Fundamentals of Software Project Management (SE4002)

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Do not write below this line

Attempt all the questions on space provided on paper.

Double sided, A4 sized, hand written cheat sheet is allowed.

For ruff work, Take extra sheet from examiner.

22L-7971   BSE-7B

Roll No   Section

Date: Dec 26th 2025

Course Instructor(s)

Momna Zaneb (BSE-7A, BSE-7B)

Javeria Sadiq (BSE-7C)

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Final Exam

Total Time (Hrs):	3hrs
Total Marks:	100
Total Questions:	6

CLO2: Apply approaches to manage and optimize the software development processes

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Question 1: Apply the Cocomo model for software estimation.   **20 Marks**

A software company has been assigned the task of developing a nationwide online examination system to be used by multiple universities simultaneously. The system will support secure student authentication, real-time online examinations, automatic and manual grading, and detailed audit logs for result verification. Due to the critical and sensitive nature of examination data, the software is expected to operate with high reliability and security and must be capable of handling thousands of concurrent users during peak examination periods. The application involves high processing and control complexity, along with a large database containing student

records, examination papers, and results. The estimated size of the system, based on early design analysis, is approximately 80,000 lines of code.

The development team consists of analysts with average capability, while the programmers are highly skilled, although the team has limited prior experience with similar large-scale examination systems. Modern software development tools and environments will be used throughout the project. The system will be deployed on a standard hardware and software platform, without extreme memory, timing, or hardware constraints.

Based on the above information, students are required to estimate the development effort and schedule using the Intermediate COCOMO model.

Mode	a	b	c	d
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

→ (Used)

Cost Driver	Very Low	Low	Nominal	High	Very High	Extra High
RELY (Required reliability)	0.75	0.88	1.00	1.15	1.40	—
DATA (Database size)	—	0.94	1.00	1.08	1.16	—
CPLX (Product complexity)	0.70	0.85	1.00	1.15	1.30	1.65
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)	—	0.87	1.00	1.15	1.30	—
TURN (Computer turnaround time)	—	0.87	1.00	1.07	1.15	—
ACAP (Analyst capability)	1.46	1.19	1.00	0.86	0.71	—
AEXP (Application experience)	1.29	1.13	1.00	0.91	0.82	—
PCAP (Programmer capability)	1.42	1.17	1.00	0.86	0.70	—
VEXP (VM experience)	1.21	1.10	1.00	0.90	—	—
LEXP (Language experience)	1.14	1.07	1.00	0.95	—	—
MODP (Modern programming practices)	1.24	1.10	1.00	0.91	0.82	—
TOOL (Use of software tools)	1.24	1.10	1.00	0.91	0.83	—
SCED (Required development schedule)	1.23	1.08	1.00	1.04	1.10	—

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1. **Estimate the total development effort. Show complete working.** 10 marks

$$EAF = 1 \times 0.91 \times 1 \times 1 \times 1 \times 0.86 \times 1.13 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1.15$$
$$\times 1.08 \times 1.15 = 1.2630999 65$$

As, it is 80,000 lines of code and significant non-functional constraints as well as nominal experience (not a lot of experience)

Semi-detached model (complexity is high but I'm not choosing very high):

$$Effort = a (Size)^b \times EAF$$
$$= 3 (80)^{1.12} \times 1.263099965$$
$$= 512.8847231 \text{ person months}$$

Left margin (rotated): Assumption // Things not mentioned are assumed as 1 (Nominal) // v. imp

2. Estimate the development time. **6 marks**

$$T_{dev} = cE^d = 2.5(512.8847)^{0.35}$$
$$= 22.2048 \text{ months.}$$

3. Estimate the team size. **4 marks**

$$N = E/T_{dev} = \frac{512.8847}{22.2048} = 23.097 \text{ persons.}$$

CLO1: *Understand project management principles and techniques*
Question 2: Write the most appropriate quality factor for each requirement. (20 Marks)

The software requirement document for the tender for development of "Super-lab", a software system for managing a hospital laboratory, consists of chapters according to the required quality factors as follows: correctness, reliability, efficiency, integrity, usability, maintainability, flexibility, testability, portability, reusability and interoperability. In the following table you will find sections taken from the mentioned requirements document. For each section, fill in the name of the factor that best fits the requirement (choose only one factor per requirements section).

