

# Chapter 4

## Activity-Based Costing

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### Solutions to Questions

**4-1** The most common methods of assigning overhead costs to products are plantwide overhead rates, departmental overhead rates, and activity-based costing.

**4-2** The assumption, implicit in conventional costing systems, that overhead cost is proportional to direct labor, is being increasingly questioned. Automation has decreased the amount of direct labor, overhead costs have increased, and companies now handle many more products that differ substantially in volume, batch size, and complexity. Activity-based costing attempts to more accurately assign overhead costs to products based on the activities required to make products and the resources consumed by those activities.

**4-3** The departmental approach to assigning overhead cost to products usually assumes that overhead costs are proportional to direct labor-hours or machine-hours. However, overhead costs are often driven by other factors, including the number of batches run and product complexity, that are only loosely related, if at all, to volume. Activity-based costing attempts to more accurately assign overhead costs to products based on the activities that they cause rather than just on the direct labor-hours required to make a unit.

**4-4** The hierarchical levels are:

1. Unit-level activities, which are performed each time a unit is produced.
2. Batch-level activities, which are performed each time a batch is handled or processed.
3. Product-level activities, which are performed to support specific products.
4. Facility-level activities, which sustain an organization's general capabilities.

**4-5** Activity-based costing involves two stages of overhead cost assignments. In the first stage, costs are assigned to activity cost pools. In the second stage, costs are allocated from the activity cost pools to products.

**4-6** In a conventional costing system, overhead costs are allocated to products using some measure of volume such as direct labor-hours or machine-hours. Consequently, the high-volume products, which have the largest amount of direct labor-hours or machine-hours, are allocated most of the overhead cost. In activity-based costing, some of the overhead costs are typically allocated using batch-level or product-level allocation bases. For example, if each product is allocated a total of \$10,000 in product-level cost irrespective of its volume, then a high-volume product will be allocated exactly the same total overhead as a low-volume product. In contrast, if a measure of volume like direct labor-hours or machine-hours were used to allocate this cost, the high-volume product would be allocated more in total than the low-volume product.

**4-7** Activity-based costing improves the accuracy of product costs in three ways. First, activity-based costing increases the number of cost pools used to accumulate overhead costs. Rather than accumulating all overhead costs in a single, plantwide pool, or accumulating them in departmental pools, costs are accumulated for each major activity. Second, the activity cost pools are more homogeneous than departmental cost pools. In principle, all of the costs in an activity cost pool pertain to a single activity. In contrast, departmental cost pools contain the costs of many different activities carried out in the department. Third, activity-based costing changes the bases used to assign overhead costs to products. Rather than assigning costs on the basis of direct labor or some other measure of volume, costs are assigned on the basis

of the activities that presumably cause overhead costs.

**4-8** While the product costs computed using activity-based costing are almost certainly more accurate than those computed using more conventional costing methods, activity-based costing nevertheless rests on some questionable assumptions about cost behavior. In particular, activity-based costing assumes that costs are proportional to activity. In reality, costs appear to increase less than in proportion to increases in activity. This implies that activity-based product costs will be overstated for purposes of making decisions. (The same criticism can be leveled at conventional product costs.) Second, the costs of implementing and maintaining an activity-based costing system can be high and its benefits may not justify this cost.

## Chapter 4: Applying Excel

The completed worksheet is shown below.

	A	B	C	D	E	F	G
1	Chapter 4: Applying Excel						
2							
3	Enter a formula into each of the cells marked with a ? below						
4	<b>Review Problem: Activity-Based Costing</b>						
5							
6	<b>Data</b>						
7		<i>Deluxe</i>	<i>Tourist</i>				
8	Annual sales in units	2,000	10,000				
9	Direct materials per unit	\$25	\$17				
10	Direct labor-hours per unit	5	4				
11							
12	Direct labor rate	\$12	per DLH				
13							
14		<i>Estimated</i>					
15		<i>Overhead</i>	<i>Expected Activity</i>				
16	<i>Activities and Activity Measures</i>	<i>Cost</i>	<i>Deluxe</i>	<i>Tourist</i>	<i>Total</i>		
17	Labor related (direct labor-hours)	\$ 80,000	10,000	40,000	50,000		
18	Machine setups (setups)	150,000	3,000	2,000	5,000		
19	Production orders (orders)	70,000	100	300	400		
20	General factory (machine-hours)	250,000	12,000	28,000	40,000		
21		<u>\$ 550,000</u>					
22							
23	<b>Compute the predetermined overhead rate</b>						
24	Estimated total manufacturing overhead (a)		\$550,000				
25	Estimated total amount of the allocation base (b)		50,000	DLHs			
26	Predetermined overhead rate (a) ÷ (b)		\$11.00	per DLH			
27							
28	<b>Compute the manufacturing overhead applied</b>		<i>Deluxe</i>	<i>Tourist</i>			
29	Direct labor-hours per unit (a)	5	DLHs	4	DLHs		
30	Predetermined overhead rate (b)	\$11.00	per DLH	\$11.00	per DLH		
31	Manufacturing overhead applied per unit (a) × (b)	\$55.00		\$44.00			
32							
33	<b>Compute traditional unit product costs</b>		<i>Deluxe</i>	<i>Tourist</i>			
34	Direct materials	\$ 25.00	\$ 17.00				
35	Direct labor	60.00	48.00				
36	Manufacturing overhead applied	55.00	44.00				
37	Traditional unit product cost	<u>\$ 140.00</u>	<u>\$ 109.00</u>				
38							
39	<b>Compute activity rates</b>		<i>Estimated</i>				
40			<i>Overhead</i>				
41	<i>Activities</i>	<i>Cost</i>	<i>Total Expected Activity</i>		<i>Activity Rate</i>		
42	Labor related	\$80,000	50,000	DLHs	\$1.60	per DLH	
43	Machine setups	\$150,000	5,000	setups	\$30.00	per setup	
44	Production orders	\$70,000	400	orders	\$175.00	per order	
45	General factory	\$250,000	40,000	MHs	\$6.25	per MH	
46							
47	<b>Compute the ABC overhead cost per unit</b>		<i>Deluxe</i>		<i>Tourist</i>		
48		<i>Activity</i>	<i>Expected</i>	<i>Expected</i>	<i>Expected</i>	<i>Expected</i>	
49	<i>Activities</i>	<i>Rate</i>	<i>Activity</i>	<i>Amount</i>	<i>Activity</i>	<i>Amount</i>	
50	Labor related	\$1.60	10,000	\$ 16,000	40,000	\$ 64,000	
51	Machine setups	\$30.00	3,000	90,000	2,000	60,000	
52	Production orders	\$175.00	100	17,500	300	52,500	
53	General factory	\$6.25	12,000	75,000	28,000	175,000	
54	Total overhead cost assigned (a)			<u>\$ 198,500</u>		<u>\$ 351,500</u>	
55	Number of units produced (b)			2,000		10,000	
56	ABC overhead cost per unit (a) ÷ (b)			\$99.25		\$35.15	
57							
58	<b>Compute the ABC unit product costs</b>		<i>Deluxe</i>	<i>Tourist</i>			
59	Direct materials	\$ 25.00	\$ 17.00				
60	Direct labor	60.00	48.00				
61	ABC overhead cost per unit (see above)	99.25	35.15				
62	ABC unit product cost	<u>\$ 184.25</u>	<u>\$ 100.15</u>				
63							

## Chapter 4: Applying Excel (continued)

The completed worksheet, with formulas displayed, is shown below.

	A	B	C	D	E	F	G
1	Chapter 4: Applying Excel						
2							
3	Enter a formula into each of the cells marked with a						
4	Review Problem: Activity-Based Costing						
5							
6	<b>Data</b>						
7		<i>Deluxe</i>	<i>Tourist</i>				
8	Annual sales in units	2000	10000				
9	Direct materials per unit	25	17				
10	Direct labor-hours per unit	5	4				
11							
12	Direct labor rate	12	per DLH				
13							
14		<i>Estimated</i>					
15		<i>Overhead</i>		<i>Expected Activity</i>			
16	<i>Activities and Activity Measures</i>	<i>Cost</i>	<i>Deluxe</i>	<i>Tourist</i>	<i>Total</i>		
17	Labor related (direct labor-hours)	80000	=B8*B10	=C8*C10	=C17+D17		
18	Machine setups (setups)	150000	3000	2000	=C18+D18		
19	Production orders (orders)	70000	100	300	=C19+D19		
20	General factory (machine-hours)	250000	12000	28000	=C20+D20		
21		=SUM(B17:B20)					
22							
23	<b>Compute the predetermined overhead rate</b>						
24	Estimated total manufacturing overhead (a)		=B21				
25	Estimated total amount of the allocation base (b)		=E17	DLHs			
26	Predetermined overhead rate (a) ÷ (b)		=C24/C25	per DLH			
27							
28	<b>Compute the manufacturing overhead applied</b>		<i>Deluxe</i>	<i>Tourist</i>			
29	Direct labor-hours per unit (a)	=B10	DLHs	=C10	DLHs		
30	Predetermined overhead rate (b)	=C26	per DLH	=B30	per DLH		
31	Manufacturing overhead applied per unit (a) × (b)	=B29*B30		=D29*D30			
32							
33	<b>Compute traditional unit product costs</b>	<i>Deluxe</i>	<i>Tourist</i>				
34	Direct materials	=B9	=C9				
35	Direct labor	=B10*B12	=C10*B12				
36	Manufacturing overhead applied	=B31	=D31				
37	Traditional unit product cost	=SUM(B34:B36)	=SUM(C34:C36)				
38							
39	<b>Compute activity rates</b>	<i>Estimated</i>					
40		<i>Overhead</i>					
41	<i>Activities</i>	<i>Cost</i>	<i>Total Expected Activity</i>	<i>Activity Rate</i>			
42	Labor related	=B17	=E17 DLHs	=B42/C42 per DLH			
43	Machine setups	=B18	=E18 setups	=B43/C43 per setup			
44	Production orders	=B19	=E19 orders	=B44/C44 per order			
45	General factory	=B20	=E20 MHs	=B45/C45 per MH			
46							
47	<b>Compute the ABC overhead cost per unit</b>		<i>Deluxe</i>	<i>Tourist</i>			
48		<i>Activity</i>	<i>Expected</i>	<i>Expected</i>			
49	<i>Activities</i>	<i>Rate</i>	<i>Activity</i>	<i>Amount</i>	<i>Activity</i>	<i>Amount</i>	
50	Labor related	=E42	=C17	=B50*C50	=D17	=B50*E50	
51	Machine setups	=E43	=C18	=B51*C51	=D18	=B51*E51	
52	Production orders	=E44	=C19	=B52*C52	=D19	=B52*E52	
53	General factory	=E45	=C20	=B53*C53	=D20	=B53*E53	
54	Total overhead cost assigned (a)			=SUM(D50:D53)		=SUM(F50:F53)	
55	Number of units produced (b)			=B8		=C8	
56	ABC overhead cost per unit (a) ÷ (b)			=D54/D55		=F54/F55	
57							
58	<b>Compute the ABC unit product costs</b>	<i>Deluxe</i>	<i>Tourist</i>				
59	Direct materials	=B34	=C34				
60	Direct labor	=B35	=C35				
61	ABC overhead cost per unit (see above)	=D56	=F56				
62	ABC unit product cost	=SUM(B59:B61)	=SUM(C59:C61)				
63							

## Chapter 4: Applying Excel (continued)

- When the direct labor requirement for the Deluxe model is reduced, the result is:

