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*Direct and overhead cost allocation is just as important to the small company as it is to its giant counterpart. But it's not enough to average costs for the entire activity for a plantwide rate. Meaningful analyses must be based on —*

## DEPARTMENTAL MACHINE-HOUR RATES IN A SMALL COMPANY

*by Thomas S. Dudick*

*Ernst & Ernst*

**D**ETAILED RECORD KEEPING and sophisticated cost systems are for the most part limited to large companies whose operations are substantial enough to sustain a fairly complex organizational structure. For the smaller company the problem is how to obtain meaningful cost analyses without the investment in staff and equipment characteristic of its larger competitor.

This task, while not impossible, is difficult. The small company's cost systems must necessarily be simpler than the large company's, but they must not be so oversimplified as to lead to misleading results.

Allocations of direct and overhead costs must take into account

differences within the manufacturing process; few operations are simple enough to permit averaging of costs for the entire activity. Fixed and variable costs must be segregated to permit calculation of breakeven points, profit/volume relationships, and individual products' marginal profit contributions. Failure to observe these simple rules can lead to erroneous conclusions about the cost and hence the profitability of products.

### *Cost differences*

The effects of failure to recognize cost differences can be illustrated by the case of a small metal stamping company which used

three types of equipment to fabricate small metal parts: multislides, punch presses, and automatics. To estimate the overhead and direct labor cost of production the company used an average costing rate of \$5 per machine-hour. This rate



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## Even the use of an average companywide overhead rate proved fallacious. . . .

was calculated by rounding the sum of \$3.32, which represented the plantwide rate for overhead, and \$1.70, which represented the hourly rate of pay for machine operators.

### **Direct labor**

Use of the overall rate of \$1.70 for direct labor in calculating costs per machine-hour for all three types of equipment led to deceptive results in costing the products made on these machines.

In the case of the automatics, which the company had perfected through innovations of its own, no direct labor operators at all were required. The machines were loaded and the necessary adjustments were made by the set-up men in the department, who were classified as overhead. Inclusion of direct labor cost in the machine-hour rate made this department appear to be less profitable than the other two when its production was costed and compared with the competitive selling prices.

Even in the other departments the use of an overall direct labor rate was not justified. For certain types of parts it was possible to use devices which, while not completely automatic, did not require the operator's full-time attention. The operator then could tend two or more machines simultaneously. Thus, instead of \$1.70 per machine-hour, the direct labor cost would have been \$.85 if the operator tended two machines or \$.57 if he tended three.

### **Overhead**

The use of an average plantwide overhead rate was equally fallacious. To show why—and to illustrate how overhead costs might be allocated in a small company—let us review the way in which the total overhead cost pool was as-

signed after the company had realized its costing deficiencies. Every small company must, of course, make its own cost allocations on the basis of its own judgment. This company's methods, however, illustrate the type of analysis required.

The eventual allocation of overhead to the three types of equipment used in the metal stamping company—and its segregation into fixed and variable costs—are shown in Exhibit 1 on page 15. This overhead breakdown became the basis for determining departmental overhead rates per machine-hour. The various categories of overhead cost were broken down and allocated in the following manner:

### **Office costs**

*Office salaries*—Office salaries as an overhead cost included the general manager, the office manager, an engineer, a production control supervisor, the purchasing agent, and several clerks. The salaries of the general manager, office manager, and a payroll clerk were distributed among the three production areas on the basis of the number of workers in each area. This decision was based on the observation that the distribution of these persons' efforts was affected by the relative number of employees to be supervised and serviced in the three production centers.

The distribution of salaries of the other overhead office personnel to the three production centers was based on the number of product types being produced in the three centers. This basis appeared to be the most reasonable because purchasing, scheduling, and engineering were affected more by number of products than by number of units produced.

*Office expenses*—Rather than code and classify such expenses as telephone, stationery, and subscrip-

tions to periodicals by individual category, clerical effort was minimized by classifying as office expenses all invoices other than those representing direct and indirect factory materials.

