

warrant investigation, and it becomes easier to determine the factors causing the overall variance. Variance reports with detailed line-item results for each unit and department are often available in public service organizations today. This approach of evaluating each line item for each department is one of the most common approaches for the investigation of variances.

One potential cause of the \$195,000 supply variance in the Radiology mentioned previously is that the manager just did not do a very good job in controlling the use of supplies. Technicians failed to place X-ray film that was not used back in the stockroom, and house-keeping threw the film away. Or perhaps the technicians made a lot of mistakes and often had to take three or four images rather than just one or two. Another possibility is that there were many more patients than anticipated. Of course, if the film is being wasted we are much more concerned than if we had an increased number of paying patients.

Another possible cause is that the price of X-ray film rose dramatically. X-ray film contains a lot of silver, so if the price of silver rises, the cost of X-ray film rises as well.

The main weaknesses of this traditional type of analysis are that it fails to take into account changes in the volume of services provided, and it does not provide as much direction as possible for the investigation of the causes of variances. Are variances due to prices paid for resources or to the amount of resources used per unit of output? A more sophisticated approach, called flexible budget variance analysis, can overcome these limitations.

Flexible Budget Variance Analysis

Flexible budget variance analysis requires a little more work than the variance analysis approach described previously but can provide managers with substantially more information. Flexible budgets, as discussed earlier in this book, provide budgets for different levels of activity. An organization not only approves a budget that assumes one specific activity level but might also prepare flexible budgets for different volume levels. The flexible budgets show the expected impacts of volume changes. They recognize the fact that some costs are fixed and some are variable. Thus, a 10 percent volume change would be unlikely to change costs by 10 percent. Flexible budget variance analysis incorporates this concept by recognizing that at least part of the total variance for any line item is often the result of changes in the level of activity.

The public sector has been slow to adopt this approach. This may reflect a historical lack of emphasis on cost control. As cost control becomes more important to the financial well-being of these organizations, increasing adoption of the technique is likely. Organizations such as hospitals, under intense financial scrutiny, largely adopted this technique in the last decade of the 20th century.

The key concept of flexible budgeting is that the amount of resources consumed will vary with the level of workload actually attained. In other words, the more service an organization provides, the greater its costs will be. It is critical to evaluate whether variances are occurring because we are spending more money to provide the expected level of services or to provide a greater amount of service. The implications of these two alternatives are substantially different.

Suppose that the following was the variance report for Meals:

Meals for the Homeless Kitchen Department March Expense Variance Report			
	Actual	Budget	Variance
Food	\$100,000	\$100,000	\$0

It looks like Meals came in right on budget. It is probable that the manager would be feeling pretty good about this line item for March. Suppose, however, that the budget of \$100,000 for food was based on an assumption of 33,000 meals served, but there were actually only 20,000 meals. One would expect that the lower volume of meals prepared should have allowed for reduction in food use and a cost savings as compared with the budget. None of that is apparent from the March variance report.

The flexible budget is a restatement of the budget based on the volume actually attained. Basically, the flexible budget shows what a line item *should* have cost, given the output level that actually occurred. If some costs are variable (see Chapter 4 for a discussion of fixed and variable costs), then increasing volumes should be accompanied by an increase in costs and decreasing levels of output should be accompanied by a decrease in costs.

In Chapter 3 we note that flexible budgets can be prepared during the planning stage. A flexible budget can give an indication of expected results at a variety of possible volume levels. For variance reporting, however, the flexible budget is prepared after the fact, when the actual volume of output is known.

Using the flexible budget technique, the variance for any line item can be subdivided to provide the manager with additional information about the cause of the variance. Each line-item variance can be divided into three pieces: the volume variance, the price (or rate) variance, and the quantity (or use) variance.

THE VOLUME VARIANCE The **volume variance** is defined as the portion of the variance in any line item that is caused simply by the fact that the output level differed from the budgeted expectation. For example, if the budget calls for the town of Millbridge to educate 2,000 pupils in its school system but actually 2,200 students enrolled, then it is expected that it would be necessary to hire more teachers and buy more books. The increased cost of the resources needed for an additional 200 students constitutes a volume variance. Such variances are often outside the control of the manager. The school superintendent would not likely be considered to be doing a bad job if the quality of the school system attracts more families with school-age children to move into the town.