No	Requirement	Quality Factor
1	The probability that the "Super-lab" software system will be found in a state of failure during peak hours (9 am to 4 pm) is required to be below 0.5%.	Reliability
2	The "Super-lab" software system will enable direct transfer of laboratory results to those files of hospitalized patients managed by the "MD-File" software package.	Interoperability
3	The "Super-lab" software system will include a module that prepares a detailed report of the patient's laboratory test results during his or her current hospitalization. (This report will serve as an appendix to the family physician's file.) The time required to obtain this printed report will be less than 60 seconds; the level of accuracy and completeness will be at least 99%.	Efficiency
4	The "Super-lab" software to be developed for hospital laboratory use may be adapted later for private laboratory use.	Flexability
5	The training of a laboratory technician, requiring no more than three days, will enable the technician to reach level C of "Super-lab" software usage. This means that he or she will be able to manage reception of 20 patients per hour.	Usability
6	The "Super-lab" software system will record a detailed users' log. In addition, the system will report attempts by unauthorized persons to obtain medical information from the	Integrity

	laboratory test results database. The report will include the following information: network identification of the applying terminal, system code of the employee who requested that information, day and time of attempt, and type of attempt.	*Integrity*
7	The "Super-lab" subsystem that deals with billing patients for their tests may eventually be used as a subsystem in the "Physiotherapy Center" software package.	*Reusability*
8	The "Super-lab" software system will process all the monthly reports for the hospital departments' management, the hospital management, and the hospital controller according to Appendix D of the development contract.	*Correctness*
9	The software system should be able to serve 12 work stations and eight automatic testing machines with a single model AS20 server and a CS25 communication server that will be able to serve 25 communication lines. This hardware system should conform to all availability requirements as listed in Appendix C	*Interoperability Testbility*
10	The "Super-lab" software package developed for the Linux operating system should be compatible for applications in a Windows NT environment.	*Portability*

CLO1: Understand project management principles and techniques

Question 3: Read the items given in Column A and choose most appropriate option from Column B. Write the chosen option(number only) in column C. Overwriting or cutting will result in loss of marks

(20 Marks)

No	A	B	C
1	ISO 9126	1B. One codes while the other reviews work in pairs	13B
2	CMMI	2B. Functionality enhancement	12B
3	Developers work in pairs	3B. RFP	1B
4	Sprint	4B. Product Transition	16B
5	Mc Calls	5B. Version	15B
6	Flexibility	6B. Integrity	7B
7	Interoperability	7B. Revision	4B
8	Product Operation	8B. Risks	6B
9	Hawthorne Effect	9B.CPM	14B
10	Configuration that existed at certain point in time	10B.Hazards	18B
11	Numbering scheme that is used to identify the state of the configuration item at any time	11B. Pert	5B

12	SVN	12B. developed by the SEI	19 B
13	A method that assumes deterministic times	13B. 1977	9B
14	A method that does not assume fixed durations.	14B. Productivity Increased	11B
15	Some are threats (bad) and some are opportunities (good).	15B. Good quality Software	10B
16	The situational factors that increase chances of bad outcomes	16B. Planned activity	8B
17	What you planned to have	17B. BCWS	2B
18	A written agreement between customer and supplier	18B. Time boxed	17B
19	A Document a company makes when it needs outside help	19B. SCM Tool	20B
20	Project	20B. SOW	3B

CLO1: Understand project management principles and techniques

Question 4: Mark the given statements True/False. Overwriting cutting will result in deduction of marks. **(20 Marks)**

No.	Statement	True/False
1	Plan is a general way of doing a task (e.g., software testing).	F
2	Groups of methods/techniques is called Methodology	T
3	Bespoke System (Custom-built)is Built from scratch for one customer only	~~B~~ T
4	Fixed Price Contract does not Agree cost set in advance	F
5	In Wideband Delphi, estimates are given openly in front of the group	F
6	Online queries are included when counting user inputs in the function point method. *(Yes in external queries & interface)*	T
7	Function points are less dependent on programming language and developer coding style than KLOC.	T
8	Corrective maintenance services involve fixing failures detected either by customers or the service team.	T
9	Most customer calls to the software support center are expected to be failure-related.	T
10	Product metrics are related to the software development process	F

(margin note, left side): It doesn't cover ... when only cover it.

