Management Services: A Magazine of Planning, Systems, and Controls

Volume 1 | Number 4 Article 8

9-1964

Budgeting - First Step in Cost Estimating

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Every business—most of all the job shop—needs to be able to predict costs accurately. The method used should conform to the over-all operating plan. This article emphasizes the importance of—

BUDGETING—FIRST STEP IN COST ESTIMATING

by Allen Weiss
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SETTING prices to earn a profit in a competitive environment requires a rather precise knowledge of costs, combined with an ability to control them. Whether a company is bidding for specific contracts or for more general markets, its prices must be low enough to attract customers yet high enough to provide a margin of profit after recovering all costs. There is, therefore, a continuing need for accurate cost prediction (estimating) in all businesses.

For the job order manufacturer, turning out a variety of products to customer specifications, estimating in advance of production is all important. While the primary purpose of this article is to discuss the relationship between budgeting and estimating for these industries, it should be remembered that makers of proprietary items are also continually estimating the costs of new products. These new products may be entirely new to the line, or they may be modifications of old ones.

In any case, the need for estimating cannot be filled by piecemeal attempts to improvise whenever a new product or a new contract is under consideration. There must be an estimating method that conforms to the over-all operating scheme. There must be a plan, or budget, for the business as a whole, and cost estimates must be based on that plan.

Once a budget has been adopted, its usefulness is not restricted to estimating. It becomes the principal tool of managerial control, permitting measurements to be taken along the way to ascertain that the plan is in fact carried out. Thus, the budget provides both the data for estimating costs and the means for controlling them.

Material costs

For many companies the most readily determinable part of production costs is the outlay for raw materials. A producer of electronic equipment, for example, knows what parts are needed for each assembly or subassembly. Similarly, a furniture maker can prepare a bill of materials identifying every board length and all the hardware required to turn out each item in his line.

And yet, even in such relatively simple cases, it is not possible to calculate material requirements in full until allowances are made for losses resulting from defects, mistakes, and machine waste which prior experience has conditioned the manufacturer to accept. Depending on the industry, some or all of four types of loss are possible:

1. *Rework* may consume considerable labor and overhead but usually results in a relatively small material cost. Refinishing, for example, may involve the application of an agent for removing the defective coat plus a duplication of finishing materials.

FIGURE 1

MACHINE PRODUCTION STANDARDS

Cost Center 12—Calendering

Table of Running Times, in Hours per 1,000 Pounds

	GAUGE											
HAND	.005	.006	.007	.008	.009	.010	.011	.012	.013	.014	.015	.016
—5	.27	.29	.31	.32	.34	.36	.38	.40	.41	.43	.44	.46
—4	.27	.29	.31	.33	.35	.36	.38	.40	.42	.44	.46	.47
—3	.28	.30	.32	.33	.35	.37	.39	.41	.42	.44	.46	.48
—2	.29	.31	.33	.34	.36	.38	.40	.42	.43	.45	.47	.49
—1	.29	.31	.33	.35	.37	.38	.40	.42	.44	.46	.48	.50
0	.30	.32	.34	.35	.37	.39	.41	.43	.44	.46	.48	.50
1	.31	.33	.35	.36	.38	.40	.42	.44	.45	.47	.49	.51
2	.31	.33	.35	.37	.39	.40	.42	.44	.46	.48	.50	.52
3	.32	.34	.36	.37	.39	.41	.43	.45	.47	.48	.50	.52
4	.33	.35	.37	.38	.40	.42	.44	.46	.47	.49	.51	.53
5	.33	.35	.37	.39	.41	.42	.44	.46	.48	.50	.52	.54
6	.34	.36	.38	.39	.41	.43	.45	.47	.49	.50	.52	.54
7	.35	.37	.39	.40	.42	.44	.46	.48	.50	.51	.53	.55

NOTE: The data in this and all subsequent tables are contrived for illustrative purposes only, and bear no relation to the operating figures of any actual company.

Products may vary in the amount of rework they require. The feasibility of setting separate loss allowances for different product groups should be part of the budget studies.

2. *Second quality products* may sell over a wide range of prices. Some fortunate companies are able to unload seconds at retail with little or no loss of income. Others find a very limited market for their seconds, with severe markdowns the rule. In either case, expected losses are a proper subject for review in preparing the budget.

3. *Scrap* may have a small positive value, if it can be sold at all, or a negative value if the company must pay to have it carted away.

Some scrap needs no allowance because it is included in the initial allocation of materials. A manufacturer of containers, for example, plans to make boxes of certain dimensions from board of a stock size. Any scrap that results from trimming edges or punching out corners is included in the original unit cost of the board.