THE PRICE (OR RATE) VARIANCE The price (or rate) variance is the portion of the total variance for any line item that is caused by spending more per unit of some input resource than had been anticipated. For example, if the average wage rate for kitchen workers at Meals is more per hour than had been expected, a **rate variance** would result. When the variance is used to measure labor resources, it is generally called a rate variance because the average hourly rate has varied from expectations. When considering the price of supplies, such as the cost of food, it is called a **price variance** because it is the purchase price that has varied. The terms “price” and “rate” are often used interchangeably in practice.

The price (or rate) variance may or may not be under the control of the manager. Suppose the HOS Purchasing Department (Purchasing) tells the Radiology director how much X-ray film is likely to cost per sheet of film. That price is built into the budget. If Purchasing then signs a contract for film at a higher price, the manager of Purchasing should be held accountable to explain the difference.

Note, however, that the extra cost for film will show up on the variance report of Radiology. Supply costs are generally assigned to the department consuming those supplies. The director of Radiology is therefore expected to explain the supply variance. If we can separate the line-item variance into several parts so that we know the part of the variance caused by changes in the price of film as opposed to changes in the amount of film used, we can make better decisions about who should be investigating and determining the cause of the variance.

THE QUANTITY (OR USE) VARIANCE The third general type of variance under the flexible budgeting approach is the quantity (or use) variance. This is the portion of the overall variance

This variance is often referred to as a use variance because it focuses on how much of the resource has been used. In industry, this variance is often called an **efficiency variance**. This is because a favorable variance would imply that each unit of output was produced using less input. Most industries can carefully measure the quality of the products they produce. If they can maintain quality at a desired level and make their products using less input, they are functioning with a higher level of efficiency.

CALCULATING THE VOLUME, PRICE, AND QUANTITY VARIANCES Suppose that the Mill-bridge School District expected to spend \$32,000 on textbooks for the fall semester, but actually spent \$37,800. When the school board questioned the school superintendent about the \$5,800 unfavorable variance (\$37,800 actual spending less the \$32,000 budget), she pointed out that there were more students enrolled, so of course they had to increase spending on textbooks. Is that explanation sufficient?

The Original Budget was based on 320 students, each using four books at a price of \$25 per book.

By inputting the actual volume of students, we calculate a Flexible Budget (often called a Flex Budget) that uses budgeted information for everything except volume.

5	<u>Flex Budget:</u>					
6	Actual Volume		Budgeted Quantity		Budgeted Price	
7	360	x	4	x	\$25	= \$36,000
8						

If we subtract the Flex Budget from the Original Budget, we find the Volume Variance. That is the portion of the total \$5,800 unfavorable variance that was in fact due to more students enrolling than expected.

[illegible]

The only difference between the Original Budget and the Flex Budget is the budgeted volume versus the actual volume (shown in bold). Both the Original Budget and Flex Budget are calculated using the budgeted quantity and budgeted price. The superintendent was correct in saying that the higher-than-expected number of enrolled students caused an unfavorable variance. However, that explains only \$4,000 of the total \$5,800 unfavorable variance. What else is going on?

The school district expected to buy four books per student. In fact, it purchased five books per student. This means there was a Quantity Variance, because the school district used more books per student than it had planned in the budget. The school district can create a **Volume and Quantity Adjusted (VQA) Budget** that indicates what it would have expected to pay for books if it had known both the actual number of students and the actual number of books per student:

9	<u>VQA Budget:</u>					
10	Actual Volume		Actual Quantity		Budgeted Price	
11	360	x	5	x	\$25	= \$45,000
12						

This budget is similar to the Flex Budget in that it is a mix of budgeted amounts and actuals. The Flex Budget uses the actual number of students (volume) but uses the budgeted quantity of books per student and the budgeted price per book. The VQA Budget uses the actual number of students, the actual number of books per student, and the budgeted price per book. If we subtract the VQA Budget from the Flex Budget, we find the Quantity Variance.

