CHAPTER 13

DISCUSSION QUESTIONS

Q13-1. Departmental overhead rates are preferred to a single rate because they improve the control of overhead by department heads responsible for controllable overhead, and they increase the accuracy of product and job costing when products or jobs move through various producing departments.

Q13-2. Departmentalizing factory overhead is an extension of methods used in establishing a single rate because (a) an application base must be selected and estimated; (b) overhead estimates must be made; and (c) actual overhead must be accumulated and compared with applied overhead. These steps are required for each producing department, whereas with a single rate, only total factory data are necessary.

Q13-3. The sum of departmental over- or underapplied overhead would be different. Every direct labor hour would have the same amount of applied overhead when a plant-wide overhead rate is used, assuming that the application base is direct labor hours. However, the use of departmental rates results in different amounts of applied overhead, depending on the labor hours in each department and the individual departmental overhead rates. For example, a firm with an overall rate of $2 would have $20,000 of applied overhead for 10,000 hours; the same firm with departmental rates of $1 and $3 for its two producing departments could have more or less applied overhead, depending on the breakdown of labor hours receiving the $1 and $3 overhead charge.

The total cost of goods sold and total inventory would also be different, because departmental rates could cause different unit costs. Therefore, inventory and cost of goods sold would be influenced by products sold or still on hand. This would not be the case if a blanket rate were used.

Q13-4. A producing department is directly concerned with manufacturing products or doing work on various jobs. A service department renders service to various departments and is not directly associated with manufacturing operations. The nature of the work done by a department determines whether it is a service or producing department. Examples of producing departments are cutting, finishing, machining, mixing, and refining. Examples of service departments are maintenance, medical, powerhouse, purchasing, receiving, and cost accounting.

Q13-5. The kinds of departments established to control and charge costs depend on (a) similarity of a company's operations, processes, and machinery; (b) location of operations, processes, and machinery; (c) responsibilities for production and costs; (d) relationship of operations to flow of product; and (e) number of departments or work centers. The number of departments established depends on the emphasis placed on cost control and on the development of overhead rates.

Q13-6. Physically different segments of a department or cost pools for different kinds of costs within a department may be driven by activity bases that are quite different, thus calling for the use of subdepartments for factory overhead accumulation, application, and analysis for each physical segment or cost pool.

Q13-7. No. A more correct method is the use of the plant asset records to compute departmental depreciation, property tax, and fire insurance charges, provided the records are sufficiently detailed for this purpose and the work involved is not too complex. Such a method would give proper recognition to the various depreciation rates used and fire insurance premiums paid because of varying types of equipment.

Q13-8. Factors involved in selecting the most equitable rate for applying factory overhead include consideration of the nature of a department's operations, the relationship of overhead elements to operations involved, and any clerical difficulties arising through the use of a particular rate.

Q13-9. The several steps followed in establishing departmental factory overhead rates are:
- (a) Estimating direct overhead of producing departments and the direct costs of service departments.
- (b) Preparing a factory survey for the purpose of distributing indirect departmental costs and service department costs.
- (c) Estimating and allocating indirect departmental costs.
- (d) Distributing service department costs.
- (e) Computing departmental factory overhead rates.

Q13-10. The questions that must be resolved in allocating service department costs to benefiting departments include:
- (a) Determining which departments are benefited.
- (b) Selecting an allocation base.
- (c) Choosing the allocation method, i.e., direct, step, or simultaneous.

Q13-11.
- (a) Direct—No service department costs are allocated to other service departments.
- (b) Step—Service department costs are allocated in the order of the departments serving the greatest number of departments and receiving service from the smallest number, or in the order of the largest service department cost allocated to other service departments. Once a service department's costs have been allocated, no costs of other service departments are allocated to it.
- (c) Simultaneous—The full reciprocal interrelationships of benefits among service departments are considered.

  The simultaneous method is the most accurate for product costing and for identifying total costs for operating particular service departments. However, this method is also the most difficult to compute.

Q13-12. Control of overhead is achieved by comparing actual results with planned or estimated results. To make such comparisons, both types of overhead must be accumulated and reported in the same manner. Since the computation of overhead rates with required overhead estimates precedes the incurrence and accumulation of actual overhead, the computation procedures determine the accounting for actual overhead.

Q13-13. Departmental over- or underapplied overhead is determined by comparing actual and applied overhead.

Q13-14. If a complex product line is produced in a nondepartmentalized factory or in a single department of a factory, one approach to accurate product costing is to use multiple overhead cost pools and multiple bases within a single responsibility center.

Q13-15. Nonmanufacturing businesses (such as retail stores, financial institutions, insurance companies, educational institutions, and hospitals) should be divided into departments to budget and control costs. For example, a retail store might be departmentalized as follows: administration, occupancy, sales promotion and advertising, purchasing, selling, and delivery. As in manufacturing businesses, departmental costs are prorated to revenue-producing sales departments by using a charging or billing rate. Departmentalization is particularly necessary for hospitals and educational institutions, which must budget their costs on a departmental basis to control costs and to charge adequate cost recovering fees.

Q13-16. Government agencies employ large numbers of people, and as they spend larger and larger sums of tax money for various services, taxpayers are demanding more efficient use of that money. Therefore, services should be rendered at the lowest cost with the greatest efficiency. Governmental activities should be budgeted and their costs controlled on a responsibility accounting basis. The efficiency of services should be measured by using such units of measurement as per capita, per mile, or per ton.