There was no sacrifice of control because these invoices were so few in number that the office manager could review and approve each one personally. (Travel expenses, which were approved by the general manager, were also included in office expenses.) After payment the invoices were filed by vendor name. Since the vendor supplying each item or service was known, if there was interest in a particular type of expense, the expense could be analyzed simply by perusing the invoice file without the need for detailed coding and summarization in sub-ledgers.

Expenses for stationery used for payroll and personnel records were allocated among the production centers on the basis of the number of workers employed since the volume of such paperwork required was related directly to the size of the work force. Usage of stationery for production records, purchasing, and blueprint supplies, on the other hand, was affected more by the number of product types than by the number of units of product; hence, these expenses were allocated on this basis.

Other office expenses were similarly analyzed. Most of them were allocated to the production centers on the basis of products rather than employees.

*Foremen and set-up men*—Each of the three machine groups had its own foreman, who was responsible for the operations of the machines in his department. Thus, each department was charged with its foreman's salary.

The set-up men removed the dies from equipment after a job was run and installed dies for the next job. They also made the needed ad-

justments in the course of each run when the parts began to get "out of spec." During long runs they occasionally had to remove dies for sharpening or for replacement of worn and broken punches. The costs of the set-up men, like those of the foremen, were identified and charged to the department they serviced.

*Maintenance salaries*—Most of the cost classified as maintenance salaries represented the time spent by toolmakers in the repair and sharpening of dies. (The portion of their time devoted to construction of new dies was not included because such costs were generally recovered through direct billings to customers.) Toolmaker costs were assigned to the production departments on the basis of services rendered.

Maintenance costs also included the salaries of the mechanics who repaired the building and equipment. Equipment maintenance costs were allocated on the same basis as toolmaker costs. The portion of maintenance costs devoted to keep-

ing the building in good repair was allocated to the production departments on the basis of the floor space they occupied.

*Depreciation*—Depreciation of the equipment in each of the three product centers, calculated by the straight-line method, was determined by analyzing the equipment records and breaking them down by type. Each production center was charged directly with the depreciation of its own equipment.

*Supplies*—The cost category of supplies, which might more accurately be termed indirect materials, included such indirect materials used in production as expendable tools, solvents used for degreasing, cleaning rags, oil, and repair parts used in equipment maintenance. Since requisitions were used to withdraw these items from stock, a breakdown of requisitions from the three centers was readily determinable. Thus, this cost could be assigned on the basis of actual usage by the production departments.

*Electricity*—The bulk of the elec-

tric power consumed was used in the operation of equipment. Distribution of this cost was based on the horsepower ratings of the motors, factored by estimated hours of usage of the various machines. This estimate was prepared by the electrician in the maintenance group.

*Occupancy costs*—Occupancy costs included such items as rent, heat, fire insurance, public liability insurance, and cleaning services. Some part of the electric power used might have been more correctly chargeable as occupancy cost, but this amount was felt to be so small that, in the interests of simplicity, it was included in the total pool of electric power costs. All costs classified as occupancy were allocated on the basis of the floor space occupied by the three production departments.

*Employee fringe benefits*—Fringe benefits included such items as the company's share of social security payments, state and Federal unemployment insurance, hospitalization insurance, pensions, and group in-

## EXHIBIT I

ASSIGNMENT OF OVERHEAD TO MACHINE GROUPS				
	Total	Multi-slides	Punch Presses	Auto-matics
Office salaries	\$20,020	8,529	8,383	3,108
Office expenses	7,553	2,595	3,251	1,707
Foremen & set-up men	10,663	4,403	4,034	2,226
Maintenance salaries	14,100	7,580	4,180	2,340
Depreciation	12,112	5,847	5,330	935
Occupancy costs	6,150	1,845	2,768	1,537
Supplies	3,455	1,589	1,194	672
Electricity	1,300	650	507	143
Employee fringe benefits	12,500	4,500	6,375	1,625
<b>Total Overhead</b>	<b>\$87,853</b>	<b>37,538</b>	<b>36,022</b>	<b>14,293</b>
RECAP OF FIXED AND VARIABLE COSTS				
Fixed	\$60,066	24,164	25,105	10,797
Variable	27,787	13,374	10,917	3,496
<b>Total Overhead</b>	<b>\$87,853</b>	<b>37,538</b>	<b>36,022</b>	<b>14,293</b>