[illegible]

The only element that differs between the Flex Budget and the VQA Budget is the budgeted quantity versus the actual quantity (shown in bold). Notice the sum of the Volume Variance and the Quantity Variance is $-\$13,000$ ($-\$4,000 + -\$9,000$), or $\$13,000$ unfavorable. However, the total variance was only $\$5,800$ unfavorable. Something else must be going on.

The school paid only $\$21$ per book, which is $\$4$ per book less than the expected price of $\$25$. The actual amount paid for books was as follows:

13	Actual:						
14	Actual Volume		Actual Quantity		Actual Price		
15	360	x	5	x	\$21	=	\$37,800
16							

We can compare the VQA Budget to the Actual amount spent to determine the Price Variance. This variance is caused by paying a different amount per book than expected and is calculated by subtracting the Actual amount from the VQA Budget.

	A	B	C	D	E	F	G	H	I	J
9	VQA Budget:									
10	Actual Volume			Actual Quantity		Budgeted Price				
11	360	x		5	x	\$25	=	\$45,000		
12										
13	Actual:									
14	Actual Volume			Actual Quantity		Actual Price				
15	360	x		5	x	\$21	=	\$37,800		
16										
17						Price Variance	=	\$7,200	F	
18										

The difference between the VQA Budget and the Actual amount spent is caused by the price. The former uses the budgeted price that was paid for each book purchased, on average, while the latter is based on the actual price per book (shown in bold).

The combined total for the Volume, Quantity, and Price Variances is $\$5,800$ unfavorable, or $-\$4,000 + -\$9,000 + \$7,200 = -\$5,800$. The Total Variance is unfavorable, despite a savings of $\$7,200$ realized because the school district was able to purchase books at a lower-than-expected price. The savings were partially offset by the increased number of students, but part of the reason for the unfavorable total variance is the higher-than-expected number of books purchased per student. Why did the school district buy more books per student than budgeted?

It is possible that no one was tracking the number of books that teachers were ordering. Meanwhile, Purchasing did a terrific job negotiating lower prices for books. If that is what happened, the school district needs to acknowledge the fine job done by purchasing but also needs to improve controls to prevent teachers from ordering books without regard to the budget. Alternatively, it is possible that teachers decided to replace one large, expensive book with several smaller, less-expensive books. If so, the school district needs to consider that the extra cost of buying more books (the $\$9,000$ unfavorable Quantity Variance) was greater than the savings from buying less-expensive books (the $\$7,200$ favorable Price Variance). It must investigate to see if the switch in books resulted in an improved outcome that justified the net $\$1,800$ increase in cost beyond the $\$4,000$ increase caused by the additional students.

The key is that by subdividing a variance into component parts, we get a better sense of what happened. Managers can then investigate the specific Volume, Quantity, and Price Variances and decide what management action, if any, is needed to better control operations and keep to the approved budget.

It should be noted that there are conventions about the way that variances are computed. One could come up with alternative approaches that shift variables from budget to actual in a different order than shown here or that use only one actual value and keep the budgeted value for the rest of the variables for all the variance computations. The problem with such alternative approaches is that they often result in volume, quantity, and price variances that do not sum to the total variance. For consistency and in order to ensure that the parts equal the whole, the approach used here is the common convention for computing variances.

The above shows variance analysis step by step. The holistic analysis might look like this:

	A	B	C	D	E
1			VQA	Flex	
2		<u>Actual</u>	<u>Budget</u>	<u>Budget</u>	<u>Budget</u>
3	Volume: Number of Students	360	360	360	320
4	Quantity: Number of Books per Student	5	5	4	4
5	Price: Cost per Book	\$21	\$25	\$25	\$25
6					
7	Total:	\$37,800	\$45,000	\$36,000	\$32,000
8					
9	Variances				
10	Due to Volume:	\$ (4,000) U			
11	Due to Quantity:	(9,000) U			
12	Due to Price:	7,200 F			
13		<u>\$ (5,800) U</u>			
14					

And to make the calculations clearer, here is the variance analysis with Excel formulas rather than results:

