



Software Project Management

Assignment - 3

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22I-252, 22I-1527, 22I-2433 | SE-D

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Task 1: Timeline Estimation and Scheduling of WBS Items

This section provides the detailed project schedule based on the updated Work Breakdown Structure (WBS). The WBS has been modified from Assignment 2 to include the new scope for implementing a **Short-Term Memory (STM)** system, as per the project announcements.

The schedule includes task durations, start and finish dates, key dependencies, and the team member responsible for each task. The project timeline is based on the original project start date of September 22, 2025.

Timeline Estimation Table

| WBS Code | Task Name | Duration (Days) | Start Date | Finish Date | Dependencies | Responsible Team Member |
|----------|--|-----------------|------------|-------------|--------------|-------------------------|
| 1.1 | Project Management | (75) | 22-Sep-25 | 05-Dec-25 | | All |
| 1.1.1 | Project Scoping & WBS Creation (A2) | 5 | 22-Sep-25 | 26-Sep-25 | | All |
| 1.1.2 | Inter-group Coordination | 50 | 29-Sep-25 | 05-Dec-25 | 1.1.1 | Dawood |
| 1.1.3 | Project Documentation Maintenance | 50 | 29-Sep-25 | 05-Dec-25 | 1.1.1 | Abdullah |
| 1.2 | Phase 1: Foundation & Stub Integration | (18) | 29-Sep-25 | 22-Oct-25 | | All |
| 1.2.1 | Define Handshake Protocol (JSON) | 3 | 29-Sep-25 | 01-Oct-25 | 1.1.1 | Dawood |
| 1.2.2 | Secure Section-wide Approval | 2 | 02-Oct-25 | 03-Oct-25 | 1.2.1 | Dawood |
| 1.2.3 | Design Agent Registry Structure | 3 | 06-Oct-25 | 08-Oct-25 | 1.2.1 | Hammad |

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|-------|---|------|-----------|-----------|---------------------|----------|
| 1.2.4 | Develop Initial Supervisor UI | 5 | 06-Oct-25 | 10-Oct-25 | 1.2.1 | Abdullah |
| 1.2.5 | Implement Core Routing Stub | 5 | 09-Oct-25 | 15-Oct-25 | 1.2.3 | Hammad |
| 1.2.6 | Collect & Populate Stub Details | 3 | 13-Oct-25 | 15-Oct-25 | 1.2.2 | Dawood |
| 1.2.7 | Call all stub agents & verify status | 5 | 16-Oct-25 | 22-Oct-25 | 1.2.4, 1.2.5, 1.2.6 | All |
| 1.3 | Phase 2: Real Agent Deployment | (15) | 23-Oct-25 | 12-Nov-25 | | All |
| 1.3.1 | Collect real agent API info | 5 | 23-Oct-25 | 29-Oct-25 | 1.2.7 | Dawood |
| 1.3.2 | Update Registry with real agent data | 2 | 30-Oct-25 | 31-Oct-25 | 1.3.1 | Hammad |
| 1.3.3 | Implement Health Check Functionality | 3 | 23-Oct-25 | 27-Oct-25 | 1.2.7 | Hammad |
| 1.3.4 | Send test requests to real agents | 5 | 03-Nov-25 | 07-Nov-25 | 1.3.2, 1.3.3 | Abdullah |
| 1.3.5 | Debug & resolve Handshake mismatches | 3 | 10-Nov-25 | 12-Nov-25 | 1.3.4 | All |
| 1.4 | Phase 3: Integration Testing | (8) | 13-Nov-25 | 24-Nov-25 | | All |
| 1.4.1 | Design integration test cases | 4 | 13-Nov-25 | 18-Nov-25 | 1.3.5 | Abdullah |
| 1.4.2 | Execute the full integration test suite | 2 | 19-Nov-25 | 20-Nov-25 | 1.4.1 | All |
| 1.4.3 | Document test results & report bugs | 2 | 21-Nov-25 | 24-Nov-25 | 1.4.2 | Abdullah |
| 1.5 | Phase 4: Core Logic & Finalization | (25) | 23-Oct-25 | 27-Nov-25 | | All |

