

	A	B	C	D	E	F	G
1	Baker Engineering Problem: Cost Allocation and Product costing						
2		Service Departments			Production Departments		Totals
3		Computer	Personnel	Janitor	Casting	Assembly	
4	Labor costs	\$95,000	\$60,000	\$22,000	\$468,000	\$580,000	
5	Material costs	12,000	5,000	1,000	169,600	109,600	\$297,200
6	Overhead costs	40,000	10,000	3,000	172,000	50,000	\$275,000
7	Total overhead	\$147,000	\$75,000	\$26,000	\$172,000	\$50,000	\$470,000
8	Total costs	\$147,000	\$75,000	\$26,000	\$809,600	\$739,600	\$1,797,200
9	Computer hours budgeted	1,500	100	0	1,800	100	3,500
10	Number of employees	6	9	3	15	21	54
11	Square feet occupied	1,000	2,000	500	10,000	5,000	18,500
12	Direct labor hours budgeted	8,320	14,560	6,240	31,200	58,000	118,320
13	Product A material				\$ 80.00	\$ 20.00	\$ 100.00
14	Product A production				1,000	1,000	\$ 2,000.00
15	Product A DLH				20	2	
16	Product A Total DLH				20,000	2,000	
17	Product B material				\$ 40.00	\$ 40.00	\$ 80.00
18	Product B production				2,240	2,240	
19	Product B DLH				5	25	
20	Product B Total DLH				11,200	56,000	
21	Wage rate/DLH				\$ 15.00	\$ 10.00	
22	Total DLH required				31,200	58,000	89,200
23		Product A	Product B				
24	Sales price	\$ 670.00	\$ 625.00				go to
25	Non-Manufacturing costs	\$ 20.00	\$ 25.00				plantwide rate
26		Overhead Costs	Allocation Bases for the production				direct alloc
27	Color coding >>>>	Product A data	Product B data				step down
28							product co
29	Plantwide rate						income sta
30	Total overhead	\$470,000					proof
31	Total production DLH	89,200					
32	Overhead rate/DLH	\$5.26905830					

All the decimals in cell B34 are merely to show that this does NOT come out even.

go to
[plantwide rate](#)
[direct alloc](#)
[step down](#)
[product co](#)
[income sta](#)
[proof](#)

direct worksheet; page 2 of 10

	A	B	C	D	E	F	G
1	Direct method: resource usage						
2		Computer	Personnel	Janitor	Casting	Assembly	Totals
3	Computer hours used	1,500	100	-	1,800	100	1,900
4	Number of employees	6	9	3	15	21	36
5	Square feet occupied	1,000	2,000	500	10,000	5,000	15,000
6	Direct labor hours budgeted	8,320	14,560	6,240	31,200	58,000	89,200
7	Direct method: ratios						
8		Computer	Personnel	Janitor	Casting	Assembly	Totals
9	Computer hour ratios				94.74%	5.26%	1.00
10	Employee ratios				41.67%	58.33%	1.00
11	Square foot ratios				66.67%	33.33%	1.00
12	Direct method: allocation table						
13		Computer	Personnel	Janitor	Casting	Assembly	Totals
14	Total costs	\$147,000	\$75,000	\$26,000	\$172,000	\$50,000	\$470,000
15	Computer services	(\$147,000)			139,263	7,737	147,000
16	Personnel		(\$75,000)		31,250	43,750	75,000
17	Janitorial services			(\$26,000)	17,333	8,667	26,000
18	Total costs	\$0	\$0	\$0	\$359,846	\$110,154	\$470,000
19	Direct labor hours				31,200	58,000	
20	Departmental rates				\$11.53354	\$1.89920	