EXERCISES

E13-1

Work in Process	33,310	
Applied Factory Overhead—Department A		
(17,000 × $.89*)		15,130
Applied Factory Overhead—Department B		
(18,000 × $1.016**)		18,180

*$17,800 ÷ 20,000 = $.89

**$20,200 ÷ 20,000 = $1.01

E13-2

	Departmental Overhead Columns				General Ledger	
	Machining	Painting	Assembly	General Factory Cost Pool	Debit	Credit
(a) Factory Overhead Control..................	1,500.00	600.00	600.00	300.00	3,000.00	
Accumulated Depr.—Buildings						3,000.00
(b) Factory Overhead Control..................	6,000.00	2,000.00	1,200.00	400.00	9,600.00	
Accumulated Depr.—Machinery						9,600.00
(c) Factory Overhead Control..................	550.00	203.33	170.00	76.67	1,000.00	
Accrued Property Tax Payable.......						1,000.00
(d) Factory Overhead Control..................	450.00	180.00	160.00	60.00	850.00	
Accr. Worker's Compensation...						850.00
(e) Factory Overhead Control..................	600.00		60.00	90.00	750.00	
Accrued Power Payable..............						750.00
(f) Factory Overhead Control...............	900.00	360.00	360.00	180.00	1,800.00	
Accounts Payable						1,800.00
(g) Factory Overhead Control...............	1,800.00		2,300.00	410.00	4,510.00	
Materials						4,510.00

E13-3

(1)	P1	P2	S1	S2
Budgeted factory overhead	$410,000	$304,000	$100,000	$50,000
Department $1 distribution (90/300, 210/300)	30,000	70,000	(100,000)	
Department S2 distribution (64/80, 16/80)	40,000	10,000		(50,000)
Budgeted factory overhead	$480,000	$384,000		
Machine hours	÷ 64,000			
Predetermined rate	$7.50			
Direct labor hours.		÷100,000		
Predetermined rate		3.84		
Job 437 overhead cost.				
Department P1 (3 × $7.50)	$22.50			
Department P2 (2 × $3.84)	7.68			
	30.18			

(2) Plant-wide predetermined factory overhead rate:

$$\frac{\$864{,}000}{135{,}000\ \text{DLH}} = \$6.40\ \text{per DLH}$$

Job 437 overhead cost (3 × $6.40) $19.20

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E13-4

(1) $$\frac{\$40{,}000+\$25{,}000+\$361{,}956+\$420{,}000}{452{,}000+567{,}250}=\frac{\$846{,}956}{1{,}019{,}250}=\$.83$$

(2)

	Total	Machining	Assembly	Building and Grounds	Factory Admin-stration
Budgeted factory overhead	$846,956	$361,956	$420,000	$40,000	$25,000
Distribution of:					
Building and grounds............		18,000	20,000	(40,000)*	2,000
Factory administration..		13,200	13,800		(27,000)**
Total.......................	$846,956	$393,156	$453,800		
Base:					
Machine hours		195,600			
Direct labor hours................			567,250		
Rate........................		$2.01	$.80		

*9/20, 10/20, 1/20 to Machining, Assembly, and Factory Administration, respectively.

**44/90, 46/90 to Machining and Assembly, respectively.

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E13-5

	Total	Cutting	Assembly	Main-tenance	Admin-istration
Overhead budget..	$1,270,000	$520,000	$400,000	$200,000	$150,000
Distribution of:					
Maintenance (21/30, 9/30)...		140,000	60,000	(200,000)	
Administration (15/25, 10/25).		90,000	60,000		(150,000)
Overhead budget..	$1,270,000	$750,000	$520,000		
Machine hours......		25,000	20,000		
Overhead rate.......		$30.00	$26.00		

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E13-6

		Producing Departments		Service Departments	
	Total	Mixing	Finishing	Cafeteria	Product Design
Budgeted factory overhead before distribution of service departments	$360,000	$100,000	$200,000	$10,000	$50,000
Distribution of service department costs:					
Cafeteria ($10,000 ÷ 200 employees = $50)...................		3,250	6,500	(10,000)	250
Product Design ($50,250 ÷ 300 product orders = $167.50)............		16,750	33,500		(50,250)
	$360,000	$120,000	$240,000		
Bases: machine hours		40,000	60,000		
Rates		$3.00	$4.00		

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E13-7

		Producing Departments		Service Departments	
	Total	P1	P2	S1	S2
Budgeted overhead....	$552,750	$208,000	$300,000	$10,000	$34,750
Distribution of:					
Department S1........		4,500	5,250	(10,000)*	250
Department S2........		20,000	15,000		(35,000)**
Total factory overhead	$552,750	$232,500	$320,250		

*180/400 to P1, 210/400 to P2, 10/400 to S2

**4,000/7,000 to P1, 3,000/7,000 to P2

P1: $232,500 ÷ 4,000 machine hours = $58.125 rate per machine hour

P2: $320,250 ÷ 10,000 direct labor hours = $32.025 rate per direct labor hour

E13-7 (Concluded)

(2) Plant-wide rate: $544,750 ÷ 15,000 direct labor hours = $36.317 plant-wide rate per direct labor hour

(3) Individual jobs may require relatively different amounts of time in each department. If P1 is machine-intensive and P2 is labor-intensive, then separate departmental rates would provide a fairer allocation of costs to jobs.

