Standard Costs and Variance Analysis

A *budget* is a quantitative expression of a plan of action. It serves as a goal that the organization strives to achieve. It is also used as a benchmark against which actual performance can be evaluated. Budgets span a specific period of time such as a month, a quarter, or a year. Organizations prepare a number of different budgets such as the sales budget, the production budget, the marketing costs budget, the cash budget, and the capital budget. This note will focus on budgets for product costs: direct costs (material and labor) and indirect costs (overhead), and their role in managing the overall costs of products and services.

Standard costs are developed based on the budgeted direct and indirect costs. A standard cost is a measure of how much one unit of product or service should cost to produce or deliver. A standard cost for a product will be made up of the costs of the components required to produce the product. For example, the standard cost of a leather jacket would include the cost of the materials (the leather, zipper, snaps, etc.), the cost of the labor (the time required to cut the pattern, stitch it, etc., at the production employee's wage rate), plus an allocation of the indirect or overhead costs related to it (the sewing machine depreciation, power, lights, etc.).

Once a standard cost is established, it provides a basis for decisions, for analyzing and controlling costs, and for measuring inventory accounts and cost of goods sold. Standard costs may be established using careful analysis of the product or service and the materials and process used to create it. Standard costs established in this way can be thought of as ideal costs. Other ways of determining standard costs, however, are also common. For example, last year's actual cost to produce a product or service can be used as the standard cost for this year.

Standard costs serve as benchmarks against which actual costs are compared. Differences between actual costs and standard costs are called *variances*. Actual costs may differ from standard costs because of price differences, quantity differences, errors or mistakes, or less than ideal conditions. Determining the reasons for variances may suggest corrective action or highlight that products are actually costing more or less than anticipated.

Although the remainder of this note emphasizes standard costs and variances in a manufacturing setting, many of the same concepts can be applied to the delivery of services. The focus on manufacturing allows a clearer discussion of material, labor and overhead variances, which are often harder to conceptualize in service organizations.

Lecturer Donella M. Rapier prepared this case as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

Direct Costs

Direct costs are costs, such as material and labor costs, that can be directly attributed to one unit of product. The standard cost for the direct costs of a product involve two components: a price component and a quantity component. The standard cost for a unit of production is the standard quantity to be used multiplied by the standard price per the unit of measure.

Example: Assume that our leather jacket should contain on average four yards of leather with a cost of $8.00 per yard, one zipper with a cost of $1.00, and two snaps with a cost of $0.25 each. Based on a time study recently done by management, a jacket requires an average of 5 hours of an employee's time to produce. Production workers are paid an average wage of $10 per hour including benefits. The standard cost for the direct costs (indirect costs will be discussed in the next section) would be as follows:

	Quantity	x	Price	=	Standard Cost
Materials:					
Leather	4 yards		$ 8.00		$32.00
Zipper	1		1.00		1.00
Snaps	2		.25		.50
Total material cost					$33.50
Labor cost	5 hours		10.00		50.00
Total direct cost					$83.50

Throughout the year, our leather jacket company will acquire leather, zippers and snaps and will hire and pay production workers. The actual amounts paid for these items, however, may not equal the amounts budgeted that formed the basis of the standard costs. For instance, the company may find leather at a lower price from a new discount supplier. A new machine purchased by the company may minimize the amount of material required for each jacket by reducing scrap material. Due to a significant order, the company might work its employees overtime which must be paid at time-and-a-half (150% of wage rate). The new machine might improve productivity so that it takes less than five hours to put a jacket together. These differences will give rise to variances between the actual and the budgeted standard costs.

An analysis of the year's results shows that the actual costs on average for the year for one jacket are as follows (no variances are assumed for zippers and snaps for simplicity):

	Quantity	x	Price	=	Actual Cost
Materials:					
Leather	3.5 yards		$ 7.50		$26.25
Zipper	1		1.00		1.00
Snaps	2		.25		.50
Total material cost					$27.75
Labor cost	4.8 hours		12.00		57.60
Total direct cost					$85.35

It is easy to see that jackets cost $1.85 more than budgeted. But without further analysis, a manager might miss potential opportunities for improving the business. For instance, a manager might miss the significance of the new supplier and the need to nurture this relationship. Or, without understanding the impact that the overtime pay has had, a manager might overlook the possibility of hiring additional workers instead of running overtime shifts. A manager might also misunderstand which department was responsible for savings, such as purchasing, and which was responsible for cost overruns, like production. Also, he or she would potentially miss the magnitude of the impact of the new machine and the possible opportunity to invest in additional machines.