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|-------|---|-----|-----------|-----------|--------------|----------|
| 1.5.1 | Design Short-Term Memory (STM) System | 3 | 23-Oct-25 | 27-Oct-25 | 1.2.7 | Hammad |
| 1.5.2 | Implement STM (e.g., context cache) | 5 | 28-Oct-25 | 03-Nov-25 | 1.5.1 | Hammad |
| 1.5.3 | Integrate STM with Routing Logic | 5 | 04-Nov-25 | 10-Nov-25 | 1.5.2 | Hammad |
| 1.5.4 | Expose a final UI to select intent | 5 | 11-Nov-25 | 17-Nov-25 | 1.5.3 | Abdullah |
| 1.5.5 | Refine routing logic (intent detection) | 4 | 18-Nov-25 | 21-Nov-25 | 1.5.3, 1.3.5 | Dawood |
| 1.5.6 | Implement logic to display results | 4 | 24-Nov-25 | 27-Nov-25 | 1.5.4 | Abdullah |
| 1.5.7 | Final system deployment | 2 | 28-Nov-25 | 01-Dec-25 | 1.4.3, 1.5.6 | All |
| 1.6 | Project Closeout | (4) | 02-Dec-25 | 05-Dec-25 | | All |
| 1.6.1 | Final Report Preparation | 3 | 02-Dec-25 | 04-Dec-25 | 1.5.7 | All |
| 1.6.2 | Code and Documentation Archiving | 1 | 05-Dec-25 | 05-Dec-25 | 1.6.1 | Hammad |

Justification for Major Work Package Estimates

Here is the justification for the time estimates provided for the project's major work packages:

- **1.2 Phase 1: Foundation & Stub Integration (18 Days):** This phase is allotted significant time because it involves foundational work (Handshake, Registry) that requires agreement from all 16 other groups. The 18-day duration includes time for defining the protocol, communicating it, building the initial registry, and performing the first round of stub integration tests.
- **1.3 Phase 2: Real Agent Deployment (15 Days):** This is a high-risk phase and is given 3 full work weeks. The duration is not for our development work, but for the

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complex, iterative process of collecting information from 16 teams, testing their real endpoints, and debugging the inevitable handshake and communication mismatches that will arise.

- **1.4 Phase 3: Integration Testing (8 Days):** Following the initial deployment, this phase is estimated at 8 days to formally design test cases for every agent's functionality, execute the full test suite, and then clearly document and report all discovered bugs.
- **1.5 Phase 4: Core Logic & Finalization (25 Days):** This is the longest phase as it runs parallel to Phase 2 and 3. It now includes the **new STM requirement**. The 25-day estimate covers the design, implementation, and integration of this new memory system, refining the UI, and improving the routing logic, all culminating in the final system deployment.

Task 2: Network Diagram (AON) and Slack Analysis

This section provides the Activity-on-Node (AON) data and slack analysis for the project. A forward pass (to find Early Start/Finish) and a backward pass (to find Late Start/Finish) were conducted using the durations and dependencies from the Task 1 schedule.

The total project duration is determined by the longest path, which in this case is the 55-day duration of the project management and documentation tasks (1.1.2 and 1.1.3).

Slack Analysis Table

The following table details the Early Start (ES), Early Finish (EF), Late Start (LS), Late Finish (LF), Total Slack, and Free Slack for every project activity.

| WBS | Task Name | Dur | ES | EF | LS | LF | TS | FS |
|-------|------------------------------|-----|----|----|----|----|----|----|
| 1.1.1 | Project Scoping & WBS | 5 | 0 | 5 | 0 | 5 | 0 | 0 |
| 1.1.2 | Inter-group Coordination | 50 | 5 | 55 | 5 | 55 | 0 | 0 |
| 1.1.3 | Project Doc. Maintenance | 50 | 5 | 55 | 5 | 55 | 0 | 0 |
| 1.2.1 | Define Handshake Protocol | 3 | 5 | 8 | 10 | 13 | 5 | 0 |
| 1.2.2 | Secure Section-wide Approval | 2 | 8 | 10 | 18 | 20 | 10 | 0 |
| 1.2.3 | Design Agent Registry | 3 | 8 | 11 | 13 | 16 | 5 | 0 |