DEPARTMENTAL OVERHEAD COSTS			
	Machine-Hours	Overhead Cost	Overhead Per Machine-Hour
Multislides	8,740	\$37,538	\$4.29
Punch presses	10,200	36,022	3.53
Automatics	7,560	14,293	1.89
Total	26,500	\$87,853	\$3.32

EXHIBIT 2

insurance. These costs were allocated on the same basis as the costs of the labor on which they were incurred.

**Fallacy of plantwide rate**

Once overhead costs had been allocated in the manner just described, with the results shown in Exhibit 1, it became obvious that for two of the three types of equipment used in the company, overhead costs per machine-hour were quite different from the plantwide average rate of \$3.32. This analysis, based on figures taken from Exhibit 1, is shown in Exhibit 2 above.

**Fixed vs. variable**

Overhead costs were further broken down into fixed and variable categories for use in evaluating the relative profitability of the various products in the line. This breakdown is shown in Exhibit 3 below.

The basis for this segregation of all the categories of costs previously discussed is described and ex-

EXHIBIT 3

BREAKDOWN OF OVERHEAD RATES BY FIXED AND VARIABLE			
	Total	Variable	Fixed
Multislides	\$4.29	1.53	2.76
Punch presses	3.53	1.07	2.46
Automatics	1.89	.46	1.43

plained in the following paragraphs:

**Office salaries**—As was previously noted, some of the office salaries were allocated to the production departments on the basis of the number of employees in the three areas. These numbers could vary with production. Nevertheless, all office salaries were considered to be fixed costs since a sustained increase or decrease in overall volume of activity of 25 to 30 per cent would not require any increase or decrease in office staff.

**Office expenses**—Office expenses that varied with the number of production employees, for example, stationery used for payroll and personnel records, were considered to be variable costs. Those that were affected more by other factors than by production, for example, stationery used for production records, purchasing, and blueprint supplies, were considered to be fixed costs. Most of the office expenses were classified as fixed costs.

**Foremen and set-up men**—The salaries of all three production foremen were considered to be fixed costs. Since the work volume of the set-up men varied directly with production volume, this cost was classified as variable.

**Maintenance salaries**—The portion of maintenance costs devoted to keeping the building in good repair was considered to be fixed. Maintenance of dies and equipment was considered to be a variable cost since it varied directly with production volume; the more

hours the machines and dies were used the greater the wear and tear.

**Depreciation**—Depreciation costs were classified as fixed.

**Supplies**—The cost of indirect supplies was categorized as variable because usage was governed by volume of production.

**Electricity**—Analysis of electricity costs showed that one-third of the electric bill, on the average, represented demand charges. These charges were fairly consistent from month to month regardless of the volume of production. They were therefore classified as fixed. The remainder of the cost of electricity was considered to be variable.

**Occupancy**—Occupancy costs were classified as fixed since they did not vary with volume of production.

**Fringe benefits**—Fringe benefits on direct labor were considered to be variable. Fringe benefits relating to indirect labor were split between fixed and variable in the same manner as the labor on which these costs were incurred.

**Product cost**

Once these analyses were completed it was a simple matter to calculate product manufacturing costs. The method used by the metal stamping company for developing this cost in the punch press department is illustrated in Exhibit 4 on page 17.

Material cost was determined in the conventional manner through analysis of material requirements per one thousand parts. Direct labor, in the example shown, was costed at one-half the hourly rate of \$1.70; since this particular operation required only half the operator's attention, he could tend another machine simultaneously.