	A	B	C	D	E	F	G
1	Chapter 4: Applying Excel						
2							
3	Enter a formula into each of the cells marked with a ? below						
4	Review Problem: Activity-Based Costing						
5							
6	Data						
7		Deluxe	Tourist				
8	Annual sales in units	2,000	10,000				
9	Direct materials per unit	\$25	\$17				
10	Direct labor-hours per unit	2	4				
11							
12	Direct labor rate	\$12	per DLH				
13							
14		Estimated					
15		Overhead	Expected Activity				
16	Activities and Activity Measures	Cost	Deluxe	Tourist	Total		
17	Labor related (direct labor-hours)	\$ 80,000	4,000	40,000	44,000		
18	Machine setups (setups)	150,000	3,000	2,000	5,000		
19	Production orders (orders)	70,000	100	300	400		
20	General factory (machine-hours)	250,000	12,000	28,000	40,000		
21		<u>\$ 550,000</u>					
22							
23	Compute the predetermined overhead rate						
24	Estimated total manufacturing overhead (a)		\$550,000				
25	Estimated total amount of the allocation base (b)		44,000	DLHs			
26	Predetermined overhead rate (a) ÷ (b)		\$12.50	per DLH			
27							
28	Compute the manufacturing overhead applied		Deluxe	Tourist			
29	Direct labor-hours per unit (a)		2	DLHs	4	DLHs	
30	Predetermined overhead rate (b)		\$12.50	per DLH	\$12.50	per DLH	
31	Manufacturing overhead applied per unit (a) × (b)		\$25.00		\$50.00		
32							
33	Compute traditional unit product costs		Deluxe	Tourist			
34	Direct materials	\$ 25.00	\$ 17.00				
35	Direct labor	24.00	48.00				
36	Manufacturing overhead applied	25.00	50.00				
37	Traditional unit product cost	<u>\$ 74.00</u>	<u>\$ 115.00</u>				
38							
39	Compute activity rates		Estimated				
40			Overhead				
41	Activities	Cost	Total Expected Activity	Activity Rate			
42	Labor related	\$80,000	44,000 DLHs	\$1.82 per DLH			
43	Machine setups	\$150,000	5,000 setups	\$30.00 per setup			
44	Production orders	\$70,000	400 orders	\$175.00 per order			
45	General factory	\$250,000	40,000 MHs	\$6.25 per MH			
46							
47	Compute the ABC overhead cost per unit		Deluxe	Tourist			
48		Activity Rate	Expected Activity	Expected Activity	Amount	Amount	
49	Activities						
50	Labor related	\$1.82	4,000	\$ 7,273	40,000	\$ 72,727	
51	Machine setups	\$30.00	3,000	90,000	2,000	60,000	
52	Production orders	\$175.00	100	17,500	300	52,500	
53	General factory	\$6.25	12,000	75,000	28,000	175,000	
54	Total overhead cost assigned (a)			<u>\$ 189,773</u>		<u>\$ 360,227</u>	
55	Number of units produced (b)			2,000		10,000	
56	ABC overhead cost per unit (a) ÷ (b)			\$94.89		\$36.02	
57							
58	Compute the ABC unit product costs		Deluxe	Tourist			
59	Direct materials	\$ 25.00	\$ 17.00				
60	Direct labor	24.00	48.00				
61	ABC overhead cost per unit (see above)	94.89	36.02				
62	ABC unit product cost	<u>\$ 143.89</u>	<u>\$ 101.02</u>				
63							

## Chapter 4: Applying Excel (continued)

- a. The effect of reducing the direct labor requirement on the predetermined overhead rate is shown below:

	<i>Original: 5 DLHs</i>	<i>Reduced: 2 DLHs</i>
Estimated total manufacturing overhead (a).....	\$550,000	\$550,000
Estimated total amount of the allocation base (b).....	50,000	44,000
Predetermined overhead rate (a) ÷ (b) .....	\$11.00	\$12.50

The predetermined overhead rate increased from \$11.00 per direct labor-hour to \$12.50 per direct labor-hour when the direct labor hour requirement decreased from 5 direct labor-hours to 2 direct-labor hours per unit of the Deluxe model. This occurs because the total amount of the allocation base (in this case, direct labor-hours) drops, but the estimated total manufacturing overhead has not changed. Unless the estimated total manufacturing overhead is strictly variable with respect to direct labor-hours, the predetermined overhead rate will increase when the total direct labor-hours drops.

- b. The effects of reducing the direct labor requirement of the Deluxe model on the unit product costs of the Tourist model appear below:

*Traditional unit product cost for the Tourist model:*

	<i>5 DLHs</i>	<i>2 DLHs</i>
Direct materials .....	\$ 17.00	\$ 17.00
Direct labor .....	48.00	48.00
Manufacturing overhead applied ...	<u>44.00</u>	<u>50.00</u>
Traditional unit product cost .....	<u>\$109.00</u>	<u>\$115.00</u>

*ABC unit product cost for the Tourist model:*

	<i>5 DLHs</i>	<i>2 DLHs</i>
Direct materials .....	\$ 17.00	\$ 17.00
Direct labor .....	48.00	48.00
ABC overhead cost per unit .....	<u>35.15</u>	<u>36.02</u>
Traditional unit product cost .....	<u>\$100.15</u>	<u>\$101.02</u>

## Chapter 4: Applying Excel (continued)

This result may seem odd. There was no change in any cost (except for the total labor cost of producing the Deluxe model) and there was no change in any of the fundamental characteristics of the Tourist model and yet under both costing methods, the unit product cost of the Tourist model increased. Why should a decrease in the labor cost of another product increase the overall unit product cost of the Tourist model? Truthfully, it shouldn't.

What happened? When the direct labor-hours required to produce the Deluxe models decreases, the proportion of the total direct labor-hours accounted for by the Tourist model increases. Therefore, if a fixed overhead cost is allocated on the basis of direct labor-hours, some of its cost will be shifted from the Tourist to the Deluxe model. This anomalous result is less pronounced under activity-based costing because less of the overhead is allocated on the basis of direct labor-hours. For this and other reasons, activity-based costing is usually better for decision-making than traditional costing systems based solely on direct labor-hours.

## Chapter 4: Applying Excel (continued)

2. With the changes in the data, the worksheet should look like this:

	A	B	C	D	E	F	G
1	Chapter 4: Applying Excel						
2							
3	Enter a formula into each of the cells marked with a ? below						
4	<b>Review Problem: Activity-Based Costing</b>						
5							
6	<b>Data</b>						
7		<i>Deluxe</i>	<i>Tourist</i>				
8	Annual sales in units	2,000	10,000				
9	Direct materials per unit	\$25	\$17				
10	Direct labor-hours per unit	5	4				
11							
12	Direct labor rate	\$12	per DLH				
13							
14		<i>Estimated</i>					
15		<i>Overhead</i>	<i>Expected Activity</i>				
16	<i>Activities and Activity Measures</i>	<i>Cost</i>	<i>Deluxe</i>	<i>Tourist</i>	<i>Total</i>		
17	Labor related (direct labor-hours)	\$ 80,000	10,000	40,000	50,000		
18	Machine setups (setups)	150,000	3,000	2,000	5,000		
19	Production orders (orders)	70,000	300	100	400		
20	General factory (machine-hours)	250,000	12,000	28,000	40,000		
21		<u>\$ 550,000</u>					
22							
23	<b>Compute the predetermined overhead rate</b>						
24	Estimated total manufacturing overhead (a)		\$550,000				
25	Estimated total amount of the allocation base (b)		50,000	DLHs			
26	Predetermined overhead rate (a) ÷ (b)		\$11.00	per DLH			
27							
28	<b>Compute the manufacturing overhead applied</b>		<i>Deluxe</i>	<i>Tourist</i>			
29	Direct labor-hours per unit (a)		5 DLHs	4 DLHs			
30	Predetermined overhead rate (b)		\$11.00 per DLH	\$11.00 per DLH			
31	Manufacturing overhead applied per unit (a) × (b)		\$55.00	\$44.00			
32							
33	<b>Compute traditional unit product costs</b>		<i>Deluxe</i>	<i>Tourist</i>			
34	Direct materials	\$ 25.00	\$ 17.00				
35	Direct labor	60.00	48.00				
36	Manufacturing overhead applied	55.00	44.00				
37	Traditional unit product cost	<u>\$ 140.00</u>	<u>\$ 109.00</u>				
38							
39	<b>Compute activity rates</b>		<i>Estimated</i>				
40			<i>Overhead</i>				
41	<i>Activities</i>	<i>Cost</i>	<i>Total Expected Activity</i>		<i>Activity Rate</i>		
42	Labor related	\$80,000	50,000	DLHs	\$1.60	per DLH	
43	Machine setups	\$150,000	5,000	setups	\$30.00	per setup	
44	Production orders	\$70,000	400	orders	\$175.00	per order	
45	General factory	\$250,000	40,000	MHs	\$6.25	per MH	
46							
47	<b>Compute the ABC overhead cost per unit</b>		<i>Deluxe</i>	<i>Tourist</i>			
48		<i>Activity</i>	<i>Expected</i>	<i>Expected</i>	<i>Expected</i>		
49	<i>Activities</i>	<i>Rate</i>	<i>Activity</i>	<i>Amount</i>	<i>Activity</i>	<i>Amount</i>	
50	Labor related	\$1.60	10,000	\$ 16,000	40,000	\$ 64,000	
51	Machine setups	\$30.00	3,000	90,000	2,000	60,000	
52	Production orders	\$175.00	300	52,500	100	17,500	
53	General factory	\$6.25	12,000	75,000	28,000	175,000	
54	Total overhead cost assigned (a)			<u>\$ 233,500</u>		<u>\$ 316,500</u>	
55	Number of units produced (b)			2,000		10,000	
56	ABC overhead cost per unit (a) ÷ (b)			\$116.75		\$31.65	
57							
58	<b>Compute the ABC unit product costs</b>		<i>Deluxe</i>	<i>Tourist</i>			
59	Direct materials	\$ 25.00	\$ 17.00				
60	Direct labor	60.00	48.00				
61	ABC overhead cost per unit (see above)	116.75	31.65				
62	ABC unit product cost	<u>\$ 201.75</u>	<u>\$ 96.65</u>				
63							



**Chapter 4: Applying Excel** (continued)

a. The traditional unit product costs are shown below:

*Original traditional unit product costs:*

	<i>Deluxe</i>	<i>Tourist</i>
Direct materials .....	\$ 25.00	\$ 17.00
Direct labor .....	60.00	48.00
Manufacturing overhead applied ...	<u>55.00</u>	<u>44.00</u>
Traditional unit product cost .....	<u>\$140.00</u>	<u>\$109.00</u>

*Revised traditional unit product costs:*

	<i>Deluxe</i>	<i>Tourist</i>
Direct materials .....	\$ 25.00	\$ 17.00
Direct labor .....	60.00	48.00
Manufacturing overhead applied ...	<u>55.00</u>	<u>44.00</u>
Traditional unit product cost .....	<u>\$140.00</u>	<u>\$109.00</u>

The change in the production order requirements for the two products has no impact on the unit product costs under the traditional costing method that is based entirely on direct labor-hours.

b. The activity-based unit product costs are shown below:

*Original ABC unit product costs:*

	<i>Deluxe</i>	<i>Tourist</i>
Direct materials .....	\$ 25.00	\$ 17.00
Direct labor .....	60.00	48.00
ABC overhead cost per unit .....	<u>99.25</u>	<u>35.15</u>
Traditional unit product cost .....	<u>\$184.25</u>	<u>\$100.15</u>

*Revised ABC unit product costs:*

	<i>Deluxe</i>	<i>Tourist</i>
Direct materials .....	\$ 25.00	\$ 17.00
Direct labor .....	60.00	48.00
Manufacturing overhead applied ...	<u>116.75</u>	<u>31.65</u>
Traditional unit product cost .....	<u>\$201.75</u>	<u>\$96.65</u>

The change in the production order requirements does affect the unit product costs under activity-based costing. The Deluxe model now requires more production orders and the Tourist model requires fewer production orders. Therefore, the Deluxe model should cost more and the Tourist model should cost less.