On the other hand, scrap normally resulting from damage to the board while machine adjustments are being made is a matter for control; a standard loss allowance can be set up. Similarly, in clothing manufacture, if gaps are created when patterns are traced on the markers that guide the cutter's knife, scrap resulting from this looseness in the markers is a proper subject for budgetary control.

Sometimes the percentage of rejects is a cost factor of major significance. This is true where the characteristics of an item are more or less uncontrollable in production and at the same time acceptable limits are set with relatively low tolerances for an important segment of sales, as in the semiconductor business. Then much more elaborate studies are required, including frequency distribution analysis of production results.

4. *Shrinkage* may result from loss of moisture, as in meat packing; from actual shrinkage of material, as in some textile operations; or from unaccounted disappearance, as in the case of liquids or gases lost through drains, exhausts, leaky pipelines, and the like.

A realistic budget will include allowances for all the losses normally incurred by the business. These allowances must not be set haphazardly or as a perpetuation of past inefficiencies. The budget-making process should involve a study of each phase of operations and a determination of the amount of loss that is reasonable and tolerable.

Loss allowances, once set after careful study, should become part of the plan under which the business operates. Variances from these allowances should be reported regularly—and investigated and acted

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upon. By building its pricing structure on costs that include these budgeted elements, a company can assure itself that budgeted margins are indeed being maintained.

One of the difficulties encountered in budgeting material costs for a full year is that prices rarely remain constant for that length of time. The techniques for segregating and reporting price variances are well known and will not be discussed here. A special situation that is worthy of mention exists in those businesses that deal with commodities. Erratic fluctuations in the prices paid for materials can make budgets difficult to interpret and even more difficult to relate to pricing decisions. A proper method of budgeting for such companies is to set prices for finished products and materials in such a manner as to arrive at a target net margin of revenue over material cost and to handle all other items in the customary fashion.

Direct labor costs

In estimating the direct labor cost to produce an item, whether old or new, a measure of the time required for the completion of each processing operation must be sought. The compilation and use of such time standards for all processes is, of course, a necessary part of budgeting as well.

Whenever possible such standards should be based on time studies, although regression-line analysis of fixed and variable components can be used effectively. In any case, the acceptance of the standards by plant management and supervisory personnel is essential to successful control. The use of the same set of standards for both estimating and control, through the budget, is in many cases the only assurance a company has that its pricing is based on fact rather than fancy.

Direct labor costs may be calculated on units of work directly, especially in a piecework operation or in a uniform process. Or a dollar rate may be set for the cost of processing time or machine time, in which case the cost per unit will then be calculated for each item on the basis of its own standard production times.

Piece rates cannot be used for budgeting and cost estimating without adjustment for one or more of the following conditions:

1. Workers whose earnings fall below statutory minimum wages must be given "make-up pay" to bring them up to the minimum. There must be a general understanding as to the accounting treatment of these payments—whether they are included in direct labor cost or in plant overhead.

2. Changes in piece rates, whether as a result of improved work methods or in recognition of tightness or looseness in the old rates, obviously must result in revised cost estimates. Annual budgets cannot be amended every time a rate is changed, but these deviations should be recognized when variances from budget are analyzed.

3. Incentive bonuses frequently introduce a variable into the unit cost of an operation. Wherever it is practicable, bonus earnings should be traced to products. Some caution should be exercised, however.

For instance, if production is reported daily and a number of different items are typically included, it is sometimes not worthwhile to assign to individual products the amounts earned as incentive bonuses. Even when there is a daily record of actual time spent on individual items, the assignment of earned bonuses to these items is often doubtful because of variations in efficiency that are not product-related. Productivity during the first hour in the morning and the hour before the luncheon break may be well below that of a midmorning peak, and the afternoon may be characterized by a similar pattern. The pressure of a heavy backlog frequently spurs workers to higher levels of output than are normally maintained. Radical changes from job to job will have an adverse effect even on experienced operators while they are adjusting to the new tasks.

These fluctuations are observable characteristics of human behavior that have nothing to do with the products being run. They can give rise to gross errors wherever bonuses or other costs are attributed to individual short-run jobs on the basis of production rates attained.

4. Premium pay for overtime or second shift can also affect piece rates. The amount of premium pay expected to be incurred by each cost center at the level of activity anticipated in the forecast could be reflected in that cost center's direct labor rate or could be budgeted as specific overhead for the cost center.

5. Losses in production were discussed earlier. It is sufficient at this

FIGURE 2

Product Activity Forecast
(M Pounds)

	PRODUCTS					
	A	B	C	D	E	Total
January 1, Inventory	1,200	240	350	890	720	3,400
January Production	800	100	500	200	500	2,100
January Sales	650	110	260	400	390	1,810
February 1, Inventory	1,350	230	590	690	830	3,690
February Production	900	150	300	500	300	2,150
February Sales	800	140	330	490	490	2,250
March 1, Inventory	1,450	240	560	700	640	3,590
March Production	800	100	300	400	400	2,000
March Sales	830	150	350	520	500	2,350
April 1, Inventory	1,420	190	510	580	540	3,240

point merely to mention that a loss occurring after expenditure of effort on an item affects unit labor cost of finished production as well as unit material cost.