	A	B	C	D	E
1			VQA	Flex	
2		<u>Actual</u>	<u>Budget</u>	<u>Budget</u>	<u>Budget</u>
3	Volume: Number of Students	360	360	360	320
4	Quantity: Number of Books per Student	5	5	4	4
5	Price: Cost per Book	\$21	\$25	\$25	\$25
6					
7	Total:	=B3*B4*B5	=C3*C4*C5	=D3*D4*D5	=E3*E4*E5
8					
9	Variances				
10	Due to Volume:	=E7-D7	=IF(B10<0,"U","F")		
11	Due to Quantity:	=D7-C7	=IF(B11<0,"U","F")		
12	Due to Price:	=C7-B7	=IF(B12<0,"U","F")		
13		=SUM(B10:B12)	=IF(B13<0,"U","F")		
14					

Throughout this analysis we have used the letter U to indicate an unfavorable variance and the letter F to indicate a favorable variance. We also have calculated the variances such that unfavorable variances are negative while favorable variances are positive. Organizations may use a combination of these conventions or simply one or the other. What is important is that the practice is consistent throughout the organization. Notice in the Excel screenshot in the middle of page 286, logical operators can be used to automatically determine and indicate whether a variance is favorable or unfavorable. For example, the formula for Cell C10 in the Excel screenshot at the bottom of page 286 is `=IF(B10<0, "U", "F")`. In words, that is, "If the value of Cell B10 is less than 0, then C10 should be U; otherwise it should be F."

Determination of the Causes of Variances

The volume, price, and quantity variances provide greater direction for the manager. They help to focus the area of investigation. If a line-item variance is caused primarily by the price variance, the manager can explore why prices differed from expectations. If the variance is primarily attributable to volume, the manager can try to determine what caused the change in volume. However, the analysis cannot tell the manager the ultimate cause of the variance. Managers still have to determine *why* these variances have occurred.

For instance, variance analysis will not tell why more students have enrolled in Millbridge's schools, why more books have been used, or why it paid less per book. But rather than simply knowing that the cost of books is over budget, the school district knows where to focus investigation. If it used more books per student, was it done to enhance education or because the school misplaced 100 expensive textbooks over the summer and had to replace them? Were books stolen, or did events in world history dictate that it buy newer editions, even though the old books were not worn out?

If the organization does not care about the answers to these questions, the variance process can be done primarily by financial managers. However, if the organization wants to use its resources efficiently, it must get answers to questions such as these. Getting these answers requires the experience and judgment of the managers who supervise each area of the organization's activities.

Common internal causes of variances include shifts in quality of service provided, changes in technology used, changes in efficiency, changes in organization policy, or simply budgets based on unrealistic expectations. External causes of variances commonly include price changes for supplies, volume changes, and unexpected shifts in the availability of staff.

Aggregation Problems

In doing variance analysis, the more we aggregate information, the greater the chance that we will misinterpret what has happened. An entire organization may spend nearly the same amount for a given month as it expected. In total, there is nearly no variance. However, that does not mean that there are no problems that need to be investigated.

Some departments might have large favorable variances, and other departments might have large unfavorable variances. Even if these offset each other, the organization would need to investigate these large variances to see why they are occurring. So managers cannot rely solely on variances measured for the entire organization; they need variance information department by department.

Moreover, it is possible that the total variance for one department might be small. However, there might be one line item within the department that has a large favorable variance and another that has a large unfavorable variance. For example, salaries may be extremely over budget and supplies extremely under budget. It is not enough to look at the overall spending of the department. Managers must examine the actual and budgeted results line by line.

However, managers cannot rely on information from the total variance for a given line item, either. Recall that each line-item variance may be subdivided into its volume, price, and quantity subcomponents. For example, for one line item in one department, it is possible that there might be a favorable volume variance and an unfavorable quantity variance. These variances might offset each other. When managers look at the total variance for the line item, it is small and does not appear to be of consequence. However, when they use flexible budget variance analysis and consider the price, quantity, and volume variances that make up the total variance for the line item, they find that there are problems to be investigated.