In order to understand a variance, it must be broken into its component parts. An analysis of the materials variance is as follows:

Materials	**Quantity**	**x**	**Price**	**=**	**Total**
Leather:					
Budgeted	4.0 yards		$ 8.00		$32.00
Actual	3.5 yards		7.50		26.25
Materials variance					$ 5.75 favorable
Price variance	($8.00 - $7.50) x 3.5 yards			=	$ 1.75 favorable
Quantity variance	(4.0 - 3.5) x $8.00			=	4.00 favorable
Materials variance					$ 5.75 favorable

An analysis of the labor variance is as follows:

Labor	**Quantity**	**x**	**Price**	**=**	**Total**
Labor:					
Budgeted	5.0 hours		$10.00		$50.00
Actual	4.8 hours		12.00		57.60
Labor variance					$ 7.60 unfavorable
Price variance	($10.00 - $12.00) x 4.8 hours			=	$ 9.60 unfavorable
Quantity variance	(5.0 - 4.8) x $10.00			=	2.00 favorable
Labor variance					$ 7.60 unfavorable

The total variance is, thus, summed up as follows:

Standard cost	$83.50
Actual cost	85.35
Total variance	$ 1.85 unfavorable
Materials variance	$ 5.75 favorable
Labor variance	7.60 unfavorable
Total variance	$ 1.85 unfavorable

Formulas for analyzing variances can be expressed as follows:

Price variance	=	(SP - AP) x AQ
Quantity variance	=	(SQ - AQ) x SP
Total variance	=	(SP x SQ) - (AP x AQ)

Where:
SP = Standard price
AP = Actual price
SQ = Standard quantity
AQ = Actual quantity

Rather than worrying about whether to put standard or actual first in the formulas or about trying to keep track and understand whether a negative result is favorable or unfavorable, just think about whether the variance is good or bad. If the actual price is lower than the standard, it is a good or favorable variance; if the actual quantity is more than the standard, it is a bad or unfavorable variance, etc.

Note that by convention, price variance is computed using *actual* quantities, whereas quantity variance is computed using *standard* prices. This enables the purchasing agents to be assessed for price variations on quantities actually purchased. Production managers are assessed for quantity differences at standard prices, ignoring price fluctuations. While there are other ways of carving up the variances, this approach is the most typical.

A material price variance is often called a *purchase price variance*, and a material quantity variance is often called a *material usage variance*. A labor price variance is often called a *labor rate variance*, and a labor quantity variance is often called a *labor efficiency variance*.

Indirect Costs

Direct costs vary in relation to the volume of units produced. Indirect or overhead costs, however, have elements that do vary directly with volume (variable overhead) and other elements that do not (fixed overhead). The volume of production will fluctuate depending on many factors, for instance, demand for the company's products, labor shortages, etc. The effects of these variations in volume creates additional complexities in analyzing performance relative to an overhead budget.

Overhead budgets One approach to overhead budgeting ignores the volume considerations. This approach is called *fixed overhead budgeting*. Under a fixed budget approach, management determines the amount of overhead that should be incurred at the normal or most likely production level. This expense total becomes the budget against which cost performance is measured regardless of the level of production output actually achieved. An example would be as follows:

Allowed Overhead (in thousands)

Rent	$ 500
Depreciation	500
Supervision	1,000
Supplies	800
Power	800
	$3,600

Performance at the end of the year would be measured against the $3,600,000 total. This approach, however, by disregarding the true nature of the costs, may lead a manager to make some inaccurate conclusions about performance. For instance, assume that this budget is based on a "normal" production level of 160,000 leather jackets. Also assume that the power costs, representing in part the cutting and sewing machines, vary with the level of production. If 200,000 jackets are produced during the year, the power costs would exceed $800,000, say these costs total $1,000,000. Comparing this to the fixed budget, a manager might conclude that the warehouse supervisor did a poor job of managing the power costs, when in fact, the overspending relates solely to the extra 40,000 jackets produced.

The more conceptually sound approach to determining overhead standards is called *flexible budgeting*. A flexible overhead budget specifies allowable cost at each possible output level. Once a period is completed and the actual production volume is known, the budget standard is determined by reference to the flexible budget for the actual level of output. This is a direct parallel to the way a budget for direct material and direct labor is determined.