## **Chapter 4: Applying Excel** (continued)

- c. The traditional costing method does not take into account any changes in cost drivers such as the number of production orders. It is based solely on direct labor-hours. Therefore, the traditional costing method is ordinarily less accurate than activity-based costing.

## Chapter 4: Applying Excel (continued)

3. The following worksheet reflects all of the changes in the data:

	A	B	C	D	E	F	G
1	Chapter 4: Applying Excel						
2							
3	Enter a formula into each of the cells marked with a ? below						
4	<b>Review Problem: Activity-Based Costing</b>						
5							
6	<b>Data</b>						
7		Deluxe	Tourist				
8	Annual sales in units	1,000	9,000				
9	Direct materials per unit	\$20	\$20				
10	Direct labor-hours per unit	1	1				
11							
12	Direct labor rate	\$10	per DLH				
13							
14		Estimated					
15		Overhead	Expected Activity				
16	<b>Activities and Activity Measures</b>	Cost	Deluxe	Tourist	Total		
17	Labor related (direct labor-hours)	\$ 33,000	1,000	9,000	10,000		
18	Machine setups (setups)	120,000	20	80	100		
19	Production orders (orders)	70,000	15	35	50		
20	General factory (machine-hours)	150,000	10,000	10,000	20,000		
21		<u>\$ 373,000</u>					
22							
23	<b>Compute the predetermined overhead rate</b>						
24	Estimated total manufacturing overhead (a)		\$373,000				
25	Estimated total amount of the allocation base (b)		10,000	DLHs			
26	Predetermined overhead rate (a) ÷ (b)		\$37.30	per DLH			
27							
28	<b>Compute the manufacturing overhead applied</b>		Deluxe	Tourist			
29	Direct labor-hours per unit (a)		1	DLHs	1	DLHs	
30	Predetermined overhead rate (b)		\$37.30	per DLH	\$37.30	per DLH	
31	Manufacturing overhead applied per unit (a) × (b)		\$37.30		\$37.30		
32							
33	<b>Compute traditional unit product costs</b>		Deluxe	Tourist			
34	Direct materials	\$ 20.00	\$ 20.00				
35	Direct labor	10.00	10.00				
36	Manufacturing overhead applied	37.30	37.30				
37	Traditional unit product cost	<u>\$ 67.30</u>	<u>\$ 67.30</u>				
38							
39	<b>Compute activity rates</b>		Estimated				
40			Overhead				
41	<b>Activities</b>	Cost	Total Expected Activity	Activity Rate			
42	Labor related	\$33,000	10,000 DLHs	\$3.30 per DLH			
43	Machine setups	\$120,000	100 setups	\$1,200.00 per setup			
44	Production orders	\$70,000	50 orders	\$1,400.00 per order			
45	General factory	\$150,000	20,000 MHs	\$7.50 per MH			
46							
47	<b>Compute the ABC overhead cost per unit</b>		Deluxe	Tourist			
48		Activity	Expected	Expected			
49	<b>Activities</b>	Rate	Activity	Amount	Activity	Amount	
50	Labor related	\$3.30	1,000	\$ 3,300	9,000	\$ 29,700	
51	Machine setups	\$1,200.00	20	24,000	80	96,000	
52	Production orders	\$1,400.00	15	21,000	35	49,000	
53	General factory	\$7.50	10,000	75,000	10,000	75,000	
54	Total overhead cost assigned (a)			<u>\$ 123,300</u>		<u>\$ 249,700</u>	
55	Number of units produced (b)			1,000		9,000	
56	ABC overhead cost per unit (a) ÷ (b)			\$123.30		\$27.74	
57							
58	<b>Compute the ABC unit product costs</b>		Deluxe	Tourist			
59	Direct materials	\$ 20.00	\$ 20.00				
60	Direct labor	10.00	10.00				
61	ABC overhead cost per unit (see above)	123.30	27.74				
62	ABC unit product cost	<u>\$ 153.30</u>	<u>\$ 57.74</u>				
63							

## Chapter 4: Applying Excel (continued)

- a. The traditional unit product costs for the two products are identical. This occurs because they have the same direct materials cost, the same direct labor cost, and the same direct labor-hour requirements. Because all of the overhead is allocated on the basis of direct labor-hours, their costs will be the same.
- b. In contrast to the traditional costing method, the ABC unit product costs for the two products are different. Even though the two products have the same direct materials cost, the same direct labor cost, and the same direct labor-hour requirements, they differ in the activities they use. While the Deluxe model has 10% of the total unit sales and 10% of the total direct labor-hours, it has 20% of the total setups, 30% of the production orders, and 50% of the total machine-hours. Therefore, the Deluxe model is allocated more of the machine setup costs, production order costs, and general factory costs than the Tourist model under activity-based costing.
- c. Assuming that machine setup costs really do vary with the number of machine setups, the production order costs do vary with the number of production orders, and the general factory costs do vary with the number of machine-hours, then the activity-based costing system will provide more accurate costs than the traditional costing method.

## The Foundational 15

1. The plantwide overhead rate is computed as follows:

Total estimated overhead cost (a).....	\$684,000
Total expected direct labor-hours (b).....	12,000 DLHs
Predetermined overhead rate (a) ÷ (b).....	\$57.00 per DLH

2. The overhead cost assignments to Products Y and Z are as follows:

	<i>Product Y</i>	<i>Product Z</i>
Total direct labor-hours (a).....	9,000	3,000
Plantwide overhead rate per DLH (b).....	\$57.00	\$57.00
Manufacturing overhead assigned (a) × (b)	\$513,000	\$171,000

3-6.

The activity rates are computed as follows:

<i>Activity Cost Pool</i>	<i>(a) Estimated Overhead Cost</i>	<i>(b) Expected Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Machining.....	\$200,000	10,000 MH	\$20 per MH
Machine setups .....	\$100,000	200 setups	\$500 per setup
Product design .....	\$84,000	2 products	\$42,000 per product
General factory .....	\$300,000	12,000 DLHs	\$25 Per DLH

7. Machine setups is a batch-level activity. A setup is performed to run a batch of units. The cost of the setup is determined by the resources consumed performing the setup and it is not influenced by the number of units processed once the setup is complete.

8. The product design activity is a product-level activity. The product design cost is determined by the number of products supported and it is not influenced by the number of batches or units processed.

**The Foundational 15** (continued)

9-10. Using the ABC system, the total overhead assigned to Products Y and Z is computed as follows:

	<i>Product Y</i>		<i>Product Z</i>	
	<i>Expected Activity</i>	<i>Amount</i>	<i>Expected Activity</i>	<i>Amount</i>
Machining, at \$20.00 per machine-hour .....	8,000	\$160,000	2,000	\$ 40,000
Machine setups, at \$500.00 per setup.....	40	20,000	160	80,000
Product design, at \$42,000 per product .....	1	42,000	1	42,000
General factory, at \$25.00 per direct labor-hour ..	9,000	<u>225,000</u>	3,000	<u>75,000</u>
Total overhead cost assigned .....		<u>\$447,000</u>		<u>\$237,000</u>

**The Foundational 15** (continued)

11-15. The percentages of overhead assigned using the plantwide and ABC approaches are computed as follows:

	<i>Product Y</i>		<i>Product Z</i>		<i>Total</i> (c)
	(a) Amount	(a) ÷ (c) %	(b) Amount	(b) ÷ (c) %	
<i>Plantwide Approach</i>					
Manufacturing overhead.....	<u>\$513,000</u>	75.0%	<u>\$171,000</u>	25.0%	<u>\$684,000</u>
 <i>Activity-Based Costing System</i>					
Machining .....	\$160,000	80.0%	\$ 40,000	20.0%	\$200,000
Machine setups .....	20,000	20.0%	80,000	80.0%	100,000
Product design .....	42,000	50.0%	42,000	50.0%	84,000
General factory.....	<u>225,000</u>	75.0%	<u>75,000</u>	25.0%	<u>300,000</u>
Total cost assigned to products	<u>\$447,000</u>		<u>\$237,000</u>		<u>\$684,000</u>

The Machining allocation percentages used in the ABC system are similar to the plantwide allocation percentages because the Machining cost pool uses a unit-level activity measure (machine-hours). Since the plantwide cost pool also uses a unit-level allocation base (direct labor-hours), it is reasonable to expect these cost allocations percentages to be comparable.

Under the ABC system, 20% and 80% of the Machine Setups cost is allocated to Products Y and Z, respectively, whereas the plantwide approach allocates 75% and 25% of all overhead costs to the two products. These allocation percentages are different because Machine Setups is a batch-level cost pool. Although Product Y is the high-volume product (14,000 units) and Product Z is the low-volume product (6,000 units), Product Y only consumes 20% of the total machine setups and Product Z consumes 80% of the total machine setups. The conventional system is allocating too much of the machine setup costs to Product Y and too little of these costs to Product Z.

## **The Foundational 15** (continued)

Under the ABC system, 50% of the Product Design cost is allocated to each product, whereas the plantwide approach allocates 75% and 25% of all overhead costs to Products Y and Z, respectively. These percentages are different because Product Design is a product-level cost pool. Although Product Y is the high-volume product (14,000 units) and Product Z is the low-volume product (6,000 units), both products consume 50% of the product design resources. The conventional system is allocating too much of the product design costs to Product Y and too little of these costs to Product Z.

Under the ABC system, the General Factory allocation percentages are the same as the plantwide allocation percentages because the General Factory cost pool is allocated to products using the same unit-level activity measure (direct labor-hours) as the plantwide approach.



**Exercise 4-1** (10 minutes)

- |                                                                                                    |                |
|----------------------------------------------------------------------------------------------------|----------------|
| a. Various individuals manage the parts inventories.                                               | Product-level  |
| b. A clerk in the factory issues purchase orders for a job.                                        | Batch-level    |
| c. The personnel department trains new production workers.                                         | Facility-level |
| d. The factory's general manager meets with other department heads to coordinate plans.            | Facility-level |
| e. Direct labor workers assemble products.                                                         | Unit-level     |
| f. Engineers design new products.                                                                  | Product-level  |
| g. The materials storekeeper issues raw materials to be used in jobs.                              | Batch-level    |
| h. The maintenance department performs periodic preventative maintenance on general-use equipment. | Facility-level |

Note: Some of these classifications are debatable and may depend on the specific circumstances found in particular companies.

