

Activity 08
Risk identification and analysis
2025-2026

Note: Be sure to include all group member's names in your submission.

A. Scenario: Estimating a TravelTech Marketplace SaaS Platform

Your team has been contracted to build a TravelTech Marketplace SaaS platform that connects travel agencies, tour operators, and individual travelers. The system will allow users to:

- Discover and book curated travel experiences
- Compare prices and itineraries across providers
- Manage bookings, payments, and reviews
- Access personalized recommendations based on preferences and location
- Integrate with third-party APIs (e.g., Google Maps, Stripe, Amadeus)

The platform must be scalable, multi-tenant, and support both web and mobile interfaces.

Project Characteristics

Attribute	Details
Estimated Size	95 KLOC
Project Type	Embedded (high complexity, tight constraints, diverse team)
Development Team	12 developers, 3 QA engineers, 1 DevOps, 1 PM
Timeline Expectation	14–18 months
Constraints	Must support multi-currency, multi-language (Arabic, English, French), and comply with GDPR and AML laws
Technology Stack	Node.js (backend), React Native (mobile), PostgreSQL, Docker, Kubernetes
Deployment Model	SaaS with subscription tiers for agencies and operators + commissions on sales

COCOMO Constants:

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

B. Student Tasks

Effort Estimation	Formula: $E = a \times (\text{KLOC})^b$ Calculation: $E = 3.6 \times (95)^{1.20} = 3.6 \times 236.1934 = 850.30$ Person-Months (PM)
Development Time	Formula: $D = c \times (E)^d$ Calculation: $D = 2.5 \times (850.30)^{0.32} = 2.5 \times 8.6593 = 21.65$ Months
Team Size	Formula: $S = \frac{E}{D}$ Calculation: $S = \frac{850.30}{21.65} = 39.28$ Persons (≈ 39 to 40 people)

1. Analysis & Discussion

1) Comparison with Client Expectations:

- Client Expectations: Delivery in 14-18 months using a total team of 17 people (12 developers, 3 QA, 1 DevOps, 1 PM).
- Basic COCOMO Results: Development time of 21.65 months requiring an average team size of 39.28 persons.
- Comparison: The client's timeline and staffing expectations are significantly underestimated under Basic COCOMO's Embedded mode. At a capacity of 17 team members, completing the estimated 850.30 Person-Months of effort would take roughly 50 calendar months ($850.30/17 \approx 50$), far exceeding the target of 14-18 months.

2) Impact of Changing Project Type:

- **Embedded** Mode: $E = 3.6 \times (95)^{1.20} = 850.30 \text{ PM}$, $D = 2.5 \times (850.30)^{0.32} = 21.65 \text{ Months}$, Team Size = 39.28 Persons
- **Semi-Detached** Mode: $E = 3.0 \times (95)^{1.12} = 492.23 \text{ PM}$, $D = 2.5 \times (492.23)^{0.35} = 21.89 \text{ Months}$, Team Size = 22.49 Persons
- **Organic** Mode: $E = 2.4 \times (95)^{1.05} = 286.30 \text{ PM}$, $D = 2.5 \times (286.30)^{0.38} = 21.46 \text{ Months}$, Team Size = 13.34 Persons

Discussion: Shifting from Embedded to Semi-Detached reduces total effort by 42.1% (from 850.30 PM to 492.23 PM) because the scale exponent b decreases from 1.20 to 1.12. Shifting further to Organic reduces effort to 286.30 PM, bringing the required average team size (13.34 persons) within the client's current team size (17 persons). This highlights that classifying a project mode heavily penalizes or rewards scale based on expected complexity and organizational constraints.

3) Limitations of Basic COCOMO & Improvement with Intermediate COCOMO:

Limitations of basic COCOMO: Basic COCOMO relies exclusively on project size, ignoring key real-world factors like developer experience, modern frameworks, automated tooling, regulatory constraints and team cohesion.

How intermediate COCOMO improves accuracy: Intermediate COCOMO introduces 15 cost drivers across Product, Hardware, Personnel, and Project attributes. It calculates an Effort Adjustment Factor to scale effort up or down based on specific project realities, yielding a much more precise and tailored estimation.