If compensation is based on hourly rates, additional factors bear on product costs. Individual differences in productivity, uneven performance, and varying time losses must all be averaged. The need for carefully constructed standards is obvious.

When an operation is machine-paced and several people are required to man the machine, a proper study of the cost of the operation must begin with a determination of the minimum number of persons actually required to perform all the crew tasks at peak efficiency. To neglect to make such a study is to abandon one of the primary objectives of budgeting, cost reduction through improved operations.

Machine speeds may vary over a range of values for one or more characteristics of each product. In the calendering of plastic film, for instance, thickness and density are determining influences on machine speeds. Both vary over wide ranges so that there are many possible combinations of them. It is helpful in cost estimating to have tables of production standards from which running times per 1,000 yards can be read for any given combination of thickness (gauge) and density (hand). Figure 1 on page 52 illustrates such a table for one machine.

Overhead costs

Before overhead costs can be charged to products, they must first be gathered for all production cost centers. Appropriate bases, most often direct labor or machine hours, are then sought for allocation of each cost center's overhead to the operating times required for the production of the items processed there.

Needless to say, both the expenses and the bases for allocating them must be consistent with the planned level of activity. The first requirement, then, in calculating burden rates for cost centers is a sales forecast covering all products. From these sales, and from estimated beginning inventories and target inventories for the budget year, production requirements are projected. Figure 2 on page 53 illustrates a product activity forecast to derive production figures from sales estimates.

Figure 3 on this page translates monthly production data for several items from units of output to time requirements for a single cost center. At this point in the budget process it is well to consider the practicality of the plan, to note conditions of imbalance in the flow of work, under-utilization of equipment, overtime requirements, and the like. The departmental production forecasts may disclose a need for revision of the basic sales and manufacturing program.

The expected level of activity having been established for each cost center, the next step is to determine man-hour requirements and anticipated expenses of all kinds. Figure 4 on page 55 illustrates a projected cost of operations schedule for a single cost center. Assignable charges associated directly with the department and distributed charges apportioned among all production departments are included in a single schedule.

In deciding upon the basis to be employed in charging each department's overhead to the various products, it is important to select a relevant measure of the usage of the department's facilities. In a sewing plant where each machine is tended by an operator, direct labor is an appropriate basis for costing over-

FIGURE 3

Cost Center 8—Blending
Production Forecast

Month and Product	Production M Pounds	Running Time Hrs./M lbs.	Running Time Hours	Average Lot Size M Lbs.	Number of Lots	Make-ready Time Hrs./Lot	Make-ready Time Hours	Total Hours Projected
January:								
B	100	.40	40	50	2	.4	1	41
C	500	.35	175	100	5	.8	4	179
D	200	.20	40	100	2	1.0	2	42
Total			255				7	262
February:								
B	150	.40	60	50	3	.4	1	61
C	300	.35	105	100	3	.8	2	107
D	500	.20	100	100	5	1.0	5	105
Total			265				8	273
March								
B	100	.40	40	50	2	.4	1	41
C	300	.35	105	100	3	.8	2	107
D	400	.20	80	100	4	1.0	4	84
Total			225				7	232
TOTAL FOR THE YEAR	9,000							3,500

head to the different styles. In a machine-paced operation like calendering, machine-hours of running time may be used. If different kinds of vegetable oil (not joint products) are being refined, all of them requiring the same amount of time and effort per pound processed, then cents per pound of output is a proper expression of a burden rate.

Applying burden on the basis of output pounds is not always a violation of conventional cost accounting precepts. Take, for example, the case of a company refining different kinds of vegetable oil (soybean, cottonseed, corn, palm kernel, etc.), on two types of facility, one continuous and the other a batch process. One facility will handle any of the oils with the same expenditure of time and effort. (In practice, this would be true of the other facility also, but in theory it need not be.) The two methods of refining incur equivalent out-of-pocket costs, so that the company may economically use either facility up to its full capacity or divide activity between them at will. There is, however, a difference in hourly burden rates between the facilities. In this situation it is both sound and useful to set a standard overhead absorption rate for refining, based on pounds of output.

A product cost estimate is illustrated in Figure 5 on page 56. Requirements for material, labor, and overhead are stated in pounds or hours for a 100,000-pound batch. Material costs are extended at standard prices, but two types of labor and overhead rates are employed: One is based on machine-hours and used for production cost centers; the other is based on pounds and used for material handling, warehousing, and the like. Finally, losses are shown as deductions from pounds of output before calculating net yield on which to base unit costs.

