CSE 566 Assignment 3 - COCOMO Calculation

Sample Project Description: Banking Software for Embedded Systems

Project Type: The project involves developing banking software for embedded systems, specifically designed to be used in Automated Teller Machines (ATMs). The software will include features such as user authentication, transaction processing, cash dispensing, and receipt generation.

Project Mode: Since the project involves developing software for embedded systems, we classify it as "Embedded" mode in COCOMO.

Project Size: The estimated size of the project is 400 KLOC (Thousand Lines of Code), considering the complexity and functionality required for banking software.

Project factors and justification of Attributes:

1. **Product Attributes:**

   - Required Reliability: Very high reliability is crucial for banking software to ensure accuracy in transactions and data integrity.

   - Database Size: The software will require a moderate-sized database to store transaction records, user accounts, and other banking data.

   - Product Complexity: Banking software involves moderate to high complexity due to the various functionalities such as user authentication, transaction processing, and security features.

2. **Computer Attributes:**

   - Execution Time Constraint: ATMs require real-time processing capabilities to handle user transactions efficiently.

- Main Storage Constraint: Embedded systems typically have limited memory resources, so memory constraints are significant.

- Platform Volatility: The platform volatility may be low as ATMs are designed to operate on stable hardware and software configurations.

- Computer Turnaround Time: Important for providing quick responses to user interactions, so turnaround time is crucial.

3. **Personnel Attributes:**

- Analyst Capability: Analysts need to understand banking requirements and translate them into software specifications accurately.

- Applications Experience: Experience in developing banking software or similar applications is essential for the project team.

- Programmer Capability: Skilled programmers are required to develop efficient and secure software for embedded systems.

- Platform Experience: Experience with embedded systems development is necessary to leverage platform-specific features and optimize performance.

- Programming Language and Tool Experience: Proficiency in programming languages and tools suitable for embedded systems development is vital.

4. **Project Attributes:**

- Modern Programming Practices: Adoption of modern programming practices such as Agile methodologies and version control systems can enhance productivity and quality.

- Use of Software Tools: Essential for enhancing efficiency and effectiveness in embedded systems development.

- Required Development Schedule: Timely delivery is critical for banking software projects, considering market demands and regulatory compliance.

5. **New Attributes:**

- Required Reusability: Important for reducing development time and effort by leveraging reusable components and modules.

- Documentation Match to Life-Cycle Needs: Critical for ensuring that documentation aligns with the project's lifecycle stages, facilitating development, testing, and maintenance.

- Personnel Continuity: Essential for maintaining consistency and knowledge transfer within the project team, especially for long-term embedded system development.

- Multisite Development: Less critical for this project as it is likely to be developed by a single team or organization, but still worth considering for future scalability or collaboration opportunities.

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Estimation Reports:

Report -1: [Sample Project Scenario]

MODE	"A" variable	"B" variable	"C" variable	"D" variable	KLOC	EFFORT, (in person-months)	DURATION, (in months)	STAFFING, (recommended)
embedded	3.2156044804972748	1.2	2.5	0.32	400.000	4263.189	36.262	117.565

COCOMO RESULTS for Banking Software for Embedded Systems

Explanation: The coefficients are set according to the project mode selected on the previous page, (as per Boehm). Note: the decimal separator is a period.

The final estimates are determined in the following manner:

effort = $a*KLOC^b$, in person-months, with KLOC = lines of code, (in thousands), and:

staffing = effort/duration

where a has been adjusted by the factors:

Product Attributes	
Required Reliability	1.15 (H)
Database Size	1.08 (H)
Product Complexity	1.15 (H)
Computer Attributes	
Execution Time Constraint	1.11 (H)
Main Storage Constraint	1.06 (H)
Platform Volatility	0.87 (L)
Computer Turnaround Time	1.00 (N)
Personnel Attributes	
Analyst Capability	0.86 (H)
Applications Experience	1.00 (N)
Programmer Capability	0.86 (H)
Platform Experience	1.00 (N)
Programming Language and Tool Experience	0.95 (H)
Project Attributes	
Modern Programming Practices	0.91 (H)
Use of Software Tools	0.91 (H)
Required Development Schedule	1.00 (N)
New (Values are probably wrong)	
Required reusability	1.05 (H)
Documentation match to life-cycle needs	1.00 (N)
Personnel continuity	1.00 (H)
Multisite development	1.00 (L)

Based on the COCOMO RESULTS for our Banking Software designed for Embedded Systems, the following metrics can be deduced for our initial settings:

- The total effort required is approximately 4263.19 person-months (rounded up).