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| Task ID | Description | Start Date | End Date | Planned Duration | Actual Duration | Completion % | Efficiency % | Budget (USD) |
|---------|------------------------------------|------------|------------|------------------|-----------------|--------------|--------------|--------------|
| 1.2.4 | Develop Initial Supervisor UI | 2023-01-01 | 2023-01-08 | 7 days | 8 days | 13% | 18% | 10 |
| 1.2.5 | Implement Core Routing Stub | 2023-01-08 | 2023-01-19 | 11 days | 11 days | 16% | 18% | 7 |
| 1.2.6 | Collect & Populate Stub Details | 2023-01-19 | 2023-01-29 | 10 days | 10 days | 13% | 20% | 10 |
| 1.2.7 | Call all stub agents | 2023-01-29 | 2023-02-17 | 18 days | 16 days | 21% | 23% | 7 |
| 1.3.1 | Collect real agent API info | 2023-02-17 | 2023-03-05 | 18 days | 21 days | 26% | 28% | 7 |
| 1.3.3 | Implement Health Check | 2023-03-05 | 2023-03-26 | 21 days | 21 days | 24% | 33% | 12 |
| 1.5.1 | Design STM System | 2023-03-26 | 2023-04-20 | 34 days | 21 days | 24% | 29% | 8 |
| 1.3.2 | Update Registry (Real) | 2023-04-20 | 2023-05-04 | 14 days | 26 days | 28% | 33% | 7 |
| 1.3.4 | Send test requests | 2023-05-04 | 2023-05-18 | 14 days | 28 days | 33% | 36% | 8 |
| 1.5.2 | Implement STM (cache) | 2023-05-18 | 2023-06-12 | 24 days | 24 days | 29% | 32% | 8 |
| 1.3.5 | Debug Handshake mismatches | 2023-06-12 | 2023-06-26 | 14 days | 33 days | 36% | 41% | 0 |
| 1.5.3 | Integrate STM w/ Routing | 2023-06-26 | 2023-07-10 | 14 days | 29 days | 34% | 37% | 0 |
| 1.4.1 | Design integration test cases | 2023-07-10 | 2023-07-24 | 14 days | 36 days | 40% | 44% | 8 |
| 1.5.4 | Expose a final UI | 2023-07-24 | 2023-08-07 | 23 days | 34 days | 39% | 42% | 8 |
| 1.5.5 | Refine routing logic | 2023-08-07 | 2023-08-21 | 14 days | 36 days | 40% | 51% | 15 |
| 1.4.2 | Execute integration test suite | 2023-08-21 | 2023-09-04 | 13 days | 40 days | 42% | 48% | 8 |
| 1.5.6 | Implement logic to display results | 2023-09-04 | 2023-09-18 | 14 days | 39 days | 43% | 47% | 8 |
| 1.4.3 | Document test results | 2023-09-18 | 2023-10-02 | 14 days | 42 days | 44% | 50% | 8 |
| 1.5.7 | Final system deployment | 2023-10-02 | 2023-10-16 | 14 days | 44 days | 46% | 52% | 8 |
| 1.6.1 | Final Report Preparation | 2023-10-16 | 2023-10-30 | 14 days | 46 days | 49% | 52% | 6 |
| 1.6.2 | Code Archiving | 2023-10-30 | 2023-11-13 | 13 days | 49 days | 50% | 54% | 5 |

Path and Slack Analysis

- **Critical Paths:** The critical path is the sequence of tasks with zero slack, which defines the total project duration. In this project, there are **two critical paths:**

1. [1.1.1 \(Project Scoping\) -> 1.1.2 \(Inter-group Coordination\)](#)

2. [1.1.1 \(Project Scoping\) -> 1.1.3 \(Project Documentation Maintenance\)](#)

Total Project Duration: The duration of these paths is **55 days** ($5 + 50$). This means the ongoing work of coordinating with 16 groups and maintaining documentation is the driving factor for the project's timeline.

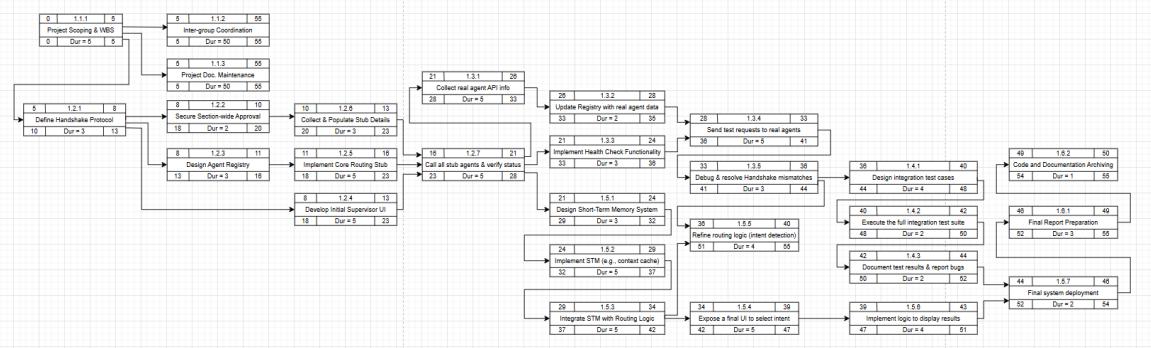
- **Parallel Paths (Development Workflow):**