step worksheet; page 3 of 10

	A	B	C	D	E	F	G
1	Step-down method: resource usage						
2	Department	Computer	Personnel	Janitor	Casting	Assembly	Totals
3	Computer hours	0	100	0	1,800	100	2,000
4	Employees	0	0	3	15	21	39
5	Square feet	0	0	0	10,000	5,000	15,000
6	Direct labor hours				31,200	58,000	89,200
7	Step-down method: ratios						
8	Computer hours	0.00%	5.00%	0.00%	90.00%	5.00%	100.00%
9	Employees	0.00%	0.00%	7.69%	38.46%	53.85%	100.00%
10	Square feet	0.00%	0.00%	0.00%	66.67%	33.33%	100.00%
11	Direct labor hours	0.00%	0.00%	0.00%	34.98%	65.02%	100.00%
12	Step-down method: cost allocation table						
13		Computer	Personnel	Janitor	Casting	Assembly	Totals
14	Total costs	\$147,000	\$75,000	\$26,000	\$172,000	\$50,000	\$470,000
15	Allocate computer services	(147,000)	7,350	0	132,300	7,350	0
16	New total costs	0	82,350	26,000	304,300	57,350	470,000
17	Allocate personnel		(82,350)	6,335	31,673	44,342	0
18	New total costs	0	0	32,335	335,973	101,692	470,000
19	Allocate janitorial services			(32,335)	21,556	10,778	0
20	New total costs	0	0	0	357,529	112,471	470,000
21	Direct labor hours				31,200	58,000	89,200
22	Departmental rates				\$11.46	\$1.94	

Baker Engineering Problem: Cost Allocation and Product costing								
Basic data reproduced								
	Service Departments			Production Departments				
	Computer	Personnel	Janitor	Casting	Assembly	Totals		
Labor costs	\$95,000	\$60,000	\$22,000	\$468,000	\$580,000	\$1,225,000		
Material costs	12,000	5,000	1,000	169,600	109,600	\$297,200		
Overhead costs	40,000	10,000	3,000	172,000	50,000	\$275,000		
Total overhead	\$147,000	\$75,000	\$26,000	\$172,000	\$50,000	\$470,000		
Total costs	\$147,000	\$75,000	\$26,000	\$809,600	\$739,600	\$1,797,200		
Computer hours budgeted	1,500	100	0	1,800	100	3,500		
Number of employees	6	9	3	15	21	54		
Square feet occupied	1,000	2,000	500	10,000	5,000	18,500		
Direct labor hours budgeted	8,320	14,560	6,240	31,200	58,000	118,320		
Step 1: identify the usage of support services and the service department costs								
Matrix of resource usage							Vector of Svce Dept Costs	
	Computer	Personnel	Janitor	Foundry	Assembly	Totals	Dept	Costs
Computer hours used	1,500	100	0	1,800	100	3,500	Computer	\$ 147,000
Number of employees	6	9	3	15	21	54	Personnel	\$ 75,000
Sq feet occupied	1,000	2,000	500	10,000	5,000	18,500	Janitor	\$ 26,000
Step 2: convert the usage amounts to percentages.								\$ 248,000
Convert units of usage to percentages.								
	Computer	Personnel	Janitor	Foundry	Assembly	Totals		
Computer hours used	0.428571	0.028571	-	0.514286	0.028571	1.000000		
Number of employees	0.111111	0.166667	0.055556	0.277778	0.388889	1.000000		
Sq feet occupied	0.054054	0.108108	0.027027	0.540541	0.270270	1.000000		
Step 3: Convert percentages to values [Edit, copy, paste special, values]								
	Computer	Personnel	Janitor	Foundry	Assembly	Totals		
Computer hours used	0.42857	0.02857	-	0.51429	0.02857	1.00000		
Number of employees	0.11111	0.16667	0.05556	0.27778	0.38889	1.00000		
Sq feet occupied	0.05405	0.10811	0.02703	0.54054	0.27027	1.00000		

