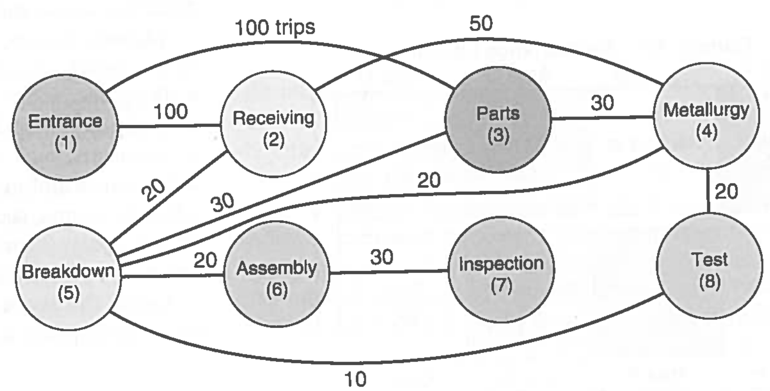
SOLUTION

First, establish Aero Maintenance's current layout, as shown in Figure 9.16. Then, by analyzing the current layout, compute material movement:

$$\begin{aligned}\text{Total movement} &= \underbrace{(100 \times 10')}_{1 \text{ to } 2} + \underbrace{(100 \times 20')}_{1 \text{ to } 3} + \underbrace{(50 \times 20')}_{2 \text{ to } 4} + \underbrace{(20 \times 10')}_{2 \text{ to } 5} \\ &\quad + \underbrace{(30 \times 10')}_{3 \text{ to } 4} + \underbrace{(30 \times 20')}_{3 \text{ to } 5} + \underbrace{(20 \times 30')}_{4 \text{ to } 5} + \underbrace{(20 \times 10')}_{4 \text{ to } 8} \\ &\quad + \underbrace{(20 \times 10')}_{5 \text{ to } 6} + \underbrace{(10 \times 30')}_{5 \text{ to } 8} + \underbrace{(30 \times 10')}_{5 \text{ to } 7} \\ &= 1{,}000 + 2{,}000 + 1{,}000 + 200 + 300 + 600 + 600 \\ &\quad + 200 + 200 + 300 + 300 \\ &= 6{,}700 \text{ feet}\end{aligned}$$

Figure 9.16
Current Material Flow

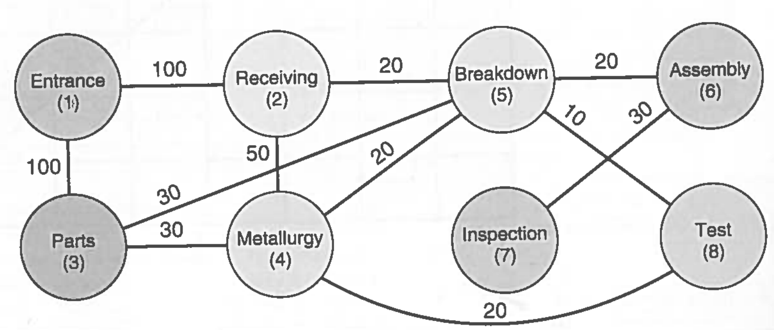


Propose a new layout that will reduce the current figure of 6,700 feet. Two useful changes, for example, are to switch departments 3 and 5 and to interchange departments 4 and 6. This change would result in the schematic shown in Figure 9.17:

$$\begin{aligned}\text{Total movement} &= \underbrace{(100 \times 10')}_{1 \text{ to } 2} + \underbrace{(100 \times 10')}_{1 \text{ to } 3} + \underbrace{(50 \times 10')}_{2 \text{ to } 4} + \underbrace{(20 \times 10')}_{2 \text{ to } 5} \\ &\quad + \underbrace{(30 \times 10')}_{3 \text{ to } 4} + \underbrace{(30 \times 20')}_{3 \text{ to } 5} + \underbrace{(20 \times 10')}_{4 \text{ to } 5} + \underbrace{(20 \times 20')}_{4 \text{ to } 8} \\ &\quad + \underbrace{(20 \times 10')}_{5 \text{ to } 6} + \underbrace{(10 \times 10')}_{5 \text{ to } 8} + \underbrace{(30 \times 10')}_{6 \text{ to } 7} \\ &= 1{,}000 + 1{,}000 + 500 + 200 + 300 + 600 + 200 \\ &\quad + 400 + 200 + 100 + 300 \\ &= 4{,}800 \text{ feet}\end{aligned}$$