- The entire development, integration, and testing workflow ([sections 1.2, 1.3, 1.4, 1.5, and 1.6](#)) runs in parallel to the critical management tasks.
- The longest development path (e.g., [1.1.1 -> 1.2.1 -> 1.2.3 -> ... -> 1.6.2](#)) has a total duration of 50 days.
- Because the main project duration is 55 days, this entire development workflow has **5 days of Total Slack** ($55 - 50 = 5$). This means the development work can be **delayed** by up to 5 days without delaying the final project deadline.
- You can see this slack reflected in the sub-paths. For example, the final task [1.6.2 \(Code Archiving\) has 5 days](#) of total slack, and [1.6.1 \(Final Report\) has 6 days](#).

- **Free Slack:**

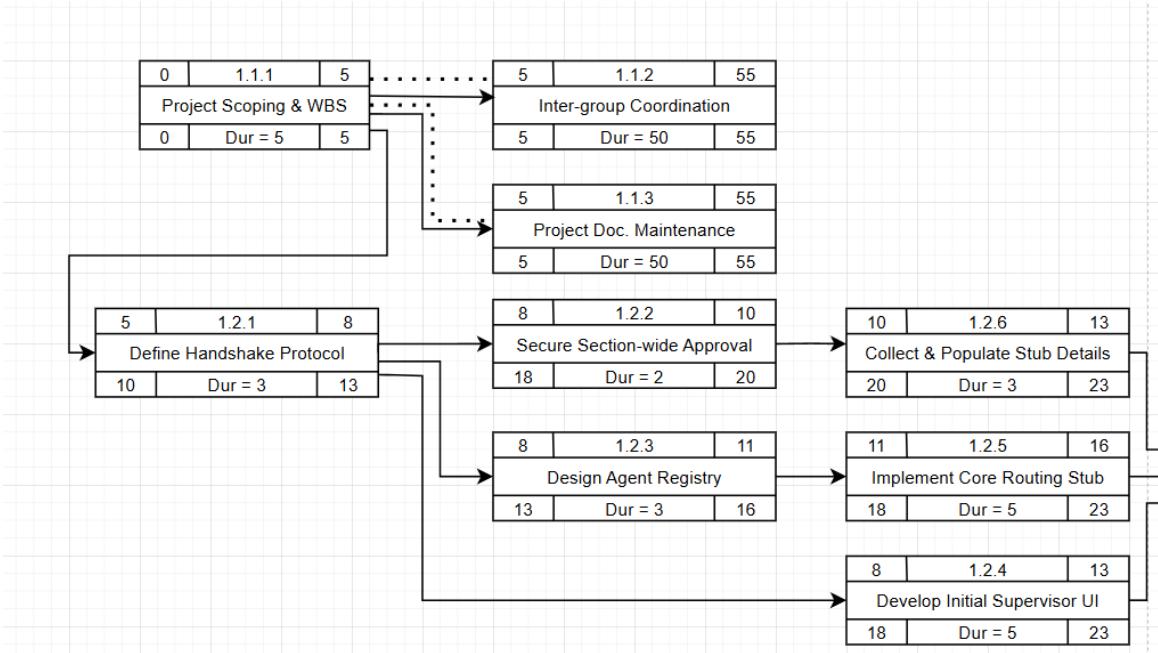
- Many tasks have **0 Free Slack** (e.g., [1.2.1, 1.2.7, 1.3.5](#)). This means that while the *path* they are on has total slack, delaying that *specific task* will immediately delay the start of the next task that depends on it (e.g., [delaying 1.2.7 will immediately delay 1.3.1, 1.3.3, and 1.5.1](#)).

AON Network Diagram



Critical Paths:

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Task 3: Cost Estimation, Budgeting, and Earned Value Analysis

This task is divided into two parts:

1. **Part A:** Creating the project budget (BAC) in MS Excel.
2. **Part B:** Performing an Earned Value Analysis (EVA) based on a 3-month project scenario.