Step 4: Transpose percentages [Edit, copy, paste special, transpose]						
	Computer hours used	Number of employees	Sq feet occupied			
Computer	0.42857	0.11111	0.05405	This is the "service matrix," [A] in matrix notation	When we transpose a matrix, the row and column orientations are reversed.	
Personnel	0.02857	0.16667	0.10811			
Janitor	-	0.05556	0.02703			
Foundry	0.51429	0.27778	0.54054			
Assembly	0.02857	0.38889	0.27027			
Totals	1.00000	1.00000	1.00000			
	Identity matrix [I]			Service Matrix [A]		
The identity matrix has ones in the diagonal cells and zeros elsewhere; it must be square [no. of rows = no. of columns]	1	0	0	0.42857	0.11111	0.05405
	0	1	0	0.02857	0.16667	0.10811
	0	0	1	-	0.05556	0.02703
Step 4: Take the difference between the Identity Matrix and the Service Department Matrix = [I] - [A]						
			0.5714	(0.1111)	(0.0541)	
			(0.0286)	0.8333	(0.1081)	
			-	(0.0556)	0.9730	
Step 5: Calculate I minus A, Inverse						
The inverse of matrix [A] is denoted as A ⁻¹ , and is read as A inverse. Matrix inversion is a tedious process requiring the calculation of determinants. Only square matrices can be inverted. Inverting anything bigger than a 2 x 2 matrix is best left to Excel or other software.	Calculate [I] minus [A] Inverse					
	1.76216	0.24328	0.12493			
	0.06087	1.21736	0.13864			
	0.00348	0.06951	1.03569			
<p>To take the inverse, use the =MINVERSE function. Highlight the area where you want Excel to put the output. Type =minverse in the formula bar or click on the function symbol and then find the function in the Math & Trig functions. Specify the range of the [I] - [A] matrix in the "array" field of the Function Arguments window. DO NOT CLICK OK. Display of the full inverted matrix requires the use of the following undocumented capability: Press <Control> <Shift> <Enter> simultaneously and the full array of the inverted matrix will appear in the output range you have specified. [Clicking OK will give you a single value in the upper left cell of the output range which is a mathematically correct number, but which is useless for subsequent calculations.]</p>						

A note about matrix multiplication is now in order. Matrices are specified by the number of rows and columns, in that order. The inverted matrix is a 3 by 3. In ordinary multiplication, order is immaterial [$2 \times 3 = 3 \times 2$]. However, order matters in matrix multiplication. Matrix multiplication requires that the number of **columns** in the first matrix be equal to the number of **rows** in the second. Therefore, we can multiply a 3 by 3 matrix by a 3 by 1 matrix, but we cannot multiply a 3 by 3 matrix by a 1 by 3 matrix. This means that the vector of service department costs must be in columnar format. To multiply the inverted [I] minus [A] matrix by the vector of service department costs, we use the =MMULT [matrix multiplication] function. The keyboard and mouse procedure is similar to that required for matrix inversion. specify the output range [3 rows by one column in this case]. Then click on the =MMULT function and specify the two arrays to be multiplied. DO NOT CLICK OK. Disply of the full output requires the use of the same <.Control> <Shift> <Enter> sequence that we used for the inversion.

Step 5: Multiplication of [I minus A] Inverse times the vector of service costs gives us [S]:

280,533
103,854
32,652

The Production resources usage matrix [P], from above, is:

Foundry	Assembly
0.5143	0.0286
0.2778	0.3889
0.5405	0.2703

Note that [P] is a 3 x 2 matrix, and [S] is a 3 x 1 matrix, so we cannot multiply these two matrices in their present form. We need to transpose [P]. [P] transposed looks like this:

Step 6: Trasnpose [P]

Foundry	0.5143	0.2778	0.5405
Assembly	0.0286	0.3889	0.2703

Step 7: Multiply [P] transpose time [S]. Remember to use the <Control> <Shift> <Enter> sequence. The output will be a 2 by 1: Note the check on the total--the sum adds up to the \$248,000 in total service department costs.

	[P] transpose * [S]
Foundry	190,772
Assembly	57,228
	248,000 QED!

Step 8: Now we are finally ready to calculate our overhead rates again.

