Solutions Manual

# Chapter 9 Supplement: Tools for Analyzing, Designing, and Selecting Processes and Layouts

1.

2 All-beef patties

Special sauce

Cheese

Lettuce

Sesame seed bun

Wrapper

Pickles

Onions

Sesame seed bun

Steps:

Bun #1 Assembly (A-1)

Apply special sauce to top bun, add lettuce and one beef patty.

Add cheese and second beef patty.

Bun #2 Assembly (A-2)

Apply onions and pickles to bottom bun. Put both halves together with the buns on the outside.

Wrapping (A-3)

Wrap sandwich.

A-1

A-2

A-3

Cognitive Domain: Analysis

Difficulty Level: Medium

2.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Step* | *Distance (ft)* | *Time (min)* | *Symbols* | *Description* |
| 1 | 10 | 2 | **→ □ ○** Ɒ | Load oranges in hopper |
| 2 | 15 | 1 | **→ □ ○** Ɒ | Deliver to peeler |
| 3 | 20 | 2 | **→ □ ○** Ɒ | Peel oranges |
| 4 | 7 | 0.5 | **→ □ ○** Ɒ | Deliver to juicer |
| 5 | 22 | 3 | **→ □ ○** Ɒ | Juice |
| 6 | 4 | 0.25 | **→ □ ○** Ɒ | Bottle juice |
| Total | 78 | 8.75 |  |  |

Cognitive Domain: Analysis

Difficulty Level: Medium

3.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Step* | *Distance (ft)* | *Time (sec)* | *Symbols* | *Description* |
| 1 | 0 | 2 | **→ □ ○** Ɒ | Select courses online |
| 2 | 0 | 1 | **→ □ ○** Ɒ | Submit course requests online |
| 3 | 0 | 0.005 | **→ □ ○** Ɒ | System prerequisite check |
| 4 | 0 | 0.005 | **→ □ ○** Ɒ | System registration hold check |
| 5 | 0 | 0.005 | **→ □ ○** Ɒ | Generate confirmation |
|  |  |  |  |  |
| Total | 0 | 3.015 |  |  |

Cognitive Domain: Analysis

Difficulty Level: Medium

4.

|  |
| --- |
| Level-1 Parking Reception Waiting Rm Reception Décor Bill |
| Level-2  Pay & go  Greet stylist  Sit in chair  Wait  Sign In  Arrive |
| F4  F3  F2  F1  Level-3  Greet customer  Cut hair  Greet customer  Collect |
| Level-4  Unclog drain |
| Potential F1 No appointment F2 Stylist running late F3 Scissors rusty F4 Register broken  Failures Customer late Chair fault Customer out of money |

Cognitive Domain: Application

Difficulty Level: Hard

5a.



Process A is cheaper.

5b.



Choose B when production volume is between 0 to 4,000; choose A when production volume is above 4,000.

Cognitive Domain: Knowledge Difficulty Level: Easy

6.



Process C from 0 to 18,750 units, and Process B from 18,751 units up.

Cognitive Domain: Knowledge

Difficulty Level: Easy

7a.



Intermittent is the best.

7b.



Repetitive is best from 50,000 to 66,667, after which point continuous is best.

7c.



Mass customization and repetitive have the same total cost at 30,769 units of output.

Cognitive Domain: Knowledge

Difficulty Level: Easy

8.



Cognitive Domain: Knowledge

Difficulty Level: Easy

9a.



9b.



Cognitive Domain: Knowledge

Difficulty Level: Easy

10a.

*ORIGINAL* = (80 × 60) + (120 × 20) + (100 × 30) + (120 × 20) + 80 × (120 + 50) + 120 × (50 + 40) + 300 × (50 × 20) + 150 × (30 + 40) + 200 × (30 + 70) + 220 × (30 + 20) + 80 × (70 + 30) + 270 × (50 + 60) + 80 × (20 + 20) + 120 × (50 + 30) + 120 × (40 + 60) = 162,000

10b. An improved layout moves six (waiting area) to Room 1, one (intake) to Room 2, four (laboratory) to Room 3, three (radiology) to Room 4, two (exam room) to Room 5, and five (gynecology) to Room 6. The trip’s distance score is reduced to 131,800.

*IMPROVED* = 80 × (50 + 120) + 120 × (30 + 50) + 100 × (60 + 50) + 120 × (70 + 30) + 80 × (60 + 40) + 120 × (30) + 300 × 20 + 150 × 60 + 200 × 20 + 220 × (20 + 30) + 80 × (20 + 50) + 270 × (20 + 20) + 80 × (50 + 40) + 120 × (70 + 30) + 120 × (30 + 40) = 131,800

Cognitive Domain: Analysis

Difficulty Level: Medium

11. The current layout requires 41,970 feet of travel. An improved layout, which keeps Department 1 in Room 1 but moves Department 4 to Room 2, Department 6 to Room 3, Department 2 to Room 4, Department 3 to Room 5, and Department 5 to Room 6, has only 34,830 feet of travel.