Do you see any room for further improvement?

Figure 9.17
Improved Layout

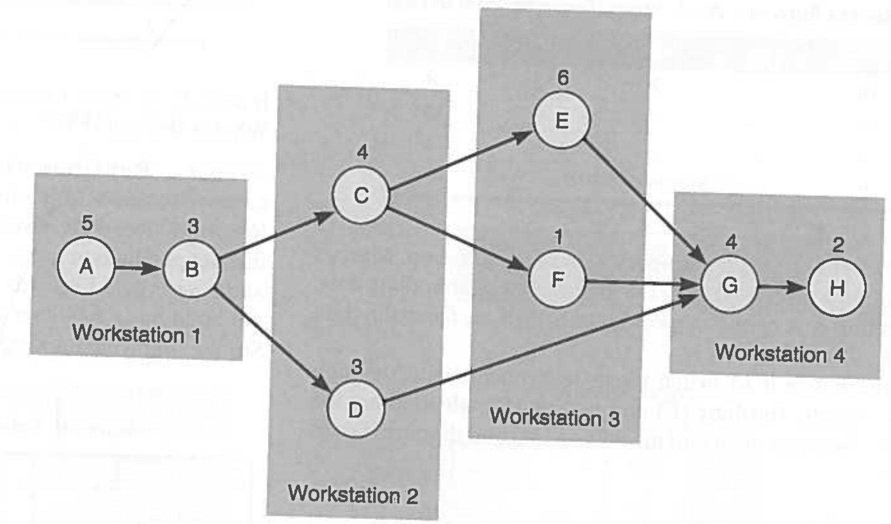


SOLVED PROBLEM 9.2

The assembly line whose activities are shown in Figure 9.18 has an 8-minute cycle time. Draw the precedence graph and find the minimum possible number of one-person workstations. Then arrange the work activities into workstations so as to balance the line. What is the efficiency of your line balance?

TASK	PERFORMANCE TIME (MINUTES)	TASK MUST FOLLOW THIS TASK
A	5	—
B	3	A
C	4	B
D	3	B
E	6	C
F	1	C
G	4	D, E, F
H	2	G
	28	

Figure 9.18
Four-Station Solution to the Line-Balancing Problem



SOLUTION

The theoretical minimum number of workstations is:

$$\frac{\Sigma t_i}{\text{Cycle time}} = \frac{28 \text{ minutes}}{8 \text{ minutes}} = 3.5, \text{ or } 4 \text{ stations}$$

The precedence graph and one good layout are shown in Figure 9.18:

$$\text{Efficiency} = \frac{\text{Total task time}}{(\text{Actual number of workstations}) \times (\text{Largest assigned cycle time})} = \frac{28}{(4)(8)} = 87.5\%$$

Problems

Note: **Px** means the problem may be solved with POM for Windows and/or Excel OM.

•• **9.1** Gordon Miller's job shop has four work areas, A, B, C, and D. Distances in feet between centers of the work areas are:

	A	B	C	D
A	—	4	9	7
B	—	—	6	8
C	—	—	—	10
D	—	—	—	—

Workpieces moved, in hundreds of workpieces per week, between pairs of work areas, are:

	A	B	C	D
A	—	8	7	4
B	—	—	3	2
C	—	—	—	6
D	—	—	—	—

It costs Gordon $1 to move 1 work piece 1 foot. What is the weekly total material handling cost of the layout? **Px**

•• **9.2** A Missouri job shop has four departments—machining (M), dipping in a chemical bath (D), finishing (F), and plating (P)—assigned to four work areas. The operations manager, Mary Marrs, has gathered the following data for this job shop as it is currently laid out (Plan A).