Department	Foundry	Assembly
Allocated costs	190,772	57,228
Direct overhead	172,000	50,000
Total costs	362,772	107,228
DLH	31,200	58,000
Overhead rate/DLH	\$ 11.63	\$ 1.85

	A	B	C	D	E	F	G	H	I
1	Product cost calculations								
2	Cost model >>	3	Step Down Method						
3	Key:	1	Plant wide						
4		2	Direct						
5		3	Step down						
6		Material	Casting labor	Assembly labor	Total labor	Foundry overhead	Assembly overhead	Total overhead	Total product cost
7	Product A	\$ 100.00	\$ 300.00	\$ 20.00	\$ 320.00	\$ 229.19	\$ 3.88	\$ 233.06	\$ 653.06
8	Product B	80.00	75.00	250.00	325.00	\$ 57.30	\$ 48.48	\$ 105.78	\$ 510.78
9									
10		Units	Extension						
11	Product A	1,000	\$ 653,063.86						
12	Product B	2,240	#####						
13	Total costs accounted for		#####						
14	Total manufacturing costs in the system to start with		#####						
15	Allocation error		\$ -						

	A	B	C	D
1	Baker Engineering Income Statement			
2	Model >>>>	Step Down Method		
3		Product A	Product B	Total
4	Units	1,000	2,240	
5	Sales price	\$ 670.00	\$ 625.00	
6	Revenue	\$ 670,000	\$ 1,400,000	\$ 2,070,000
7	Cost of goods sold			
8	Direct material	\$ 100,000	\$ 179,200	\$ 279,200
9	Direct labor	\$ 320,000	\$ 728,000	\$ 1,048,000
10	Overhead	233,064	236,936	\$ 470,000
11	Total cost of goods sold	653,064	1,144,136	\$ 1,797,200
12	Gross margin	\$ 16,936	\$ 1,163,064	\$ 1,180,000
13	Non-mfg costs	20,000	56,000	\$ 76,000
14	Net income	\$ (3,064)	\$ 1,107,064	\$ 1,104,000
15	Return on sales	-0.46%	79.08%	53.33%

	A	B	C	D	E	F	G
1	Proof of allocation of total overhead						
2		Plantwide		Direct		Stepdown	
3	Department	Foundry	Assembly	Foundry	Assembly	Foundry	Assembly
4	Overhead rate	\$ 5.27	\$ 5.27	\$ 11.53	\$ 1.90	\$ 11.46	\$ 1.94
5	Product A hours	20	2	20	2	20	2
6	Product B units	1,000	1,000	1,000	1,000	1,000	1,000
7	Total costs	\$ 105,381.17	\$ 10,538.12	\$ 230,670.83	\$ 3,798.40	\$ 229,185.57	\$ 3,878.29
8	Product totals		\$ 115,919.28		\$ 234,469.22		\$ 233,063.86
9	Product B hours	5	25	5	25	5	25
10	Product B units	2240	2240	2240	2240	2240	2240
11	Total costs	\$ 59,013.45	\$ 295,067.26	\$ 129,175.66	\$ 106,355.11	\$ 128,343.92	\$ 108,592.22
12	Product totals		\$ 354,080.72		\$ 235,530.78		\$ 236,936.14
13	Total allocated costs		\$ 470,000		\$ 470,000		\$ 470,000
14	Total costs to be allocated		\$ 470,000		\$ 470,000		\$ 470,000
15	Difference (sh/be zero)		0		0		0

	A	B	C	D	E	F	G
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2	Cost Allocation and Product Costing						
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6	Material costs	12,000	5,000	1,000	169,600	109,600	\$297,200
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9	Total costs	\$147,000	\$75,000	\$26,000	\$809,600	\$739,600	\$1,797,200
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13	Direct labor hours budgeted	8,320	14,560	6,240	31,200	58,000	118,320
14	Product A material				\$ 80.00	\$ 20.00	\$ 100.00
15	Product A production				1,000	1,000	
16	Product A DLH				20	2	
17	Product A Total DLH				20,000	2,000	
18	Product B material				\$ 40.00	\$ 40.00	\$ 80.00
19	Product B produciton				2,240	2,240	
20	Product B DLH				5	25	
21	Product B Total DLH				11,200	56,000	
22	Wage rate/DLH				\$ 15.00	\$ 10.00	
23	Total DLH required				31,200	58,000	89,200
24		Product A	Product B				
25	Sales price	\$ 670.00	\$ 625.00				
26	Non-Manufacturing costs	\$ 20.00	\$ 25.00				
27							
28	This sheet is included so you can see where I have used values in the original data worksheet.						
29	All of the cells shaded in blue are entered as values. All other cells <u>in the entire model</u> are cell						
30	formulas based on cell references.						