- The total development time required is estimated to be 37 months (rounded up).

- Approximately 118 people would be needed to complete the project (rounded up).

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Report -2: [Worst Case Scenario]

COCOMO RESULTS for Banking Software for Embedded Systems								
MODE	"A" variable	"B" variable	"C" variable	"D" variable	KLOC	EFFORT, (in person-months)	DURATION, (in months)	STAFFING, (recommended)
embedded	216.0314267566282	1.2	2.5	0.32	400.000	286410.492	139.372	2055.003

Explanation: The coefficients are set according to the project mode selected on the previous page, (as per Boehm). Note: the decimal separator is a period.

The final estimates are determined in the following manner:

effort = a*KLOC^b, in person-months, with KLOC = lines of code, (in thousands), and:

staffing = effort/duration

where a has been adjusted by the factors:

Product Attributes		
Required Reliability	1.40 (XH)	
Database Size	1.16 (VH)	
Product Complexity	1.65 (XH)	
Computer Attributes		
Execution Time Constraint	1.66 (XH)	
Main Storage Constraint	1.56 (XH)	
Platform Volatility	1.15 (H)	
Computer Turnaround Time	1.15 (VH)	
Personnel Attributes		
Analyst Capability	1.46 (VL)	
Applications Experience	1.13 (L)	
Programmer Capability	1.00 (N)	
Platform Experience	1.10 (L)	
Programming Language and Tool Experience	1.14 (VL)	
Project Attributes		
Modern Programming Practices	1.24 (VL)	
Use of Software Tools	1.24 (VL)	
Required Development Schedule	1.10 (VH)	
New (Values are probably wrong)		
Required reusability	1.00 (VL)	
Documentation match to life-cycle needs	1.30 (XH)	
Personnel continuity	1.25 (VL)	
Multisite development	1.15 (XH)	

In the worst-case scenario, all attributes have been set to their worst-case conditions, potentially leading to increased effort, cost, and schedule due to lower productivity, higher complexity, and greater uncertainty which can be observed from the obtained metrics:

- The total effort required is approximately 286410.50 person-months (rounded up).

- The total development time required is estimated to be 140 months (rounded up).

- Approximately 2056 people (rounded up) would be needed to complete the project.

Report - 3: [Ideal Conditions]:

COCOMO RESULTS for Banking Software for Embedded Systems								
MODE	"A" variable	"B" variable	"C" variable	"D" variable	KLOC	EFFORT, (in person-months)	DURATION, (in months)	STAFFING, (recommended)
embedded	0.9271579363191496	1.2	2.5	0.32	400.000	1229.209	24.357	50.467

Explanation: The coefficients are set according to the project mode selected on the previous page, (as per Boehm). Note: the decimal separator is a period.

The final estimates are determined in the following manner:

effort = $a*KLOC^b$, in person-months, with KLOC = lines of code, (in thousands), and:

staffing = effort/duration

where a has been adjusted by the factors:

Product Attributes	
Required Reliability	1.15 (H)
Database Size	0.94 (L)
Product Complexity	1.00 (N)
Computer Attributes	
Execution Time Constraint	1.00 (L)
Main Storage Constraint	1.00 (VL)
Platform Volatility	0.87 (VL)
Computer Turnaround Time	0.87 (L)
Personnel Attributes	
Analyst Capability	0.71 (VH)
Applications Experience	0.91 (H)
Programmer Capability	0.70 (VH)
Platform Experience	0.90 (H)
Programming Language and Tool Experience	0.95 (VH)
Project Attributes	
Modern Programming Practices	0.82 (VH)
Use of Software Tools	0.83 (VH)
Required Development Schedule	1.04 (H)
New (Values are probably wrong)	
Required reusability	1.15 (XH)
Documentation match to life-cycle needs	1.00 (L)
Personnel continuity	1.00 (VH)
Multisite development	1.00 (VL)

In ideal conditions, all attributes have been set to their best-case conditions, potentially resulting in decreased effort, cost, and schedule due to higher productivity, lower complexity, and greater predictability which can be observed from the obtained metrics:

- The total effort required is approximately 1229.21 person-months (rounded up) has been reduced by 71% compared to initial estimation.

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- The total development time required is estimated to be 25 months (rounded up) which is a year (12 months) sooner than the initial estimation.

- Approximately 51 people (rounded up) would be needed to complete the project, which is 57% of the initial estimation.

References:

1. https://youtu.be/PfD4G4ZZAMA?si=98UjmuY71hCcMfXQ [COCOMO Model Tutorial]