This could call attention to a serious problem. For instance, suppose that in one department of HOS the number of patients is falling but staffing has not been reduced. The salary line item will not show any variance in total. Because the volume of work is falling, the volume variance is favorable. But if HOS does not reduce staffing, it will be consuming more staff time per patient. So there will be an unfavorable quantity variance. If these two variances offset, which is likely, the manager may fail to see the departmental problem. The department is using too much staff time per patient without being aware of it.

Thus, it is essential to calculate price, quantity, and volume variances for every line item of every department. That way organizations will have a much better chance of detecting problems at an early stage.

Exception Reporting

For large organizations with numerous departments, we cannot expect either the CEO or the chief financial officer (CFO) to have time to review all variances each month. To cope with this problem, organizations use **exception reports** to list only those variances that are deemed to warrant a manager's attention. Thus, organizations would calculate all variances, but the CEO might review just a report with a brief listing of the most significant ones. Since variance reports are often prepared on a computer, this process is relatively simple.

The CEO, for example, might review all variances that are greater than \$10,000 or more than 20 percent over or under budget. The CFO in turn might review a listing of all variances that are more than \$5,000 or 10 percent. The exact cutoffs used can be determined by individual managers. If an organization's director believes in tight, centralized control, the cutoffs will be relatively low. Other managers who prefer to allow the organization to be run on a decentralized basis will want to review only variances that are extremely large.

Although high-level managers will receive only summary exception reports, all variances should be reviewed monthly. Each department head should be examining a listing of all variances for his or her department. If the department is particularly large and a number of managers report to the department director, then the director might look at only an exception report. However, each of the managers who report to that director would closely review all variances for their area of the department.

Fixed and Variable Costs

A key element of flexible budget variance analysis is the concept that the flexible budget may differ from the original budget because of a change in volume. However, this assumes that the line item being evaluated represents a variable cost. If costs are fixed, the amount of resources consumed would not change as a result of a change in activity.

In the case of fixed costs, the original and flexible budgets would be the same, and the volume variance would be zero. Furthermore, in the case of some fixed costs such as rent, it may not be helpful to separate the variance into price and quantity components. Therefore, it may be necessary to evaluate the total variance for the line item without the aid of subdivision into components for some fixed-cost line items.

Investigation and Control of Variances

One of the more perplexing aspects of variance analysis is deciding when a variance is large enough to warrant investigation. Should a manager investigate a \$100 variance? How about \$500? \$1,000? How big a variance is too big to tolerate without investigation?

Random, uncontrollable events will cause actual results to vary over and under the budget from month to month. It would be unusual for spending to come out to be exactly the budgeted amount. Therefore, small variances are often ignored because organizations should not waste managers' valuable time investigating minor random variances. They do, however, want to investigate any variances that would indicate that spending is out of control.

But how much is small? Unfortunately, there is no general agreement on an answer to this question. Managers must use their skill, judgment, and experience to determine how large a variance represents a potentially important problem that we would need to investigate and that might possibly require corrective action.

Sometimes control charts are used to determine if a variance is so large that it must be investigated. Exhibit 8-2 provides an example of a variance analysis control chart. In the chart, the monthly budgeted value for labor costs has been plotted for an entire year. A range above and below the budget has also been plotted. That range can be a set dollar amount above or below the budget, or it might be a percentage above or below the budget, or perhaps a statistical measure, such as 2 standard deviations above or below the budget. In this case, the control limits have been plotted 20 percent above and below the budget. In each organization managers must decide what amount or percentage is so great that if it is exceeded there is a great enough potential that things are getting out of control and that investigation of the variance is needed.

As each month goes by, the actual value is plotted onto the control chart. Here we see that everything proceeded fine for January through April. Each month the actual result differed from the budget, but the actual result was within the upper and lower control limits. However, in the most recent month, May, we see that spending appears significantly over budget. The actual result was higher than the upper control limit. Managers would have to investigate and see if there are reasonable explanations for the higher spending or if managerial action is needed to get spending back under control. Control charts can be a valuable managerial tool in the area of variance analysis.

EXHIBIT 8-2 Variance Control Chart Budget and Actual Labor Costs by Month

