule

Source: Boehm, Software Engineering Economics, 1981.

Attributes	Very Low	Low	Nominal	High	Very High	Extra High
Product Attributes						
RELY	Effect: slight	Easily recover loses	Recoverable losses	High financial loss	Risk to human life	
DATA		D/P < 10	10 < D/P < 100	100 < D/P < 1000	D/P > 1000	
CPLX	Very low	Low complexity	Nominal	Highly complex	Very complex	
Computer Attributes						
TIME			< 50% use of time	70%	85%	95%
STOR			< 50% use of storage	70%	85%	95%
VIRT		Major chg 1 per 12 mos, min: 1 per mo	Maj: 1/6 mos Min: 1/2 wks	Maj: 1/2 mos Min: 1/week	Maj: 1/2 wks Min: 1/2 days	
TURN		Interactive	< 4 hrs	4 – 12 hrs	> 12 hrs	
Personnel Attributes						
ACAP	15 th percentile	35 th percentile	55 th percentile	75 th percentile	90 th percentile	
AEXP	< 4 mos exp	1 year	3 years	6 years	12 years	
PCAP	15 th percentile	35 th percentile	55 th percentile	75 th percentile	90 th percentile	
VEXP	< 1 month	4 months	1 year	3 years		
LEXP	< 1 month	4 months	1 year	3 years		
Project Attributes						
MODP	No use	Beginning use	Some use	General use	Routine use	
TOOL	Basic micro	Basic mini tools	Strong mini	Strong maxi	Adv maxi	
SCED	75% of nominal	85% of nominal	100% of nominal	130% of nominal	160% of nominal	

Attributes		Very Low	Low	Nominal	High	Very High	Extra High
Product Attributes							
RELY	Required software reliability	.75	.88	1.00	1.15	1.40	
DATA	Database size		.94	1.00	1.08	1.16	
CPLX	Product complexity	.70	.85	1.00	1.15	1.30	1.65
Computer Attributes							
TIME	Execution time constraint			1.00	1.11	1.30	1.66
STOR	Main storage constraint			1.00	1.06	1.21	1.56
VIRT	Virtual machine volatility		.87	1.00	1.15	1.30	
TURN	Computer turnaround time		.87	1.00	1.07	1.15	
Personnel Attributes							
ACAP	Analyst capability	1.46	1.19	1.00	.86	.71	
AEXP	Applications Experience	1.29	1.13	1.00	.91	.82	
PCAP	Programmer capability	1.42	1.17	1.00	.86	.70	
VEXP	Virtual machine experience	1.21	1.10	1.00	.90		
LEXP	Programming language experience	1.14	1.07	1.00	.95		
Project Attributes							
MODP	Use of modern programming practice	1.24	1.10	1.00	.91	.82	
TOOL	Use of software tools	1.24	1.10	1.00	.91	.83	
SCED	Required development schedule	1.23	1.08	1.00	1.04	1.10	

Effort and Schedule

Expected Effort in Staff Months:

$$\begin{aligned} \text{SM} &= 2.8 * \text{PEM} * (\text{KDSI})^{1.2} \\ &= 2.8 * 1.17 * (10)^{1.2} \\ &= 2.8 * 1.17 * 15.849 \\ &= 52 \text{ SM} \end{aligned}$$

Expected Schedule in Months:

$$\begin{aligned} T_{\text{DEV}} &= 2.5 * (\text{SM})^{0.32} \\ &= 2.5 * (52)^{0.32} \\ &= 9 \text{ Months} \end{aligned}$$

Average Staff (Level Loaded):

$$\begin{aligned} \text{Staff} &= 52 \text{ SM} / 9\text{M} \\ &= 5.8 \text{ Staff} \end{aligned}$$