Variable overhead is shown in Exhibit 4 as \$.54. This is based on the hourly variable rate of \$1.07 for punch presses multiplied by .5 hours per 1,000 pieces. The same principle applies to fixed overhead, i.e., .5 hours multiplied by the fixed overhead cost per hour of \$2.46.

Separation of fixed and variable costs has many uses beyond product costing. It is necessary, for example, in the calculation of the breakeven point—and the small company's need to know its breakeven point is even greater than its larger competitor's. The same basic figures used in the breakeven analysis can be used to determine profitability at various volume levels.

**Breakeven analysis**

Breakeven point analysis, this time for a company other than our previous example of the metal stamping company, is illustrated in Exhibit 5 on page 18.

Note in Column 1 that the \$59,000 profit represents a return of 14.8 per cent on total sales. Column 2, which is the breakeven level, shows neither profit nor loss because the variable costs at this level of sales plus the total fixed costs exactly equal the sales income.

Column 3 analyzes the excess over breakeven. The "excess" sales are \$129,670 while the variable costs are \$70,670, leaving marginal income of \$59,000. Inasmuch as the fixed costs of \$123,000 have already been absorbed in the breakeven sales shown in Column 2, there are no fixed costs left. The entire \$59,000 therefore becomes profit.

Since the profit of \$59,000 applies to the sales above breakeven, the return on sales may be viewed not as 14.8 per cent of \$400,000 but as 45.5 per cent of the sales above breakeven. Similarly, failure to attain breakeven sales may be viewed as resulting in a loss of 45.5 cents for each dollar by which sales fall short of the breakeven point.

**Marginal contribution**

Separation of fixed and variable costs is also useful in calculating the marginal contribution of individual products. The marginal contribution concept is useful in comparing the relative profitability of

it evaluates products not on the basis of their full cost but rather on the basis of how much each product contributes to the liquidation of the fixed or committed costs that exist regardless of the type of product being made.

This computation is made by calculating the profit after deducting variable costs from sales but before considering fixed or committed costs. The percentage of profit before fixed cost (usually referred to as marginal income) becomes an index of relative profitability. One type of such a calculation is demonstrated in Exhibit 6 on page 18.

Product B has the higher selling price of the two products in Exhibit 6. Many salesmen might thereby infer that it would be more advantageous to "push" the higher-priced item. However, when the profitability of both products is evaluated in terms of the percentage of the sales dollar left to cover fixed costs, it becomes obvious that, sales dollar for sales dollar, Product A is the more profitable of the two.

Such an evaluation of relative profitability might also indicate to management that the design of the product or the method of manufacture should be changed in order to reduce the variable costs and thus leave a greater portion of the sales dollar available for fixed costs and profits.

Marginal contribution analysis can be useful in deciding whether to abandon or retain a product. This application is illustrated by the case of a plastics-product manufacturer that made combs and plastic ornaments. Evaluations of the financial results of the two products consistently showed the combs to be profitable and the ornaments unprofitable. The general manager's inclination, naturally enough, was to drop the unprofitable ornaments and concentrate on combs. However, he agreed to hold his decision in abeyance pending an impartial study.

This study produced quite dif-

PRODUCT COST PUNCHED PRESS DEPARTMENT	
	Cost Per 1000
Material	\$ .79
Direct labor (one operator for two presses)	.85
Variable overhead (2000 pieces per machine-hour)	.54
	<u>\$2.18</u>
Fixed overhead (2000 pieces per machine-hour)	1.23
Total Manufacturing Cost	<u><u>\$3.41</u></u>

EXHIBIT 4

ferent conclusions. In all the previous analyses the method of arriving at financial results had been to split selling, advertising, and the general and administrative costs between the two products on the basis of sales. This seemed a logical way to determine whether each product was standing on its own.