**Exercise 4-2** (15 minutes)

1. The activity rates are computed as follows:

<i>Activity Cost Pool</i>	<i>(a) Estimated Overhead Cost</i>	<i>(b) Expected Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Labor related .....	\$ 52,000	8,000 DLHs	\$ 6.50 per DLH
Machine related.....	15,000	20,000 MHs	0.75 per MH
Machine setups .....	42,000	1,000 setups	42.00 per setup
Production orders .....	18,000	500 orders	36.00 per order
Product testing.....	48,000	2,000 tests	24.00 per test
Packaging.....	75,000	5,000 packages	15.00 per package
General factory .....	<u>108,800</u>	8,000 DLHs	13.60 per DLH
Total .....	<u>\$358,800</u>		

2. The predetermined overhead rate based entirely on direct labor-hours would be computed as follows:

Total estimated overhead cost (a).....	\$358,800
Total expected direct labor-hours (b).....	<u>8,000</u> DLHs
Predetermined overhead rate (a) ÷ (b).....	<u>\$ 44.85</u> per DLH

**Exercise 4-3** (30 minutes)

The unit product costs for the products are a combination of direct materials, direct labor, and overhead costs. The overhead costs assigned to each product would be computed as follows:

	<i>J78</i>		<i>B52</i>	
	<i>Expected Activity</i>	<i>Amount</i>	<i>Expected Activity</i>	<i>Amount</i>
Labor related, at \$7.00 per direct labor-hour .....	1,000	\$ 7,000	40	\$ 280
Machine related, at \$3.00 per machine-hour.....	3,200	9,600	30	90
Machine setups, at \$40.00 per setup .....	5	200	1	40
Production orders, at \$160.00 per order.....	5	800	1	160
Shipments, at \$120.00 per shipment .....	10	1,200	1	120
General factory, at \$4.00 per direct labor-hour ....	1,000	<u>4,000</u>	40	<u>160</u>
Total overhead cost assigned (a).....		\$22,800		\$ 850
Number of units produced (b).....		<u>4,000</u>		<u>100</u>
Overhead cost per unit (a) ÷ (b).....		<u>\$ 5.70</u>		<u>\$8.50</u>

The unit product costs combine direct materials, direct labor, and overhead costs as follows:

	<i>J78</i>	<i>B52</i>
Direct materials .....	\$ 6.50	\$31.00
Direct labor .....	3.75	6.00
Manufacturing overhead (see above).....	<u>5.70</u>	<u>8.50</u>
Unit product cost .....	<u>\$15.95</u>	<u>\$45.50</u>

**Exercise 4-4** (30 minutes)

1. Using the company's conventional costing system, the overhead costs applied to the products would be computed as follows:

	<i>Product H</i>	<i>Product L</i>	<i>Total</i>
Number of units produced (a) .....	40,000	8,000	
Direct labor-hours per unit (b) .....	<u>0.40</u>	<u>0.40</u>	
Total direct labor-hours (a) × (b) .....	<u>16,000</u>	<u>3,200</u>	19,200
Total manufacturing overhead (a) .....	\$1,632,000		
Total direct labor-hours (b) .....	<u>19,200</u>	DLHs	
Predetermined overhead rate (a) ÷ (b) .....	<u>\$ 85.00</u>	per DLH	
	<i>Product H</i>	<i>Product L</i>	<i>Total</i>
Manufacturing overhead applied per unit			
0.40 DLH per unit × \$85.00 per DLH .....	\$ 34.00	\$ 34.00	
Number of units produced .....	<u>40,000</u>	<u>8,000</u>	
Total manufacturing overhead applied .....	<u>\$1,360,000</u>	<u>\$272,000</u>	\$1,632,000

2. Using the proposed ABC system, overhead costs would be assigned as follows:

	<i>Product H</i>	<i>Product L</i>	<i>Total</i>
Total manufacturing overhead assigned (a) .....	\$816,000	\$816,000	\$1,632,000
Number of units produced (b) .....	<u>40,000</u>	<u>8,000</u>	
Manufacturing overhead per unit (a) ÷ (b) .....	<u>\$ 20.40</u>	<u>\$ 102.00</u>	

### **Exercise 4-4** (continued)

3. Under the company's old method of allocating overhead costs, the high-volume product, Product H, was allocated most of the overhead cost. This occurred simply because the high-volume product is responsible for most of the direct labor-hours. When the overhead is split evenly between the two products, \$544,000 of overhead cost is shifted from the high-volume product, Product H, to the low-volume product, Product L. Consequently, the shift from direct labor-hours as an allocation base to an even split of the overhead costs between the two products favors the high-volume product, Product H, and penalizes the low-volume product, Product L. Note that on a per unit basis, the impact is much greater for the low-volume product, Product L, than for the high-volume product, Product H.

**Exercise 4-5** (30 minutes)

1. The activity rates are computed as follows:

<i>Activity Cost Pool</i>	<i>(a) Estimated Overhead Cost</i>	<i>(b) Expected Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Labor related .....	\$ 156,000	26,000 DLHs	\$6.00 per DLH
Purchase orders .....	11,000	220 orders	\$50.00 per order
Parts management .....	80,000	100 part types	\$800.00 per setup
Board etching .....	90,000	2,000 boards	45.00 per board
General factory .....	<u>180,000</u>	20,000 MHs	9.00 per MH
Total .....	<u>\$517,000</u>		

**Exercise 4-5** (continued)

2. The overhead assigned to each product can be computed as follows:

***Product A***

<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related.....	\$6 per DLH	6,000 DLHs	\$ 36,000
Purchase orders.....	\$50 per order	60 orders	3,000
Parts management..	\$800 per part type	30 part types	24,000
Board etching.....	\$45 per board	500 boards	22,500
General factory.....	\$9 per MH	3,000 MHs	<u>27,000</u>
Total .....			<u><u>\$112,500</u></u>

***Product B***

<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related.....	\$6 per DLH	11,000 DLHs	\$ 66,000
Purchase orders.....	\$50 per order	30 orders	1,500
Parts management..	\$800 per part type	15 part types	12,000
Board etching.....	\$45 per board	900 boards	40,500
General factory.....	\$9 per MH	8,000 MHs	<u>72,000</u>
Total .....			<u><u>\$192,000</u></u>

***Product C***

<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related.....	\$6 per DLH	4,000 DLHs	\$ 24,000
Purchase orders.....	\$50 per order	40 orders	2,000
Parts management..	\$800 per part type	40 part types	32,000
Board etching.....	\$45 per board	600 boards	27,000
General factory.....	\$9 per MH	3,000 MHs	<u>27,000</u>
Total .....			<u><u>\$112,000</u></u>

**Exercise 4-5** (continued)

***Product D***

<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related.....	\$6 per DLH	5,000 DLHs	\$ 30,000
Purchase orders.....	\$50 per order	90 orders	4,500
Parts management...	\$800 per part type	15 part types	12,000
Board etching.....	\$45 per board	0 boards	0
General factory.....	\$9 per MH	6,000 MHs	54,000
Total .....			<u>\$100,500</u>



**Exercise 4-6** (15 minutes)

1. & 2.

	<i>Activity</i>	<i>Activity Classification</i>	<i>Examples of Activity Measures</i>
a.	Preventive maintenance is performed on general-purpose production equipment.	Facility-level	Not applicable; these costs probably should not be assigned to products or customers.
b.	Products are assembled by hand.	Unit-level	Time spent assembling products.
c.	A security guard patrols the company grounds after normal working hours.	Facility-level	Not applicable; these costs probably should not be assigned to products or customers.
d.	Purchase orders are issued for materials to be used in production.	Batch-level	Number of purchase orders; time spent preparing purchase orders.
e.	Modifications are made to product designs.	Product-level	Number of modifications made; time spent making modifications.
f.	New employees are hired by the personnel office.	Facility-level	Not applicable; these costs probably should not be assigned to products or customers.
g.	Machine settings are changed between batches of different products.	Batch-level	Number of batch setups; time spent doing setups.
h.	Parts inventories are maintained in the storeroom. (Each product requires its own unique parts.)	Product-level	Number of products; number of parts; time spent maintaining inventories of parts.
i.	Insurance costs are incurred on the company's facilities.	Facility-level	Not applicable; these costs probably should not be assigned to products or customers.

**Exercise 4-7** (45 minutes)

1. The unit product costs under the company's conventional costing system would be computed as follows:

	<i>Mercon</i>	<i>Wurcon</i>	<i>Total</i>
Number of units produced (a) .....	10,000	40,000	
Direct labor-hours per unit (b) .....	<u>0.20</u>	<u>0.25</u>	
Total direct labor-hours (a) × (b) .....	<u>2,000</u>	<u>10,000</u>	12,000
Total manufacturing overhead (a) .....	\$336,000		
Total direct labor-hours (b) .....		12,000 DLHs	
Predetermined overhead rate (a) ÷ (b) .....		\$28.00 per DLH	
	<i>Mercon</i>	<i>Wurcon</i>	
Direct materials .....	\$10.00	\$ 8.00	
Direct labor .....	3.00	3.75	
Manufacturing overhead applied:			
0.20 DLH per unit × \$28.00 per DLH .....	5.60		
0.25 DLH per unit × \$28.00 per DLH .....		<u>7.00</u>	
Unit product cost .....	<u>\$18.60</u>	<u>\$18.75</u>	

**Exercise 4-7** (continued)

2. The unit product costs with the proposed ABC system can be computed as follows:

<i>Activity Cost Pool</i>	<i>Estimated Overhead Cost*</i>	<i>(b) Expected Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Labor related .....	\$168,000	12,000 direct labor-hours	\$14.00 per direct labor-hour
Engineering design ....	<u>168,000</u>	8,000 engineering-hours	\$21.00 per engineering-hour
	<u>\$336,000</u>		

\*The total manufacturing overhead cost is split evenly between the two activity cost pools.

Manufacturing overhead is assigned to the two products as follows:

	<i>Mercon</i>		<i>Wurcon</i>	
	<i>Expected Activity</i>	<i>Amount</i>	<i>Expected Activity</i>	<i>Amount</i>
Labor related, at \$14.00 per direct labor-hour .....	2,000	\$ 28,000	10,000	\$140,000
Engineering design, at \$21.00 per engineering-hour .	4,000	<u>84,000</u>	4,000	<u>84,000</u>
Total overhead cost assigned (a) .....		\$112,000		\$224,000
Number of units produced (b).....		10,000		40,000
Overhead cost per unit (a) ÷ (b).....		\$11.20		\$5.60

**Exercise 4-7** (continued)

The unit product costs combine direct materials, direct labor, and manufacturing overhead costs:

	<i>Mercon</i>	<i>Wurcon</i>
Direct materials .....	\$10.00	\$ 8.00
Direct labor .....	3.00	3.75
Manufacturing overhead (see above) .	<u>11.20</u>	<u>5.60</u>
Unit product cost .....	<u>\$24.20</u>	<u>\$17.35</u>

3. The unit product cost of the high-volume product, Wurcon, declines under the activity-based costing system, whereas the unit product cost of the low-volume product, Mercon, increases. This occurs because half of the overhead is applied on the basis of engineering design-hours instead of direct labor-hours. When the overhead was applied on the basis of direct labor-hours, most of the overhead was applied to the high-volume product. However, when the overhead is applied on the basis of engineering-hours, more of the overhead cost is shifted over to the low-volume product. Engineering design is a product-level activity, so the higher the volume, the lower the unit cost and the lower the volume, the higher the unit cost.

