Solutions Manual

# Chapter 3 Supplement: Project Management

1a. P(completed within 12 weeks) =

1b. P(completed within 15 weeks) =

1c. P(completed within 18 weeks) =

1d. 95% likelihood=

Cognitive Domain: Knowledge

Difficulty Level: Easy

2a. P(completed within 50 days) =

2b. P(completed within 70 days) =

2c. P(completed within 90 days) =

2d. 99% likelihood=

Cognitive Domain: Comprehension

Difficulty Level: Medium

3a. P(completed within 50 days) =

P(completed within 70 days) =

P(completed within 90 days) =

3b. 99% likelihood =

Cognitive Domain: Comprehension

Difficulty Level: Easy

4a. Expected time for activity A 

Variance for activity A 

All other activity expected times and variances are in the table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Activity* | *Optimistic* | *Most Likely* | *Pessimistic* | *TE* | *Variance* |
| A | 1 | 4 | 7 | 4 | 1.00 |
| B | 2 | 6 | 7 | 5.5 | 0.69 |
| C | 3 | 3 | 6 | 3.5 | 0.25 |
| D | 6 | 13 | 14 | 12 | 1.78 |
| E | 3 | 6 | 12 | 6.5 | 2.25 |
| F | 6 | 8 | 16 | 9 | 2.78 |
| G | 1 | 5 | 6 | 4.5 | 0.69 |

F has the greatest variance.

4b. Expected duration 

B

C

D

E

F

A

G

4c. Critical path variance 

Critical path standard deviation 

Z.90 = 1.282

90% probability completion estimate 

Cognitive Domain: Comprehension

Difficulty Level: Easy

5a. Activity times in table: Activity A calculations shown as follows.

Expected time for Activity A 

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Activity* | *Optimistic* | *Most Likely* | *Pessimistic* | *TE* | *Variance* |
| A | 1 | 4 | 7 | 4 | 1.00 |
| B | 2 | 6 | 10 | 6 | 1.78 |
| C | 3 | 3 | 9 | 4 | 1.00 |
| D | 6 | 13 | 14 | 12 | 1.78 |
| E | 4 | 6 | 14 | 7 | 2.78 |
| F | 6 | 8 | 16 | 9 | 2.78 |
| G | 2 | 5 | 8 | 5 | 1.00 |

5b. Project total length = B + C + E + G = 6 + 4 + 7 + 5 = 22 weeks

|  |  |  |
| --- | --- | --- |
| *Activity* | *TE* | *Slack* |
| A | 4 | 1 |
| B | 6 | 0 |
| C | 4 | 0 |
| D | 12 | 1 |
| E | 7 | 0 |
| F | 9 | 2 |
| G | 5 | 0 |

5c. Critical path is B – C – E – G = 22 weeks; Paths A – D – G and A – E – G are 21 weeks and have 1 week slack; Path B – F – G has 2 weeks slack.

5d. Burst activities are A & B; merge activities are E & G.

5e. CP variance is 1.78 + 1.00 + 2.78 + 1.00 = 6.56; CP standard deviation = 2.56.

Likelihood of finishing within 24 weeks 

5f. 99% completion probability 

Cognitive Domain: Comprehension

Difficulty Level: Easy

6ab.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | *a* | *m* | *b* | *TE* | *VAR* |
| A | 1 | 4 | 8 | 4.17 | 1.36 |
| B | 3 | 5 | 9 | 5.33 | 1.00 |
| C | 4 | 6 | 10 | 6.33 | 1.00 |
| D | 3 | 7 | 15 | 7.67 | 4.00 |
| E | 5 | 10 | 16 | 10.17 | 3.36 |
| F | 3 | 6 | 15 | 7.00 | 4.00 |
| G | 4 | 7 | 12 | 7.33 | 1.78 |

A – B – D – F – G on critical path; their variances sum to 1.36 + 1 + 4 + 4 + 1.78 = 12.14

A – B – D – F – G expected times sum to 4.17 + 5.33 + 7.67 + 7 + 7.33 = 31.50

6c. Likelihood of finishing within 34 weeks 

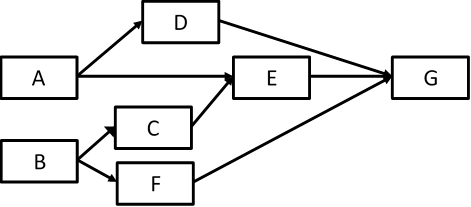
6d. 99% likelihood of finishing is a deadline 