*DistanceIMPROVED* = 70 × 30 + 58 × 60 + 20 × 90 + 30 × 120 + 15 × 150 + 55 × 30 + 27 × 60 + 46 × 90 +20 × 120 + 47 × 30 + 18 × 60 + 40 × 90 + 100 × 30 + 33 × 60 + 24 × 30 = 34,830

Cognitive Domain: Knowledge

Difficulty Level: Easy

|  |  |  |
| --- | --- | --- |
| Department 9 | Department 6 | Department 7 |
| Department 3 | Department 5 | Department 8 |
| Department 4 | Department 1 | Department 2 |

12.

Cognitive Domain: Analysis

Difficulty Level: Medium

13.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *FROM/TO* | *Customer Movements* | | | | | |
| *Electronics* | *Men’s* | *Boys* | *Girls* | *Women’s* | *Infants* |
| Electronics | \_\_ | 50 |  |  |  |  |
| Men’s | 70 | \_\_ | 30 | 20 |  |  |
| Boys | 50 | 30 | \_\_ | 40 |  |  |
| Girls | 20 |  | 30 | \_\_ | 50 |  |
| Women’s | 10 | 40 | 50 | 60 | \_\_ | 50 |
| Infants |  |  |  |  | 40 | \_\_ |

Cognitive Domain: Analysis

Difficulty Level: Medium

14a.



14b.



14c.



Cognitive Domain: Knowledge

Difficulty Level: Easy

15a. Cycle time is 9 minutes.

A = 8; B = 5; D = 3; C = 3; F = 2; E = 2; H = 1; G = 1; I = 0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Most following tasks rule CT = 9 | | | |  |  |  |
| Station | 1 | 2 | 3 | 4 | 5 | 6 |
| Tasks | A | B E | D C | F | H | G I |
| Work time | 8 | 5 4 | 5 4 | 9 | 9 | 6 3 |
| Idle | 1 | 0 | 0 | 0 | 0 | 0 |

Balance efficiency = 53/54 = 98.1%

15b. A = 53; B = 32; D = 23; C = 22; F = 18; E = 16; H = 12; G = 9; I = 3

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Ranked positional weight rule CT = 9 | | | |  |  |  |
| Station | 1 | 2 | 3 | 4 | 5 | 6 |
| Tasks | A | B E | D C | F | H | G I |
| Work time | 8 | 5 4 | 5 4 | 9 | 9 | 6 3 |
| Idle | 1 | 0 | 0 | 0 | 0 | 0 |

Balance efficiency = 53/(6×9) = 98.1%

15c. The efficiencies are identical.

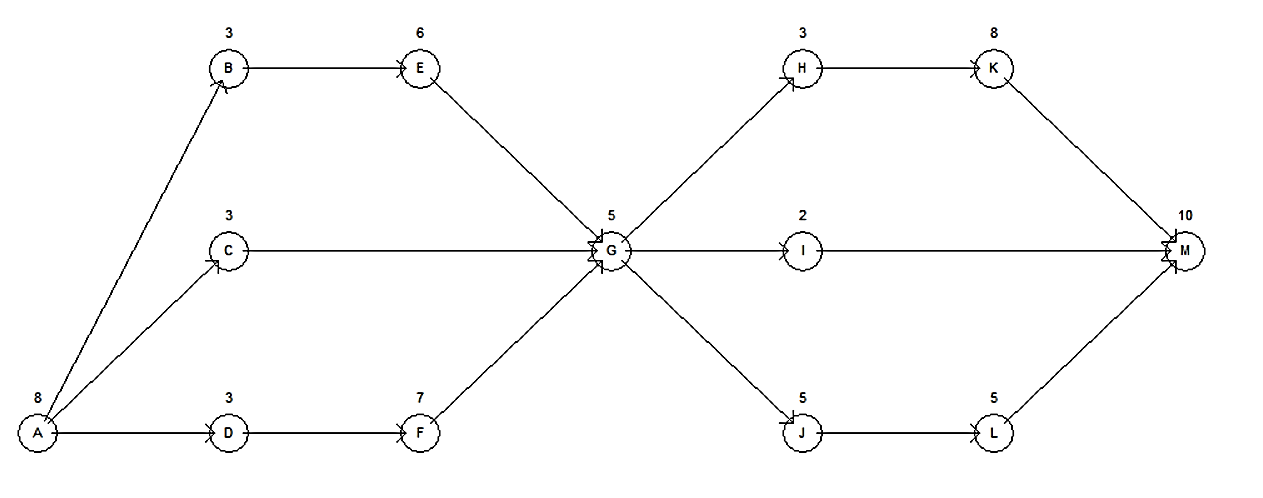
Cognitive Domain: Analysis

Difficulty Level: Medium

16a.