**Exercise 4-8** (30 minutes)

1. Activity rates can be computed as follows:

<i>Activity Cost Pool</i>	<i>(a) Estimated Overhead Cost</i>	<i>(b) Expected Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Machine setups .....	\$21,600	180 setups	\$120 per setup
Special processing ...	\$180,000	4,000 MHs	\$45 per MH
General factory .....	\$288,000	24,000 DLHs	\$12 per DLH

2. The unit product costs would be computed as follows, starting with the computation of the manufacturing overhead:

	<i>Rims</i>	<i>Posts</i>
Machine setups:		
\$120 per setup × 100 setups .....	\$ 12,000	
\$120 per setup × 80 setups .....		\$ 9,600
Special processing:		
\$45 per MH × 4,000 MHs .....	180,000	
\$45 per MH × 0 MHs .....		0
General factory:		
\$12 per DLH × 8,000 DLHs .....	96,000	
\$12 per DLH × 16,000 DLHs .....		<u>192,000</u>
Total overhead cost (a) .....	\$288,000	\$201,600
Number of units produced (b) .....	20,000	80,000
Overhead cost per unit (a) ÷ (b) .....	\$14.40	\$2.52
	<i>Rims</i>	<i>Posts</i>
Direct materials .....	\$17.00	\$10.00
Direct labor:		
\$16 per DLH × 0.40 DLHs .....	6.40	
\$16 per DLH × 0.20 DLHs .....		3.20
Manufacturing overhead (see above) .....	<u>14.40</u>	<u>2.52</u>
Unit product cost .....	<u>\$37.80</u>	<u>\$15.72</u>

**Exercise 4-9** (30 minutes)

1. Activity Rates:

<i>Activity Cost Pool</i>	<i>(a) Estimated Overhead Cost</i>	<i>(b) Expected Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Customer deliveries .....	\$400,000	5,000 deliveries	\$80.00 per delivery
Manual order processing ....	\$300,000	4,000 orders	\$75.00 per manual order
Electronic order processing .	\$200,000	12,500 orders	\$16.00 per electronic order
Line item picking .....	\$500,000	400,000 line items	\$1.25 per line item picked

**Exercise 4-9** (continued)

2. Activity costs are assigned to the two hospitals as follows:

*City General:*

<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Activity</i>	<i>(a) × (b) ABC Cost</i>
Customer deliveries.....	\$80.00 per delivery	10 deliveries	\$ 800
Manual order processing....	\$75.00 per order	0 orders	0
Electronic order processing	\$16.00 per order	10 orders	160
Line item picking .....	\$1.25 per line item	100 line items	<u>125</u>
Total activity costs .....			<u>\$1,085</u>

*County General:*

<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Activity</i>	<i>(a) × (b) ABC Cost</i>
Customer deliveries.....	\$80.00 per delivery	20 deliveries	\$ 1,600
Manual order processing.....	\$75.00 per order	40 orders	3,000
Electronic order processing ..	\$16.00 per order	0 orders	0
Line item picking .....	\$1.25 per line item	260 line items	<u>325</u>
Total activity costs .....			<u>\$4,925</u>

3. Hospitals that require frequent deliveries, place a high volume of manual orders, and order many line items are likely to be more expensive to serve.

**Exercise 4-10** (30 minutes)

- Under the traditional direct labor-hour based costing system, manufacturing overhead is applied to products using the predetermined overhead rate computed as follows:

$$\begin{aligned} \text{Predetermined overhead rate} &= \frac{\text{Estimated total manufacturing overhead cost}}{\text{Estimated total direct labor - hours}} \\ &= \frac{\$2,200,000}{110,000 \text{ DLHs}^*} = \$20.00 \text{ per DLH} \end{aligned}$$

\*25,000 units of Xactive @ 1.4 DLH per unit + 75,000 units of the Pathbreaker @ 1.0 DLH per unit = 35,000 DLHs + 75,000 DLHs = 110,000 DLHs

Consequently, the unit product costs using the traditional approach would be computed as follows:

	<i>Xactive</i>	<i>Pathbreaker</i>
Direct materials.....	\$1,620,000	\$3,825,000
Direct labor.....	455,000	975,000
Manufacturing overhead applied @ \$20.00 per direct labor-hour.....	<u>700,000</u>	<u>1,500,000</u>
Total manufacturing cost (a)	\$2,775,000	\$6,300,000
Number of units (b).....	25,000	75,000
Unit product cost (a) ÷ (b)...	\$111.00	\$84.00



**Exercise 4-10** (continued)

2. The activity rates are computed as follows:

<i>Activity Cost Pools</i>	<i>(a) Total Cost</i>	<i>(b) Total Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Supporting direct labor .....	\$797,500	110,000 DLH	\$7.25 per DLH
Batch setups .....	\$680,000	400 setups	\$1,700 per setup
Product sustaining .	\$650,000	2 products	\$325,000 per product
General factory	\$72,500	10,000 MHR	\$7.25 Per MHR

3. Under the activity-based costing system, the unit product costs would be computed as follows:

	<i>Xactive</i>	<i>Pathbreaker</i>
Direct materials.....	\$1,620,000	\$3,825,000
Direct labor.....	455,000	975,000
Supporting direct labor .....	253,750	543,750
Batch setups.....	425,000	255,000
Product sustaining .....	325,000	325,000
General factory	<u>18,125</u>	<u>54,375</u>
Total cost (a) .....	\$3,096,875	\$5,978,125
Number of units (b).....	25,000	75,000
Unit product cost (a) ÷ (b)	\$123.88	\$79.71

4. The traditional system uses one unit-level activity measure, direct labor hours, to assign 31.8% ( $\$700,000 \div \$2,200,000$ ) of all overhead to the Xactive product line and 68.2% ( $\$1,500,000 \div \$2,200,000$ ) of all overhead to the Pathbreaker product line. The ABC system assigns 62.5% ( $\$425,000 \div \$680,000$ ) of Batch setup costs (a batch-level activity) to the Xactive product line and 37.5% ( $\$255,000 \div \$680,000$ ) to the Pathbreaker product line. The ABC system assigns 50% ( $\$325,000 \div \$650,000$ ) of Product sustaining costs (a product-level activity) to each product line.

**Exercise 4-11** (30 minutes)

1. The activity rates are computed as follows:

<i>Activity Cost Pool</i>	<i>(a) Estimated Overhead Cost</i>	<i>(b) Expected Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Labor related .....	\$18,000	2,000 DLHs	\$9.00 per DLH
Purchase orders ..	\$1,050	525 orders	\$2.00 per order
Product testing ....	\$3,500	350 tests	\$10.00 per test
Template etching.	\$700	28 templates	\$25.00 per template
General factory ...	\$50,000	10,000 MHs	\$5.00 per MH

2. a. Overhead cost is assigned to the products as follows:

<i>Product A</i>			
<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related .....	\$9.00 per DLH	500 DLHs	\$ 4,500
Purchase orders ....	\$2.00 per order	80 orders	160
Product testing .....	\$10.00 per test	200 tests	2,000
Template etching...	\$25.00 per template	0 templates	0
General factory .....	\$5.00 per MH	3,400 MHs	<u>17,000</u>
Total .....			<u>\$23,660</u>

**Exercise 4-11** (continued)

<i>Product B</i>			
<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related .....	\$9.00 per DLH	100 DLHs	\$ 900
Purchase orders ....	\$2.00 per order	105 orders	210
Product testing .....	\$10.00 per test	60 tests	600
Template etching...	\$25.00 per template	14 templates	350
General factory .....	\$5.00 per MH	2,200 MHs	<u>11,000</u>
Total .....			<u>\$13,060</u>

<i>Product C</i>			
<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related .....	\$9.00 per DLH	700 DLHs	\$ 6,300
Purchase orders ....	\$2.00 per order	180 orders	360
Product testing .....	\$10.00 per test	0 tests	0
Template etching...	\$25.00 per template	10 templates	250
General factory .....	\$5.00 per MH	1,800 MHs	<u>9,000</u>
Total .....			<u>\$15,910</u>

<i>Product D</i>			
<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related .....	\$9.00 per DLH	700 DLHs	\$ 6,300
Purchase orders ....	\$2.00 per order	160 orders	320
Product testing .....	\$10.00 per test	90 tests	900
Template etching...	\$25.00 per template	4 templates	100
General factory .....	\$5.00 per MH	2,600 MHs	<u>13,000</u>
Total .....			<u>\$20,620</u>

**Exercise 4-11** (continued)

3. The conventional system would assign 5% ( $100 \text{ DLH} \div 2,000 \text{ DLH}$ ) of all overhead costs to Product B. The ABC system would assign 20% ( $105 \text{ orders} \div 525 \text{ orders}$ ) of the purchase order activity costs to Product B. It would assign approximately 17% ( $60 \text{ tests} \div 350 \text{ tests}$ ) of the product testing activity costs to Product B, 50% ( $14 \text{ templates} \div 28 \text{ templates}$ ) of the template etching costs to Product B, and 22% ( $2,200 \text{ machine-hours} \div 10,000 \text{ machine-hours}$ ) of the general factory costs to Product B. The conventional cost system would undercost Product B relative to the ABC cost allocations.

**Problem 4-12** (30 minutes)

- Under the traditional direct labor-dollar based costing system, manufacturing overhead is applied to products using the predetermined overhead rate computed as follows:

$$\begin{aligned} \text{Predetermined overhead rate} &= \frac{\text{Estimated total manufacturing overhead cost}}{\text{Estimated total direct labor dollars}} \\ &= \frac{\$508,625}{\$162,500} = \$3.13 \text{ per DL\$} \end{aligned}$$

The unit product costs using the conventional approach would be computed as follows:

	<i>EX300</i>	<i>TX500</i>
Direct materials.....	\$366,325	\$162,550
Direct labor.....	120,000	42,500
Manufacturing overhead applied @ \$3.13 per direct labor-dollar .....	<u>375,600</u>	<u>133,025</u>
Total manufacturing cost (a)	\$861,925	\$338,075
Number of units (b).....	60,000	12,500
Unit product cost (a) ÷ (b)..	\$14.37	\$27.05

**Problem 4-12** (continued)

2. The activity rates are computed as follows:

<i>Activity Cost Pools</i>	<i>(a) Total Cost</i>	<i>(b) Total Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Machining .....	\$198,250	152,500 MHR	\$1.30 per MHR
Setups .....	\$150,000	375 setup hrs.	\$400 per setup hr.
Product-level .....	\$100,250	2 products	\$50,125 per product
General factory .....	\$60,125	162,500 DL\$	\$0.37 per DL\$

Under the activity-based costing system, the unit product costs would be computed as follows:

	<i>EX300</i>	<i>TX500</i>
Direct materials.....	366,325	162,550
Direct labor.....	120,000	42,500
Machining.....	117,000	81,250
Setups .....	30,000	120,000
Product sustaining .....	50,125	50,125
General factory .....	<u>44,400</u>	<u>15,725</u>
Total cost (a) .....	727,850	472,150
Number of units (b) .....	60,000	12,500
Unit product cost (a) ÷ (b)	\$12.13	\$37.77

3. The traditional system uses one unit-level activity measure, direct labor dollars, to assign 73.8% ( $\$375,600 \div \$508,625$ ) of all overhead costs to the EX300 product line and 26.2% ( $\$133,025 \div \$508,625$ ) of all overhead costs to the TX500 product line. The ABC system assigns 59.0% ( $\$117,000 \div \$198,250$ ) of Machining costs to the EX300 product line and 41.0% ( $\$81,250 \div \$198,250$ ) to the TX500 product line. It assigns 20.0% ( $\$30,000 \div \$150,000$ ) of Setup costs (a batch-level activity) to the EX300 product line and 80.0% ( $\$120,000 \div \$150,000$ ) to the TX500 product line. It also assigns 50% ( $\$50,125 \div \$100,250$ ) of product-level costs to each product line.