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E13-8

(1)

	Total	Maintenance	Personnel	Machining	Assembly
Budgeted factory overhead...............	$270,000	$30,000	$15,000	$150,000	$75,000
Allocate Maintenance ($30,000 ÷ 40,000 sq. ft. = $.75 per sq. ft.)		(30,000)	3,000	14,250	12,750
Allocate Personnel ($18,000 ÷ 120 employees = $150 per employee).			(18,000)	6,000	12,000
	$270,000			$170,250	$99,750
Divided by machine hours				22,700	
Divided by direct labor hours					16,625
Factory overhead rate				$7.50	$6.00

(2) Job No. 3752:

	Machining	Assembly	Total
Materials	$ 60	$ 7	$ 67
Direct labor	24	99	123
Factory overhead:			
10 machine hours @ $7.50.............	75		
11 direct labor hours @ $6.00........		66	141
	$159	$172	$331

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E13-9

(1) Equation 1: $E = \$20,000 + .20F$
Equation 2: $F = \$20,000 + .20E$
Equation 3: $G = \$10,000 + .30E + .10F$

Substituting Equation 2 into Equation 1:

$$E = \$20,000 + .20(\$20,000 + .20E)$$
$$E = \$20,000 + \$4,000 + .04E$$
$$.96E = \$24,000$$
$$E = \$25,000$$

Substituting E = $25,000 into Equation 2:

$$F = \$20,000 + .20(\$25,000)$$
$$F = \$25,000$$

Substituting E = $25,000 and F = $25,000 into Equation 3:

$$G = \$10,000 + .30(\$25,000) + .10(\$25,000)$$
$$G = \$20,000$$

(2)

	Producing Departments		Marketing		Service Departments			
	S	T	Department	General Office	E	F	G	Total
Department overhead before distribution of service departments	$60,000	$ 90,000			$20,000	$20,000	$10,000	$200,000
Distribution of.:								
Department E........		12,500			(25,000)	5,000	7,500	
Department F........	7,500	10,000			5,000	(25,000)	2,500	
Department G.......	8,000	6,000	$4,000	$2,000			(20,000)	
Total.....	$75,500	$118,500	$4,000	$2,000				$200,000

E13-10

Distribution of Department	Total	Production Departments A	Production Departments B	Service Departments C	Service Departments D	Service Departments E	Service Departments F
	$51,000	$15,000	$12,000	$ 12,000	$ 8,000	$ 2,000	$ 2,000
F		1,000			600	400	$(2,000)
D		3,400	1,600	2,600	$(8,600)	1,000	
C			14,600	$(14,600)			
E		1,360	2,040			$(3,400)	
	$51,000	$20,760	$30,240				

E13-11

	Total	Production Departments A	Production Departments B	Service Departments C	Service Departments D	Service Departments E	Service Departments F
Actual costs............	$401,000	$100,000	$ 80,000	$ 120,000	$ 56,000	$ 15,000	$ 30,000
Distribution of service department costs:							
F (5/10, 0, 0, 3/10, 2/10)		15,000			9,000	6,000	(30,000)
D (125/325, 60/325, 100/325, 40/325)		25,000	12,000	20,000	(65,000)	8,000	
C (0, 100%, 0)			140,000	(140,000)			
E (15/40, 25/40)....		10,875	18,125			(29,000)	
Actual costs............	$401,000	$150,875	$250,125				

E13-12

Let: S1 = \$20,000 + .20S2
S2 = \$17,600 + .10S1

Substituting: S1 = \$20,000 + .20(\$17,600 + .10S1)
Solving: S1 = \$20,000 + \$3,520 + .02S1
.98S1 = \$23,520
S1 = \$24,000

Substituting: S2 = \$17,600 + .10(\$24,000)
= \$17,600 + \$2,400
= \$20,000

Total P1 overhead = \$94,000 +.40(S1) + .50(S2)
= \$94,000 +.40(\$24,000) + .50(\$20,000)
= \$94,000 + \$9,600 + \$10,000
= \$113,600

E13-13

(1) The dual predetermined overhead rates are:

$$\frac{\$200{,}000}{16{,}000 \text{ direct labor hours}} = \$12.50 \text{ per direct labor hour}$$

and

$$\frac{\$300{,}000}{4{,}000 \text{ machine hours}} = \$75 \text{ per machine hour}$$

(2) Job #345

Direct material		\$1,000
Direct labor (30 × \$10)		300
Applied overhead:		
30 × \$12.50	= \$375	
10 × \$75	= \$750	1,125
Total		2,425

E13-14

(1) **The dual predetermined overhead rates are:**

$$\frac{\$900,00}{3,600 \text{ machine hours}} = \$250 \text{ per machine hour}$$

and

$$\frac{\$600,000}{300 \text{ tons}} = \$2,000 \text{ per ton}$$

(2)

Job #103	
Parts and materials	$22,000
Applied overhead:	
70 × $250 = $17,500	
4 × $2,000 = 8,000	25,500
Total	$47,500

PROBLEMS

P13-1

(1) Distribution of Service Department Overhead Using the Direct Method

		Producing Departments		Service Departments	
	Total	Grinding	Smoothing	Maintenance	General Factory
Overhead before distribution of service departments	$681,000	$175,000	$230,000	$76,000	$200,000
Distribution of					
Maintenance.........		12,667	63,333	(76,000)*	
Gen'l Factory		133,333	66,667		(200,000)**
Total factory overhead............	$681,000	$321,000	$360,000		
Machine hours......		÷ 4,000			
Direct labor hours.			÷ 30,000		
Overhead rates:					
per machine hr...		$ 80.25			
per direct labor hr...........			$ 12		