16b.



16c.



16df.

A = 12; B = 8; D = 8; F = 7; E = 7; C = 7; G = 6; J = 2; H = 2; K = 1; L = 1; M = 0

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Most following tasks rule | | | | | | Balance efficiency = 68/90 = 75.56% | | | | |
| Station | 1 | 2 | 3 | 4 | 5 | | 6 | 7 | 8 | 9 |
| Task | A | B, D, C | F | E | G, | | J, H, I | K | L | M |
| Work | 8 | 3, 3, 3 | 7 | 6 | 5, | | 5,, 3, 2 | 8 | 5 | 10 |
| Idle | 2 | 1 | 3 | 4 | 5 | | 0 | 2 | 5 | 0 |

16ef.

A = 68; D = 48; B = 47; F = 45; E = 44; C = 41; G = 38; H = 33; J = 20; K = 18; L = 15; I = 12; M = 10

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Positional weight | | | | | | Balance efficiency = 68/90 = 75.56% | | | | |
| Station | 1 | 2 | 3 | 4 | 5 | | 6 | 7 | 8 | 9 |
| Task | A | D, B, C | F | E | G, | | H, J | K | L, I | M |
| Work | 8 | 3, 3, 3 | 7 | 6 | 5, | | 3, 5 | 8 | 5, 2 | 10 |
| Idle | 2 | 1 | 3 | 4 | 5 | | 2 | 2 | 3 | 0 |

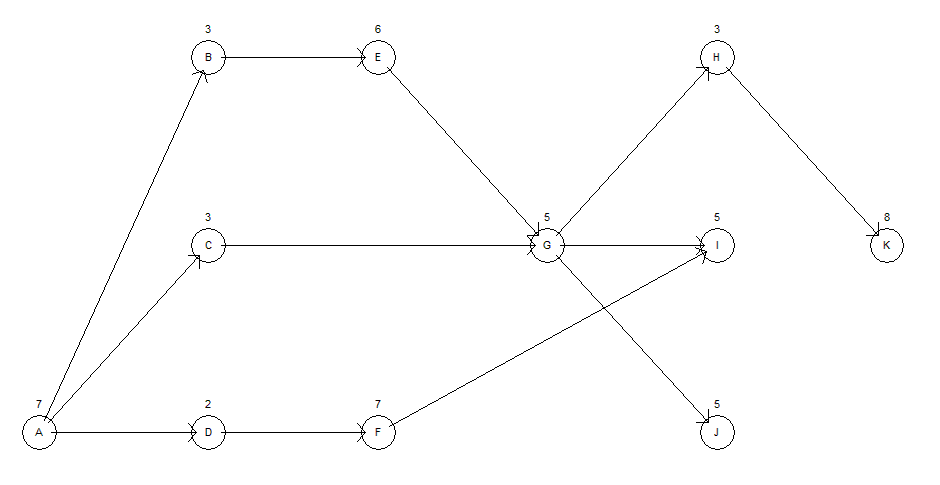
16g. The two rules achieve identical balance efficiency.

Cognitive Domain: Analysis

Difficulty Level: Medium

17a. 

17b.



17c.



17df.

A = 10; B = 7; E = 5; C = 5; G = 4; D = 3; F = 1; H = 1; K = 0, I = 0, J = 0

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Most following tasks rule | | | | |
| Station | 1 | 2 | 3 | 4 | | 5 | 6 |
| Task | A | B, C, D | E, | G, F | | H, K | I, J |
| Work | 7 | 3, 3,2 | 6, | 5, 7 | | 3, 8 | 5, 5 |
| Idle | 5 | 4 | 6 | 0 | | 1 | 2 |

Balance efficiency = 54/72 = 75%

17ef.

A = 54; B = 35; E = 32; C = 29; G = 26; D = 14; F = 12; H = 11; K = 8; I = 5; J = 5

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Ranked positional weight rule | | | | Balance efficiency = 54/72 = 75% | | | |
| Station | 1 | 2 | 3 | | 4 | 5 | 6 |
| Task | A | B, C, D | E | | G, F | H, K | I, J |
| Work | 7 | 3, 3, 2 | 6 | | 5,7 | 3, 8 | 5, 5 |
| Idle | 5 | 4 | 6 | | 0 | 1 | 2 |

17g. The two rules achieve the same balance efficiency.