FIGURE 4

Cost Center 8—Blending
Projected Cost of Operations

Production: 9,000 M lbs. Productive time: 3,500 hours Down-time allowance: 400 hours	Man Hours	Rate	Dollars	Dollars per Productive Hour
DIRECT LABOR:				
Regular rates:	3,900	$3.00	$11,700	
	3,900	2.75	10,725	
	3,900	2.25	8,775	
	2,100	1.75	3,675	
Total at regular rates	13,800	$2.53	$34,875	
Premiums:				
Shift	5,200	.10	520	
Overtime	690	1.26	870	
Double time				
Total direct labor			$36,265	$10.36
OVERHEAD:				
Assignable overhead:				
Indirect labor			$10,500	
Holiday and vacation pay			3,880	
Fringe benefits			6,100	
Supplies			3,600	
Repairs and parts			6,500	
Depreciation—machinery			4,100	
Total assignable overhead			$34,680	$9.91
Distributed overhead:				
Property taxes			$250	
Insurance			40	
Building depreciation			50	
Maintenance			900	
Light and power			3,800	
Heat			1,600	
Plant administration			1,300	
Total distributed overhead			$7,940	$2.27
TOTAL OVERHEAD			$42,620	$12.18

Control

In the course of preparing a budget, a company reviews its operations and applies standards of performance to measure activities;

FIGURE 5

Product X

Cost Estimate

	Number of Units	Cost per Unit	Production M Pounds	Cost in Dollars: Materials	Direct Labor	Plant Overhead
MATERIALS:						
Resin	50,000 lbs.	$ .15/lb.		$7,500		
Plasticizer	10,000 lbs.	.18/lb.		1,800		
Stabilizer	5,000 lbs.	.20/lb.		1,000		
Filler	30,000 lbs.	.03/lb.		900		
Lubricant	2,000 lbs.	.10/lb.		200		
Color	3,000 lbs.	.30/lb.		900		
Total Materials			100M	$12,300		
PACKING MATERIALS:						
Cores, paper, labels	200 ea.	.06		12		
LABOR & OVERHEAD:						
Receiving and material handling	100,000 lbs.	L. 3.15/M lbs. O.H. 4.80/M lbs.			$315	$480
Blending	22 hrs.	L. 10.36/hr. O.H. 12.18/hr.	(2)		228	268
Milling	38 hrs.	L. 15.10/hr. O.H. 20.40/hr.	(1)		574	775
Calendering	32 hrs.	L. 18.20/hr. O.H. 6.35/hr.	(4)		582	203
Finishing and wrapping	8 hrs.	L. 3.55/hr. O.H. 2.50/hr.			28	20
Warehouse and shipping	93,000 lbs.	L. 3.15/M lbs. O.H. 4.80/M lbs.			293	446
TOTALS			93M	$12,312	$2,020	$2,192
COST PER POUND				$.1324	$.0217	$.0236

these standards are used in costing products and also in exercising control. It is to the control function that we now turn.

The extent to which budgeted standards will actually be utilized for control depends in large measure on the availability of relevant data to the persons responsible for maintaining efficiency. Relevant data include both actual and standard figures, expressed and presented in a manner that facilitates comparisons.

Inasmuch as operating personnel are concerned basically with statistical data (pounds, yards, man-hours, machine-hours), it is good practice to present budget comparisons in these units. A foreman responsible for the yield of a refining process needs to know the number of pounds processed and the percentage loss at actual and standard. He does not need to know the dollar value of the input. As a matter of fact, if the price is volatile, dollar values reported over a period of time will serve only to confuse him.

The reporting of statistical data for control has another advantage. Because data are ordinarily collected in the form of pounds, man-hours, etc., and then converted to dollars for accounting purposes, considerable reporting time is saved when the original data are used for control reports before conversion. Nowhere is promptness of greater importance than in control. This consideration by itself would be sufficient reason to prefer statistical reports over monetary reports for operating personnel.

There is still another advantage to be derived from statistical reporting where it is feasible. Because financial statements are normally prepared monthly, statistical data can be accumulated each month for a one-time conversion to dollars at the end. This will suffice for analyses of variances in connection with operating statements. Frequently substantial savings can be realized by use of a system that does not require price extensions for every withdrawal of material and that involves no distribution of payroll dollars until the end of each accounting period.

Conclusion

In the normal course of running a business, occasions inevitably arise when it is necessary to predict or to estimate the cost of a product. The time must come, also, when costs are reviewed from the standpoint of efficiency and control. This review can best be accomplished by comparisons between results and measured standards. In fact, the aims of control and cost estimating can best be achieved by a budget program based on careful planning and prior operational studies followed by reporting feedback to discover areas of substandard performance.