**Problem 4-13** (15 minutes)

	<i>Activity</i>	<i>Level</i>	<i>Possible Activity Measures</i>
a.	Milling machines are used to make components for products.	Unit	Number of units processed; Machine-hours
b.	A percentage of all completed goods are inspected on a random basis.	Unit	Number of units inspected; Inspection time
c.	Production orders are issued for jobs.	Batch	Number of production orders
d.	The company's grounds crew maintains planted areas surrounding the factory.	Facility	Arbitrary*
e.	Employees are trained in general procedures.	Facility or Product	Arbitrary if factory-level*
f.	The human resources department screens and hires new employees.	Facility	Arbitrary*
g.	Purchase orders are issued for materials required in production.	Batch	Number of purchase orders
h.	Material is received on the receiving dock and moved to the production area.	Batch or Unit	Number of material moves
i.	The plant controller prepares periodic accounting reports.	Facility	Arbitrary*
j.	The engineering department makes modifications in the designs of products.	Product	Engineering time
k.	Machines are set up between batches of different products.	Batch	Number of setups; Setup time
l.	The maintenance crew does routine periodic maintenance on general-purpose equipment.	Facility	Arbitrary*

\*Facility-level costs are commonly allocated using an arbitrary allocation base such as direct labor-hours.

**Problem 4-14** (60 minutes)

1. The first step is to determine the activity rates:

	<i>Serving a Party</i>	<i>Serving a Diner</i>	<i>Serving Drinks</i>
Total cost (a) .....	\$32,800	\$211,200	\$69,600
Total activity (b).....	8,000 parties	32,000 diners	58,000 drinks
Cost per unit of activity (a)÷(b) .	\$4.10 per party	\$6.60 per diner	\$1.20 per drink

2. According to the ABC system, the cost of serving each of the parties can be computed as follows:

	<i>Serving a Party</i>	<i>Serving a Diner</i>	<i>Serving Drinks</i>
Cost per unit of activity .	\$4.10 per party	\$6.60 per diner	\$1.20 per drink

a. A party of four diners who order three drinks:

	<i>1</i> <i>party</i>	<i>4</i> <i>diners</i>	<i>3</i> <i>drinks</i>	
Cost .....	\$4.10	\$26.40	\$3.60	\$34.10

b. A party of two diners who order no drinks:

	<i>1</i> <i>party</i>	<i>2</i> <i>diners</i>	<i>0</i> <i>drinks</i>	
Cost .....	\$4.10	\$13.20	\$0.00	\$17.30

c. A lone diner who orders two drinks:

	<i>1</i> <i>party</i>	<i>1</i> <i>diner</i>	<i>2</i> <i>drinks</i>	
Cost .....	\$4.10	\$6.60	\$2.40	\$13.10



### Problem 4-14 (continued)

3. The average cost per diner for each party can be computed by dividing the total cost of the party by the number of diners in the party as follows:
- a.  $\$34.10 \div 4 \text{ diners} = \$8.53 \text{ per diner}$
  - b.  $\$17.30 \div 2 \text{ diners} = \$8.65 \text{ per diner}$
  - c.  $\$13.10 \div 1 \text{ diner} = \$13.10 \text{ per diner}$
4. The average cost per diner differs from party to party under the activity-based costing system for two reasons. First, the cost of serving a party (\$4.10) does not depend on the number of diners in the party. Therefore, the average cost per diner of this activity decreases as the number of diners in the party increases. With only one diner, the cost is \$4.10. With two diners, the average cost per diner is cut in half to \$2.05. With four diners, the average cost per diner would be approximately \$1.03. And so on. Second, the average cost per diner differs also because of the differences in the number of drinks ordered by the diners. If a party does not order any drinks, as was the case with the party of two, no costs of serving drinks are assigned to the party.

The average cost per diner differs from the overall average cost of \$9.80 per diner because the \$9.80 per diner figure does not recognize differences in the diners' demands on resources. It does not recognize that some diners order more drinks than others nor does it recognize that there are some economies of scale in serving larger parties. (The batch-level costs of serving a party can be spread over more diners if the party is larger.)

We should note that the activity-based costing system itself does not recognize all of the differences in diners' demands on resources. For example, there are undoubtedly differences in the costs of preparing the various meals on the menu. It may or may not be worth the effort to build a more detailed activity-based costing system that would consider such nuances.

**Problem 4-15** (45 minutes)

1. The company's estimated total direct labor-hours for the year can be computed as follows:

Flexible model: 1,000 units × 2.0 DLH per unit....	2,000
Rigid model: 10,000 units × 1.0 DLH per unit.....	<u>10,000</u>
Total direct labor-hours.....	<u>12,000</u>

Using direct labor-hours as the allocation base, the predetermined overhead rate would be:

$$\begin{aligned} \text{Predetermined overhead rate} &= \frac{\text{Total manufacturing overhead}}{\text{Total direct labor-hours}} \\ &= \frac{\$600,000}{12,000 \text{ DLHs}} = \$50.00 \text{ per DLH} \end{aligned}$$

The unit product costs are computed as follows:

	<i>Flexible</i>	<i>Rigid</i>
Direct materials .....	\$110.00	\$ 80.00
Direct labor .....	30.00	15.00
Manufacturing overhead:		
\$50.00 per DLH × 2.0 DLHs ...	100.00	
\$50.00 per DLH × 1.0 DLHs ...		<u>50.00</u>
Unit product cost.....	<u>\$240.00</u>	<u>\$145.00</u>

2. Activity rates can be computed as follows:

<i>Activity Cost Pool</i>	<i>(a)</i>	<i>(b)</i>	<i>(a) ÷ (b)</i>
	<i>Estimated Overhead Cost</i>	<i>Expected Activity</i>	
Purchase orders ..	\$20,000	400 orders	\$50.00 per order
Rework requests .	\$10,000	200 requests	\$50.00 per request
Product testing....	\$210,000	2,100 tests	\$100.00 per test
Machine related...	\$360,000	4,000 MHs	\$90.00 per MH

**Problem 4-15** (continued)

3. a.

	<i>Flexible</i>		<i>Rigid</i>	
	<i>Expected Activity</i>	<i>Amount</i>	<i>Expected Activity</i>	<i>Amount</i>
Purchase orders, at \$50.00 per order.....	100	\$ 5,000	300	\$ 15,000
Rework requests, at \$50.00 per request.....	60	3,000	140	7,000
Product testing, at \$100.00 per test .....	900	90,000	1,200	120,000
Machine related, at \$90.00 per MH.....	1,500	<u>135,000</u>	2,500	<u>225,000</u>
Total overhead cost assigned (a) .....		\$233,000		\$367,000
Number of units produced (b).....		1,000		10,000
Overhead cost per unit (a) ÷ (b).....		\$233.00		\$36.70

b. Using activity-based costing, the unit product costs would be:

	<i>Flexible</i>	<i>Rigid</i>
Direct materials .....	\$110.00	\$ 80.00
Direct labor .....	30.00	15.00
Manufacturing overhead....	<u>233.00</u>	<u>36.70</u>
Unit product cost.....	<u>\$373.00</u>	<u>\$131.70</u>

### **Problem 4-15** (continued)

4. Unit product costs are distorted as a result of using direct labor-hours as the base for applying overhead costs to products. Although the flexible model requires twice as much labor as the rigid model, it still is not being assigned enough overhead cost according to the activity-based costing system.

According to the activity-based costing system, the flexible model is more expensive to manufacture than the company thought. Note that the flexible model accounts for 37.5% of the machine-hours worked, although it represents a small part of the company's total output. Also, it consumes a disproportionately large amount of the other activities.

When activity-based costing is used in place of direct labor-hours as the basis for assigning overhead cost to products, the unit product cost of the flexible model jumps up from \$240.00 to \$373.00. If the \$240.00 figure is being used as the basis for pricing, then the selling price may be too low for the flexible model. This may be the reason why profits have been declining for the last several years. It may also be the reason why sales of the flexible model have been increasing rapidly.

**Problem 4-16** (45 minutes)

1. The company expects to work 40,000 direct labor-hours, computed as follows:

LEC 40: 60,000 units × 0.40 DLH per unit.....	24,000 DLHs
LEC 90: 20,000 units × 0.80 DLH per unit.....	<u>16,000</u> DLHs
Total direct labor-hours.....	<u>40,000</u> DLHs

Using direct labor-hours as the base, the predetermined manufacturing overhead rate would be:

$$\begin{aligned} \text{Predetermined overhead rate} &= \frac{\text{Total manufacturing overhead}}{\text{Total direct labor-hours}} \\ &= \frac{\$912,000}{40,000 \text{ DLHs}} = \$22.80 \text{ per DLH} \end{aligned}$$

The unit product cost of each product would be:

	<i>LEC 40</i>	<i>LEC 90</i>
Direct materials .....	\$30.00	\$50.00
Direct labor .....	6.00	12.00
Manufacturing overhead:		
\$22.80 per DLH × 0.40 DLHs ....	9.12	
\$22.80 per DLH × 0.80 DLHs ....		<u>18.24</u>
Unit product cost.....	<u>\$45.12</u>	<u>\$80.24</u>

**Problem 4-16** (continued)

2. Activity rates can be computed as follows:

<i>Activity Cost Pool</i>	<i>(a) Estimated Overhead Cost</i>	<i>(b) Expected Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Maintaining inventory.....	\$225,000	1,500 part types	\$150.00 per part type
Processing purchase orders ....	\$182,000	2,800 orders	\$65.00 per order
Quality control.....	\$45,000	2,250 tests	\$20.00 per test
Machine-related .....	\$460,000	10,000 MHs	\$46.00 per MH

3 a.

	<u>LEC 40</u>		<u>LEC 90</u>	
	<i>Expected Activity</i>	<i>Amount</i>	<i>Expected Activity</i>	<i>Amount</i>
Maintaining parts inventory, at \$150.00 per part type ..	600	\$ 90,000	900	\$135,000
Processing purchase orders, at \$65.00 per order .....	2,000	130,000	800	52,000
Quality control, at \$20.00 per test.....	500	10,000	1,750	35,000
Machine-related, at \$46.00 per MH .....	1,600	<u>73,600</u>	8,400	<u>386,400</u>
Total manufacturing overhead cost .....		<u>\$303,600</u>		<u>\$608,400</u>
Units produced.....		60,000		20,000
Manufacturing overhead per unit .....		\$5.06		\$30.42

**Problem 4-16** (continued)

b. Using activity-based costing, the unit product costs would be:

	<i>LEC 40</i>	<i>LEC 90</i>
Direct materials .....	\$30.00	\$50.00
Direct labor .....	6.00	12.00
Manufacturing overhead (see above) ...	<u>5.06</u>	<u>30.42</u>
Unit product cost .....	<u>\$41.06</u>	<u>\$92.42</u>

4. Although the LEC 90 accounts for only 25% of the company's total production, it is responsible for 60% of the part types carried in inventory and 84% of the machine-hours worked. It is also responsible for 78% of the tests needed for quality control. These factors have been concealed as a result of using direct labor-hours as the base for assigning overhead cost to products. Since the LEC 90 is responsible for a majority of the activity, under activity-based costing it is assigned a larger amount of overhead cost.

The LEC 90 may not be as profitable as management believes, and this may be the reason for the company's declining profits. Note that from part (1), the unit product cost of the LEC 90 is \$80.24. In part (3), however, the activity-based costing system sets the unit product cost of the LEC 90 at \$92.42. This is a difference of \$12.18 per unit. If management bases the LEC 90's selling price on the lower figure of \$80.24, it is possible that the company may actually be losing money on this product. This could explain declining profits and the apparent popularity of the LEC 90.