Cognitive Domain: Comprehension

Difficulty Level: Easy

7ab.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Activity* | *a* | *m* | *b* | *TE* | *VAR* | *Slack* | *ES* | *LS* | *EF* | *LF* |
| A | 1 | 4 | 7 | 4.00 | 1.00 | 1 | 0 | 1 | 4 | 5 |
| B | 2 | 6 | 10 | 6.00 | 1.78 | 0 | 0 | 0 | 6 | 6 |
| C | 3 | 3 | 9 | 4.00 | 1.00 | 0 | 6 | 6 | 10 | 10 |
| D | 6 | 13 | 14 | 12.00 | 1.78 | 1 | 4 | 5 | 16 | 17 |
| E | 4 | 6 | 14 | 7.00 | 2.78 | 0 | 10 | 10 | 17 | 17 |
| F | 6 | 8 | 16 | 9.00 | 2.78 | 2 | 6 | 8 | 15 | 17 |
| G | 2 | 5 | 8 | 5.00 | 1.00 | 0 | 17 | 17 | 22 | 22 |



Total project length = B – C – E – G = 22 weeks.

7c. Critical path is B – C – E – G and is 22 weeks long. Alternative paths and their slack are A – E – G(1), A – D – G(2), and B – F – G(2).

7d. Activities B and A are the burst activities. Activities E and G are merge activities.

7e. Likelihood of finishing within 24 weeks 

7f. 99% likelihood of finishing is a deadline 

An additional 27.88 – 22 = 5.88 weeks are needed.

Cognitive Domain: Comprehension

Difficulty Level: Easy

8a. The cost per day to crash is given by .

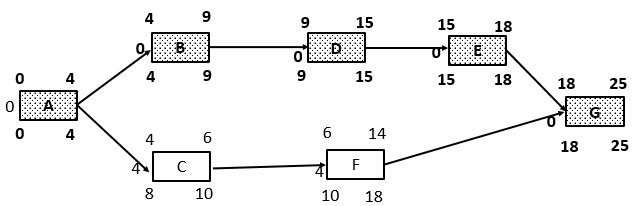
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | *Normal* | *Norm Cost (in U.S. dollars)* | *Crashed* | *Crash Cost (in U.S. dollars)* | *Crash Cost Per Day (in U.S. dollars)* |
| A | 4 | 1,000 | 3 | 2,000 | 1,000 |
| B | 5 | 2,500 | 3 | 5,000 | 1,250 |
| C | 3 | 750 | 2 | 1,200 | 450 |
| D | 7 | 3,500 | 5 | 5,000 | 750 |
| E | 2 | 500 | 1 | 2,000 | 1,500 |
| F | 5 | 2,000 | 4 | 3,000 | 1,000 |
| G | 9 | 4,500 | 7 | 6,300 | 900 |

8b. The least expensive activities to crash per day are C, D, and G.

Cognitive Domain: Application

Difficulty Level: Medium

9a. The project duration is 25 weeks. Activities C and F have 4 weeks of slack time. The critical path is A – B – D – E – G.



9b. To reduce the project duration as inexpensively as possible, expedite activities on the critical path, starting from least expensive to most expensive. The first action should be to reduce Activity D by 2 weeks at $2,000 per week. Then reduce Activity E by 1 week for $2,500 and Activity G by 1 week for $2,500.

9c. After the actions in Part B are completed, the critical path is still A – B – D – E – G. The project completion time has shrunk to 21 weeks.

9d. The next purchases would be to reduce B by 1 week for $3,000 and A by 1 week for $4,000 to bring the project down to 19 weeks.

The total extra cost to crash the project from 25 weeks to 21 weeks = $2,000 x 2 + $2,500 + $2,500 = $9,000. The penalty cost for completing the project in 21 weeks instead of 19 weeks = 2 weeks x $5,000 = $10,000. The total cost of completing the project in 21 weeks = $9,000 + $10,000 = $19,000.

The next alternative is to crash the project from 25 weeks to 20 weeks by crashing B by 1 week for $3,000. All activities are now critical. The crash cost = $9,000 + $3,000 = $12,000. The penalty cost = 1 week x $5,000. The total cost of completing the project in 20 weeks = $12,000 + $5,000 = $17,000.

The next alternative is to crash the project from 25 weeks to 19 weeks by crashing A by 1 week for $4,000. All activities are critical. The crash cost = $12,000 + $4,000 = $16,000. The penalty cost = $0. The total cost of completing the project in 19 weeks = $16,000.