Cognitive Domain: Analysis

Difficulty Level: Medium

18. Cycle time is 11 minutes.

A = 10; B = 7; E = 5; C = 5; G = 4; D = 3; F = 1; H = 1; K = 0, I = 0, J = 0

Most following tasks rule

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Station | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Task | A | B, C, D | E | G, | F, | H, K | I, J |
| Work | 7 | 3, 3, 2 | 6 | 5 | 7, | 3, 8 | 5, 5 |
| Idle | 4 | 3 | 5 | 6 | 4 | 0 | 1 |

Balance efficiency = 54/77 = 70%

Cognitive Domain: Analysis

Difficulty Level: Medium

19.

|  |  |  |
| --- | --- | --- |
| Department 1 | Department 2 | Department 3 |
| Department 6 | Department 5 | Department 4 |

Cognitive Domain: Analysis

Difficulty Level: Medium

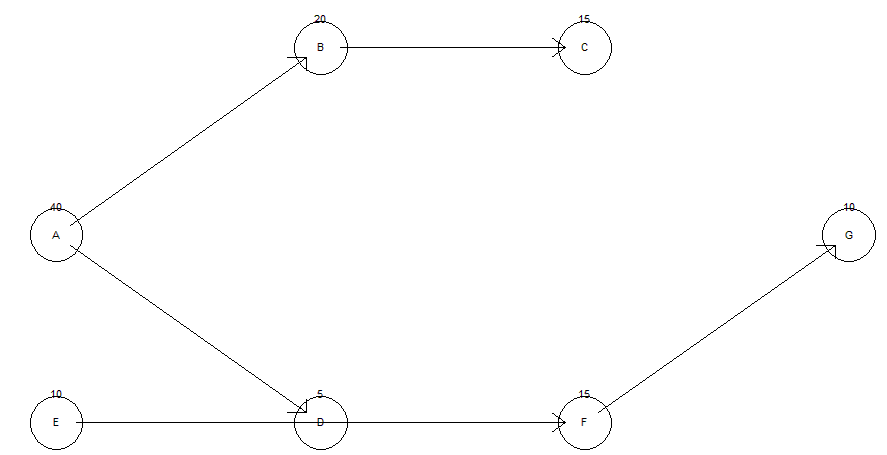
20.

|  |  |  |
| --- | --- | --- |
| Department 3 | Department 2 | Department 6 |
| Department 5 | Department 1 | Department 4 |

Cognitive Domain: Analysis

Difficulty Level: Medium

21a.



21b.

Total time to assemble one unit = 40 + 10 + 5 + 20 + 15 + 15 + 10 = 115 minutes



21c.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Most following tasks rule | | | Efficiency = 115/120 = 95.83% | |
| Station | 1 | 2 | 3 |  |
| Task | A | E, D, B | F, C, G | Σ |
| Work | 40 | 10, 5, 20 | 15, 15, 10 | 115 |
| Time | 0 | 5 | 0 | 5 |

21d. In order to produce 90 cases per week: Task A has to be redesigned so that it can be completed in 26 minutes instead of 40.

Cognitive Domain: Analysis

Difficulty Level: Medium

22a.



22bcd.

Positional weight rule

A = 58; B = 48; D = 35; C = 32, F = 29; E = 18, H = 13; G = 11; I = 4

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Station | 1 | 2 | 3 | 4 | 5 | 6 |
| Task | A | B, E | D, C | F | H | G, I |
| Work | 10 | 5, 5 | 6, 3 | 9 | 9 | 7, 4 |
| Idle | 2 | 2 | 4 | 3 | 3 | 1 |

Balance efficiency = 58/72 = 81%

22c.

Most following tasks rule

A = 8; B = 7; D = 4; C = 4; F = 3; E = 2; H = 1; G = 1; I = 0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Station | 1 | 2 | 3 | 4 | 5 | 6 |
| Task | A | B, E | D, C | F | H | G, I |
| Work | 10 | 5, 5 | 6, 3 | 9 | 9 | 7, 4 |
| Idle | 2 | 2 | 4 | 3 | 3 | 1 |

Balance efficiency = 58/72 = 81%

22d. The two rules have the same efficiency because the task sequence is identical.

Cognitive Domain: Analysis

Difficulty Level: Medium

23a.

23b.

*Total CostREFURB = $1,200 + 5,000 × $2.5 = $13,700*

*Total CostNEW MACHINE = $2,500 + 5,000 × $0.8 = $6,500*

*Total CostDESIGN MODS = $1,600 + 5,000 × $1.2 = $7,600*

The new machine is the lowest cost alternative.

23c. From 2000 to 2250, design modification is least expensive; from 2250 to 3000, new machine is least expensive.

Cognitive Domain: Analysis

Difficulty Level: Medium

24a. At 25,000 units, mass customization yields the highest profit. 

24b. From 15,000 to 20,000 units, the most profitable process is mass customization.

Cognitive Domain: Analysis

Difficulty Level: Medium