11	Paying developers early and receiving savings later is an example of cash flow issues.	T
12	Net profit considers when the income and costs occur during the project.	F
13	Payback period is simple to calculate but limited in long-term analysis.	T
14	Net profit, ROI, and payback period all consider the timing of cash flows	F
15	Both the Post-Architecture and Early Design models use the same functional form to estimate the amount of effort and calendar time it will take to develop a software project.	T
16	The subscript NS in PMNS and TDEVNS represents non-standard schedule estimates.	T
17	COCOMO II expresses size only in thousands of source lines of code (KSLOC).	T
18	Story Points measure the absolute time required to complete a task.	F
19	Velocity is calculated as the total number of tasks completed per sprint.	T

(margin note): total no. of story points per sprint

| 20 | Using a higher discount rate adjusts NPV for risky projects. | F |

CLO2: Apply approaches to manage and optimize the software development processes

Question 5: A software company developed a hospital management system over a period of eight months. To monitor progress, the project team defined eight major milestones corresponding to key development activities. At the end of the project, management observed that five milestones were completed on their scheduled dates, while the remaining milestones were completed late. When the delays were analysed, it was found that the total accumulated delay across all milestones was 16 days. During quality assurance activities, errors detected throughout the project were classified based on their origin and severity. Each error was assigned a numerical severity weight according to its impact on system operation. The analysis revealed that, Errors originating from coding activities had a total severity weight of 96, distributed across 24 individual code errors. Errors originating from earlier development activities such as requirements analysis and design had a total severity weight of 140, distributed across 28 development-related errors. **With the help of provided data, apply suitable metrics to evaluate the project's performance.**

(10 Marks)

a. List down appropriate metrics applicable to this scenario.

2 marks

TTO, ADMS, ASCE, ASDE ie Time table & Error severity (Process Metrics) ②

b. Apply Metrics to the data and show results.

8 marks ⑧

Metric Name	Metric Formula	Calculations
Time table ~~Conformence~~	TTO = MSD / MS	TTO = 5/8 = 0.625

(handwritten): which ... 1, there, milestone are behind schedule.

Average delay of Milestone Completion	$ADMS = TCDAM/MS$	$ADMS = 16/8 = 2$
Average severity of code error	$ASEE = WCE/NCE$	$ASCE = 96/24 = 4$
Average severity of development errors	$ASDE = WDE/NDE$	$ASDE = 140/28 = 5$
Time table observance	$TTO = MSOT/MS$	$TTO = 5/8 = 0.625$

CLO2: Apply approaches to manage and optimize the software development processes

Question 6: A multinational e-commerce company is reviewing its customer order and inventory management system due to uncertainty in future growth caused by rapidly changing consumer demand and emerging competitors. Management estimates that there is a 30% chance the market will expand rapidly over the next three years, while a 70% chance exists that growth will remain moderate. The company is considering three strategic options. One option is to maintain the existing system, which would perform adequately and generate a net present value of £120,000 if growth is moderate, but would become overloaded and result in a loss of £200,000 if the market expands rapidly. Another option is to upgrade the system incrementally in two phases: the first phase requires immediate investment, after which management can decide whether to proceed to a second phase based on observed market conditions. If growth remains moderate after Phase 1, the system will perform well and deliver £180,000, but if growth is rapid, management must choose to either proceed with Phase 2, yielding £260,000, or stop further investment, yielding £40,000. The third option is to replace the system immediately, which would allow aggressive scaling and produce £350,000 if the market expands rapidly, but would be underutilized and result in a loss of £80,000 if growth is moderate. **(10 marks)**