*180/1,080 to Grinding, 900/1,080 to Smoothing
**6/9 to Grinding, 3/9 to Smoothing

P13-1 (Continued)

(2) First, the simultaneous equations are solved:

Let: M = \$76,000 + (1/10)G
G = \$200,000 + (720/1,800)M

Substituting: M = \$76,000 + .1(\$200,000 + .40M)
Solving: M = \$76,000 + \$20,000 + .04M
.96M = \$96,000
M = \$100,000

Substituting: G = \$200,000 + .40(\$100,000)
= \$200,000 + \$40,000 = \$240,000

Distribution of Service Department Overhead
Using the Simultaneous Method

		Producing Departments		Service Departments	
	Total	Grinding	Smoothing	Main-tenance	General Factory
Overhead before tribution of service depart-ments	\$681,000	\$175,000	\$230,000	\$ 76,000	\$ 200,000
Distribution of Maintenance		10,000	50,000	(100,000)	40,000*
Gen'l Factory		144,000	72,000	24,000	(240,000)**
Total factory overhead	\$681,000	\$329,000	\$352,000		
Machine hours		÷ 4,000			
Direct labor hours			÷ 30,000		
Overhead rates: per machine hr.		\$ 82.25			
per direct labor hr.			\$ 11.73		

*180/1,800 to Grinding, 900/1,800 to Smoothing, and 720/1,800 to General Factory
**6/10 to Grinding, 3/10 to Smoothing, and 1/10 to Maintenance

P13-1 (Concluded)

Distribution of Service Department Overhead Using the Step Method

		Producing Departments		Service Departments	
	Total	Grinding	Smoothing	Maintenance	General Factory
Overhead before distribution of service departments	$681,000	$175,000	$230,000	$ 76,000	$ 200,000
Distribution of:					
Maintenance		7,600	38,000	(76,000)	30,400*
Gen'l Factory		153,600	76,800		(230,400)**
Total factory overhead	$681,000	$336,200	$344,800		
Machine hours		÷ 4,000			
Direct labor hours			÷ 30,000		
Overhead rates:					
per machine hr.		$ 84.05			
per direct labor hr.			$ 11.49		

*180/1,800 to Grinding, 900/1,800 to Smoothing, and 720/1,800 to General Factory
**6/9 to Grinding, 3/9 to Smoothing

P13-2

(1)

	Cutting Department	Assembly Department	Finishing Department
Predetermined factory overhead rate........................	\$ 2.40/MH	\$ 5.00/DLH	\$ 1.60/DL\$
Actual activity base amount...	× 10,800 MH	× 12,400 DLH	× \$ 66,000
Applied factory overhead	\$25,920	\$62,000	\$105,600

(2)

$$\text{Revised factory overhead rate} = \frac{\left(\begin{array}{c}\text{Actual overhead for}\\ \text{first six months}\end{array}\right) + \left(\begin{array}{c}\text{Projected overhead for}\\ \text{second six months}\end{array}\right)}{\left(\begin{array}{c}\text{Actual activity base}\\ \text{for first six months}\end{array}\right) + \left(\begin{array}{c}\text{Projected activity base}\\ \text{for second six months}\end{array}\right)}$$

Cutting Department (machine hours):

$$\frac{\$22,600 + \$23,400}{10,800 + 9,200} = \frac{\$46,000}{20,000} = \$2.30 \text{ per machine hour}$$

Assembly Department (direct labor hours):

$$\frac{\$56,800 + \$57,500}{12,400 + 13,000} = \frac{\$114,300}{25,400} = \$4.50 \text{ per direct labor hour}$$

Finishing Department (direct labor dollars):

$$\frac{\$98,500 + \$96,500}{\$66,000 + \$64,000} = \frac{\$195,000}{\$130,000} = \$1.50 \text{ per direct labor dollar}$$

P13-2 (Concluded)

(3) The applied overhead accounts should be adjusted by the difference in the factory overhead rates (revised rate less original rate) times the actual activity for the first six months.

Cutting Department	(($2.30 – $2.40)	×	10,800)	$ (1,080)
Assembly Department	(($4.50 – $5.00)	×	12,400)	(6,200)
Finishing Department	(($1.50 – $1.60)	×	$66,000)	(6,600)
Decrease in applied factory overhead				$(13,880)

The applied overhead adjustment is allocated to the inventory accounts and cost of goods sold on the basis of the unadjusted overhead component in each account.