An example of a simplified flexible budget might look something like the following:

Flexible Budget

				"Normal" ↓		
Capacity Utilization:	**40%**[a]	**60%**	**70%**	**80%**	**100%**	
Labor Cost (piece rate):	**$4,000**	**$6,000**	**$7,000**	**$8,000**	**$10,000**	
Allowed Overhead						Cost Behavior
Rent	$ 500	$ 500	$ 500	$ 500	$ 500	Pure nonvariable or "fixed"
Depreciation	500	500	500	500	500	Pure nonvariable or "fixed"
Supervision	500	1,000	1,000	1,000	1,500	"Step" cost[b]
Supplies	400	600	700	800	1,000	Pure variable at 10% of labor
Power	600	700	750	800	900	Semivariable: $400 + 5% of labor
Total	$2,500	$3,300	$3,450	$3,600	$4,400	

[a]It is assumed that volume would never fall below 40% of capacity.

[b]A "step" cost is one which does not vary directly with production but does increase in lump-sum jumps when volume rises substantially. An example would be adding a second supervisor when volume rose to the level where a second shift was needed.

A flexible budget allows us to more intelligently analyze variable overhead spending.

Overhead absorption Now that our flexible overhead budget is established, we need a way to allocate the overhead to our products. The cost of a product should include all costs incurred in bringing the product to its completed form. Therefore, in addition to the direct labor and material costs, the standard cost of a product includes indirect costs, as well. But labor and material are easily measured and assigned to the products. It is much more difficult to determine how much rent, or supplies, or depreciation is consumed by a particular product.

Accountants resolve this dilemma by using an allocation method. This is termed *overhead absorption*, as the costs are *absorbed* into inventory. Overhead costs are first collected in *cost pools*. One pool might include all rent, another all costs related to inspection, another might be supervisory expenses. The cost pools are then allocated down to the products using a *cost driver*. For simplicity, in the remainder of this note, we will assume that all overhead is aggregated into a single pool.

Assume that all of our overhead expenses for our leather jacket company are set forth in the table above and are accumulated in one cost pool for allocation to products.

In single-product firms, the overhead pool might be allocated on a per-unit basis, i.e., using units as the cost driver. The total budgeted overhead ($3.6 million using the example above) would be divided by the planned production volume (assume 200,000 jackets for this illustration). Then for every jacket produced, $18.00 ($3.6 million divided by 200,000) would be applied as overhead. The standard cost for a jacket under this method would thus be as follows:

Standard Cost:	
Materials	$ 33.50
Labor	50.00
Overhead	18.00
Total standard cost	$101.50

In multiproduct firms, however, it is necessary to use an allocation method or cost driver other than number of units produced in order to more fairly apportion the overhead. For instance, if our company made leather gloves in addition to jackets, and the gloves could be manufactured in one-quarter of the time it takes to produce a jacket, it would be unfair to burden each pair of gloves with the same dollar amount of overhead as a jacket. Some other measure of capacity utilization must be used, such as labor hours, labor dollars, or machine hours. The choice of a volume measure in a particular business should be based on which variable best measures the level of capacity utilization for that business. For example, a machine depreciation cost pool might be allocated using number of machine hours per product as the driver. A supervision cost pool might be allocated using direct labor hours as the cost driver.

Since our jacket production process is fairly labor-intensive, we will use direct labor dollars as our allocation method. Using direct labor dollars, the standard overhead cost for a jacket would be $0.45 for every direct labor dollar ($3.6 million total budgeted overhead divided by $8 million budgeted labor cost). So for one jacket, $22.50 would be applied ($50.00 labor dollars per jacket multiplied by the $0.45 per labor dollar overhead rate). The total standard cost would be as follows:

Standard Cost:	
Materials	$ 33.50
Labor	50.00
Overhead	22.50
Total standard cost	$106.00

This is the amount that would be accumulated as inventory throughout the year for every jacket produced. However, differences in planned versus actual volume will give rise to a *volume variance*.

Above we demonstrated how variable overhead would fluctuate with volume and therefore, could not be intelligently compared to a fixed or static budget. On the other hand, fixed overhead does not vary with volume. As indicated in our flexible budget above, rent and depreciation are the same amounts under all levels of production. But, let's think about the mechanics for a moment. If, throughout the year, $22.50 is allocated or absorbed into inventory for every jacket produced, what if the number of jackets is different than we planned? Certainly, if we produced the exact number planned, 160,000, the overhead absorbed would equal the actual overhead (assuming no spending variances).