100s of Workpieces Moved Between Work Areas Each Year Plan A

	M	D	F	P
M	—	6	18	2
D	—	—	4	2
F	—	—	—	18
P	—	—	—	—

Distances Between Work Areas (Departments) in Feet

	M	D	F	P
M	—	20	12	8
D	—	—	6	10
F	—	—	—	4
P	—	—	—	—

It costs \$0.50 to move 1 workpiece 1 foot in the job shop. Marrs's goal is to find a layout that has the lowest material handling cost.

a) Determine cost of the current layout, Plan A, from the data above.

b) One alternative is to switch those departments with the high loads, namely, finishing (F) and plating (P), which alters the distance between them and machining (M) and dipping (D), as follows:

Distances Between Work Areas (Departments) in Feet Plan B

	M	D	F	P
M	—	20	8	12
D	—	—	10	6
F	—	—	—	4
P	—	—	—	—

What is the cost of *this* layout?

c) Marrs now wants you to evaluate Plan C, which also switches milling (M) and drilling (D), below.

Distance Between Work Areas (Departments) in Feet Plan C

	M	D	F	P
M	—	20	10	6
D	—	—	8	12
F	—	—	—	4
P	—	—	—	—

What is the cost of *this* layout?

d) Which layout is best from a cost perspective? **PX**

• **9.3** Three departments—milling (M), drilling (D), and

per day and the distances between the centers of the work areas, in feet, follow.

Pieces Moved Between Work Areas Each Day

	M	D	S
M	—	23	32
D	—	—	20
S	—	—	—

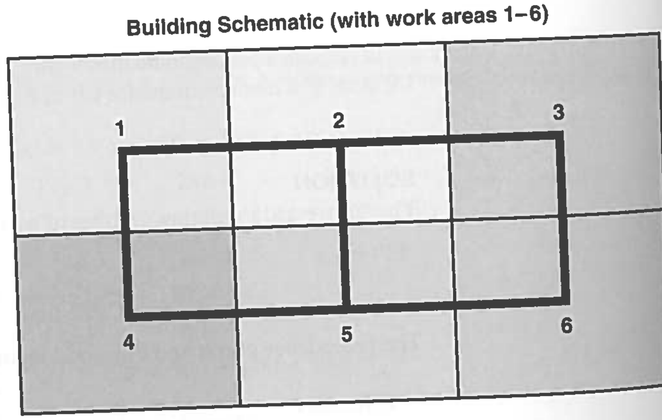
Distances Between Centers of Work Areas (Departments) in Feet

	M	D	S
M	—	10	5
D	—	—	8
S	—	—	—

It costs \$2 to move 1 workpiece 1 foot.
What is the cost? **PX**

•• **9.4** Roy Creasey Enterprises, a machine shop, is planning to move to a new, larger location. The new building will be 60 feet long by 40 feet wide. Creasey envisions the building as having six distinct production areas, roughly equal in size. He feels strongly about safety and intends to have marked pathways throughout the building to facilitate the movement of people and materials. See the following building schematic.

Building Schematic (with work areas 1–6)



His foreman has completed a month-long study of the number of loads of material that have moved from one process to another in the current building. This information is contained in the following flow matrix.

Flow Matrix Between Production Processes

FROM \ TO	MATERIALS	WELDING	DRILLS	LATHES	GRINDERS	BENDERS
Materials	0	100	50	0	0	50
Welding	25	0	0	50	0	0
Drills	25	0	0	0	50	0
Lathes	0	25	0	0	20	0
Grinders	50	0	100	0	0	0
[illegible]	[illegible]	0	20	0	0	[illegible]