a. Calculate expected monetary values for each option. **3 marks**

1- Maintain:
$$= (0.7 \times 120000) + (0.3 \times -200,000) = 24000 \$$$

3- Replace $= (0.3 \times 350,000) + (0.7 \times -80,000) = 49000 \$$

2- Upgrade =

if proceeds $= (0.3 \times 260,000) + (0.7 \times 180,000)$
$$= 204000 \$$$

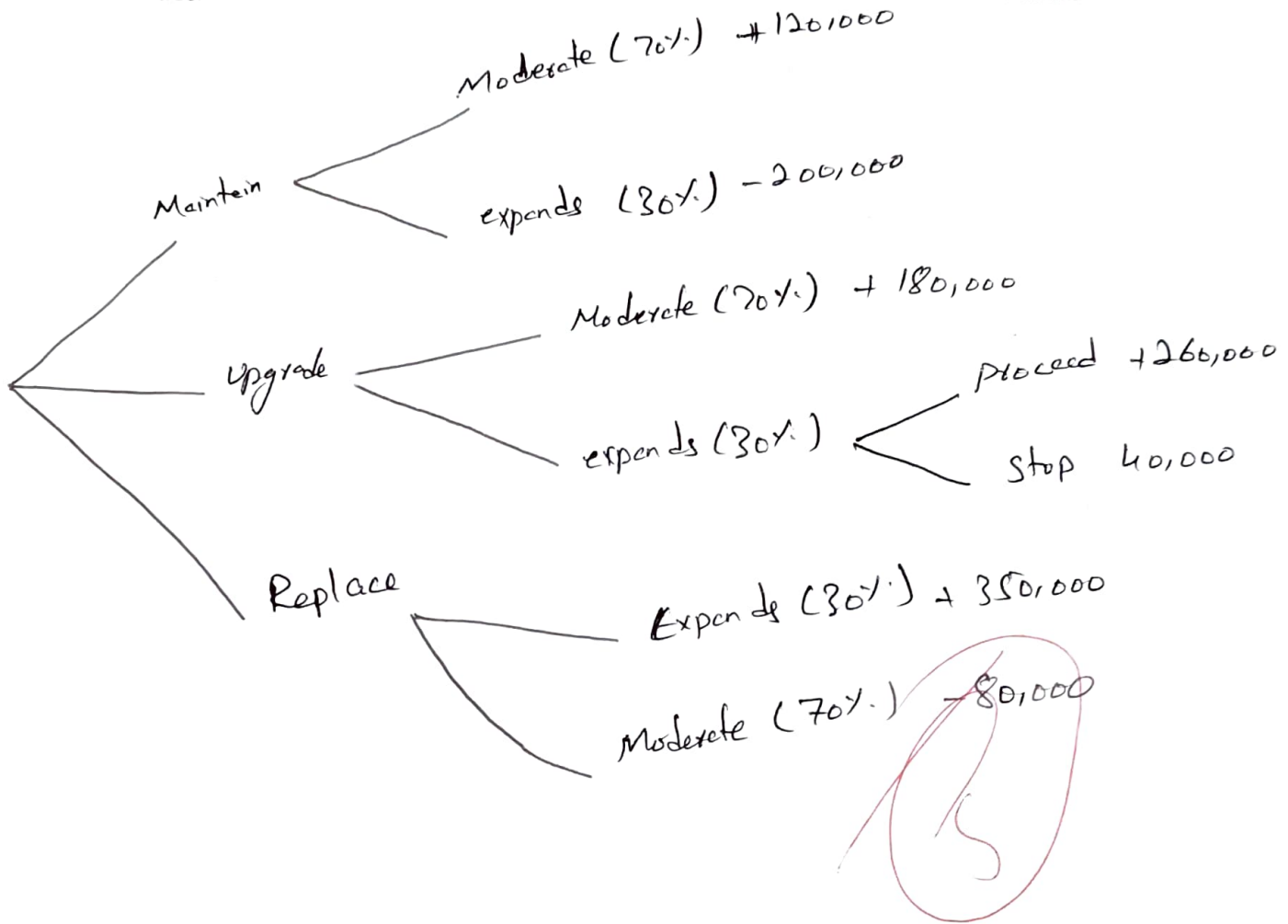if Stops $= (0.3 \times 40000) + (0.7 \times 180000)$
$$= 138,000 \$$$

For the whole of update both choice we use max
ie $(0.3 \times 260,000) + (0.7 \times 180000)$
$$= 204,000 \$$$

In this case we say both proceed & stop are equally likely.

b. Considering these uncertainties and potential outcomes, perform sensitivity analysis using decision tree.

5 marks

Maintein

Moderate (70%) + 120,000

expends (30%) -200,000

upgrade

Moderate (70%) + 180,000

expends (30%)

proceed +260,000

stop 40,000

Replace

Expende (30%) + 350,000

Moderate (70%) -80,000

c. Determine most suitable option based on results of sensitivity analysis and EMV. **2 marks**

Based of the above information, user should upgrade (& ~~expand in case~~ of proceed in case of rapid expension to Phase 2).