Labor per jacket	$ 50.00
Overhead rate	x .45
Overhead/jacket	22.50
Number of jackets	x 160,000
Total overhead applied	$3,600,000

This would be equal to the total overhead planned. If, on the other hand, only 140,000 jackets were produced, the amount absorbed would be as follows:

Labor per jacket	$ 50.00
Overhead rate	x .45
Overhead/jacket	22.50
Number of jackets	x 140,000
Total overhead applied	$3,150,000

Let's assume that all of the $3.6 million overhead is fixed. At the end of the year, our accounts would show that $3.15 million of overhead was absorbed into inventory but our actual costs were $3.6 million. This gives us a variance of $450 thousand. What does this variance tell us? Does this tell us much about how we managed our overhead? Not really. The costs were fixed at $3.6 million and that's what was spent. It does indicate that at a lower level of production, our per unit cost is higher as our fixed costs are spread over fewer units, but this is to some extent, merely a function of the planned production chosen at the beginning of the year that we used to derive our overhead rate.

This variance, called a *volume variance*, is essentially just the mathematical difference that arises because overhead is applied as if it were a variable expense (a budgeted rate times a cost driver such as direct labor dollars), but it is actually fixed. The absorption rate is set to just absorb into inventory the planned overhead when the company operates at its normal volume. It is necessary to isolate the volume variance from the spending variance, which is much more managerially significant, because otherwise we would make inappropriate conclusions about our performance against the budget.

Analyzing the Total Overhead Variance

Now that we have isolated the separate pieces of the overhead variance, the spending variance and the volume variance, let's work through an example. Assume the following:

Planned production	160,000	
80% capacity		
$8 million direct labor dollars		
Actual production	140,000	
70% capacity		
$7 million direct labor dollars		
(in thousands)		
Absorbed overhead	$3,150	($7,000 labor dollars at $0.45)
Actual overhead	3,610	
Unfavorable variance	460	

Spending variance To analyze the spending variance, compare the actual overhead to the flexible budget at 70% capacity:

	Flexible Budget Allowance at Actual Volume of $7,000 Direct Labor Dollars	Actual Expense at Actual Volume	Spending Variance
Rent	$ 500	$ 500	--
Depreciation	500	600	$100U
Supervision	1,000	1,050	50U
Supplies	700	690	10F
Power	750	770	20U
Total	$3,450	$3,610	$160U

The difference between actual overhead incurred and the flexible budget at this level of output is the *overhead spending variance*. It measures cost control performance.

Volume variance To analyze the volume variance, compare the allowed overhead at 70% capacity to the absorbed overhead (in thousands):

Allowed overhead (70% capacity)	$3,450
Absorbed overhead	3,150
Unfavorable volume variance	300

The difference between the allowed overhead and the absorbed overhead at this level of output is the *production volume variance*. It results from the difference between planned and actual production volume. It is made up of under- or over-absorbed *fixed manufacturing overhead*. It does not include any variable overhead because items that vary directly with production are treated identically in both the absorption rate and in the flexible budget.

Total variance You will note that the sum of the spending variance and the volume variance is equal to the total variance. To express the variance analyses mathematically:

(Actual OH - Allowed OH)	+	(Allowed OH - Absorbed OH)	=	(Actual OH - Absorbed OH)
Spending Variance	+	Volume Variance	=	Total Variance

Plugging in our amounts from above (in thousands):

($3,610 - $3,450)	+	($3,450 - $3,150)	=	($3,610 - $3,150)
$160	+	$300	=	$460

Another way to look at the total variance is as follows:

Total variance	=	Actual OH - Absorbed OH
Spending variance	=	Actual OH - Allowed OH
Volume variance	=	Allowed OH - Absorbed OH

To proof:

Spending variance	+	Volume variance	=	Total variance

Conclusion

The important questions that follow the calculation of variances concern *why* actual costs are different from standard costs. Variances provide clues for managers to investigate further. Sometimes the answers are obvious, but often they are not. For example, favorable material price variances may be caused by lower quality but cheaper material being used. This may lead to more labor time being spent by workers of high skill (and higher wages) leading to an unfavorable labor usage (quantity) variance. Skilled managers analyzing variances often try to weave clues together into a "story" to explain why the variances arose in order to make appropriate decisions to improve performance in the future.