Work in Process	$ 12,000	5%
Finished Goods	48,000	20
Cost of Goods Sold	180,000	75
	$240,000	100%

	Debit	Credit
Applied Factory Overhead—Cutting	1,080	
Applied Factory Overhead—Assembly	6,200	
Applied Factory Overhead—Finishing	6,600	
Work in Process Inventory ($13,880 × .05)		694
Finished Goods ($13,880 × .20)		2,776
Cost of Goods Sold ($13,880 × .75)		10,410

P13-3

	Producing Departments			Service Departments		
	Dept. 10	Dept. 12	Dept. 14	Store-room	Repairs and Main-tenance	General Factory Cost Pool
Direct departmental overhead:						
Supervision	$20,500	$16,000	$14,000	$7,200	$8,000	$24,000
Indirect labor	5,400	6,000	8,000	6,133	7,200	18,000
Indirect supplies	4,850	5,600	5,430	1,400	3,651	1,070
Labor fringe benefits	6,872	9,349	10,145	640	760	2,100
Equipment depreciation	6,000	8,000	10,000	560	1,740	1,100
Property tax, depreciation of buildings, etc.						20,000
Total	$43,622	544,949	$47,575	$15,933	$21,351	$66,270
Proration of light and power	1,860	2,325	2,790	279	1,116	930
Total	$45,482	$47,274	$50,365	$16,212	$22,467	$67,200
Distribution of service departments:						
General Factory Cost Pool	16,800	20,160	23,520	2,688	4,032	(67,200)*
Storeroom	8,694	5,670	2,835	(18,900)**	1,701	
Repairs and Maintenance	9,024	7,896	11,280		(28,200)***	
Total—producing departments	$80,000	$81,000	$88,000			
Machine hours	800	900	1,600			
Overhead rate per machine hr.	$100.00	$90.00	$55.00			

*General Factory Cost Pool can be distributed either on the basis of $.80 per square foot ($67,200 ÷ 84,000 sq. ft.) or on the basis of the following percentages: 25%, 30%, 35%, 4%, and 6% for the first five departments. The percentages are determined by dividing the square footage in each department by the total square footage.

** Storeroom can be distributed either on the basis of $.07 per requisition ($18,900 ÷ 270,000 requisitions) or on the basis of the following percentages: 46%, 30%, 15%, and 9% for the three producing and one service departments. The percentages are determined by dividing the number of requisitions in each department by the total requisitions.

*** Repairs and maintenance can be distributed either on the basis of $1.88 per maintenance hour ($28,200 ÷ 15,000 hours) or on the basis of percentages: 32%, 28%, and 40% to the three producing departments. The percentages are determined by dividing the maintenance hours in each department by the total maintenance hours.

P13-4

(1)

	Departments			
	Repair	Power	Molding	Assembly
Department costs...............	$48,000	$250,000	$200,000	$320,000
Allocation of service department costs:				
Repair (1/9, 8/9)...................	(48,000)		5,333	42,667
Power (7/8, 1/8)		(250,000)	218,750	31,250
Total overhead cost............			$424,083	$393,917
Direct labor hours			40,000	160,000
Overhead rate per direct labor hour............................			$10.60	$2.46

(2) Algebraic calculations:

R = Repair Department
P = Power Department

$$R = \$48{,}000 + .20P$$
$$P = \$250{,}000 + .10R$$

Substituting: $R = \$48{,}000 + .20(\$250{,}000 + .10R)$

Solving: $R = \$48{,}000 + \$50{,}000 + .02R$
$$.98R = \$98{,}000$$
$$R = \$100{,}000$$

Substituting: $P = \$250{,}000 + .10(\$100{,}000)$

$$P = \$260{,}000$$

	Departments			
	Repair	Power	Molding	Assembly
Department costs...............	$48,000	$250,000	$200,000	$320,000
Allocation of service department costs:				
Repair (1/10, 1/10, 8/10)	(100,000)	10,000	10,000	80,000
Power (2/10, 7/10, 1/10)	52,000	(260,000)	182,000	26,000
Total overhead cost..........			$392,000	$426,000
Direct labor hours			40,000	160,000
Overhead rate per direct labor hour			$9.80	$2.66

(3) Allocating service department costs to producing departments only ignores any service rendered by one service department to another, while the simultaneous method recognizes service departments' support to one another through the use of simultaneous equations. The latter method is more complete and should lead to results of greater use to management.

P13-5

(1)

	Total	P1	P2	S1	S2
Before distribution	$65,000	$25,000	$23,800	$ 7,200	$ 9,000
Distribution of S1 (4/9, 5/9)....		3,200	4,000	(7,200)	
Distribution of S2 (2/6, 4/6)....		3,000	6,000		(9,000)
After distribution....................	$65,000	$31,200	$33,800		

(2)

	Total	P1	P2	S1	S2
Before distribution	$65,000	$25,000	$23,800	$ 7,200	$ 9,000
Distribution of S2 (2/10, 4/10, 4/10)...................................		1,800	3,600	3,600	(9,000)
Distribution of S1 (4/9, 5/9)....		4,800	6,000	(10,800)	
After distribution....................	$65,000	$31,600	$33,400		

(3) Let: S1 = $7,200 + .40S2
S2 = $9,000 + .10S1

Substituting: S1 = $7,200 + .40($9,000 + .10S1)

Solving: .96S1 = $10,800
S1 = $11,250

Substituting: S2 = $9,000 + .10($11,250)
S2 = $10,125

	Total	P1	P2	S1	S2
Before distribution	$65,000	$25,000	$23,800	$ 7,200	$ 9,000
Distribution of S1 (4/10, 5/10 1/10)....................................		4,500	5,625	(11,250)	1,125
Distribution of S2 (2/10, 4/10, 4/10		2,025	4,050	4,050	(10,125)
After distribution....................	$65,000	$31,525	$33,475		