**Problem 4-17** (45 minutes)

1. a. When direct labor-hours are used to apply overhead costs to products, other factors affecting the incurrence of overhead costs are ignored. The company's predetermined overhead rate would be:

$$\begin{aligned} \text{Predetermined overhead rate} &= \frac{\text{Total manufacturing overhead}}{\text{Total direct labor-hours}} \\ &= \frac{\$1,785,000}{21,000 \text{ DLHs}} = \$85.00 \text{ per DLH} \end{aligned}$$

- b. The unit product costs are computed as follows:

	<i>Model N 800 XL</i>	<i>Model N 500</i>
Direct materials .....	\$ 75.00	\$ 25.00
Direct labor:		
\$18.00 per DLH × 3.0 DLHs ..	54.00	
\$18.00 per DLH × 1.0 DLHs ..		18.00
Manufacturing overhead:		
\$85.00 per DLH × 3.0 DLHs ..	255.00	
\$85.00 per DLH × 1.0 DLHs ..		<u>85.00</u>
Unit product cost .....	<u>\$384.00</u>	<u>\$128.00</u>

2. a. Activity rates can be computed as follows:

<i>Activity Cost Pool</i>	<i>(a) Estimated Overhead Cost</i>	<i>(b) Expected Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Machine setups .....	\$360,000	300 setups	\$1,200.00 per setup
Special processing ..	\$165,000	16,500 MHs	\$10.00 per MH
General factory .....	\$1,260,000	21,000 DLHs	\$60.00 per DLH



**Problem 4-17** (continued)

b. The unit product costs would now be computed as follows, starting with the computation of the manufacturing overhead:

	<i>Model N 800 XL</i>	<i>Model N 500</i>
Machine setups:		
\$1,200.00 per setup × 100 setups ....	\$120,000	
\$1,200.00 per setup × 200 setups ....		\$240,000
Special processing:		
\$10.00 per MH × 16,500 MHs .....	165,000	
\$10.00 per MH × 0 MHs .....		0
General factory:		
\$60.00 per DLH × 9,000 DLHs .....	540,000	
\$60.00 per DLH × 12,000 DLHs .....		<u>720,000</u>
Total overhead cost (a) .....	<u>\$825,000</u>	<u>\$960,000</u>
Number of units produced (b) .....	3,000	12,000
Overhead cost per unit (a) ÷ (b) .....	\$275.00	\$80.00

	<i>Model N 800 XL</i>	<i>Model N 500</i>
Direct materials .....	\$ 75.00	\$25.00
Direct labor:		
\$18.00 per DLH × 3.0 DLHs .....	54.00	
\$18.00 per DLH × 1.0 DLHs .....		18.00
Manufacturing overhead (see above)....	<u>275.00</u>	<u>80.00</u>
Unit product cost .....	<u>\$404.00</u>	<u>\$123.00</u>

3. It is important to note that, even under activity-based costing, 71% of the company's overhead costs continue to be assigned to products on the basis of direct labor-hours:

Machine setups (number of setups).....	\$ 360,000	20%
Special processing (machine-hours).....	165,000	9
General factory (direct labor-hours).....	<u>1,260,000</u>	<u>71</u>
Total .....	<u>\$1,785,000</u>	<u>100%</u>

### Problem 4-17 (continued)

Thus, the shift in overhead cost from the high-volume product Model N 500 to the low-volume product Model N 800 XL occurred as a result of reassigning only 29% of the company's overhead costs.

The increase in unit cost of Model N 800 XL can be explained as follows: First, where possible, overhead costs have been traced to the products rather than being lumped together and spread uniformly over all units. Therefore, special processing costs, which are all due to processing Model N 800 XL, have been assigned to Model N 800 XL and none to Model N 500 under the activity-based costing approach.

Second, the costs associated with the batch-level activity (machine setups) have been assigned on the basis of setups rather than direct labor-hours. Each setup, regardless of the batch size, is assigned the same amount of machine setup cost. Some products are produced in large batches and some are produced in small batches. The smaller the batch, the higher unit cost. In this example, the data can be analyzed as follows:

*Model N 800 XL:*

Machine setup cost from ABC system (a).	\$1,200 per setup
Average number of units per setup	
3,000 units ÷ 100 setups (b) .....	30 units per setup
Average setup cost per unit (a) ÷ (b).....	\$40.00 per unit

*Model N 500:*

Machine setup cost from ABC system (a).	\$1,200 per setup
Average number of units per setup	
12,000 units ÷ 200 setups (b) .....	60 units per setup
Average setup cost per unit (a) ÷ (b).....	\$20.00 per unit

Thus, the average setup cost per unit is 2.0 times as great for Model N 800 XL as for Model N 500. Such cost differences are obscured when direct labor-hours (or any similar measure of volume) is used as the basis for applying overhead costs to products.

**Problem 4-18** (30 minutes)

1. The activity rates are computed as follows:

<i>Activity Cost Pool</i>	<i>(a) Estimated Overhead Cost</i>	<i>(b) Expected Activity</i>	<i>(a) ÷ (b) Activity Rate</i>
Labor related .....	\$35,000	7,000 DLHs	\$5 per DLH
Production orders ...	\$4,000	2,000 orders	\$2 per order
Material receipts .....	\$10,450	950 receipts	\$11 per receipt
Relay assembly .....	\$7,000	1,000 relays	\$7 per relay
General factory .....	\$240,000	40,000 MHs	\$6 per MH

2. Overhead cost is assigned to the products as follows:

<i>Product A</i>			
<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related .....	\$5 per DLH	2,400 DLHs	\$12,000
Production orders .....	\$2 per order	100 orders	200
Material receipts .....	\$11 per receipt	400 receipts	4,400
Relay assembly .....	\$7 per relay	170 relays	1,190
General factory .....	\$6 per MH	12,000 MHs	<u>72,000</u>
Total .....			<u>\$89,790</u>

<i>Product B</i>			
<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related .....	\$5 per DLH	500 DLHs	\$ 2,500
Production orders .....	\$2 per order	350 orders	700
Material receipts .....	\$11 per receipt	208 receipts	2,288
Relay assembly .....	\$7 per relay	170 relays	1,190
General factory .....	\$6 per MH	7,000 MHs	<u>42,000</u>
Total .....			<u>\$48,678</u>

**Problem 4-18 (continued)**

<i>Product C</i>			
<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related .....	\$5 per DLH	3,500 DLHs	\$17,500
Production orders .....	\$2 per order	800 orders	1,600
Material receipts .....	\$11 per receipt	342 receipts	3,762
Relay assembly .....	\$7 per relay	300 relays	2,100
General factory .....	\$6 per MH	8,000 MHs	<u>48,000</u>
Total .....			<u>\$72,962</u>

<i>Product D</i>			
<i>Activity Cost Pool</i>	<i>(a) Activity Rate</i>	<i>(b) Actual Activity</i>	<i>(a) × (b) ABC Cost</i>
Labor related .....	\$5 per DLH	600 DLHs	\$ 3,000
Production orders .....	\$2 per order	750 orders	1,500
Material receipts .....	\$11 per receipt	0 receipts	0
Relay assembly .....	\$7 per relay	360 relays	2,520
General factory .....	\$6 per MH	13,000 MHs	<u>78,000</u>
Total .....			<u>\$85,020</u>

3. The conventional system would assign 20% (8,000 MHs ÷ 40,000 MHs) of all overhead costs to Product C. The ABC system would assign 50% (3,500 DLHs ÷ 7,000 DLHs) of the labor related activity costs to Product C. It would assign approximately 40% (800 orders ÷ 2,000 orders) of the production orders activity costs to Product C, 36% (342 receipts ÷ 950 receipts) of the material receipts activity costs to Product C, and 30% (300 relays ÷ 1,000 relays) of the relay assembly costs to Product C. The conventional cost system would undercost Product C relative to the ABC cost allocations.

## Communicating in Practice (30 minutes)

Date: Current Date  
To: Maria Graham  
From: Student's Name  
Subject: Overhead Allocation

I understand that you are thinking about purchasing a small manufacturing company that assembles and packages its many products by hand. The company currently uses direct labor hours to allocate overhead to its products, but you plan to introduce automation. You have asked me to comment on whether this technique should be continued.

Direct labor is an appropriate allocation base for overhead when overhead is highly correlated with direct labor and direct labor “drives” overhead costs. This may have been true when the assembly process was largely manual, but after automation you may find that the relation between direct labor and overhead is far weaker. When a factory is automated, direct labor tends to decrease while overhead costs increase. Direct labor costs decrease because machines replace direct laborers. Overhead costs increase as a result of additional depreciation, power costs, insurance, and other related costs. This suggests that there will no longer be a direct relationship between overhead and direct labor (that is, when direct labor costs increase there is not a related increase in overhead costs). Hence, direct labor will no longer be an appropriate way to allocate overhead costs to products.

Activity-based costing may be the best alternative. In activity-based costing, overhead costs are allocated based on the activities required to make the products and the resources that are consumed by these activities. This technique is more complex than the approach the company is currently using. Activity-based costing is costly to implement and to maintain, but you may find that the benefits of having more accurate product costs will outweigh these costs—particularly if you intend to rely on product costs for pricing and other decisions.

## Teamwork in Action

Student answers will vary depending on the operations they observe at the restaurant they visit and on how they define a unit and products. The following are only suggestive of the answers that might be offered for a fast food restaurant that sells hamburgers and beverages:

- |                                        |                                                                                                                |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------|
| a. Unit-level activities and costs     | Grilling a burger, assembling a hamburger, making a milkshake, costs of ingredients, costs of containers, etc. |
| b. Customer-level activities and costs | Taking an order, assembling ordered items, bagging order, taking payment, etc.                                 |
| c. Product-level activities and costs  | Cost of soft ice cream maker, cost of deep fat fryer, cost of soda dispenser, etc.                             |
| d. Facility-level activities and costs | Cost of building rent, cost of manager's salary, heating and lighting the building, etc.                       |

### **Ethics Challenge** (15 minutes)

Most people would probably feel that the most equitable way to divide the dinner bill among a group of friends is for each person to pay for the cost of what he or she individually consumed. However, it would be easier to split the bill equally among the individuals.

This relates to material in the chapter because the method of dividing up the bill according to what each individual order is similar to ABC and the method of simply dividing the bill by the number of individuals is similar to traditional costing methods. Figuring out the cost of what each individual consumes properly allocates costs to the individuals who incurred them. However, it sometimes is difficult to trace some costs to individuals. For example, some dishes may be shared. This is also similar to ABC in that some costs are easier to trace than others.