Therefore, it makes sense to crash the project from 25 weeks to 19 weeks.

Cognitive Domain: Application

Difficulty Level: Hard

10. Value is calculated as Plan x Percentage Complete.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *#11* | *Jan* | *Feb* | *Mar* | *Apr* | *May* | *Jun* | *Plan* | *% Complete* | *Value* |
| Staffing | 8 | 7 |  |  |  |  | 15 | 100 | 15 |
| Blueprinting |  | 4 | 6 |  |  |  | 10 | 100 | 10 |
| Prototype development |  |  | 2 | 8 |  |  | 10 | 70 | 7 |
| Full design |  |  |  | 3 | 8 | 10 | 21 | 67 | 14.07 |
| Construction |  |  |  |  | 2 | 30 | 32 | 25 | 8 |
| Transfer |  |  |  |  |  | 10 | 10 | 0 | 0 |
| Monthly plan | 8 | 11 | 8 | 11 | 10 | 50 |  |  |  |
| Cumulative | 8 | 19 | 27 | 38 | 48 | 98 |  |  |  |

Cognitive Domain: Application

Difficulty Level: Hard

11.

Estimate Time to Completion = (1/0.52 x 12) = 21.75

Actual Cost of Work Performed (AC) = 10 + 15 + 6 + 14 + 9 + 40 = 94

Cost Performance Index= (54.07/94) = 0.58

Estimated Cost to Completion = (1/0.58 x $125,000) = $217,310.89

Cognitive Domain: Application

Difficulty Level: Hard

12.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Schedule Variance Work Units* | *A* | *B* | *C* | *D* | *E* | *F* | *Total* |
| Planned value (PV) | 20 | 15 | 10 | 25 | 20 | 20 | 110 |
| Cumulative planned value | 20 | 35 | 45 | 70 | 90 | 110 |  |
| Earned value (EV) | 25 | 10 | 10 | 20 | 25 | 15 | 105 |
| Cumulative earned value | 25 | 35 | 45 | 65 | 90 | 105 |  |
| Schedule variance |  |  |  |  |  |  |  |
| Schedule performance index | 1.25 | 1 | 1 | 0.93 | 1 | 0.95 |  |
| Estimated time to completion | 4.8 | 6 | 6 | 6.46 | 6 | 6.29 |  |

The schedule performance index (SPI) is calculated as EVCumulative/PVCumulative. The estimated time to completion is calculated as (1/SPI)Planned Time—in this case, 6 time units.

Cognitive Domain: Application

Difficulty Level: Hard

13.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Activity*** | ***Jan*** | ***Feb*** | ***Mar*** | ***Apr*** | ***Plan*** | ***%C*** | ***Value*** |
| Clearing | 2 | 2 |  |  | 4 | 100 | 4 |
| Leveling | 1 | 4 |  |  | 5 | 100 | 5 |
| Draining |  | 2 | 3 |  | 5 | 80 | 4 |
| Paving |  |  | 1 | 5 | 6 | 50 | 3 |
| Construction |  |  |  | 12 | 12 | 50 | 6 |
| Monthly plan Cumulative | 3 | 11 | 15 | 32 | 32 |  | 22 |
| Monthly actual | 3 | 9 | 5 | 20 |  |  |  |
| Cumulative actual | 3 | 12 | 17 | 37 |  |  |  |

13a.

Planned Value (PV) = 32

Earned Value (EV) = 22

Schedule Performance Index = 22/32 = 0.6875

Estimated Time to Completion = 1/0.6875 x 9 = 13.09

13b.

Actual Cost of Work Performed = 37

Earned Value = 22

Cost Performance Index =22/37 = 0.5946

Estimated Cost to Completion = 1/0.5946 x $100,000 = $168,181.82

Cognitive Domain: Analysis

Difficulty Level: Medium

14. Planned Value (PV) = 65

Earned Value (EV) = 58

SPI = 58/65 = 0.892

Estimated Time to Completion = 15 \* (1/0.892) = 16.81 months

Cognitive Domain: Application

Difficulty Level: Hard

15. Planned Value (PV) = 75

Earned Value (EV) = 80

SPI = 80/75 = 1.067

Estimated Time to Completion = 15 \* (1/1.067) = 14.06.81 months

Cognitive Domain: Application

Difficulty Level: Hard