P13-6

(1) Let: x = Powerhouse; y = Personnel; z = General Factory

Equation 1:
$$x = \$16{,}000 + .10y + .20z$$
$$x - .10y - .20z = \$16{,}000$$

Equation 2:
$$y = \$29{,}500 + .10x + .15z$$
$$-.10x + y - .15z = \$29{,}500$$

Equation 3:
$$z = \$42{,}000 + .20x + .05y$$
$$-.20x - .05y + z = \$42{,}000$$

Multiply Equation 2 by 10 and add to Equation 1:
$$\begin{aligned} x - .10y - .20z &= \$\ 16{,}000 \\ \underline{-x + 10.00y - 1.50z} &= \underline{\ \ 295{,}000} \\ 9.90y - 1.70z &= \$311{,}000 \end{aligned}$$

Multiply Equation 3 by 5 and add to Equation 1:
$$\begin{aligned} x - .10y - .20z &= \$\ 16{,}000 \\ \underline{-x - .25y + 5.00z} &= \underline{\ \ 210{,}000} \\ -.35y + 4.80z &= \$226{,}000 \end{aligned}$$

Then eliminate y between the resulting equations:
$$\begin{aligned} 9.90y - 1.70z &= \$311{,}000 \\ -.35y + 4.80z &= \$226{,}000 \end{aligned}$$

$$\begin{aligned} (.35)(9.90y) - (.35)(1.70z) &= (.35)(\$311{,}000) \\ (9.90)(-.35y) + (9.90)(4.80z) &= (9.90)(\$226{,}000) \end{aligned}$$

$$\begin{aligned} 3.465y - .595z &= \$\ \ 108{,}850 \\ \underline{-3.465y + 47.520z} &= \underline{\$2{,}237{,}400} \\ 46.925z &= \$2{,}346{,}250 \\ z &= \$\ \ \ \ 50{,}000 \end{aligned}$$

From the last equation, z = \$50,000; putting z = \$50,000 in any one of the equations in which x has been eliminated enables one to find y:
$$\begin{aligned} 9.90y - 1.70z &= \$311{,}000 \\ 9.90y - 1.70(\$50{,}000) &= \$311{,}000 \\ 9.90y &= \$396{,}000 \\ y &= \$\ 40{,}000 \end{aligned}$$

Then putting y = \$40,000 and z = \$50,000 in any one of the original equations enables one to find x:
$$\begin{aligned} x - .10y \quad - .20z \quad &= \$16{,}000 \\ x - .10(\$40{,}000) - .20(\$50{,}000) &= \$16{,}000 \\ x &= \$30{,}000 \end{aligned}$$

Hence the solution is:
x = \$30,000
y = \$40,000
z = \$50,000

P13-6 (Concluded)

(2)

	Total	Mixing	Refining	Finishing	Power-house	Person-nel	General Factory
Primary cost.....	$482,500	$200,000	$ 90,000	$105,000	$ 16,000	$ 29,500	$ 42,000
Distribution:							
Powerhouse.....		7,500	7,500	6,000	(30,000)	3,000	6,000
Personnel		14,000	12,000	8,000	4,000	(40,000)	2,000
General Factory		12,500	10,000	10,000	10,000	7,500	(50,000)
	$482,500	$234,000	$119,500	$129,000			

P13-7

(1) Annual normal cost center overhead rates:

	Total Rate	Fixed Rate	Variable Rate
Department 10:			
Cost Center 10-1	$2.40	$ .90	$1.50
Cost Center 10-2	3.00	1.15	1.85
Department 20:			
Cost Center 20-1	$1.15	$ .32	$ .83
Cost Center 20-2	1.25	.30	.95

(2) Factory overhead applied to:

	Cost Centers	Depts.
Department 10:		
Cost Center 10-1: 1,220 machine hours × $2.40 =	$2,928	
Cost Center 10-2: 2,000 machine hours × $3.00 =	6,000	$8,928
Department 20:		
Cost Center 20-1: 2,250 labor hours × $1.15 =	$2,587.50	
Cost Center 20-2: 1,650 labor hours × $1.25 =	2,062.50	$4,650

(3)

	Dept. 10	Dept. 20
Actual factory overhead	$9,430.00	$4,005.00
Factory overhead applied..................................	8,928.00	4,650.00
Underapplied (overapplied)	$ 502.00	$ (645.00)

P13-8

(1) The dual predetermined overhead rates are:

$$\frac{\$400{,}000}{\$16{,}000 \text{ direct labor hours}} = \$25 \text{ per direct labor hour}$$

and

$$\frac{\$600{,}000}{\$20{,}000 \text{ machine hours}} = \$30 \text{ per machine hour}$$

(2)

Job #564		
Direct material		$2,000
Direct labor (30 × $10)		300
Applied overhead:		
30 × $25 =	$750	
10 × $30 =	300	1,050
Total		$3,350

(3)

Job #632		
Direct material		$2,000
Direct labor (30 × $10)		300
Applied overhead:		
30 × $25 =	$ 750	
60 × $30 =	1,800	2,550
Total		$4,850

(4) (a) A single predetermined overhead rate based on direct labor hours would be:

$$\frac{\$400{,}000 + \$600{,}000}{\$16{,}000 \text{ direct labor hours}} = \$62.50 \text{ per direct labor hour}$$

P13-8 (Concluded)

(b) Job #564	
Direct material	$2,000
Direct labor (30 × $10)	300
Applied overhead (30 × $62.50)	1,875
Total	$4,175

(c) Job #632	
Direct material	$2,000
Direct labor (30 × $10)	300
Applied overhead (30 × $62.50)	1,875
Total	$4,175

(5) The competitive implications of a single overhead rate are that on jobs requiring much labor and little machine time (e.g., Job #564), MTI will compute its costs at too high a level and will therefore quote too high a price to the customer. These jobs will probably be lost to competitors who know their costs better. On jobs requiring much machine time and little labor (e.g., Job #632), MTI will calculate its costs at too low a level and will, therefore, quote too low a price. These jobs will probably be won by MTI because of the low price, but will generate less profit than expected, or perhaps even a loss.