**Case** (150 minutes)

1. a. The predetermined overhead rate would be computed as follows:

$$\frac{\text{Expected manufacturing overhead cost}}{\text{Estimated direct labor-hours}} = \frac{\$3,000,000}{50,000 \text{ DLHs}}$$

$$= \$60 \text{ per DLH}$$

b. The unit product cost per pound, using the company's present costing system, would be:

	<i>Mona Loa</i>	<i>Malaysian</i>
Direct materials (given) .....	\$4.20	\$3.20
Direct labor (given) .....	0.30	0.30
Manufacturing overhead:		
0.025 DLH × \$60 per DLH.....	<u>1.50</u>	<u>1.50</u>
Total unit product cost .....	<u>\$6.00</u>	<u>\$5.00</u>

2. a. Overhead rates by activity:

<i>Activity Center</i>	<i>(a)</i> <i>Estimated</i> <i>Overhead</i> <i>Costs</i>	<i>(b)</i> <i>Expected</i> <i>Activity</i>	<i>(a) ÷ (b)</i> <i>Activity Rate</i>
Purchasing .....	\$513,000	1,710 orders	\$300 per order
Material handling .	\$720,000	1,800 setups	\$400 per setup
Quality control .....	\$144,000	600 batches	\$240 per batch
Roasting.....	\$961,000	96,100 hours	\$10 per hour
Blending.....	\$402,000	33,500 hours	\$12 per hour
Packaging.....	\$260,000	26,000 hours	\$10 per hour



## Case (continued)

Before we can determine the amount of overhead cost to assign to the products, we must first determine the activity for each of the products in the six activity centers. The necessary computations follow:

Number of purchase orders:

Mona Loa:  $100,000 \text{ pounds} \div 20,000 \text{ pounds per order} = 5 \text{ orders}$

Malaysian:  $2,000 \text{ pounds} \div 500 \text{ pounds per order} = 4 \text{ orders}$

Number of batches:

Mona Loa:  $100,000 \text{ pounds} \div 10,000 \text{ pounds per batch} = 10 \text{ batches}$

Malaysian:  $2,000 \text{ pounds} \div 500 \text{ pounds per batch} = 4 \text{ batches}$

Number of setups:

Mona Loa:  $10 \text{ batches} \times 3 \text{ setups per batch} = 30 \text{ setups}$

Malaysian:  $4 \text{ batches} \times 3 \text{ setups per batch} = 12 \text{ setups}$

Roasting hours:

Mona Loa:  $1 \text{ hour} \times (100,000 \text{ pounds} \div 100 \text{ pounds}) = 1,000 \text{ hours}$

Malaysian:  $1 \text{ hour} \times (2,000 \text{ pounds} \div 100 \text{ pounds}) = 20 \text{ hours}$

Blending hours:

Mona Loa:  $0.5 \text{ hour} \times (100,000 \text{ pounds} \div 100 \text{ pounds}) = 500 \text{ hours}$

Malaysian:  $0.5 \text{ hour} \times (2,000 \text{ pounds} \div 100 \text{ pounds}) = 10 \text{ hours}$

Packaging hours:

Mona Loa:  $0.1 \text{ hour} \times (100,000 \text{ pounds} \div 100 \text{ pounds}) = 100 \text{ hours}$

Malaysian:  $0.1 \text{ hour} \times (2,000 \text{ pounds} \div 100 \text{ pounds}) = 2 \text{ hours}$

**Case** (continued)

Using the activity figures, manufacturing overhead costs can be assigned to the two products as follows:

	<i>Mona Loa</i>		<i>Malaysian</i>	
	<i>Expected Activity</i>	<i>Amount</i>	<i>Expected Activity</i>	<i>Amount</i>
Purchasing, at \$300 per order .....	5 orders	\$ 1,500	4 orders	\$1,200
Material handling, at \$400 per setup .....	30 setups	12,000	12 setups	4,800
Quality control, at \$240 per batch .....	10 batches	2,400	4 batches	960
Roasting, at \$10 per roasting hour.....	1,000 hours	10,000	20 hours	200
Blending, at \$12 per blending hour .....	500 hours	6,000	10 hours	120
Packaging, at \$10 per packaging hour.....	100 hours	<u>1,000</u>	2 hours	<u>20</u>
Total overhead cost.....		<u>\$32,900</u>		<u>\$7,300</u>

b. According to the activity-based costing system, the manufacturing overhead cost per pound is:

	<i>Mona Loa</i>	<i>Malaysian</i>
Total overhead cost assigned (above) (a)...	\$32,900	\$7,300
Number of pounds manufactured (b) .....	100,000	2,000
Cost per pound (a) ÷ (b).....	\$0.33	\$3.65

c. The unit product costs according to the activity-based costing system are:

	<i>Mona Loa</i>	<i>Malaysian</i>
Direct materials (given) .....	\$4.20	\$3.20
Direct labor (given).....	0.30	0.30
Manufacturing overhead.....	<u>0.33</u>	<u>3.65</u>
Total unit product cost .....	<u>\$4.83</u>	<u>\$7.15</u>

**Case** (continued)

3. MEMO TO THE PRESIDENT: Analysis of CBI's data shows that several activities other than direct labor drive the company's manufacturing overhead costs. These activities include purchase orders issued, number of setups for material processing, and number of batches processed. The company's present costing system, which relies on direct labor time as the sole basis for assigning overhead cost to products, significantly undercosts low-volume products, such as the Malaysian coffee, and significantly overcosts high-volume products, such as our Mona Loa coffee.

## Case (continued)

### ALTERNATIVE SOLUTION:

Most students will compute the manufacturing overhead cost per pound of the two coffees as shown above. However, the cost per pound can also be computed as shown below. *This alternative approach provides additional insight into the data and facilitates emphasis of some points made in the chapter.*

	<u>Mona Loa</u>		<u>Malaysian</u>	
	<i>Total</i>	<i>Per Pound (÷ 100,000)</i>	<i>Total</i>	<i>Per Pound (÷ 2,000)</i>
Purchasing .....	\$ 1,500	\$0.015	\$1,200	\$0.600
Material handling ..	12,000	0.120	4,800	2.400
Quality control .....	2,400	0.024	960	0.480
Roasting .....	10,000	0.100	200	0.100
Blending .....	6,000	0.060	120	0.060
Packaging .....	<u>1,000</u>	<u>0.010</u>	<u>20</u>	<u>0.010</u>
Total .....	<u>\$32,900</u>	<u>\$0.329</u>	<u>\$7,300</u>	<u>\$3.650</u>

Note particularly how batch size impacts unit cost data. For example, the cost to the company to process a purchase order is \$300, regardless of how many pounds of coffee are contained in the order. Twenty thousand pounds of the Mona Loa coffee are purchased per order (with five orders per year), and just 500 pounds of the Malaysian coffee are purchased per order (with four orders per year). Thus, the purchase order cost *per pound* for the Mona Loa coffee is just 1.5 cents, whereas the purchase order cost *per pound* for the Malaysian coffee is 40 times as much, or 60 cents. As stated in the text, this is one reason why unit costs of low-volume products, such as the Malaysian coffee, increase so dramatically when activity-based costing is used.

**Analytical Thinking** (150 minutes)

1.

	<i>(a)</i> <i>Estimated Overhead Costs</i>	<i>(b)</i> <i>Expected Activity</i>	<i>(a) ÷ (b)</i> <i>Activity Rate</i>
Purchasing .....	\$15,000	300 orders <sup>1</sup>	\$50 per order
Material handling .....	16,000	400 receipts <sup>2</sup>	\$40 per receipt
Production orders and setups .....	6,000	60 setup-hours <sup>3</sup>	\$100 per setup-hour
Inspection .....	18,000	600 inspection-hours	\$30 per inspection-hour
Frame assembly .....	12,000	1,500 assembly-hours	\$8 per assembly-hour
Machine related .....	32,000	8,000 machine-hours <sup>4</sup>	\$4 per machine-hour

<sup>1</sup>60 + 90 + 150 = 300

<sup>2</sup>80 + 105 + 215 = 400

<sup>3</sup> Standard: 10 setups × 1 hour per setup .....	10 hours
Specialty: 25 setups × 2 hours per setup .....	<u>50 hours</u>
Total setup hours .....	<u>60 hours</u>

<sup>4</sup> Standard: 10,000 units × 0.5 hours per unit...	5,000 hours
Specialty: 2,500 units × 1.2 hours unit .....	<u>3,000 hours</u>
Total machine-hours .....	<u>8,000 hours</u>

## Analytical Thinking (continued)

Overhead cost charged to each product:

	<i>Standard</i>		<i>Specialty</i>	
	<i>Activity</i>	<i>Amount</i>	<i>Activity</i>	<i>Amount</i>
Purchasing, at \$50 per order:				
Leather .....	50	\$ 2,500	10	\$ 500
Fabric .....	70	3,500	20	1,000
Synthetic.....	0	0	150	7,500
Material handling, at \$40 per receipt:				
Leather .....	70	2,800	10	400
Fabric .....	85	3,400	20	800
Synthetic.....	0	0	215	8,600
Production orders and setups, at \$100 per hour .....	10	1,000	50	5,000
Inspection, at \$30 per hour .....	200	6,000	400	12,000
Frame assembly, at \$8 per hour...	700	5,600	800	6,400
Machine related, at \$4 per hour ...	5,000	<u>20,000</u>	3,000	<u>12,000</u>
Total manufacturing overhead cost.....		<u>\$44,800</u>		<u>\$54,200</u>

Manufacturing overhead cost per unit of product:

Standard:  $\$44,800 \div 10,000 \text{ units} = \$4.48 \text{ per unit}$

Specialty:  $\$54,200 \div 2,500 \text{ units} = \$21.68 \text{ per unit}$

**Analytical Thinking** (continued)

2. The unit product cost of each product under activity-based costing is given below. For comparison, the costs computed by the company's accounting department using conventional costing are also provided.

	<i>Activity-Based Costing</i>		<i>Direct Labor-Hour Base</i>	
	<i>Standard</i>	<i>Specialty</i>	<i>Standard</i>	<i>Specialty</i>
Direct materials .....	\$10.00	\$20.00	\$10.00	\$20.00
Direct labor .....	6.00	4.80	6.00	4.80
Manufacturing overhead..	<u>4.48</u>	<u>21.68</u>	<u>8.25</u>	<u>6.60</u>
Total unit product cost ....	<u>\$20.48</u>	<u>\$46.48</u>	<u>\$24.25</u>	<u>\$31.40</u>

3. The president was probably correct in being concerned about the profitability of the products, but the problem is apparently with the specialty product rather than the standard. Traditional overhead cost assignment using a volume-based measure has resulted in the high-volume product subsidizing the low-volume product. Thus, unit costs for both products are badly distorted. These distorted costs have had a major impact on management's pricing policies and on management's perception of the margin being realized on each product. The specialty briefcases are apparently being sold at a loss even without considering nonmanufacturing costs:

	<i>Standard Briefcases</i>	<i>Specialty Briefcases</i>
Selling price per unit .....	\$26.25	\$42.50
Unit product cost .....	<u>20.48</u>	<u>46.48</u>
Gross margin (loss) per unit .....	<u>\$ 5.77</u>	<u>\$(3.98)</u>

Based on these data, the company should not shift its resources entirely to the production of specialty briefcases. Whether or not the specialty briefcases can be made profitable depends on a number of factors including the sensitivity of the market to an increase in the selling price of the specialty briefcase.

## **Analytical Thinking** (continued)

*Note to the Instructor:* You may wish to mention to your class that before any decision can be made regarding dropping a product line, a careful analysis will have to be made of the potential avoidable costs. The unit product costs probably include some idle capacity costs and facility-level costs that are not relevant in such a decision.

4. Perhaps the competition hasn't been able to touch FirstLine Cases' price because the company has been selling its specialty briefcases at a price that is below its cost. Thus, rather than "gouging" its customers, FirstLine Cases' competitor is probably just pricing its specialty items at a normal markup over their cost. Indeed, according to the activity-based costing system, if FirstLine Cases is to realize a profit on its specialty items it may need to charge a price more in line with its competitor's price (over \$50 per unit).

When a company sells a product at a price substantially below that of its competitors, the company's management should take a careful look at the costing system to be sure that the product is being assigned all the costs that it causes.