C. Intermediate COCOMO:

1. Introduce cost drivers from Intermediate COCOMO:

Intermediate COCOMO introduces 15 Cost Drivers across 4 categories (Product, Hardware, Personnel, and Project) to adjust effort estimates based on specific project characteristics and team capabilities. Below are the selected cost drivers, ratings, multipliers, and justifications for the TravelTech SaaS platform scenario:

1. Selected Cost Drivers & Justifications

- **Product** Attributes:
 - Required Software Reliability (RELY): High (1.15): High reliability is essential due to handling online financial transactions (Stripe) and complying with GDPR and AML regulations.
 - Size of Application Database (DATA): High (1.08): Large multi-tenant database required to manage agencies, tour operators, bookings, listings, and reviews.
 - Complexity of Product (CPLX): High (1.15): High system complexity from integrating third-party APIs (Google Maps, Stripe, Amadeus), multi-currency processing, and multi-language support (Arabic, English, French).
- **Hardware** Attributes:
 - Run-time Performance Constraints (TIME): Standard (1.00): Standard SaaS cloud hosting with scalable infrastructure.
 - Memory Constraints (STOR): Standard (1.00): Standard memory allocation dynamically managed in the cloud.
 - Environment Volatility (PVOL): Standard (1.00): Stable production environment using Docker and Kubernetes.
 - Required Turnaround Time (TURN): Standard (1.00): Standard interactive development and deployment cycles.

- **Personnel** Attributes:

- Analyst Capability (ACAP): High (0.86): Experienced Project Manager and analysts defining clear SaaS domain requirements.
- Applications Experience (AEXP): High (0.91): Development team has strong prior experience with marketplace/travel platforms.
- Software Engineer Capability (PCAP): High (0.86): Highly competent engineering team capable of complex full-stack execution.
- Production Environment Experience (VEXP): High (0.90): High familiarity with cloud, container, and database tools (PostgreSQL, Docker, Kubernetes).
- Programming Language Experience (LEXP): High (0.95): Proficient in JavaScript/TypeScript (Node.js, React Native) and SQL.

- **Project** Attributes:

- Application of SW Engineering Methods (MODP): High (0.91): Modern software engineering practices used (Agile methods, CI/CD, DevOps).
- Use of Software Tools (TOOL): High (0.91): Advanced toolchains for development, testing, and container management.
- Required Development Schedule (SCED): High (1.04): Compressed schedule pressure to fit within the client's 14-18 month timeline.

	Ratings					
	Very Low	Low	Nominal	High	Very High	Extra High
Product attributes						
Required software reliability	0.75	0.88	1.00	1.15	1.40	
Size of application database		0.94	1.00	1.08	1.16	
Complexity of the product	0.70	0.85	1.00	1.15	1.30	1.65
Hardware attributes						
Run-time performance constraints			1.00	1.11	1.30	1.66
Memory constraints			1.00	1.06	1.21	1.56

Volatility of the production environment (servers)		0.87	1.00	1.15	1.30	
Required turnabout time		0.87	1.00	1.07	1.15	
Personnel attributes						
Analyst capability	1.46	1.19	1.00	0.86	0.71	
Applications experience	1.29	1.13	1.00	0.91	0.82	
Software engineer capability	1.42	1.17	1.00	0.86	0.70	
Production environment experience (servers technology)	1.21	1.10	1.00	0.90		
Programming language experience	1.14	1.07	1.00	0.95		
Project attributes						
Application of software engineering methods	1.24	1.10	1.00	0.91	0.82	
Use of software tools	1.24	1.10	1.00	0.91	0.83	
Required development schedule	1.23	1.08	1.00	1.04	1.10	

2. Adjust your estimates based on selected drivers and justify your choices.

$$\text{EAF} = \text{RELY} \times \text{DATA} \times \text{CPLX} \times \text{TIME} \times \text{STOR} \times \text{PVOL} \times \text{TURN} \times \text{ACAP} \times \text{AEXP} \\ \times \text{PCAP} \times \text{VEXP} \times \text{LEXP} \times \text{MODP} \times \text{TOOL} \times \text{SCED}$$

$$\text{EAF} = 1.15 \times 1.08 \times 1.15 \times 1.00 \times 1.00 \times 1.00 \times 1.00 \times 0.86 \times 0.91 \times 0.86 \times 0.90 \times 0.95 \\ \times 0.91 \times 0.91 \times 1.04$$

$$\text{EAF} \approx 0.7078$$