CASES

C13-1

(1) Empco Inc. is currently using a plant-wide overhead rate that is applied on the basis of direct labor dollars. In general, a plant-wide manufacturing overhead rate is acceptable only if a similar relationship between overhead and direct labor exists in all departments, or the company manufactures products which receive proportional services from each department.

In most cases, departmental overhead rates are preferable to plant-wide overhead rates because plant-wide overhead rates do not provide:

- a framework for reviewing overhead costs on a departmental basis, identifying departmental cost overruns, or taking corrective action to improve departmental cost control.
- sufficient information about product profitability, thus increasing the difficulties associated with management decision-making.

(2) Because Empco uses a plant-wide overhead rate applied on the basis of direct labor dollars, the elimination of direct labor in the Drilling Department through the introduction of robots may appear to reduce the overhead cost of the Drilling Department to zero. However, this change will not reduce fixed manufacturing expenses such as depreciation, plant supervision, etc. In reality, the use of robots is likely to increase fixed expenses because of increased depreciation expense. Under Empco's current method of allocating overhead costs, these costs will merely be absorbed by the remaining departments.

(3) (a) In order to improve the allocation of overhead costs in the Cutting and Grinding Departments, Empco should:

- establish separate overhead accounts and rates for each of these departments;
- select an application basis for each of these departments that best reflects the relationship of the departmental activity to the overhead costs incurred (e.g., direct labor hours, machine hours, etc.);
- identify, if possible, fixed and variable overhead costs and establish fixed and variable overhead rates.

(b) In order to accommodate the automation of the Drilling Department in its overhead accounting system, Empco should:

- establish separate overhead accounts and rates for the Drilling Department;
- identify, if possible, fixed and variable overhead costs and establish fixed and variable overhead rates;
- apply overhead costs to the Drilling Department on the basis of robot or machine hours.

C13-2

(1) **The company should use departmental overhead rates since the two departments are producing heterogeneous products. The added accuracy is required for pricing decisions and for better cost control information.**

(2) **The fixed cost of both service departments should be allocated based on long-range facilities utilization. Variable cost of purchasing would be better allocated using a cost driver, such as purchase orders, because there is a stronger explained relationship than by use of volume of materials ordered. Allocation of variable cleaning cost based on square footage seems reasonable; however, the variable cost of maintaining equipment should be isolated and charged to departments based on the cost of services provided.**

A fuller consideration of the interactive benefits of departments would be achieved by use of the step or simultaneous methods, and preferably the simultaneous method. Such consideration is desirable because the service departments provide services to each other.

C13-3

A letter to the president of Summerville Inc:

(1) **Dear Sir:**

From a study of the manufacturing operations of Summerville Inc., it is recommended that in distributing its factory overhead, the company use predetermined overhead rates applied as percentages of the direct labor cost. The company should use predetermined rates based on normal capacity rather than actual overhead rates because of the wide cyclical fluctuations in its business. Using actual rates would, due to large fixed overhead costs, make the per unit overhead cost high in the low production periods and low in the high production periods. Using predetermined rates, the per unit overhead cost would be level the year round. For quoting prices and pricing inventories per unit, costs which are neither inflated nor deflated by the cost of factory facilities are best.

The company should use departmental overhead rates because the rates obviously vary so markedly between departments. An overall rate would not be correct for any department. Summerville Inc.'s overhead is a large part of factory cost, and any inaccuracy in the per unit cost caused by the use of an overall rate would be material. If all the products made used all departments proportionately, an overall rate would result in a substantially accurate total (but not departmental) unit overhead cost. However, in Summerville Inc. the products do not use all the departments proportionately. Furthermore, use of departmental rates aids in pinpointing cost control responsibility.

C13-3 (Concluded)

(2) Wage rates are substantially uniform within the separate departments, and departmental labor costs are closely proportionate to labor time. Therefore, distributing the factory overhead on the basis of direct labor cost would in this case effect about as accurate a distribution as would the direct labor hours base. The clerical expense of the direct labor cost base would be low because the method does not require accumulation of the number of direct labor hours applicable to each job.

Applying overhead on the basis of prime cost is not recommended because of the wide differences in the costs of the materials used to make a given lamp or fixture. Factory overhead is the cost of factory facilities. The factory facilities used to make a lamp of silver are not more than those used to make the same lamp of copper. For this reason, the use of prime cost (since it includes materials cost) would result in an excessive charge to lamps using expensive materials.