Part A: Cost Estimation and Budgeting (MS Excel)

The project budget is built primarily around the human resource cost for the 3-person supervisor group, with additional costs for software and cloud infrastructure.

Cost Assumptions:

- **Team Size:** 3 members (Dawood, Hammad, Abdullah).
- **Project Duration:** 3 months (approx. 66 working days).
- **Team Workload:** 4 hours per member per working day (a realistic estimate for a student project).
- **Labor Rate:** A standard junior developer rate of \$20.00/hour.

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- **Infrastructure:** A basic cloud server to host the supervisor agent API, estimated at \$50/month.
- **Contingency:** A 15% reserve for unexpected costs.

Project Budget (BAC) Spreadsheet

Here is the data for your MS Excel spreadsheet.

| | A | B | C | D | E | F | G |
|----|----------------------------|-----------------------------------|----------|-------------|-------------|--------------------|---|
| 1 | Category | Line Item | Quantity | Unit | Unit Cost | Subtotal | |
| 2 | 1. Human Resources (Labor) | | | | | | |
| 3 | | Dawood Qamar | 264 | Hours | \$20.00 | \$5,280.00 | |
| 4 | | Hammad Zahid | 264 | Hours | \$20.00 | \$5,280.00 | |
| 5 | | Abdullah Asif | 264 | Hours | \$20.00 | \$5,280.00 | |
| 6 | | (Calc: 66 days * 4 hrs/day) | | | | | |
| 7 | | Labor Subtotal | | | | \$15,840.00 | |
| 8 | 2. Infrastructure | | | | | | |
| 9 | | Cloud Server Hosting | 3 | Months | \$50.00 | \$150.00 | |
| 10 | | Infrastructure Subtotal | | | | \$150.00 | |
| 11 | 3. Software & Assets | | | | | | |
| 12 | | Software Licenses / API Fees | 1 | Lump Sum | \$100.00 | \$100.00 | |
| 13 | | Software Subtotal | | | | \$100.00 | |
| 14 | | | | | | | |
| 15 | | Total Baseline Cost | | | | \$16,090.00 | |
| 16 | | Contingency Reserve (15%) | 0.15 | of Baseline | \$16,090.00 | \$2,413.50 | |
| 17 | | | | | | | |
| 18 | | TOTAL PROJECT BUDGET (BAC) | | | | \$18,503.50 | |
| 19 | | | | | | | |

Part B: Earned Value Analysis (EVA)

This analysis is based on the scenario: "assume you have completed three months of the project".

1. EVA Assumptions

- **Status Date:** At the 3-month (project completion) mark.
- **Planned Value (PV):** At the end of the project, the total *planned* work is 100% of the project.
 - PV = \$18,503.50 (This is the total planned budget, or BAC).
- **Earned Value (EV):** We assume the team completed all work except for the final "Project Closeout" phase (WBS 1.6) due to debugging delays in Phase 1.4.
 - Budget for 1.6.1 (Final Report):
 - 3 members * 4 hrs/day * 3 days * \$20/hr
 - = \$720
 - Budget for 1.6.2 (Archiving):

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- $3 \text{ members} * 4 \text{ hrs/day} * 1 \text{ day} * \$20/\text{hr}$
- $= \$240$
- **Total Budget for WBS 1.6** = \$960
- **EV = BAC - (Budget of uncompleted work)**
 - $= \$18,503.50 - \960
 - $= \$17,543.50$
- **Actual Cost (AC):** We assume the debugging in Phase 1.4 required 50 hours of unplanned overtime, but the team did not (yet) spend the money budgeted for Phase 1.6.
 - **Planned cost of work done (Baseline - WBS 1.6)**
 - $= \$16,090 - \960
 - $= \$15,130$
 - **Overtime Cost**
 - $= 50 \text{ hours} * \$20/\text{hr}$
 - $= \$1,000$
 - **AC = (Planned cost of work done) + (Overtime)**
 - $= \$15,130 + \$1,000$
 - $= \$16,130$

2. Calculations and Interpretation

Here are the answers to questions a-e:

a. Cost Variance (CV) and Schedule Variance (SV)

- **CV = EV - AC**
 - $= \$17,543.50 - \$16,130$
 - $= +\$1,413.50$
- **SV = EV - PV**
 - $= \$17,543.50 - \$18,503.50$
 - $= -\$960.00$

b. Cost Performance Index (CPI) and Schedule Performance Index (SPI)