This approach, however, ignored one fact of life—that certain costs of being in business were unavoidable and could not be changed materially. The salesmen who sold the combs were the same salesmen who took orders for the ornaments. Elimination of the ornaments from the line would not materially reduce selling costs; they would remain about the same in the aggregate whether plastic ornaments were sold or not. The same held for advertising and for the general and administrative expenses.

The conclusion reached as a result of the marginal contribution study was that the ornaments, although showing a reported loss, were actually recovering some of the selling, advertising, and general administrative costs that would otherwise have to be borne completely by the combs. The tentative decision to get out of the plastic ornament business was therefore abandoned.

BREAKEVEN ANALYSIS		
	Dollars	Per Cent
Sales	\$400,000	100.0%
Variable costs		
Material	\$79,000	
Direct labor	85,000	
Variable overhead	54,000	
	<u>218,000</u>	<u>54.5%</u>
Marginal income	\$182,000	45.5%
Fixed costs		
Fixed overhead	123,000	
Pre-tax profit	<u>\$ 59,000</u>	
Breakeven point: $\frac{\$123,000}{45.5\%} =$	<u>\$270,330</u>	

  

RECAP OF ABOVE			
	From Above	Breakeven Level	Excess Over Breakeven
	(1)	(2)	(3)
Sales	\$400,000	\$270,330	\$129,670
Variable costs (54.5% of sales)	218,000	147,330	70,670
Marginal income	\$182,000	\$123,000	\$ 59,000
Fixed cost	123,000	123,000	—
Pre-tax profit	<u>\$ 59,000</u>	<u>—</u>	<u>\$ 59,000</u>
Return on Sales	14.8%	—	45.5%

EXHIBIT 5

EXHIBIT 6

MARGINAL CONTRIBUTION ANALYSIS		
	Product A	Product B
Selling price	\$30.00	\$35.00
Variable Costs		
Material	\$ 7.10	\$ 9.70
Direct labor	1.94	2.42
Manufacturing overhead	3.86	4.83
Sales commissions	1.50	1.75
Total Variable Cost	<u>\$14.40</u>	<u>\$18.70</u>
% Variable Cost to Selling Price	48%	53%
% of Selling Price Left for Fixed Costs and Profit	52%	47%

Although the marginal contribution approach has much value in product profitability analysis, a word of caution is in order. Indiscriminate use of this technique in pricing can be disastrous.

**Marginal pricing**

A company manufacturing a brand name product that is fully

priced is reasonably safe in introducing a private brand on a marginal contribution basis. The margin of safety lies in the fact that regular brand sales can be counted on to recover fixed costs fully, which makes even a relatively small contribution toward fixed costs by the private brand "plus" business.

Many companies, however, do

not have the alternatives of brand name and private brand selling. In such cases selling at reduced prices carries the risk that too great a portion of the sales will be priced at a reduction with little or no fully priced sales to absorb the fixed costs.

If natural control such as that which can be exercised between regular brand and private brand products is lacking, all sales made at less than full cost must be closely monitored. One way to do this is to code all incoming orders taken on a reduced price basis so that sales analyses will continuously show the proportion of marginally priced business. When the percentage reaches a predetermined level, appropriate steps can be taken quickly to prevent excessive losses.

**Conclusion**

Because of the tendency of management personnel in smaller companies to wear more than one hat, many decisions necessarily must be based on rule of thumb guides rather than on factually documented analyses. Such guides, used by individuals who have good business sense, have proved their worth time and again.

These overall guides save a company many dollars of clerical expense. There are times, however, when such guides should be subjected to scrutiny.

One such guide is the method used for costing products—a point of weakness in many small companies. Introduction of departmental machine-hour rates, coupled with a breakdown of fixed and variable costs, provides tools that are useful not only for measuring the profit potential of individual products but also for determination of breakeven points, profit/volume relationships, and marginal contribution.

The highly competitive business climate, in which small business finds its lot more and more difficult, makes the availability and use of such tools mandatory.