Sincerely,

C13-4

(1) The ten cost items can be categorized into four basic groups for purposes of discussion:

Item	Allocation Method	Justification
I. All items in this category should be distributed.		
(a) Salaries and benefits	Direct	The costs of these two items are directly incurred by the activity centers and can be controlled by the supervisor. A part of the salaries and benefits might be excluded from a variable cost charging rate.
(b) Supplies	Direct	

C13-4 (Continued)

Item	Allocation Method	Justification
II. All items in this category should be distributed because a direct causal basis exists, but they should be excluded from a variable cost charging rate.		
(c) Equipment maintenance..............	Direct	The costs of these items are directly incurred by the activity centers but are controlled by corporate policy. They would be included in a full cost charging rate and excluded from a variable cost charging rate.
(d) Insurance	Direct	
(g) Equipment and furniture depreciation	Direct	The costs of these items are directly incurred by the activity centers. They are not controllable by the centers in the usual sense. They would be included in a full cost rate and excluded from a variable cost charging rate.
(e) Heat and air conditioning..............	Direct (one center only)	
(h) Building improvements depreciation	Direct (one center only)	
III. This item should be distributed because a reasonable measure for estimating the causal relationship exists.		
(f) Electricity............	Equipment and wattage ratings	A reasonable estimate can be made and of the electrical charges that can be controlled by efficient use of equipment. The cost should be included in a full cost and a variable cost charging rate.

C13-4 (Concluded)

Item	Allocation Method	Justification
IV. The following items should be distributed if a full cost charging rate is required.		
(f) Building occupancy and security	Square feet	There is no cost control benefit from allocation of these costs. The only reason to allocate is for a full cost charging rate.
(j) Corporate administrative charges	Number of employees or some other general basis	

(2) The number of hours selected for determining the charging rate depends upon the purpose of establishing the rate. If the objective is to charge user departments for all the costs of Computer Operations, the actual hours that can be identified with the user departments will be included in the base hours. This amounts to 3,500 hours, determined as follows:

Actual User Time

Testing and debugging programs	250
Setup of jobs	500
Processing jobs	2,750
Total hours	3,500

To promote cost control, the company might consider a dual charging rate, whereby the variable costs would be charged over actual user time (3,500 hours) and fixed costs over available time (4,242 hours).

Available Time

Testing and debugging programs	250
Setup of jobs	500
Processing jobs	2,750
Idle time	742
Total hours	4,242

C13-5

(1)

Actual factory overhead	$65,000	
Applied factory overhead	60,000	(15,000 hrs. × $4)
Underapplied factory overhead	$ 5,000	

(2)

(a) The 100 overtime hours resulted in $400 additional applied factory overhead. The overtime premium increased the actual factory overhead of the department $525 (($10.50 ÷ 2) × 100 hours). The extent to which these items affect the underapplied factory overhead depends on whether or not they were included in estimates used in computing the $4 factory overhead rate.

(b) Wage increases to direct laborers do not affect factory overhead directly. However, such increases will cause an increase in numerous fringe benefit costs such as FICA tax, unemployment taxes, worker's compensation, and pensions. If the increase were also granted to indirect workers of all categories, the increase in factory overhead might be substantial, causing a larger underapplied overhead amount, or a smaller overapplied amount.

(c) The Fabricating Department's share of the loss would be $112.50 and would be a factor in causing a larger, underapplied overhead amount, or a smaller overapplied amount. Since the distribution was most likely a management decision, the reason(s) should be given in an explanatory note in the cost reports and the supervisor relieved of the responsibility.

C13-6

(1) Allocation basis:

	October		November	
	Hours	%	Hours	%
Machine hours:				
Fast food furniture	1,320	6.67	2,560	13.06
Custom furniture	18,480	93.33	17,040	86.94
	19,800	100.00	19,600	100.00
Direct labor hours:				
Fast food furniture	10,000	25.00	17,500	40.00
Custom furniture	30,000	75.00	26,250	60.00
	40,000	100.00	43,750	100.00

Cost reallocation:

	October		November	
	Dollars	%	Dollars	%
Machine hour base:				
Maintenance	$ 50,000		$ 48,000	
Depreciation	42,000		42,000	
Property tax	8,000		8,000	
All other	32,000		24,500	
Total to be allocated	$132,000		$122,500	
Fast food furniture	$ 8,800	6.67	$ 16,000	13.06
Custom furniture	123,200	93.33	106,500	86.94
	$132,000	100.00	$122,500	100.00

	October		November	
	Dollars	%	Dollars	%
Labor hour base:				
Supervision	$ 13,000		$ 13,000	
Employee benefits	95,000		109,500	
Total to be allocated	$108,000		$122,500	
Fast food furniture	$ 27,000	25.00	$ 49,000	40.00
Custom furniture	81,000	75.00	73,500	60.00
	$108,000	100.00	$122,500	100.00

(2) When gross profit is recalculated, with the factory overhead reallocated on the base recommended by the controller, as shown in the following schedule, the figures tend to support the controller's conclusion. Also, the allocation bases suggested appear to have a reasonable relationship to the costs being allocated.

C13-6 (Concluded)

AQUA FURNISHINGS COMPANY
Revised Statement of Gross Profit
(in thousands)

	October		November	
	Fast Food Furniture	Custom Furniture	Fast Food Furniture	Custom Furniture
Gross sales	$400.0	$900.0	$800.0	$800.0
Direct materials	$200.0	$225.0	$400.0	$200.0
Direct labor:				
Forming	17.0	82.0	31.0	72.0
Finishing	40.0	142.0	70.0	125.0
Assembly	33.0	60.0	58.0	53.0
Factory overhead allocation:				
Machine hour base	8.8	123.2	16.0	106.5
Labor hour base	27.0	81.0	49.0	73.5
Cost of goods sold	$325.8	$713.2	$624.0	$630.0
Gross profit	$ 74.2	$186.8	$176.0	$170.0
Gross profit percentage	18.6%	20.8%	22.0%	21.25%