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- $CPI = EV / AC$

- $= \$17,543.50 / \$16,130$
- $= 1.087$

- $SPI = EV / PV$

- $= \$17,543.50 / \$18,503.50$
- $= 0.948$

c. Interpretation of Results

- **Cost:** The project is **UNDER BUDGET**. The **positive CV (+\$1,413.50)** and **$CPI > 1.0$** show that we have earned more value for every dollar spent than we originally planned.
- **Schedule:** The project is **BEHIND SCHEDULE**. The **negative SV (-\$960.00)** and **$SPI < 1.0$** show that we have not completed all the work that was planned by this date (specifically, WBS 1.6 is missing).

d. Estimate at Completion (EAC)

- $EAC = BAC / CPI$

- $= \$18,503.50 / 1.087$
- $= \$17,022.54$

- **Comment:** The project is performing *better* than planned financially. The new forecasted total cost (EAC) is approximately **\$1,500 less** than the original budget (BAC).

e. Estimated Time to Finish

- $EAC \text{ (Time)} = \text{Original Duration} / SPI$

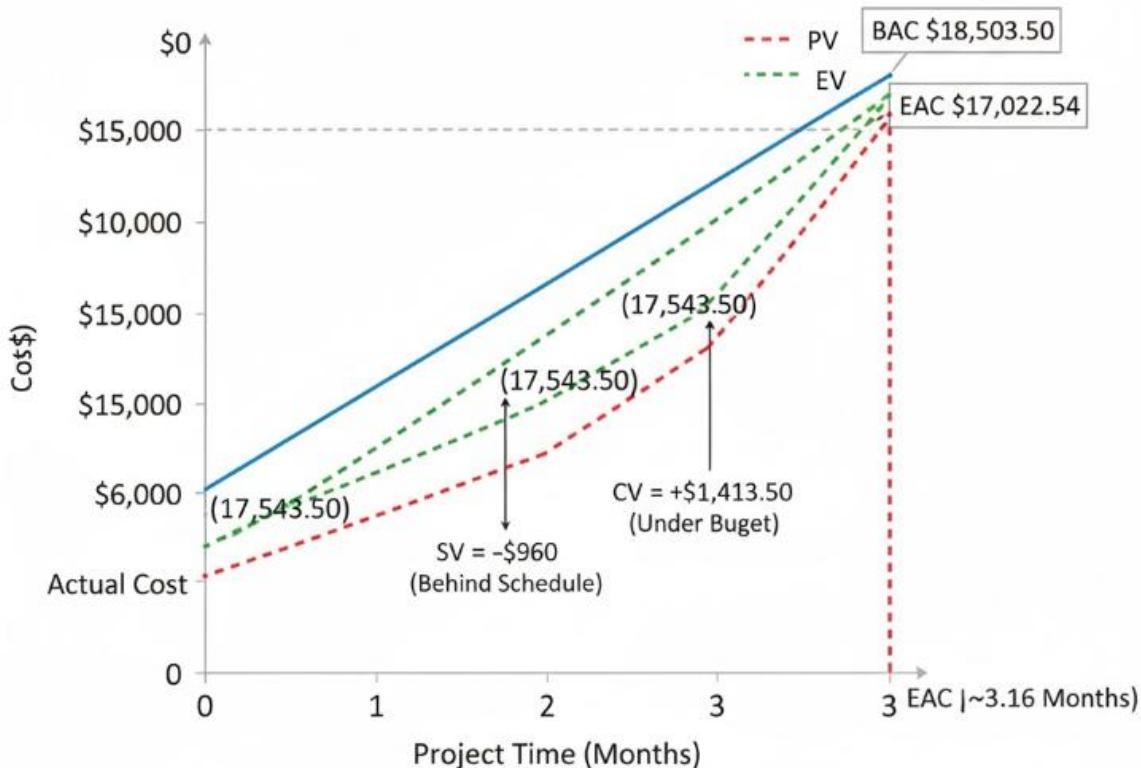
- $= 3 \text{ months} / 0.948$
- $= 3.16 \text{ months}$

- **Comment:** The project will take longer than the planned 3 months to be fully completed. The new forecast suggests it will take **3.16 months** to finish all the work.

3. Earned Value Chart (Sketch)

Earned Value Analysis - 3-Month Project Snapshot

SPI = 0.948, CPI = 1.087



NOTE :::: REPLACE THIS CHART WITH A PROPER HANDMADE CHART

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